Wage Bargaining, Competition, and Innovation

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Abstract

We study the effect of wage bargaining in an endogenous model of innovation based on public knowledge capital and expanding varieties of goods. We find that a higher bargaining power of workers has a negative effect on the long run growth rate of the economy since it decreases the profit share earned by firms.

We then assume a simple form of lobbying on the wage rate by the unions. The introduction of the lobbying activity allows to take into consideration the general equilibrium interaction between goods market policies and the labor market.

1 Introduction

In this article we study the effect of wage bargaining in an endogenous model of innovation based on public knowledge capital and expanding varieties of goods. The bargaining process takes the form of decentralized efficient bargaining between monopolistically competitive firms and unions that choose the wage and employment in each sector. Firms than engage in R&D activities by hiring researchers in order to develop new varieties of the products. Unemployment does not display in equilibrium because the wage paid to the R&D workers clears out the labor market. We find that a higher bargaining power of workers has a negative effect on the long run growth rate of the economy since it decreases the profit share earned by firms.

We then assume a simple form of lobbying on the wage rate by the unions. This allows to link the bargaining power of workers in the manufacturing sector to the elasticity of substitution among varieties, which we consider as a policy parameter. What we find is that, for some parameter range, a higher elasticity of substitution may lead to a higher growth rate of the economy because of the interaction with the labour market parameters. This would not normally hold if we consider the bargaining power of workers to be exogenous and challenges the schumpeterian view that lower competition on the goods market is needed to foster the innovation rate of the economy. Our contribution is close in spirit with that of Meeusen and Rayp (2000). They set up a similar model to study the effect of social security on the rate of innovation and the long run behavior
of the economy, with the difference that they consider a monopoly union, an assumption that does not allow them to take into consideration the effect of the bargaining power of workers. Bargaining is instead considered in Blanchard and Giavazzi (2003) and Fiori et al. (2008), two contributions that study the interaction between goods and labour market deregulation, the first from a theoretical point of view and the second from both a theoretical and an empirical point of view. In a general equilibrium framework, they investigate the possible complementarity between goods and labor market deregulation on the wage and the unemployment rate.

The paper is structured as follows. The next section presents the static part of the model and the bargaining solution between firms and unions. The third paragraph addresses the dynamic equilibrium and solves for the long run growth rate of the economy. In the fourth section lobbying by the unions is introduced and its effect on the long run behaviour of the economy is analyzed. The fifth section concludes.

2 The Model

We consider an economy populated by $N$ infinitely lived individuals with love of variety preferences over $n$ differentiated goods produced under monopolistic competition. The intertemporal utility index associated to consumption takes the form:

$$U_t = \int_t^{\infty} e^{-\rho(\tau-t)} \log D(\tau) d\tau$$

where $\rho$ is the subjective discount rate and $D(\tau)$ represents an aggregate index of consumption at time $\tau$ and amounts to:

$$D = \left[ \sum_{i=1}^{n} c_i^{(\sigma-1)} \right]^{1/(\sigma-1)}$$

where $c_i$ is consumption of good $i$, $n$ is the number of differentiated products produced in the economy and $\sigma > 1$ is the constant elasticity of substitution between goods.

Given the logarithm form of intertemporal utility, the representative agent’s maximization problem can be solved in two stages. In the first stage, it is possible to find the optimal allocation of income among the different varieties of goods in every instant of time. In the second stage, the intertemporal path of aggregate spending can be derived independently. The static maximization problem is solved in the next section.

2.1 Static Equilibrium
The solution to the static maximization problem follows directly from Dixit and Stiglitz (1977). In every instant the composite index \( D \) is maximized under the budget constraint \( \sum_{i=1}^{n} p_i c_i \leq e \), where \( e \) is individual expenditure. The dual price-index \( P \) associated with \( D \) takes the form: \( P = \left[ \sum_{i=1}^{n} p_i^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \).

From the first order conditions we can derive the individual demand for a good of type \( i \):

\[
c_i = \left( \frac{p_i}{P} \right)^{-\sigma} e \frac{P}{P}.
\]

(3)

and by aggregating over all consumers it is possible to obtain the total demand for good \( i \), \( x_i \):

\[
x_i = Nc = \left( \frac{p_i}{P} \right)^{-\sigma} E \frac{P}{P}.
\]

(4)

where \( E = Ne = \sum_{i=1}^{n} p_i x_i \) is aggregate spending.

We keep the supply side of the economy as simple as possible by assuming that the \( n \) goods are produced by the same constant returns to scale function with labor as the only input: \( x_i = l_i \), \( i = 1, \ldots, n \).

Given the production function, profit per firm may now be written as: \( \pi_i = (p_i - w_i)x_i \), where \( w_i \) is the wage paid to labor hired by firm \( i \).

### 2.2 Wage Bargaining

We now turn to wage determination. We consider decentralized bargaining by assuming that wages and employment in a given sector are the result of a negotiation process between the firm and a union. This amounts to say that negotiation takes the form of efficient bargaining.\(^1\) The union maximizes the excess utility its members enjoy with respect to the a competitive wage, \( w_R \), earned by workers in the R&D sector (i.e. manufacturing workers are unionized while R&D workers are not). Reverting to instantaneous indirect utility functions we can write the objective function of the union as:

\[
\left( \frac{w_i}{P} - \frac{w_R}{P} \right) l_i
\]

(5)

Given 5 and the expression for the profit level of the firm we can write the Nash maximand of the efficient bargaining as:

\[
\max_{w_i(1-\tau), l_i} \beta \log [w_i - w_R] l_i + (1 - \beta) \log (p_i - w_i) l_i
\]

(6)

\(^1\)Our contribution is close in spirit to that of Meeusen and Rayp (2000). They set up a model of innovation where the union has monopoly power over the wage level. By assuming efficient bargaining, our contribution extends theirs by allowing to take explicitly into consideration the bargaining power of both unions and firms.
Since \( l_i = x_i = \left( \frac{p_i}{P} \right)^{-\sigma} \frac{E}{P} \), the firm and the union set the price \( p_i \) and the net wage \( w_i(1 - \tau) \) that maximize 6, given the aggregate price level \( P \).\(^2\) The solution to the bargaining problem delivers the following optimal values for the price chosen by the firm and the (gross) wage:

\[
p_i = (1 + \mu)w_R
\]
\[
w_i = (1 + \beta \mu)w_R
\]

Hence, in the short-run partial equilibrium the price set by the firm and the wage earned by employed workers are proportional to \( w_R \), where the factor of proportion is given by one plus the mark-up, \( \mu = \frac{1}{\sigma - 1} \), for the optimal price and one plus \( \beta \) times the mark-up for the optimal wage. Turning to efficiency, note that rents per unit of output are given by \( (p_i - w_R) = \mu w_R \). Workers get a share \( \beta \) of these rents and the firm gets a share \( (1 - \beta) \).

We are now ready to describe the short-run general equilibrium of the model. From 7, prices and wages are equal across sectors, this implies that the equilibrium is completely symmetrical and we can write:

\[
p_i = p, w_i = w \quad l_i = l = x_i = x = 1/np
\]
\[
\pi_i = \pi = 1 - \frac{\beta}{\sigma n} \quad i = 1, ..., n
\]

Note that the profit rate is clearly increasing in the firm’s bargaining power and decreasing in the number of varieties and the elasticity of substitution among goods.

3 Long Run Equilibrium

We now turn to the description of the dynamic side of the economy.

3.1 The Intertemporal Evolution of Aggregate Spending

Given the symmetry of the static equilibrium, we have \( D = E/P \) and the intertemporal maximization problem may be written as:

\[
\max_{E(\tau)} U_t = \int_t^\infty e^{-\rho(\tau-t)} [\log E(\tau) - \log P(\tau)] d\tau
\]

subject to the intertemporal budget constraint:

\(^2\)Since firms operate in monopolistic competition, entrepreneurs do not take into account the effect that a change in the price of the variety that they produce has on the price index, \( P \). As a consequence, we can equivalently use nominal or real variables in the Nash maximand.
\[
\int_{t}^{\infty} e^{-[R(\tau) - R(t)]} E(\tau) d\tau \leq \int_{t}^{\infty} e^{-[R(\tau) - R(t)]} w(\tau) d\tau + W(t) 
\]

(10)

where \( R(\tau) \) is the cumulative interest rate, \( w \) is the wage rate earned in the manufacturing sectors and \( W(t) \) is the value of asset holdings.\(^3\)

It can be shown that the optimization problem delivers as a solution the following time path for the rate of growth of individual expenditure:

\[
\frac{\dot{E}}{E} = r - \rho 
\]

(11)

where we are considering a constant interest rate \( r(t) = r \) for every \( t \). To pin down the value of the price level we can set \( E = 1 \) and measure prices at every moment against the choice of the numeraire. Obviously this amounts to constraint the time path of aggregate spending to be constant and implies that the interest rate is equal to the subjective discount factor, \( r = \rho \).

### 3.2 Long-run Equilibrium

We closely follow Grossman and Helpman (1991) in shaping the features of the dynamic properties of the economy. Firms innovate by engaging in Research and Development activities in order to expand the number of varieties of goods produced. Each firm is protected by a patent that makes the infinite stream of profits last forever. Denoting with \( v(t) \) the value of a claim to the infinite stream of profits that accrues to a typical firm at time \( t \), we have:

\[
v(t) = \int_{t}^{\infty} e^{-[R(\tau) - R(t)]} \pi(\tau) d\tau 
\]

(12)

Time differentiation of 12 yields the following no arbitrage condition on capital markets:

\[
\pi + \dot{v} = rv 
\]

(13)

The left hand side of 13 is the total return to the owners of the firm. The no arbitrage condition thus states that this return must be equal to that of a riskless loan.

R&D activity is characterized by knowledge spillovers. Besides the stream of profits that the blueprint yields to the inventor, each research project contributes to the stock of general knowledge capital \( K_n(t) \) in the form of a collection of ideas and methods that will be useful to later generations of innovators. If the total amount of labor devoted to the activity of R & D is \( L_R \), we can specify the technology for product innovation \( \dot{h} = L_R K_n/a \) new products in a time interval \( dt \). The cost of labor devoted to R & D is \( w_R L_R dt \). The research effort creates

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\(^3\)Obviously, \( w \) should be replaced with \( w_R \) in the case of a worker in the R&D sector.
value to the entrepreneurs equal to $v(LRK_n/a)dt$. If we assume that $K_n$ is proportional to the number of varieties present in the economy at each moment in time, $K_n = n$, the rate of introduction of new products can be expressed as $g = n/n = LR/a$. Hence, for the activity of R & D to take place it must be the case that:

$$w_Ra/n \geq v \quad \text{with equality whenever} \quad \dot{n} > 0 \quad (14)$$

If the former condition holds with disequality, the amount of labor devoted to R & D would be set to zero. So with free entry and constant returns in the research lab 14 must hold with equality to have new products introduced in the economy with a finite amount of labor devoted to it. Finally, denote with $L_m$ the total labor force hired for manufacturing and R & D at a given moment in time. The total amount of labor hired for manufacturing is $L_m = 1/p$, while the total amount of labor devoted to the R&D activity is $LR = an/n$. Hence we must have:

$$ag + 1/p = L \quad (15)$$

with $p \geq 1/L$ for employment in every activity to be non negative. The above full employment condition determines the value of the competitive wage paid to workers in R&D:

$$w_R = \frac{\sigma - 1}{\sigma L - ag} \quad (16)$$

It is now possible to solve for the steady state growth rate of the economy. First of all, the R&D activity is profitable only when the reward for successful research is sufficiently high, that is $g > 0$ implies that $v > \varphi$. Combining 14 with the constraint $p \geq 1/L$ and the equilibrium expression for $w_R$ we get:

$$\varphi = \frac{a(\sigma - 1)}{\sigma L a} \quad (17)$$

Defining the variable $V = 1/nv$, the previous condition becomes:

$$V < \frac{\sigma L}{a(\sigma - 1)} \quad (18)$$

Combining the free-entry condition for R&D, the price equation and the full employment condition we can find a first expression for the growth rate of the economy:

$$g = \frac{\dot{n}}{n} = \left\{ \begin{array}{ll}
\frac{L}{a} - \frac{a-1}{\sigma}V & \text{for} \ V < \frac{\sigma L}{a(\sigma - 1)} \\
0 & \text{for} \ V > \frac{\sigma L}{a(\sigma - 1)}
\end{array} \right\} \quad (19)$$

Writing the previous expression for $V$ we can find a first condition relating $V$ and the growth rate $g$: 6
\[ V = \frac{\sigma}{\sigma - 1} \left( \frac{L}{a} - g \right) \]  

(20)

From the no arbitrage condition and the fact that \( r = \rho \) we have:

\[ \frac{\dot{v}}{v} = \rho - \frac{1 - \beta}{\sigma n v} \]  

(21)

Now note that by the definition of \( V \): \( V/V = -g - \dot{v}/v \). It follows that:

\[ \frac{\dot{V}}{V} = (1 - \beta) \frac{V}{\sigma} - (g + \rho) \]  

(22)

so that when \( \dot{V} = 0 \) we have:

\[ V = \frac{\sigma}{1 - \beta} (g + \rho) \]  

(23)

By equating 20 and 23 we can get the expression for the long run growth rate of the economy:

\[ g^* = \frac{1 - \beta}{\sigma - \beta} \frac{L}{a} - \frac{\sigma - 1}{\sigma - \beta} \rho \]  

(24)

A graphical representation of the equilibrium is given in Figure 1. The \( LL \) line is downward sloping since it expresses a resource constraint. The higher the rate of innovation, the greater is employment in the research sector and the lower is employment in manufacturing, therefore lowering the supply of goods. From equation 16 the higher employment in R&D leads to an increase of \( w_R \) and hence of \( w, p \) and \( v \), which in turn implies a lower level of \( V \). The upward sloping line \( VV \) represents the locus of points where \( \dot{V}/V = 0 \), or in other words where the rate of expansions of new varieties equates the rate of decline in the value of the firm. From equation 22 it is clear that above the \( VV \) line \( V \) is increasing while the opposite is true below it. Points above the line are characterized by the fact that \( g < -\dot{v}/v \), that is the rate of growth of new varieties is lower than the rate of decline in the stock market value of the firm. For points below the line the opposite holds. This justifies the direction of the arrows on the \( LL \) line. \( E \) is clearly the point where growth is balanced: \( V \) and \( g \) reach constant values, which means that innovation goes on indefinitely at a fixed rate and the value of the firm becomes constant as well as the division of labor between R&D and manufacturing. It is possible to show that the model does not displays transitional dynamics: with perfect foresight the economy jumps immediately to the steady-state equilibrium. Suppose that \( V \) is at a higher value with respect to the one associated to point \( E \). This means that eventually \( g \) will become zero and \( V \) will tend to infinite. With a zero rate of expansion of new varieties, \( V \) goes to infinite only if \( v \) goes to zero. But with a finite measure of varieties, profit per brand must be positive and this contradicts the fact that \( v \) has become zero.
Along paths like this expectations must therefore be unfulfilled. The opposite holds if \( V \) is at a lower level than the one reached in \( E \).

Note that the model displays scale effects since the steady-state growth rate of the economy is higher the higher the labor force. This is simply because a higher total labor force means higher employment in each sector and hence a larger pool of resources from which firms can hire workers. Substituting the value of \( g^* \) in equation 16 we get the steady state value of the competitive wage:

\[
W^*_R = \frac{\sigma - \beta}{\sigma} \frac{1}{L + a\rho} \tag{25}
\]

and, consequently, the steady state values of:

\[
\begin{align*}
L^*_R &= ag^* \\
p^* &= \frac{\sigma - \beta}{\sigma(1 - \beta)} \frac{1}{L + a\rho} \\
w^* &= \frac{\sigma - \beta}{\sigma} \left[ \frac{\sigma - (1 - \beta)}{\sigma - 1} \frac{1}{L + a\rho} \right] \\
L^*_m &= \frac{1}{p^*} = \frac{\sigma - \beta}{\sigma - 1} (L + a\rho)
\end{align*} \tag{26}
\]

We now turn to check the effect of an increase in the bargaining power of workers, \( \beta \), on steady-state growth rate of the economy. It is easy to check that \( g \) is decreasing in \( \beta \), i.e.,

\[
\frac{\partial g^*}{\partial \beta} = -\frac{1}{(\sigma - \beta)^2} \left( \frac{L}{a} + \rho \right) < 0 \tag{27}
\]

The effect of \( \beta \) on the long-run equilibrium of the model is depicted in Figure 2. An increase in the bargaining power of workers has no effect on the \( LL \) curve, while it shifts upward the \( VV \) line to \( V^0V^* \), thereby reducing the growth rate of the economy. The effect comes directly through the decrease of the profit share of the representative firm. From the no arbitrage condition in equation 21, the decrease in profits leads to an increase in the rate of variation of the value of the firm. For given \( g \), this means that points on the former \( VV \) line are now characterized by a rate of expansion of new varieties which is higher than the rate of decline of the market value of the firm: \( g > -v/v \). It follows that the \( V = 0 \) must shift upward to restore equilibrium and the growth rate of the economy must decrease.

A deeper understanding of the effects that a change in the bargaining power of unionized workers produces on the economic system may also be grasped by considering the steady state values written in equation 26. A higher bargaining power of workers causes an opposite movement of employment in the R&D sector and in the manufacturing sector, decreasing the former and increasing the latter. These movements in the labor force induce a decrease in the competitive wage \( w_R \) in order to maintain full employment in the labor market. It is easy to check, instead, that the bargained wage \( w \) increases if \( \beta < 1/2 \), while it decreases if \( \beta > 1/2 \). This is due to the general equilibrium effect through which the competitive wage depends on \( \beta \). We may think that a stronger union is able to obtain higher wages in the bargaining process and is thus also more favourable.
to allow for wage decreases when the outside option falls with respect to a union with lower bargaining power. Hence, a strong union reacts to a decrease in the competitive wage by decreasing the negotiated wage, while a weak union reacts in the opposite way. No matter the movement of the wage, however, the decrease in the price level of the firm leads to a decrease of the profit rate. This, along with the lower level of employment in the R&D sector, dampens the innovation activity and hence the long run growth rate of the economy.

A second issue that is important for the analysis we will carry on in the next section concerns the effect that an increase in $\sigma$ has on the steady-state rate of innovation. Taking the derivative of $g^*$ with respect to $\sigma$ we get:

$$\frac{\partial g^*}{\partial \sigma} = -\frac{1 - \beta}{(\sigma - \beta)^2} \left( \frac{L}{a} + \rho \right) < 0$$  \hspace{1cm} (28)

In Figure 3 are represented the shifts in the $LL$ and $VV$ curves. As it can be seen, the $LL$ curve rotates inward around point $A$, which is the higher level that the growth rate of the economy may achieve, $L/a$, given the resources available; the $VV$ line shifts upward with a combined effect of a reduction in both $g^*$ and $V$.

A higher $\sigma$ means a higher demand elasticity for the firm and hence a decrease in profits. The effect of a variation of $\beta$ is not clear, if $\sigma + \beta > 2$, then an increase in $\beta$ makes the negative effect of an increase in $\sigma$ on $g^*$ stronger. (derivative equals $\frac{1}{(\sigma - \beta)^2}$). We will check the effect of a change in the elasticity of substitution on the steady-state values of wages and the employment levels in the next section.

4 Lobbying on the Wage Level

The next step we take is to make $\beta$ endogenous by assuming lobbying on the wage level by the unions. Recently many contributions have highlighted the interdependence between labor market and goods market regulations. The focus is, among other issues, especially on the possible complementarity between the two kinds of interventions. In particular, some theoretical and empirical contributions have shown that deregulating the goods market may lead in turn to deregulation on the labor market. A deeper understanding of the links, effects and counter-effects relating the two forms of regulation is of fundamental importance from a policy point of view. The complementarity, in fact, has important consequences on the timing of deregulation in the two markets, implying that labor market deregulation should follow the deregulation on the goods market, since the former should ease the resistance of workers to more flexibility and liberalization of the labor market. The basic argument is simple and is based on the bargaining process previously described, extended to consider the fact that unions may undertake lobbying activities in order to raise the wage level and gain a higher share of the profits of the firm. Various forms of liberalization on the goods market, like easier entry conditions through lower entry costs, may lead to a decrease in the profits earned by the firms. With a lower level of profits
the intensity of lobbying should decrease leading to a lower bargaining power of unionized workers and lowering in turn their resistance to labor market reforms.

To explore this issue we follow Blanchard and Giavazzi (2003) and Fiori et al. (2007) by interpreting the elasticity of substitution between varieties, $\sigma$, has a policy parameter. From this point of view, an increase in $\sigma$ may be due to a decrease of trade barriers or the elimination of standardization policies which make it easier to sell products on different markets. To differentiate this interpretation of the elasticity of substitution from the original one, we will use the term $\bar{\sigma}$. The second step is to assume some form of lobbying by the unions. We consider a very simple lobbying function which is quadratic in the cost of lobbying:

$$h\left( w - w_R \right) L_m - \alpha^2 \beta^2$$

(29)

The union maximizes the excess utility of workers net of lobbying costs. Note that in 29 we have considered the total level of employment in the manufacturing sector, $L_m$. This means that while the bargaining process is decentralized since the unions operate at a sectoral level, the lobbying activity takes place at an economy-wide level. We can think of the lobby as an organization that aggregates the preferences of the various unions in different sectors to exercise pressure on the Government.

Substituting the value for $w$ from equation 7 and maximizing with respect to $\beta$ we get:

$$\beta^* = \frac{\mu}{\alpha(1 + \mu)} = \frac{1}{\alpha\bar{\sigma}}$$

(30)

Considering lobbying by the unions allows to make the bargaining power of workers endogenous and dependent on the mark-up set by the firm. It is easy to check that $\beta^*$ is increasing in $\mu$, which means that an increase in $\bar{\sigma}$ leads to a lower bargaining power of workers or, in other words, that $\beta$ and $\mu$ are complements: goods market deregulation may ease labor market deregulation in the form of lower pressure by the union for higher wage levels. Substituting $\beta^*$ in the wage equation we have:

$$w = \frac{\alpha(1 + \mu) + \mu^2}{\alpha(1 + \mu)} w_R = \frac{\alpha\bar{\sigma}(\bar{\sigma} - 1) + 1}{\alpha\bar{\sigma}(\bar{\sigma} - 1)} w_R$$

(31)

We can think of $\alpha$ as an inverse measure of the pressure that the lobby is able to exert on the Government in order to gain higher power in the bargaining process. A high level of this cost may due to information and coordination failures that the lobby encounters in aggregating the interests of the different unions, thereby making the lobbying activity less effective. Obviously the wage level is decreasing in $\alpha$. A more fundamental issue is what happens, in the short run general equilibrium, to the bargained wage as $\bar{\sigma}$ varies, that is whether goods market deregulation leads to an increase or a decrease of the wage level. It is straightforward to show that a condition for goods market deregulation (an increase in $\bar{\sigma}$) to lead to a decrease in the wage level in the manufacturing
sector, given \( w_R \), is \( \beta^* > 1/2 \), or equivalently that the lobbying cost is sufficiently low: \( \alpha < 2/\sigma \). Hence, when the lobby is strong the complementarity between goods and labor market deregulation turns out to decrease the wage level, while the opposite is true when the power of the lobby is low. A rationale for this result may be as follows: a stronger lobby is able to gain higher wages in the bargaining process but it also allows more easily for wage cuts, when the total rents decrease, with respect to a weaker lobby. The rent of the firm becomes \( \pi = \frac{\alpha \sigma - 1}{\alpha \sigma - 1} \) and is obviously increasing in the cost of lobbying, \( \alpha \).

We now turn to explore the effect of the interaction between goods market deregulation and labor market deregulation on the long run growth rate of the economy. From 28, we already noticed how, without considering the lobbying activity of the union, the negative effect of an increase in \( \sigma \) is lower the higher the bargaining power workers. We can now rewrite the expression for the long run growth rate of the economy in 24 substituting into it the expression for \( \beta^* \) to get:

\[
g^*_l = \frac{\alpha \sigma - 1}{\alpha \sigma - 1} L - \frac{\alpha \sigma (\sigma - 1)}{\alpha \sigma^2 - 1} \rho
\]

A first question concerns the behavior of the growth rate with respect to \( \alpha \). In other terms we want to check the effect of an exogenous variation in the strength of the lobby on the steady-state behavior of the economy. Taking the derivative of \( g^*_l \) with respect to \( \alpha \) we get:

\[
\frac{\partial g^*_l}{\partial \alpha} = \frac{\pi(\sigma - 1)}{(\alpha \sigma^2 - 1)^2} \left( L + \rho \right) > 0
\]

Clearly a weaker union is able to bid for lower wages and thus the rent share earned by the firm increases, fostering the innovation activity and thus leading to a higher level of \( g \).

The most interesting issue is anyway to consider the behavior of \( g \) as \( \sigma \) increases, taking now into consideration the interaction between the change in the policy variable on the good market and the bargaining power of the union in the labor market, that is taking into account that an increase in \( \sigma \) will trigger a variation of the institutional conditions on the labor market. To assess the argument quantitatively we can take the derivative of \( g^*_l \) with respect to \( \sigma \):

\[
\frac{\partial g^*_l}{\partial \sigma} = -\frac{\alpha (\alpha \sigma^2 - 2 \sigma + 1)}{(\alpha \sigma^2 - 1)^2} \left( \frac{L}{\sigma} + \rho \right)
\]

The sign of the derivative depends now on the parameter values. In particular we have that \( \frac{\partial g^*_l}{\partial \sigma} \geq 0 \) if \( \alpha \leq \bar{\sigma} = \frac{2 \sigma - 1}{\alpha \sigma^2} \). The important aspect to note is that the interaction between the policies in the two markets raises the possibility that an increase in \( \sigma \), or equivalently a deregulation of the goods market, raises the long run growth rate of the economy. Such a possibility arises obviously through the effect that such a policy intervention has on the labor market. In order to get a deeper view of the argument we can rewrite the steady-state values of equation 26 substituting \( \beta^* \) to get:
\[
\begin{align*}
L^*_R,l &= a^*y^*_l \\
L^*_R,l &= \frac{\sigma \sigma^2 - 1}{\sigma \sigma^2 - 1} L^* + a \rho \\
L^*_m,l &= 1/p^*_l = \frac{\sigma \sigma^2 - 1}{\sigma \sigma^2 - 1} L^* + a \rho \\
\end{align*}
\]

We can now consider the general equilibrium effects of a change in \( \sigma \). Checking derivatives we have that if \( \alpha \sigma^2 - 1 < 2 \sigma^2 \), \( L^*_R \) increases, \( p^*_l \) increases and \( L^*_m \) decreases with respect to \( \sigma \). \( w^*_R \) is always increasing both in nominal and real terms. \( w^*_l \) increases in \( \sigma \) if \( \alpha \sigma^2 - 1 < 4 \sigma^2 - 3 \). What matters, anyway, is the behavior of the real wage in the manufacturing sector. Since the real wage in the manufacturing sector does not depend on \( w_R \), the general and the partial equilibrium effects are the same and as we saw, \( w_l/p_l \) increases if \( \alpha > \sigma = 2/\sigma \) or, equivalently, if \( \beta^* < 1/2 \). It is easy to check that \( \sigma < \sigma \) always. This means that when \( \alpha < \sigma \), the economy displays an increasing long-run growth rate associated to a decreasing wage. Obviously this is possible because of the interplay of the policies on goods and labor markets. When the union is strong, there is a complementarity of the policies on the two different markets: liberalization on the goods market in the form of an increase in the elasticity of substitution among varieties brings along a corresponding form of liberalization in the labor market in the form of a lower real wage. For the given parameter values, the growth rate of the economy increases since the mark-up (or unitary profit in real terms) increases. In our model, however, the decrease in the real wage in the manufacturing sector does not create higher employment in this sector as \( L^*_m,l \) decreases. Such a decrease leaves room to a higher level of employment in the research sector which fosters the innovation activity and hence growth. When \( \sigma < \alpha < \sigma \), the growth rate of the economy decreases along with a decreasing real wage in the manufacturing sector. This is because the price of the good starts lowering and the mark up decreases. When \( \alpha > \sigma \) the economy displays a decreasing growth rate associated to an increasing real wage in the manufacturing sector.

### 5 Conclusions

We presented a model of growth and innovation where monopolistically competitive firms bargain with unions over the wage of manufacturing workers. We then considered the effect of wage bargaining on the long run growth rate of the economy in a setting where firms innovate by expanding the number of varieties produced. It is shown that a higher bargaining power of workers decreases the growth rate of the economy. This happens fundamentally because a higher bargaining power of workers decreases the share of the profit rate for entrepreneurs and hinders in this way the innovation activity.

We then introduced lobbying by the unions to study the effect of an increase of the elasticity of substitution among goods, considered as a policy parameter.
For some parameter values, we find that an increase in the elasticity of substitution may foster the growth rate of the economy through the interaction with the labor market institutions. This challenges the Schumpeterian view that a lower level of competition is needed for a high level of innovation to take place.

One shortcoming of the model is the absence of unemployment in equilibrium. In our model, the full employment condition holds since the R&D wage rate clears out the market. It would be of course interesting to consider a version of the model with a positive level of unemployment in equilibrium in order to study the effect of wage bargaining and the lobbying activity on unemployment. To do so we would have to consider a reservation wage given by an unemployment benefit financed through taxation by the government.

A second aspect concerns the bargaining process. We have considered efficient bargaining, where the firms and the unions negotiate on both the wage rate and the employment level. An extension of the model would be to see what happens with the right to manage bargaining process, where firms choose employment unilaterally after negotiating with the union on the wage rate.

6 References


