Short-run bargaining, factors shares and growth

Renato Balducci and Stefano Staffolani*

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Abstract

In this paper we assume that, in the short run, firms and unions bargain efficiently on wages and employment and determine the labour and capital shares. Using an endogenous growth model based on human capital accumulation, and on the hypothesis that firms invest profits in physical capital while workers optimally allocate their earnings between consumption and investment in human capital, we determine the wage rate and the labour share that maximizes individual expected utility. Our main result is that the optimal labour share must be higher than the one arising from perfect competition in the labour market. Therefore, trade unions are necessary for optimal economic growth.

1 Introduction

During the 1950s and 60s, the economic literature studied the complex relationship between income distribution and economic growth. This issue was debated, amongst others, by Kaldor (1956), Pasinetti (1962, 1969) and Samuelson - Modigliani (1966). Attention focused mainly on the different propensities to save of the social classes comprising workers and capitalists, and on the change in the average value of the rate of saving brought about by variation in the proportions of total income accruing to one or other class.

In this paper we show that a unionized labour market can increase economic growth when social classes behave differently, as hypothesized by Kaldor. Our aim is to develop a branch of growth theory which focuses on

* *Department of Economics*
University of Ancona
P.zza Martelli, 8
60121 Ancona
E-Mail: Balducci@dea.unian.it; Staffolani@dea.unian.it

the distributive conflict that takes place in non-competitive labour markets. It has long been recognized that trade unions are able to influence capital accumulation through their involvement in the fixing of wage and employment levels. In a competitive firm, higher wages lead to the substitution of labour by capital and to a fall-off in production. The overall effect on the capital stock is therefore ambiguous.

When companies and unions bargain over both wages and employment, in the absence of binding agreements between the parties it is likely that the incentive to invest will diminish (Grout (1984), Van der Ploeg (1987)): in fact, a larger capital stock and greater labour productivity will induce the unions to demand higher wages, thereby eroding the expected return on capital. When firms see the shortfall in their expected return, they will have less incentive to invest.

Daveri and Tabellini (1997), using an overlapping generation model, consider the effect of taxation of labour income on firms' labour costs. When Government taxes labour income the share of the tax which is discharged on firm increases when unions exist. Therefore, unions increase labour costs. The higher labour costs (with respect to the case of a competitive labour market) increase unemployment and induce firms to substitute capital for labour, thereby reducing the marginal productivity of capital and so the incentive to accumulate. Unions lead the economic system to a reduced employment rate and to a lower growth rate.

Using a similar model (growth driven by externalities, overlapping generation model), Irmen and Wigger (2001) show that the negative effect of the lower employment rate on accumulation may be overstated by a positive effect which arises from the higher revenue young people receive due to trade-union activity. The higher saving rate of the young generation increase accumulation and growth. Which of the two effects prevails depends on the characteristics of the aggregate production function and on the importance that unions give to employment level in their objective function. Therefore, unions may be growth enhancing.

Agell and Lommerud (1993) present a two sectors model where the availability of resources in the modern sector (which uses capital intensive technologies) is the engine of growth. Unions reduce wage disparities between the two sectors, which induces firms operating in the traditional sector to reduce their number of employees and firms operating in the modern sector to increase it. In this way, unions, unless wage disparities are reduced "too much", increase the growth rate. However, the employment rate should be reduced by the unions' actions.

A paper presented by Lingens (2002) bases endogenous growth on $R\&D$

and considers three productive sectors. Unions bargain on wages in the intermediate sector in accordance with the right-to-manage hypothesis. The research-sector labour market is competitive. In the intermediate sector, wages are above the competitive level because of union bargaining. These hypotheses lead to two consequences: on the one hand, unemployment rises and, consequently, the growth rate falls; on the other, the relative wage in the research sector diminishes so that employment rises in the sector that is the engine of growth. According to Lingens' hypothesis on production and utility functions, the former effect always prevails; therefore an increase in union bargaining power reduces the economy's growth rate.

Parreno and Sanchez Losada ((2002) assume an overlapping generation model where individual actions may depend on altruistic action toward the future generation. Given a final and an educational sector, these authors assume both that trade unions operate in both sectors and solely in one of the two. The results of the paper show that the relationship between growth and trade-unions power may assume both a positive and a negative sign, because "fathers" have interest in investing in their children's education only if altruism exists but is not too strong; in this case, trade unions enhance growth because, by raising the wage rate, they increase investments in education. This positive relationship is more likely to exist if unions operate in the final sector, reducing in this way the relative wage in the educational sector and so the relative cost of education.

Wait unemployment is the engine of the De Groot (2001) model. Two sectors coexist in the economy: a high-tech monopolistic sector, where unions operate, and a traditional competitive sector. Unions increase the relative wage in the high-tech sector so that unemployed people (the new entrants, or those fired by the high-tech sector) find it more convenient to search for a job in the unionized sector than to accept job offers in the competitive sector. Search unemployment increases, and the employment rate in the high-tech sector decreases. These two effects give rise to a negative correlation between union bargaining power and growth.[1]

Wapler (2001) introduce heterogeneity in the labour market, considering skilled and unskilled workers. The former are characterized by greater human capital and are paid more by firms (skill premium). Unions seek to increase the relative wage of unskilled workers, so that the unskilled alone are supporters of unions. Higher union bargaining power leads to a reduction in the amount of unskilled employment; depending on the complementarity between the two kinds of workers, the number of skilled employed and their

[1] Other channels which confirm the negative relationship are analysed by De Groot.

productivity may move in both directions; the same happens for the growth rate of the economy as a whole.

The models briefly presented above show that the results concerning the relationship between union power and economic growth are diverse and that the paths to these results are also diverse. This suggests that there is no consensus on the effects of labour unions on endogenous growth. We intend to highlight this relationship by considering a growth model based on human capital.

The crucial role of human capital in explaining economic growth is well known. The "Solow residual" is now commonly considered to be the human capital contribution to growth. There is little dispute that human capital accumulation plays an important role in the growth process because education, by producing a particular form of capital based on intellectual skills, increases output.

The traditional two-factor production function of earlier growth models has gradually been replaced by a three-factor production function based on two accumulable factors (human and physical capital) and a non accumulable one (labour). Lucas's paper (1988) showed that the inclusion of human capital in growth models gives rise to an unresolved question on the functional distribution of income: which factor earns the part of product due to human capital? By raising the efficiency of both workers and physical capital, human capital is a sort of "public good" (justifying the public financing of educational systems) whose value added may be appropriated by both workers and capitalists.

In order to clarify the first point, consider the following aggregate production function, which displays constant returns to scale in the accumulable factors:

$$Y = b(LH)^{\alpha}K^{1-\alpha} \tag{1}$$

where Y is production, b is an exogenous scale parameter, L employment, H human capital and K physical capital.

With perfect competition in the product and the labour markets, it is usually assumed that the labour share equals α. Thus, human capital revenue entirely accrues to workers. In fact, considering human capital to be a skill which results from devoting time to its acquisition (like Lucas, 1988), it is impossible to distinguish "education" from the "educated" individual worker; in this case it seems plausible to attribute to workers the total increase in productivity due to education.

> Lucas supposes there to be a set of perfectly competitive risk neutral firms producing the single good for consumers. They maxi-

> mize profits and pay a wage equal to labour's marginal product. Workers, by acquiring skills, forego some of their wage in favor of the higher wage their skill gain will command (F. Hahn, p. 9-10).

This of course seems very simplistic. In fact, higher skills and better education improve the productivity of machinery. Furthermore,

> ... intellectually skilled workers facilitate the transfer of technology...This suggests that a high level (rather than a high growth rate) of intellectual skills is associated with increase in output. If this alternative interpretation is correct, the conflict between the predicted and actual profit share may not be so easily resolved (K. Foley and R. Michl, 1999, page 173.)

Foley and Michl's hypothesis seems to consider human capital as some sort of externality (and it has many characteristics of a public good) which raises productivity of both labour and capital, whose earnings may be not completely appropriated by workers. The trade unions endeavor to increase the revenue accruing to workers generated by this externality.

In our approach we consider both the case of workers' "specific" human capital and the case of externality (even if we concentrate on the former, postponing analysis of the latter to appendix A). In the latter hypothesis, we will assume that the State operates through taxation in order to force individuals to internalise this externality.

Our aim is to re-examine bargaining, functional distribution of income and endogenous growth based on human capital, following:

- the Lucas "indeterminacy" of factor shares when human capital enters the production function;
- the Kaldorian hypothesis of different propensities to save for the different social classes (or, more appropriately, earners of different types of revenue);
- the Mc-Donald, Solow (1981) model of efficient bargaining between the social partners.

The following sections will present a two stage model on the basis of the following hypotheses:

- in the short run, the social partners (trade unions and firms) bargain efficiently at a decentralized level over wages and employment; the

contract curve sets the employment level as a function of the wages. Therefore, employment, production and the factor shares are determined as a function of the bargained wage. According to the Nash bargaining model, determination of the equilibrium levels of employment and wages requires definition of a given level of bargaining power for firms and trade unions. Instead of solving the model and leaving the equilibrium dependent on an exogenous bargaining power, we prefer to leave the wage rate undetermined in the short run. Therefore the short run equilibrium is "open" in the sense given to the term by the classical and marxian theories of *conventional* wage models.

- in the long run, households maximize their expected utility. On the hypothesis that the capital share is completely reinvested, as in the Ricardian and classical tradition,[2] whereas the labour share is optimally allocated between consumption and investment in human capital[3], the optimal wage rate is determined. Therefore, in a long run perspective, households, as the owners of physical capital, decide to leave profits to firms in order to increase the physical capital stock and, as consumers and owners of human capital, decide how much to invest in human capital in order to maximize the expected utility.

We obtain the result that, in steady state, the optimal wage rate must be such that the last unit invested in physical capital and in human capital generates the same increase in the current value of the utility deriving from consumption. Furthermore, there exists an optimal labour share, depending on preferences and technological parameters alone, which must be higher than the one arising from perfect competition on the labour market (the α parameter of the production function): hence, trade unions are needed to attain optimality in the economic system.

In section 2 we define the behaviour of workers, trade unions and firms in the short run. Section 3 presents an endogenous growth model where firms invest profits in physical capital while workers optimally allocate their earnings between consumption and investment in human capital. In Section

[2]Modern macroeconomic theory justifies the role played by profits in explaining the investment rate through capital market imperfections which invalidate the Modiglian-Miller theorem. In particular, real profits (internal funds), enable firms to combat liquidity constraints when access to capital markets is not perfect; Chirinko (1987), Stiglitx and Weiss (1981), Greenwald and Stiglitz, 1987, Fazzari et al, (1988)

[3]Investment in human capital is usually measured by school enrolment, financed partly by the general taxation system and partly by households directly. Hence, the cost of schooling is mainly transferred to households. For a recent survey of empirical measures of human capital see Wöβmann (2003) and Le, Gibson, Oxley (2003).

4 we analyse the relationship between short run behaviour and long run optimality. Finally, we propose some concluding remarks.

2 Short-run bargaining

We assume decentralized efficient bargaining, in the sense that each firm and each trade union bargain jointly on wage and employment (Mc Donald, Solow, 1984).

The trade union at firm j maximizes the following union utility function:

$$W_j = L_j(w_j - v)^z$$

where v is some reference wage which we assume to be invariant across firms. As will be seen later, the reference wage is a crucial determinant of the long run equilibrium; it is usually assumed to represent the last bargained wage, or the wage of some foreign "reference" country, or unemployment benefits augmented by the utility deriving from greater leisure, and so on. We assume that the "reference" wage is higher than workers' reservation wage. The parameter z indicates the relative weight of the wage in the trade unions' utility. Risk neutral firms maximize profits:

$$\Pi_j = AL_j^{\alpha} - w_j L_j$$

where, in the short run production function $Y(L) = AL^{\alpha}$, we define $A = bH^{\alpha}K^{1-\alpha}$.

The contract curve is given by the set of tangency points between trade unions' iso-utility and firms' iso-profit curves[4] in the space w_j, L_j, so that $\frac{W_{L_j}}{W_{w_j}} = \frac{\Pi_{L_j}}{\Pi_{w_j}}$. Equating the two slopes we obtain the contract curve at firm level, which can be solved for the employment level and can be aggregated across firms (with a mass equal to 1) in order to obtain the aggregate contract curve:

$$L(w) = \left(\frac{\alpha z A}{(z-1)w + v}\right)^{\frac{1}{1-\alpha}} \tag{2}$$

Along the contract curve, employment is decreasing in the wage rate if $z > 1$, which represents the case where trade unions care more about wages than employment. We make a further assumption: we suppose that $z = 1$,

[4]From the definition of union utility function and firm profit function, we obtain the slope of the iso-utility curve, that is: $\frac{dw_j}{dL_j} = -\frac{w_j - v}{zL_j}$ and the slope of the iso-profits curve: $\frac{dw_j}{dL_j} = -\frac{Y'_{L_j} - w_j}{-L_j}$

so that trade unions maximize the wage bill. This simplification enables us to obtain a vertical contract curve, so that the employment level is now independent of the bargained wage:

$$L^* = \left(\alpha \frac{A}{v}\right)^{\frac{1}{1-\alpha}} \tag{3}$$

lower than the labour force because of our assumption of $v < w_R$, with w_R workers' reservation wage. Therefore, involuntary unemployment exists.

The labour share may be written as follows:

$$q = \frac{wL^*}{Y(L^*)} = \frac{wL^*}{AL^{*\alpha}} = w\frac{L^{*(1-\alpha)}}{A}$$

Using equation 3, we easily obtain:

$$q(w) = \alpha \frac{w}{v} \tag{4}$$

Hence, $q(w)$ is increasing in the wage rate.

3 Endogenous growth and wage determination

Let us consider production, human capital and physical capital in per capita units, defining:

$$y(t) = \frac{Y(t)}{L^*} \qquad h(t) = \frac{H(t)}{L^*} \qquad k(t) = \frac{K(t)}{L^*}$$

so that:

$$y(h,k) = Bh(t)^{\alpha}k(t)^{1-\alpha} \tag{5}$$

where $B = bL^{*\alpha} = b\left(\alpha\frac{A}{v}\right)^{\frac{\alpha}{1-\alpha}}$ is constant over time if we assume that $\frac{\dot{A}}{A} = \frac{\dot{v}}{v}$, where $\frac{\dot{A}}{A} = \alpha\frac{\dot{h}}{h} + (1-\alpha)\frac{\dot{k}}{k} \equiv g$. In the steady state equilibrium, we assume that the "reference" wage will grow at a rate g.

In the long run, the utility of each household depends on consumption level, $C(t)$. It is convenient to write consumption in per capita terms: $c(t) = \frac{C(t)}{L^*}$. We assume a CRRA utility function:

$$U(t) = \frac{1}{1-\sigma}c(t)^{1-\sigma} \tag{6}$$

Profits are always invested in physical capital ($\dot{k}(t)$), whereas labour income is optimally allocated between consumption ($c(t)$) and investment in human capital[5] ($\dot{h}(t)$). Therefore:

$$\dot{k}(t) = [1 - q(w)]y(h(t), k(t)) \tag{7}$$

$$\dot{h}(t) = q(w)y(h(t), k(t)) - c(t) \tag{8}$$

Households must choose two variables: the wage rate, which defines the capital share and hence the accumulation of physical capital, and the consumption level, which determines the accumulation of human capital.

The Hamiltonian for the problem is:[6]

$$\aleph(c, w, h, k, \lambda, \mu) =$$
$$e^{-\rho t}\frac{1}{1-\sigma}c^{1-\sigma} + \lambda[q(w)y(h, k) - c] + \mu[(1 - q(w)y(h, k)]$$

The first order conditions are:

$$\aleph'_c = e^{-\rho t}c^{-\sigma} - \lambda = 0 \tag{9}$$

$$\aleph'_w = y(h, k)(\lambda - \mu)\frac{dq}{dw} = 0 \tag{10}$$

$$-\aleph'_h = \dot{\lambda} = -[\mu(1 - q(w)) + \lambda q(w)]]\alpha\frac{y(h, k)}{h} \tag{11}$$

$$-\aleph'_k = \dot{\mu} = -[\mu(1 - q(w)) + \lambda q(w)](1 - \alpha)\frac{y(h, k)}{k} \tag{12}$$

and transversality conditions are:

$$\lim_{t\to\infty} \lambda(t)h(t) = 0 \tag{13}$$

$$\lim_{t\to\infty} \mu(t)k(t) = 0 \tag{14}$$

Given that $\frac{dq}{dw} \neq 0$, equation 10 implies $\lambda(t) = \mu(t)\forall t$, which, in turn, implies $\frac{\dot{\lambda}}{\lambda} = \frac{\dot{\mu}}{\mu}\forall t$.

[5] In the text we are implicitly assuming that human capital is specific to each worker, so that each household is interested in investing in it. If human capital were supposed to increase welfare only through externality in the production process, each household could not be interested in investing in education. The traditional free rider problem arises in the presence of externality. In Appendix A we analyse this case, assuming that the Government, through an optimal taxation on labour earnings, induces households to invest the optimal amount of revenue in education. We will obtain the same results shown herel.

[6] In what follows, we do not write the time index unless it is necessary.

The dynamic laws of equations 11 and 12 become, respectively:

$$\frac{\dot{\lambda}}{\lambda} = -\alpha\frac{y}{h} \tag{15}$$

$$\frac{\dot{\mu}}{\mu} = -(1-\alpha)\frac{y}{k}$$

So that:

$$k = \frac{1-\alpha}{\alpha}h \tag{16}$$

Therefore, along the optimal growth path, physical and human capital must grow at the same rate, so that the production function of equation 5 can be written as:

$$y(k) = B\left(\frac{\alpha}{1-\alpha}\right)^{\alpha}k \tag{17}$$

and:

$$y(h) = B\left(\frac{1-\alpha}{\alpha}\right)^{1-\alpha}h \tag{18}$$

Substituting equation 17 in equation 7, we obtain:

$$\frac{\dot{k}}{k} \equiv g_k = [1-q(w)]B\left(\frac{\alpha}{1-\alpha}\right)^{\alpha} \tag{19}$$

Equation 15 becomes:

$$\frac{\dot{\lambda}}{\lambda} = (1-\alpha)B\left(\frac{\alpha}{1-\alpha}\right)^{\alpha} \tag{20}$$

Substituting equation 18 in equation 8, we obtain the human capital growth rate:

$$\frac{\dot{h}}{h} \equiv g_h = \left(\frac{1-\alpha}{\alpha}\right)^{1-\alpha}Bq(w) - \frac{c}{h}$$

Given equations 7 and 8, and given the steady state solutions for the per capita product 17 and 18, we can write:

$$\frac{c}{h} = B\left(\frac{\alpha}{1-\alpha}\right)^{\alpha}\left(\frac{q(w)}{\alpha} - 1\right) \tag{21}$$

Which implies that, to have positive consumption, $q(w) > \alpha$ must hold. Note that this condition is implied by equation 13; in fact, by integrating equations 19 and 15 and taking the limit for $t \to \infty$, we obtain $q(w) > \alpha$.

Substituting equation 18 in equation 21, we obtain the marginal propensity to consume:

$$\frac{c}{y} = \frac{q(w) - \alpha}{1 - \alpha} \tag{22}$$

Differentiating equation 9 with respect to time, we obtain:

$$\frac{\dot{\lambda}}{\lambda} = -\rho - \sigma \frac{\dot{c}}{c}$$

and substituting in equation 20 we obtain the consumption growth rate:

$$\frac{\dot{c}}{c} \equiv g^* = \frac{B\alpha^{\alpha}(1-\alpha)^{1-\alpha} - \rho}{\sigma} \tag{23}$$

The growth rate of consumption is equal to that of human capital because of equation 21 and because of the constancy of the labour share; and, given equation 16, it must also be equal to the growth rate of physical capital. The per capita production function (equation 5) shows that the optimal economy growth rate (g^*) coincides with the per capita consumption growth rate.

Equations 21 and 23 characterize the economy described in our model. The former equation shows that the equilibrium labour share must be higher than the parameter α, the latter displays the optimal economy growth rate.[7]

4 Trade unions, bargaining and optimality

Equations 23 and 19, give the following definition for the equilibrium labour share, the one which allow the economy to growth optimally:

$$q(w) \equiv q^* = 1 - \frac{1-\alpha}{\sigma}\left[1 - \frac{\rho}{B}\frac{1}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}}\right] \tag{24}$$

[7] In order to investigate on the role played from our focal hypotheses of equality between capital share and investment in physical capital let us remove it, assuming that the whole income accrues to households who decide how to allocate it in consumption, investment in physical capital and investment in human capital. Following the same steps shown above, we obtain[8] the "not constrained" growth rate (g^*_{NC}):

$$g^*_{NC} = \frac{1}{\alpha + \sigma}[B\alpha^{\alpha}(1-\alpha)^{1-\alpha} - \rho] = \frac{\sigma}{\alpha + \sigma} g^*$$

which is lower than the one obtained in equation 23: $g^*_{NC} < g^*$. As one could expect, if profits must be necessarily invested, the economy grows more. Therefore, when capital market imperfections exist, the optimal growth rate of the whole economy is higher than the optimal one of the "perfectly competitive" economy, but at the expense of a lower per-capita consumption and, for $q(w) = \alpha$, a nil per capita consumption (see equation 22).

Therefore, the labour share that maximizes expected utility does not depend on wages, but on the "fundamentals", i.e. technology and preferences.[9]

Considering equation 23, we can also write the optimal labour share as follow:

$$q^* = \frac{g^*[\sigma - (1-\alpha)] + \rho}{g^*\sigma + \rho}$$

Or, equivalently[10]:

$$g^* = \frac{\rho}{\frac{1-\alpha}{1-q} - \sigma}$$

To obtain these results, we assumed that the labour share and the employment rate were constant over time. Obviously, in order to keep the labour share constant, we must have from equation 4:

$$\frac{\dot{w}}{w} = \frac{\dot{v}}{v} \tag{25}$$

From equation 3 we can write the dynamic of employment:

$$\frac{\dot{L}}{L} = \frac{\dot{A}}{A} - \frac{\dot{v}}{v} \tag{26}$$

Hence, given the definition of A, employment is constant over time if:

$$\frac{\dot{v}}{v} = g^* \tag{27}$$

Equations 25 and 27 imply that, if the labour share is constant, so that equation 25 is respected, employment is constant as well, and the wage rate grows at the same rate as the whole economy.

We have no guarantee that bargaining between the social partners, as described in equation 4, leads the economy to the optimal equilibrium of equation 24. To reach the optimal growth path, the bargained wage level should be such that the two equations mentioned are equal, so that:

$$\frac{w^*}{v} = \frac{q^*}{\alpha} \tag{28}$$

[9] Note that transversality conditions of equation 14 are fulfilled if $\rho > B(1-\alpha)^{1-\alpha}\alpha^{\alpha}(1-\sigma)$. Therefore the optimal labour share is always higher than the traditional one (the α parameter of the production function), so that $q^* > \alpha$ (with q^* defined in equation 24). Furthermore, the transversality conditions imply a positive consumption (see equation 21) and a positive growth rate of the economic system (see equation 23)

[10] It is straightforward to show that $q^* > \alpha$, so that $c > 0$ implies: $g^* < \frac{\rho}{1-\sigma}$

where q^* is defined in equation 24. Are there factors which make equation 28 respected?

Let us conceive the economy described as a sequence of short-run equilibria, where the trade unions determine the wage rate:

1. considering the existence of a wage rate which maximizes the household utility (rational behaviour);

2. according to their goals, completely ignoring the existence of an optimal wage rate (myopic behaviour).

In the first hypothesis (rational trade unions) the dynamic behaviour of the wage rate is completely determined by considering the optimal wage rate defined in equation 28. Unions operate in order to maximize the expected utility of individuals.

In the second case, unions pursue their own goals. The standard procedure to solve for the wage in bargaining is based on the Nash bargaining model, which maximizes, with respect to employment and the wage rate, the weighted product of expected gains from bargaining obtained by trade unions and firms. The solution of the model yelds the contract curve (equation 3) and the bargained wage rate (w_{SR}), which takes the form:

$$w_{SR} = \frac{\eta + \alpha(1-\eta)}{\eta[1 - z(1-\alpha)] + \alpha(1-\eta)} v$$

where $0 \leq \eta \leq 1$ is the trade unions' bargaining power (and $1-\eta$ is the firms' bargaining power). With efficient bargaining, the labour share of equation 4 becomes:

$$q(\eta) = \alpha + \eta(1-\alpha)$$

The short run labour share as defined in the previous equation and the optimal labour share (q^*) as defined in equation 24 are equal if :

$$\eta^* = \frac{q^* - \alpha}{1-\alpha} = 1 - \frac{1}{\sigma}\left[1 - \frac{\rho}{B}\frac{1}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}}\right] \tag{29}$$

which is increasing in σ and ρ and has a maximum for $\alpha = 0.50$.

Therefore, there exists a level of trade-union bargaining power that is "optimal" for the economic system. Consider that the unions' bargaining power (η) must coincide with the average propensity to consume as described in equation 22. Empirically, this implies that union power should exceed 50%.

Obviously, on a priori grounds there is no reason to believe that trade union power is exactly the one described in equation 29. Suppose that bargaining power, and hence wages and the labour share, are less than optimality: in this case, employment is higher. Even if this situation is a stable steady state, because equation 25 is respected, so that the labour share and the employment rate are constants, the growth rate of human capital is lower than optimality. This is a situation of human capital shortage. Households consume less output, and at a reduced growth rate.

Are there endogenous mechanisms able to lead the bargaining power to the optimal level? It is obvious that trade union bargaining power is influenced by various factors, like the unemployment level, the general public's perception that the trade unions are doing the "right thing" in bargaining, the relative level of wages and profits. But, at least in our model, there are no evident factors which can lead the parameter η to the optimal value of equation 29.

Hence, even if unions are indeed useful for economic growth (by raising the wage rate above the competitive one), they should incorporate household optimal behaviour in their objective function.

5 Conclusion

In this paper we have revisited, from a modern perspective, the relationship between the functional distribution of income and growth envisaged by the Ricardian tradition. In an endogenous growth model based on human capital, we have assumed that the revenue accruing to human capital must be split between the social partners according to some bargaining rule, and that the functional distribution of income influences investment in the accumulable factors.

In the short run, efficient bargaining between the social partners determines the employment level and the labour share as a function of the wage rate.

In the long run, the capital share accruing to firms defines the growth path of physical capital, whereas the labour share accruing to households is optimally split between human capital investment and consumption. Hence, households decide the path of human capital accumulation by choosing the amount of income to invest in education.

We have thus obtained analytical results for short run equilibrium (as the outcome of bargaining between firms and unions) and for long run optimal growth (as the outcome of households' intertemporal maximization).

Our main result is that there exists a given labour share depending on preferences and technology alone which maximizes the expected household utility. This labour share is grater than the "traditional" one, requiring a functional distribution of income more favorable to workers than the one arising from a competitive market ($q^* > \alpha$).

This result depends on the hypothesis of an imperfect capital market (not modelled in this paper) which induces firms to invest their profit entirely in physical capital because of liquidity constraints and leaves the financing of human capital to households alone .

The optimal labour share may be achieved thanks to the trade union. In fact, our results show that trade unions are required to allow the economic system to reach optimality, but also that their presence, even though it is necessary, is not sufficient.

The effective behavior of trade unions gives rise to the households' desired labour share only if the unions are able to internalize the effect of their behaviour on growth (the "rational" trade unions). Otherwise ("myopic" unions), there exists a given positive union bargaining power (coinciding with the propensity to consume) which maximize the economy's growth rate. The question still unresolved concerns the economic mechanism which may eventually lead trade union bargaining power toward the optimal one.

Appendix A: Human capital as externality

We assume that the Government behaves in order to maximize the expected utility of the representative household. It therefore withdraws taxes from households and uses the amount it obtains to finance the general education system, which must be attended by every individual[11]. In this way, it is able to solve the coordination problem among individuals raised by the externality generated by education.

Given the production function (equation 5) and the utility function (equation 6) presented in the text, we must now change the dynamic constraint of equation 8:

$$\dot{h} = \tau q(w) y(h(t), k(t))$$

where τ is the tax rate, whereas the constraint 7 remains unchanged.

Per capita consumption is simply given by:

$$c(t) = (1-\tau) q(w) y(h(t), k(t))$$

Now, households choose the wage rate (and hence the labour share) whereas the Government chooses the rate of taxation. Consequently, first order conditions 9 and 10 become, respectively:

$$\aleph_\tau = \left[-e^{-\rho t}[(1-\tau)q(w)y]^{-\sigma} + \mu\right] qy = 0$$

$$\aleph_w = \left[-e^{-\rho t}[(1-\tau)q(w)y]^{-\sigma}(1-\tau) - \lambda + \mu\tau\right] y\frac{dq}{dw} = 0$$

Combining the two first order conditions yields $\lambda(t) = \mu(t) \forall t$. Given this result, all the other optimality conditions are completely equal to the one in the text referring to the decentralized solution.

Therefore, with the same procedure as shown in the text, we obtain the following results:

- the transversality condition $q(w) > \alpha$ holds;
- the optimal economy growth rate is the some as the one displayed in equation 23;
- the optimal labour share is the same as the one displayed in equation 24; it may also be written as a function of the optimal tax rate:

$$q^* = \frac{\alpha}{\alpha + \tau^*(1-\alpha)}$$

[11] See also Zagler and Dürneker, 2003 for an analysis of the effect of taxes and investment in education on growth.

where the labour share is defined as:

$$\tau^* = \frac{\alpha}{1-\alpha} \frac{\frac{1-\alpha}{\sigma}\left[1 - \frac{\rho}{B}\frac{1}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}}\right]}{1 - \frac{1-\alpha}{\sigma}\left[1 - \frac{\rho}{B}\frac{1}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}}\right]}$$

- all the other results presented in the text hold.

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