Market power, Growth and Unemployment*

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Abstract

Unemployment occurs when some agents, say unions, have control over the wage and set it above the market-clearing level. In other words, it is generated by their exercise of market power. What if, in addition, firms have control over prices in the product market? In this case, market power of wage setters interacts with market power of price setters. Understanding this interaction sheds new light on the effects of policy interventions on unemployment and growth. Reforms that result in lower labor costs reduce unemployment and boost growth because they expand the scale of the economy and generate more competition in the product market. The reduction in unemployment is larger than one would expect if the pro-competitive effect of the reforms were ignored. These reforms, thus, are even more attractive when one considers the endogenous structure of the product market. If they are implemented jointly with a reduction of barriers to innovation in the product market, an even larger reduction in unemployment and increase in growth is achieved.

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1 Introduction

Traditional explanations of unemployment focus on labor market rigidities and ignore the characteristics of the product market. Some economists argue that this approach is flawed and likely to yield ineffective policy prescriptions (see, e.g., Solow 2000, Blanchard 2000, Blanchard and Giavazzi 2000). In this paper, I exploit recent developments in endogenous growth theory to pursue this criticism in a specific direction: I argue that unemployment and productivity growth are related because they both depend on the structure of the product market, and that this relation has important implications for policy.

I start from the simple observation that most of the available explanations of unemployment posit that some agents (typically unions) have control over the wage and set it above the market-clearing level. In other words, unemployment is generated by their exercise of market power. I then ask: What if, in addition, firms have control over prices in the product market? In this case, market power in the product market interacts with market power in the labor market. Analysis of this interaction sheds new light on the effects on unemployment and growth of policy interventions in the labor and the product markets. Let me consider them separately.

Labor market institutions, tax policy and other factors affect labor costs and thus unemployment. I provide two related results:

- policies that reduce labor costs reduce unemployment and raise growth;
- the reduction in unemployment due to these policies is larger when one considers their effects on the structure of the product market.

To illustrate, consider the role of labor income taxes (unemployment benefits have similar effects). Given the structure of the product market, higher labor income taxes generate higher unemployment via their traditional effect on the cost of labor. The economy then operates at a smaller scale. This results in lower returns to entry and less competition in the product market which,

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1 In his recent review of the empirical evidence, for example, Nickell (1997, p. 72) concludes: “High unemployment is associated with the following labor market features: (1) generous unemployment benefits that are allowed to run indefinitely, combined with little or no pressure on the unemployed to obtain work and to low levels of active intervention to increase the ability and willingness of the unemployed to work; (2) high unionization with wages bargained collectively and no coordination between either union or employers in wage bargaining; (3) high overall taxes impinging on labor or a combination of high minimum wages for young people associated with high payroll taxes; and (4) poor educational standards at the bottom end of the labor market.”
in turn, results in higher market power for price setters. In equilibrium, the market power of price setters must equal the inverse of the market power of wage setters. The reduction in competition that raises the market power of price setters, therefore, must be matched by an increase in unemployment that reduces the market power of wage setters. Growth falls because firms operate in a less competitive market. Summarizing, labor income taxes raise unemployment and reduce growth. This result is consistent with the evidence discussed in Nickell and Layard (1997), who find that the total tax burden on labor has a negative effect on growth. It is also consistent with the evidence discussed in Daveri and Tabellini (2000), who show that the increase in unemployment and reduction in growth that occurred in the recent decades in the OECD is driven by the increase in labor income taxes. Finally, it is consistent with the evidence provided by Wu and Zhang (2000), who show that in the OECD countries there is a positive correlation between taxation and the mark-ups that firms charge over marginal cost.

Next, I consider the role of factors that raise the cost of innovation, reduce product substitution and thus price competition, or raise entry costs for entrants but do not affect incumbents. I provide three results:

- lower costs of innovation raise growth and reduce unemployment;
- tougher price competition has ambiguous effects on growth and unemployment;
- lower barriers to entry do not necessarily reduce growth while reduce unemployment.

These results emphasize the importance of the details of the pro-growth policy that a country adopts. Reducing barriers to innovation is the most effective policy to promote growth because it reduces at the same time barriers to the creation of new firms and barriers to innovation within the firm. As a result, it fosters investment on both the intensive and the extensive margin and, more importantly, it exploits the positive relation between competition and growth. In so doing, it also reduces unemployment. In contrast, fostering growth by protecting incumbents – which is fairly common in Europe where governments protect “national champions” – is self-defeating because it raises unemployment by restricting competition. Moreover, less competition reduces firms’ incentives to undertake R&D so that growth might not rise at all.

The analysis sketched above has two general implications concerning policy. First, labor market reforms that reduce the cost of labor, like those...
advocated by the OECD in its Jobs Study (1994), have effects in the product market that reinforce their direct effects on unemployment. Specifically, these reforms boost growth because they expand the scale of the economy, attract entry, and thus generate more competition in the product market. Since the rise in product market competition further reduces unemployment, \textit{the reduction in unemployment that these reforms generate is larger than one would expect if the product market effect of lower labor costs were ignored.} In other words, the reforms advocated by the OECD are even more attractive when one considers the positive feedback that runs through the endogenous structure of the product market.

The second implication stems from a positive feedback in the other direction. Product market reforms that foster innovation reduce unemployment because they attract entry and generate more competition in the product market. The reduction in unemployment expands the economy’s scale of activity and attracts more entry, which further boosts R&D spending by firms. Hence, \textit{the acceleration in growth that these reforms generate is larger than one would expect if the labor market effect of lower barriers to innovation were ignored.} These results provide a theoretical rationale for the pro-competitive reforms advocated in a series of studies undertaken at the McKinsey Global Institute (1995, 1997), and show that these reforms are even more attractive when one considers the positive feedback on market structure and growth that runs through the labor market.\textsuperscript{2}

One feature of my approach drives these results. In order to focus on market power, I deviate from the existing literature on growth and unemployment that follows the “creative destruction” tradition.\textsuperscript{3} I consider a model where growth is driven by the activities of firms that are not put out of business by outside innovators but are long-lived profit centers that innovate repeatedly in-house.\textsuperscript{4} The main difference between the two approaches is that “creative destruction” models exhibit a \textit{negative} relation between product market competition and growth, while the “creative accumulation” model that I consider exhibits a \textit{positive} relation. This relation, supported empirically by the recent work of Nickell (1996) and Pagano and Schivardi (2000), has the important implication that a more competitive product market generates both faster growth and lower unemployment. Moreover, in “creative destruction” models the degree of competition is pinned down by

\textsuperscript{2}See also Baily (1993), Baily and Gersbach (1995), Gersbach and Sheldon (1996) and Gersbach (1999) for a survey article.

\textsuperscript{3}See Aghion and Howitt (1992) and (1998, chapter 4) for a review of recent results.

an exogenous parameter whereas in my “creative accumulation” model it depends on the number of firms, which is endogenous.

I organize the paper as follows. In Section 2, I set up the model. In Section 3, I study the product market and characterize the relation between competition and growth. In Section 4, I study the labor market and show how the exercise of market power by a monopoly union generates unemployment. In Section 5, I study the general equilibrium of the model and show how the interaction of market power in the product and labor markets determines unemployment, market structure, and growth. In Section 6, I discuss the effects of structural parameters and policy instruments. I conclude in Section 7.

2 The Model

Consider a closed economy with one representative household with $\lambda$ members. $\lambda$ is constant. Each member of the household is endowed with one unit of labor. When employed, the members of the household belong to monopoly unions that operate at the firm level. For simplicity, I assume that the capital market is competitive.

2.1 Production, Innovation and Entry

There is a final good that can be consumed or invested. The final good is produced by assembling differentiated intermediate goods according to

$$Y = N^{\frac{1}{\varepsilon(N)} - 1} \left[ \int_1^N X_i^{\frac{\varepsilon(N)}{\varepsilon(N) - 1}} \, di \right]^{\frac{\varepsilon(N)}{\varepsilon(N) - 1}}, \quad e'(N) > 0$$

where $e(N)$ is the elasticity of product substitution, $X_i$ is the final producer’s use of each differentiated good, and $N$ is the mass of intermediate goods (the mass of intermediate firms). The final good is the numeraire.

The elasticity of substitution is an increasing function of the mass of firms, bounded from above and from below, $\infty > e(\infty) > e(1) > 1$. This allows me to capture the role of endogenous market power while retaining the desirable features of a monopolistic competition model defined over a continuum of goods.$^5$

The final producer maximizes profits subject to the budget constraint

$$Y = \int_1^N P_i X_i \, di,$$

where $P_i$ is the price of intermediate good $i$. This yields

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$^5$The traditional approach to generating endogenous market power from CES preferences is to define the number of goods as an integer and allow the typical firm to internalize
the demand schedule faced by firm $i$,

$$X_i = \frac{Y}{N} P_i^{-e(N)}.$$  \hspace{1cm} (1)

Notice that the price index of intermediate goods – which the atomistic intermediate firms take as given – must be equal to the price of the final good and thus is equal to one. The typical intermediate firm produces with the technology

$$X_i = Z_i L_i^\gamma, \quad 0 < \gamma < 1$$  \hspace{1cm} (2)

where $X_i$ is output, $L_i$ is labor and $Z_i$ is the firm’s cumulated stock of cost-reducing innovations.

Firms run in-house R&D facilities to produce a continuous flow of innovations according to

$$\dot{Z}_i = \alpha R Z_i, \quad \alpha > 0$$  \hspace{1cm} (3)

where $\dot{Z}_i$ is the flow of innovations generated by an R&D project employing $R Z_i$ units of the final good for an interval of time $dt$. Entrepreneurs create new firms by running R&D projects that develop new products and their manufacturing processes. I assume that the entry level of productivity is equal to average productivity, $Z$, and that the cost of entry is proportional to the entry level of productivity. This captures the idea that entrants face escalating R&D entry costs because of the industry’s ongoing technological advance. This setup allows me to posit the entry technology

$$\dot{N} = \frac{\alpha}{\beta Z} R N, \quad \beta > 1$$  \hspace{1cm} (4)

its effect on the industry’s price index. For example, I could define

$$Y = N^{-\frac{1}{\epsilon}} \left[ \sum_{i=1}^{N} X_i^{\frac{1}{\epsilon}} \right]^{-\frac{\epsilon}{1-\epsilon}}, \quad \epsilon > 1.$$

In symmetric equilibrium the price elasticity of the demand curve for product $i$ is

$$e(N) \equiv -\frac{\partial X_i}{\partial P_i} \frac{P_i}{X_i} = \epsilon - (\epsilon - 1) \frac{1}{N},$$

which features the qualitative properties that I posit in the text and yields results similar to those that I discuss in the paper. My formulation with a continuum of goods is more flexible and allows me to sidestep some technical issues that I would need to address if I took this approach.
where \( R_N \) is the amount of final good devoted to starting up \( \dot{N} \) new firms for an interval of time \( dt \). The parameter \( \beta \) captures non-R&D components of the entry cost by reducing the overall productivity of resources devoted to entry. The important feature of this parameter is that it does not affect incumbents. Hence, it captures exogenous barriers to entry.

### 2.2 Consumption, Saving and Labor Supply

The household maximizes

\[
U(0) = \int_0^\infty e^{-\rho t} \lambda \left[ \log \left( \frac{C(t)}{\lambda} \right) + \psi \log \left( \frac{\lambda - L^s(t)}{\lambda} \right) \right] dt, \quad \rho, \psi > 0
\]

subject to the flow budget constraint

\[
\dot{A} = rA + L^s [W(1 - \tau) p_e + B p_u] + T - C, \quad 0 < \tau < 1
\]

where \( \rho \) is the individual discount rate, \( C \) is consumption, \( L^s \) is the number of household members that offer their labor for a wage, \( A \) is assets holding, and \( T \) is a lump sum transfer from the government. The assets available to the household are ownership shares of firms. Hence, \( r \) is the rate of return on stocks. Three things are new in this setup. First, the instantaneous utility of the household contains a term that captures the role of household members that do not participate in the labor market; one can think of home production or other related activities the output of which is shared by all household members. Second, the budget constraint contains the household’s expected income: each household member that participates in the labor market earns the after-tax wage \( W(1 - \tau) \) if he is employed and the unemployment benefit \( B \) if he is unemployed. The probability of being employed is \( p_e \); the probability of being unemployed is \( p_u \).\(^6\)

The maximization problem outlined above has a well-known structure. First, the household sets

\[
\frac{\dot{C}}{C} = r - \rho.
\]

\(^6\) Implicit in this setup is the assumption that the household insures its members participating in the labor market against unemployment. This simplifies the analysis because it ensures that all household members get the same flow of consumption and therefore of utility. Notice that I am also assuming that participation in the labor market prevents the individual from contributing to household production even if he is unemployed; one can think that participation while unemployed takes up the individual’s time as much as if he were working. Relaxing this assumption by allowing unemployed individuals to work at home complicates the analysis but does not change the qualitative results of the model.
Taking as given this time-path of consumption, the household chooses labor supply. This yields
\[ L^s = \lambda - \frac{\psi C}{W(1 - \tau)p_e + Bp_u}. \] (6)

Labor supply is decreasing in consumption, \( C \), and increasing in the wage, \( W \), and the unemployment benefit, \( B \).

I now turn to the probabilities. Given labor demand \( L^d \), the unemployment rate is
\[ u = 1 - \frac{L^d}{L^s}, \]
where \( L^s \) is the household labor supply derived above. Assuming random allocation of work among household members participating in the labor market, I can write \( p_u = u \) and \( p_e = 1 - u \). This implies that labor supply depends on the unemployment rate via two effects. First, lower unemployment means that the participating individual is more likely to be employed and this raises the expected benefit of participation. Second, the individual is less likely to be unemployed and thus to draw the benefit \( B \), which reduces the expected benefit of participation. I show below that the model’s equilibrium conditions imply \( W(1 - \tau) > B \) so that labor supply is decreasing in the unemployment rate.

3 The Product Market

In this section, I construct the symmetric Nash equilibrium of the intermediate sector of the economy. The firm’s production technology yields the cost function
\[ WL_i = W(Z_i^{-1}X_i) \wedge. \] (7)

Firms maximize the present discounted value of net cash flow,
\[ V_i(0) = \int_0^\infty e^{-\int_0^t r(v)dv} \Pi_i(t)dt, \] (8)
subject to the demand schedule (1), the cost function (7), the R&D function (3), \( Z_i(0) = Z > 0 \) (the initial knowledge stock is given), \( Z_j(t) \) for \( t > 0 \) and \( j \neq i \) (the firm takes as given the rivals’ innovation paths), and \( \dot{Z}_j(t) \) for \( t > 0 \) (innovation is irreversible). Instantaneous profits are \( \Pi_i = P_iX_i - WL_i - RZ_i \),
where \( RZ_i \) is R&D expenditure. With perfect foresight, \( V_i \) is the stock market value of the firm, the price of the ownership share of an equity holder. The firm’s problem can be split in the following stages.

First, facing demand (1) the firm sets

\[
P_i = \frac{e}{e-1} W \frac{1}{\gamma} (Z_i^{-1} X_i)^{\frac{1}{\gamma} - 1} Z_i^{-1}.
\]

(9)

Substituting this expression in the cost function (7) yields labor demand

\[
L_i = \frac{\gamma (e - 1) P_i X_i}{eW}.
\]

(10)

Given these instantaneous choices of price and scale of operations, the firm finances R&D by issuing ownership claims on the flow of profits generated by cost-reducing innovations. Let the market value of such financial assets be \( q_i \). The firm is willing to undertake R&D if the value of the innovation is equal to its cost, \( q_i = \frac{1}{\alpha} \iff RZ_i > 0 \). Since the innovation is implemented in-house, its benefits are determined by the marginal profit it generates. Thus, the return to the innovation must satisfy the arbitrage condition

\[
r = \frac{\partial \Pi_i}{\partial Z_i} \frac{1}{q_i} \frac{\dot{q}_i}{q_i}.
\]

(11)

Using the cost function (7) and the price strategy (9), I can write

\[
\frac{\partial \Pi_i}{\partial Z_i} = \frac{(e - 1) P_i X_i}{eZ_i}
\]

Taking logs and time derivatives of \( q_i = \frac{1}{\alpha} \), substituting into (11) and rearranging terms yields

\[
r = \frac{\alpha (e - 1) P_i X_i}{eZ_i},
\]

(12)

which defines the rate of return to in-house innovation.

The value of the firm must satisfy the arbitrage condition

\[
r = \frac{\Pi_i}{V_i} + \frac{\dot{V}_i}{V_i},
\]

(13)

which is obtained by taking logs and time-derivatives of (8). Entry costs \( \frac{\partial}{\partial Z} \) and produces value \( V_i \). Entrants are active if the value of entry is equal
to its cost, \( V_i = \frac{\beta}{\alpha} Z \iff \dot{N} > 0 \). Taking logs and time derivatives and substituting into (13), I obtain

\[
r = \frac{\alpha \Pi_i}{\beta Z} + \frac{\dot{Z}}{Z}.
\]

Using the cost function (7), the price strategy (9) and the expression for profits, I obtain

\[
r = \frac{\alpha}{\beta Z} \left[ P_i X_i \left( 1 - \frac{\gamma (e - 1)}{e} \right) - RZ_i \right] + \frac{\dot{Z}}{Z}.
\]

This is the rate of return to entry (firm ownership).

In symmetric equilibrium, I have \( P_i X_i = \frac{Y}{N} \). Hence:

\[
r_{R&D} = \frac{\alpha Y}{NZ} \frac{e - 1}{e} ;
\]

\[
r_{entry} = \frac{\alpha Y}{NZ} \frac{1}{\beta} \left[ 1 - \frac{\gamma (e - 1)}{e} \right] + \frac{\beta - 1}{\beta} g,
\]

where \( g \equiv \frac{\dot{Z}}{Z} \) is the rate of growth of labor productivity, which determines growth of income per capita in this economy. These equations define the returns to two types of investment. No-arbitrage in the capital market requires that they yield equal rates of return.

To study the properties of the Nash equilibrium, one can represent the interaction of incumbents and entrants in a diagram with the rate of return, \( r \), on the vertical axis and growth, \( g \), on the horizontal axis. The equilibrium with positive growth is at the intersection of the horizontal line (15) with the upward sloping line (16).\(^7\) It exists if (15) is higher than the intercept of (16), otherwise (15) and (16) cross for a negative value of \( g \), the non-negativity constraint on R&D is binding, and \( g = 0 \). In order to focus the analysis and streamline the presentation, I impose the following restriction

\[
e(1) > \frac{\beta + \gamma}{\beta + \gamma - 1} > 1,
\]

\(^7\)This equilibrium is stable in the following sense: to its right the rate of return to R&D is lower than the rate of return to entry and investors wish to reduce growth since this reduces the rate of return to entry; to its left the rate of return to R&D is higher than the rate of return to entry and investors wish to raise growth since this raises the rate of return to entry.
which ensures that the interior equilibrium exists for all \( N \). If this condition does not hold, there exists a threshold \( N_0 \) such that \( g > 0 \) for \( N > N_0 \) and \( g = 0 \) for \( 1 \leq N \leq N_0 \). Analysis of the model in this case is feasible but complicated by the fact that one needs to worry about the corner solution and the endogenous regime switch that it implies (see Peretto 1998). Since this feature is not essential to understanding the interaction of growth and unemployment, I rule it out.

The conclusion of this discussion is that in equilibrium growth is

\[
g = \frac{\alpha Y (\beta + \gamma) (e - 1) - e}{NZ e (\beta - 1)} \tag{17}
\]

and the associated rate of return to R&D and entry is

\[
r = \frac{\alpha Y e - 1}{NZ e}. \tag{18}
\]

According to (17), growth is increasing in the firm’s scale of operations, \( \frac{Y}{N} \). To see why, note that the rate of return to R&D increases with the scale of production over which cost-reducing innovations apply. Similarly, the rate of return to entry increases with the anticipated scale of production of the firm. In both cases, the intuition is that R&D and entry costs are fixed costs that larger firms spread over larger volumes of production. Recent work by Cohen and Klepper (1996a, 1996b) and Adams and Jaffe (1996) shows that this cost-spreading mechanism is important in explaining the role of firm size emphasized in many empirical studies.

### 4 The Labor Market

My setup for the labor market follows Daveri and Tabellini (2000) with the difference that here firms are not competitive and that labor supply is elastic. Wages are set by monopoly unions that operate at the firm level and maximize the difference between the after-tax wage and the unemployment benefit for the firms’ employees.\(^8\) The typical union’s problem is

\[
\max_{W_i} [W_i (1 - \tau) - B] L_i,
\]

\(^8\)In my setup the alternative to the wage paid by the firm is the unemployment benefit because the individual who participates in the labor market cannot take part in household production. Moreover, I assume that the benefit is not taxed. This is extreme, but it is simply meant to capture the fact that unemployment benefits are taxed more lightly than wages; see Daveri and Tabellini (2000, pp. 58–59) for evidence on this point. Notice, finally, that assuming that the union maximizes the surplus for an employed worker yields the same results as assuming that the union maximizes in a utilitarian fashion the expected
where \( L_i \) is the firm’s labor demand given by (10). This yields

\[
W_i = \frac{B}{1 - \tau} \frac{eW_i}{eW_i - 1}, \quad eW_i \equiv \frac{\partial L_i}{\partial W} W
\]

This wage-setting relation is the traditional mark-up rule for a monopolist, where \( \frac{B}{1 - \tau} \) is the marginal (opportunity) cost of working for a wage and \( eW_i \) is the wage elasticity of labor demand. To characterize this condition more sharply, I use the demand schedule (1) and the production function (2) to rewrite labor demand (10) as

\[
L_i = \left[ \frac{\gamma(e - 1)}{eW_i} \left( \frac{Y}{N} \right)^{\frac{1}{\gamma}} Z_i^{\frac{1}{\gamma}} \right]^{\frac{1}{1 - \gamma e - 1}}.
\]

This yields

\[
eW = \frac{1}{1 - \gamma e - 1} > 1,
\]

which says that labor demand becomes more elastic as a result of product market competition. This follows from the fact that an increase in the wage raises the firm’s marginal cost and this has a larger effect on the firm’s scale of production – and thus labor demand – the tougher is price competition in the product market. The wage-setting relation then reads

\[
W = \frac{B}{\gamma(1 - \tau)} \frac{e}{e - 1}.
\]

As I show below, this expression implies that the wage is above the market-clearing level so that there is unemployment.

To characterize the labor market more sharply, it is useful to assume that the government cannot borrow and satisfies the budget constraint \( T = \tau WL - B(L^s - L) \), which determines the lump-sum transfer, \( T \), as the difference between tax revenues and expenditure on benefits.\(^9\) It also useful income of those who participate in the labor market. This, in turn, is consistent with individual utility maximization because households insure their members against the risk of unemployment.\(^9\) This setup keeps to a minimum the effect of the government on economic activity. Only two distortions matter: taxation, which lowers labor supply and raises the wage that unions demand, and the unemployment benefit, which raises both labor supply and the wage that unions demand.

\(^9\)
to assume that the unemployment benefit is a constant fraction of income per capita. I thus posit $B = \sigma \frac{Y}{X}$. This yields

$$W = \frac{\sigma Y}{\lambda \gamma (1 - \tau)} \frac{e}{e - 1}. \quad (19)$$

Aggregate labor demand is $L^d = \int_1^N L_i \text{d}i$. Given the wage, (10) yields

$$L = \frac{\gamma^2 \lambda (1 - \tau)}{\sigma} \left( \frac{e - 1}{e} \right)^2. \quad (LL)$$

Employment is decreasing in the tax rate and the replacement ratio, and increasing in product market competition.

To show that the monopoly wage (19) generates unemployment, I now use (LL) and (6), to obtain an implicit equation,

$$\frac{1 - u}{1 - \tau} \left[ \sigma - \frac{\psi}{\frac{(1 - u) e}{\gamma (e - 1)} + u \frac{C}{Y}} \right] = \gamma^2 \left( \frac{e - 1}{e} \right)^2, \quad (20)$$

which determines the rate of unemployment as a function decreasing in $N$ and $\frac{C}{Y}$ and increasing in $\sigma$ and $\tau$. The rate of unemployment is decreasing in the consumption ratio because higher consumption reduces labor supply.

To see in finer detail what lies behind equation (20), the following textbook interpretation is useful (see, e.g., Blanchard 1996, chapter 17). Begin by noticing the following relation between $L$ and $u$ that I obtain from the definition of unemployment and (LL):

$$L = \lambda \frac{1 - u}{\sigma} \left[ \sigma - \frac{\psi}{\frac{(1 - u) e}{\gamma (e - 1)} + u \frac{C}{Y}} \right].$$

I can now use the expression for the monopoly wage to obtain the following wage-setting relation

$$W = Z \frac{\sigma}{\gamma (1 - \tau)} \left( \frac{N}{\lambda} \right)^{1-\gamma} \left( \frac{1 - u}{\sigma} \left[ \sigma - \frac{\psi}{\frac{(1 - u) e}{\gamma (e - 1)} + u \frac{C}{Y}} \right] \right)^{\gamma}. \quad (WW)$$

Similarly, I can use (LL) to construct the price-setting relation

$$W = Z \frac{\gamma (e - 1)}{e} \left( \frac{N}{\lambda} \right)^{1-\gamma} \left( \frac{1 - u}{\sigma} \left[ \sigma - \frac{\psi}{\frac{(1 - u) e}{\gamma (e - 1)} + u \frac{C}{Y}} \right] \right)^{-1+\gamma}. \quad (PP)$$

13
Figure 1 illustrates the partial equilibrium of the labor market as the intersection of the $WW$ and $PP$ loci in $(u, W)$ space.

By construction, $(PP)$ expresses the relation between the wage and production per firm that one obtains from the firm’s pricing rule. Specifically, firms’ market power determines a wedge between price and marginal cost. Given the wage, this determines the level of output, the only item in the determination of production cost that is under firms’ control at a given moment in time. This produces the upward sloping price-setting relation, $PP$. Intuitively, higher unemployment means lower output and lower marginal cost. Since firms’ power in the product market pins down the price-cost margin, the wage must rise to offset the reduction in marginal cost due to the lower volume of production. In contrast, the wage-setting relation, $WW$, is downward sloping because higher unemployment implies lower employment, which reduces output and thus the unemployment benefit. As a result, the union charges the same markup over a lower marginal (opportunity) cost of labor and the wage falls.\footnote{Since the unemployment benefit is the value of the alternative for the union in a bargaining setup, the lower benefit is interpretable as lower market power for the union.} 

Equilibrium occurs where the union’s market power matches the inverse of firms’ market power, that is, at the level of unemployment such that the markup that the monopolistic union charges over the marginal (opportunity) cost of labor equals the inverse of the markup that oligopolistic firms charge over the marginal cost of production. There is thus a downward sloping relation between the number of firms and unemployment, captured by equation (20). An increase in the number of firms reduces firms’ market power and shifts up the price-setting relation.\footnote{The reader might have noticed that the increase in the number of firms also shifts up both curves by the same amount because of the aggregation effect of technologies that exhibit diminishing returns to scale at the firm level. This effect raises the wage but cancels out in the determination of unemployment.} Equilibrium is restored by a reduction in unemployment that implies (a) higher market power of wage setters in the labor market and (b) higher output that raises producers’ marginal costs and thereby reduces the price-wage margin in the product market.

## 5 General Equilibrium

In this Section, I discuss the main analytical results of the paper. I characterize the dynamics and the steady state of the model and then provide an intuitive interpretation of the results.
Figure 1: The Labor Market and Unemployment
5.1 Dynamics

Associated to the employment equation \((LL)\), there is aggregate output

\[
Y = NZ \left( \frac{L}{N} \right)^\gamma = ZN^{1-\gamma} \left[ \frac{\gamma^2 \lambda (1 - \tau)}{\sigma} \left( \frac{e - 1}{e} \right)^2 \right]^\gamma,
\]

\((YY)\)

which is increasing in \(N\) directly – in addition to through \(e(N)\) – because diminishing returns to scale with respect to labor imply that the economy produces more when there are many small firms than when there are few large ones. I can now use \((YY)\) to rewrite \((17)\) as

\[
g = \alpha \left[ \frac{\lambda N \gamma^2 (1 - \tau)}{\sigma} \left( \frac{e - 1}{e} \right)^2 \right]^\gamma \frac{(\beta + \gamma) (e - 1) - e}{e (\beta - 1)}.
\]

\((21)\)

This equation reveals that the number of firms determines growth at all moments in time. There are two effects: the market share effect, captured by the term \(\frac{\lambda}{N}\), and the rivalry effect, captured by the term \(\frac{e - 1}{e}\), which is increasing in \(N\).

To characterize the general equilibrium of this economy I impose output and capital market clearing. The partial equilibrium of the labor market affects the path of the economy through the output equation \((YY)\), which determines the resources constraint. The saving schedule \((5)\) determines the rate of return to saving that the household demands. The construction of the general equilibrium of this economy is then straightforward. There is an Euler equation characterizing the equilibrium of the capital market, whereby all rates of return are equalized, and an equation characterizing the equilibrium of the goods market, whereby output is allocated to consumption and investment. The latter equation is where this model deviates from the standard setup because the state variable of this economy is the number of firms.

To streamline the presentation, I present the details of the transition dynamics in the Appendix. The model admits the possibility of two steady states, one unstable and one stable. Since the former is not interesting I rule it out by imposing the restriction

\[
\alpha \left[ \frac{\gamma^2 \lambda (1 - \tau)}{N \sigma} \left( \frac{e(1) - 1}{e(1)} \right)^2 \right]^\gamma \frac{e(1) - (1 + \gamma) (e(1) - 1)}{e(1) (\beta - 1)} > \rho,
\]

which states that the net rate of return, \(r - g\), generated by a global monopolist \((N = 1)\) is higher than the discount rate. Let \(c = \frac{C}{\alpha Z}\). The phase
diagram in Figure 2 and the following Proposition characterize dynamics in $(N, c)$ space.

**Proposition 1** There is a unique perfect-foresight general equilibrium. If the initial number of firms is smaller than the steady state number of firms, $N^*$, the economy jumps on the saddle path and converges to the steady state $(N^*, c^*)$. If the initial number of firms is larger than $N^*$, the economy enters immediately a steady state with no entry.

**Proof.** See the Appendix. ■

This proposition implies that there is a continuum of steady states to the right of $N^*$ where the number of firms is exogenous. This is the region of hysteresis where entry is not profitable and the number of firms does not respond to parameter changes.

### 5.2 The Interior Steady State

To characterize the interior steady state it is useful to proceed as follows. First, notice that the net rate of return must equal the discount rate, $r - g = \rho$. Using (18) and $(YY)$ and (21) derived above, this condition reduces to the following implicit equation that determines the number of firms:

$$
\alpha \left[ \frac{\gamma^2 \lambda (1 - \tau)}{N \sigma} \left( \frac{e - 1}{e} \right)^2 \right] \gamma \frac{e - (1 + \gamma) (e - 1)}{e (\beta - 1)} = \rho. 
$$

(This is the $\dot{c} = 0$ locus derived in the Appendix.) On the left-hand side of this equation there is the measure of firm size $\frac{\alpha^Y}{N^Z}$; see $(YY)$. This follows from the fact that in equilibrium both the rate of return to investment and the rate of productivity growth are proportional to firm size; see (18) and (17). Hence, equation $(NN)$ states that shocks and policy interventions that expand the size of the market raise firm size and thus the profits of incumbents. As a consequence, they attract entry.

I now solve $(NN)$ for firm size $\frac{\alpha^Y_{NZ}}{N^Z}$ and substitute into (17) to obtain an equation that describes growth as an increasing function of market competition,

$$
g = \rho \left( \frac{(\beta + \gamma) (e - 1) - e}{e - (1 + \gamma) (e - 1)} \right).
$$

This equation holds only for equilibria where entry is profitable. The analysis of the model’s dynamics, on the other hand, shows that there are equilibria
Figure 2: General Equilibrium Dynamics
where entrants are not active. I discuss those in the next subsection. An important property of this equation is that the parameter \( \alpha \) is missing. This is because its effects on the intensive and extensive margins are identical and thus cancel out in the arbitrage condition that equalizes the returns to R&D by incumbents and R&D by entrants.\(^{12}\)

Next, I construct the \( UU \) locus. Output market clearing requires \( Y = C + NR_Z \). From this and \((GG)\) I obtain

\[
\frac{C}{Y} = \frac{\beta e - \gamma (e - 1)}{(\beta - 1) e}.
\]

Using (20), I then have

\[
\frac{\gamma^2 (e - 1)^2}{e^2} = \frac{1 - u}{1 - \tau} \left[ \sigma - \frac{\psi}{\gamma (e - 1)} + \frac{\beta e - \gamma (e - 1)}{(\beta - 1) e} \right]. \quad (UU)
\]

On the left-hand side of \((UU)\) there is the positive effect of \( N \) on labor demand, which reduces unemployment. On the right-hand side, there is the effect of \( N \) on labor supply. This has two components. First, product market competition raises the fraction of output devoted to R&D and thus reduces the consumption ratio. This raises labor supply. Second, product market competition raises the elasticity of labor demand and thus reduces the wage that unions set. This reduces labor supply. The plausible net effect of an increase in the number of firms is a fall in unemployment.

Given this structure, to determine growth, output, employment and unemployment, I simply substitute \( N^* \) obtained from \((NN)\) into, respectively, \((GG)\), \((YY)\), \((LL)\) and \((UU)\).

The positive relation between competition and growth captured by the upward sloping \( GG \) locus determines the growth effects of policy interventions and exogenous shocks that affect the labor market. Specifically, changes in labor market equilibrium are transmitted to the product market through changes in the number of firms that produce a movement along the \( GG \) locus. This effect is fully summarized by the term

\[
\frac{1 - \tau}{\sigma},
\]

\(^{12}\)The reader should also note that the equation does not contain terms that measure the size of the economy. Hence, the economy’s labor endowment affects growth only through its (positive) effect on the number of firms. As a result, the model exhibits a nonlinear scale effect, bounded from above. Since I have already discussed this property of this class of models in Peretto (1998, 1999), I do not examine this effect here and refer the reader to those papers for details.
which determines the cost of labor. Thus, *policy interventions in the labor market that reduce the cost of labor raise the economy’s scale of activity, attract entry and, as a result of the rivalry effect, raise growth.* This growth effect is larger the less competitive is the economy and vanishes when the economy approaches the upper bound for the elasticity of substitution.

The negative relation between the number of firms and unemployment captured by the downward sloping *UU* locus determines the unemployment effects of policy interventions and exogenous shocks that affect the product market. These are fully summarized by the two terms

\[
\left( \frac{e - 1}{e} \right)^2 \text{ and } \frac{\beta e - \gamma (e - 1)}{(\beta - 1) e},
\]

which capture, respectively, the increase in labor demand and labor supply due to an increase in the number of firms. One can see that *policy interventions in the product market that attract entry raise employment and reduce unemployment purely because they increase competition.* I discuss in details the effects of interventions in the labor and product markets in the next section.

### 5.3 The Region of Hysteresis

I now describe the model’s equilibrium when entry is not profitable and the number of firms does not respond to parameters changes. The rate of return to investment is given by the rate of return to R&D only. Setting \( r - g = \rho \) and using \((YY)\), I obtain

\[
g = \begin{cases} \alpha \left( \frac{\lambda \gamma^2 (e-1)^2}{e^2} \frac{1-r}{\sigma} \right)^{\gamma} \frac{e-1}{e} - \rho & N < N < \bar{N} \quad (GG_{hysterisis}) \\ 0 & \text{otherwise} \end{cases}
\]

Proceeding as in the previous subsection, I also obtain

\[
\left\{ \begin{array}{l}
\frac{\gamma^2 (e-1)^2}{e^2} = \frac{1-u}{1-\tau} \left[ \sigma - \frac{\gamma \psi}{1-u+\sigma u} \left[ \frac{1}{e} + \frac{\rho}{\alpha} \left( \frac{\lambda \gamma^2 (e-1)^2}{e^2} \frac{1-r}{\sigma} \right)^{\gamma} \right] \right] \quad N < N < \bar{N} \\
\frac{\gamma^2 (e-1)^2}{e^2} = \frac{1-u}{1-\tau} \left[ \sigma - \frac{\gamma \psi}{1-u+\sigma u} \right] \quad \text{otherwise} \end{array} \right. \quad (UU_{hysterisis})
\]

These equations make the analysis of the effects of parameters changes very easy. \((GG_{hysterisis})\) states that growth is increasing in \( \alpha \) and decreasing in \( \tau \) and \( \sigma \). \((UU_{hysterisis})\) states that unemployment is increasing in \( \alpha, \tau \) and \( \sigma \). The result concerning \( \alpha \) might strike the reader as surprising. In fact, it
is quite intuitive. According to (LL), employment is unrelated to $\alpha$ since in
the region of hysteresis the number of firms is fixed. On the other hand, $\alpha$
raises R&D spending which depresses consumption and raises labor supply.
As a result, unemployment raises.

6 The Effects of Labor and Product Market Factors on Unemployment and Growth

The dynamic response of the economy to a change in parameters is subject
to hysteresis since increases in the number of firms are irreversible. It is thus
necessary to distinguish between (a) results that characterize economies with
different parameters (comparative statics results) and (b) results that char-
acterize the response of one economy to a parameter change (comparative
dynamics results).

6.1 Factors Affecting Labor Costs

This subsection makes two related points:

- policies that reduce labor costs reduce unemployment and raise growth;
- the reduction in unemployment due to these policies is larger when
  one considers the endogenous number of firms.

To illustrate, I consider the effects of labor income taxes.

Proposition 2. Effects of the labor income tax rate, $\tau$. (a) An economy
with higher $\tau$ converges to a steady state with lower growth, a smaller num-
ber of firms, lower employment and higher unemployment than economies
with lower $\tau$. (b) In response to an increase in $\tau$, the economy jumps to a
steady state with lower growth, the same number of firms, lower employment
and higher unemployment. In response to a reduction in $\tau$, the economy con-
verges to a steady state with higher growth, a larger number of firms, higher
employment and lower unemployment.

Proof. Consider Figure 3. Point A is the steady state reached by an
economy with a high tax rate; point B is the steady state reached by an
economy with a low tax rate. Consider the economy at point B. If $\tau$
increases, the economy is in the hysteresis region and employment, output and
growth fall immediately while unemployment raises. This is the jump from
Figure 3: The Effects of the Labor Income Tax, $\tau$
point $B$ to point $C$ on the $(GG_{hysterisis})$ and $(UU_{hysterisis})$ loci corresponding to the high tax rate. If $\tau$ returns to the original value, employment, output, growth, and unemployment return to the original values. Consider now the economy at point $A$. If $\tau$ decreases, the economy jumps on the saddle path that converges to point $B$. ■

The comparative statics results for the interior steady state can be explained in two steps. First, notice that the tax raises the cost of labor and thus reduces employment and output. This means that firm size is lower. To keep the net rate of return equal to the discount rate, the number of firms must be lower so that there is a compensating market share effect. The second step is to check the shifts of the $GG$ and $UU$ loci, which combined with the reduction in the number of firms give the overall effects of the higher tax on growth and unemployment. The $GG$ locus does not shift because it does not depend directly on the tax. Hence, growth falls purely because the tax reduces competition. The $UU$ locus, in contrast, shifts down. Hence, the tax produces higher unemployment. This is the sum of the traditional labor market effect – the shift up of the $UU$ locus – and the product market effect – the reduction in $N$.

Consider now the dynamics subject to hysteresis. When the tax increases, the number of firms does not change while employment falls. This reduces the firms’ scale of activity and thereby reduces growth. The reduction in output and growth yields a raise in the consumption ratio, which raises labor supply. Combined with the fall in employment, this produces higher unemployment. This chain of effects is in line with traditional intuition built on models that ignore the effects of the endogenous structure of the product market. Things are quite different when the number of firms adjusts endogenously. A lower tax generates a positive feedback through the product market that reinforces the benefits of lower taxation. These benefits are reaped over time as the number of firms raises gradually. The lower panel of Figure 3 illustrates this point by separating the pro-competitive or product market effect of the lower tax rate from its traditional labor market effect. Given the number of firms, the lower tax rate yields a lower $UU$ locus and reduces unemployment. The larger number of firms then reduces unemployment further.

The asymmetric response of the economy to decreases and increases in the labor income tax rate requires one to distinguish the time-series implications of the model from its cross-section implications. The model predicts that countries with higher labor income taxes exhibit higher unemployment and lower growth. This is consistent with intuition. This correlation, how-
ever, is very hard to detect in studies that cover several countries at a moment in time because it is dominated by country-specific fixed effects in cross-sectional regressions. One then needs to check how variations of tax rates over time affect unemployment within a country (Daveri and Tabellini 2000). If labor taxation keeps increasing over a period of time, the time-paths of unemployment and growth track the time-path of the tax rate. More precisely, the model predicts that each time the tax rate rises, unemployment rises and growth falls. This is consistent with the empirical evidence provided by Daveri and Tabellini (2000) for the OECD countries. They show that the upward trend in labor income tax rates drives the upward trend in unemployment and the downward trend in growth. On the other hand, the model predicts that the effects of tax breaks are spread over time and generate a protracted expansion of output accompanied by a falling rate of unemployment. I shall return to this aspect of the model.

The replacement ratio has effects similar to those of the tax with the important difference that the labor income tax reduces labor supply while the replacement ratio raises it. Hence, the tax creates less unemployment than the replacement ratio.

6.2 Factors Affecting Product Market Competition

Several factors determine competition in the product market; see, e.g., Geroski (1996). The model allows me to consider – in an admittedly stylized fashion – the following:

- regulations/frictions that raise the cost of innovation can be modeled as a lower $\alpha$;

- regulations/frictions that reduce product substitution and thus price competition can be modeled as a lower $\epsilon$, where $\epsilon$ is a parameter that shifts up the function $e(N; \epsilon)$;

---

13 The model understates the negative effect of rising taxes because it does not allow for exit, and thus rules out the possibility that the upward trend in taxation lead to fewer firms and less competition. Including exit, for example by positing that firms incur instantaneous fixed costs, complicates the algebra but does not change the results discussed in the text. In particular, allowing for exit reduces the size of the region of hysterisis but does not eliminate it. The size of this region depends on how large is the entry sunk cost relative to the instantaneous fixed cost. If the latter is zero, as in this model, firms never exit and the region of hysterisis extends from the free-entry steady state to infinity; if it is positive, the region of hysterisis is a finite interval. In the latter case, the negative effect of taxation on firms' cash flow could be large enough to push them against the exit margin thereby triggering a feedback through the product market that reinforces the negative effects of taxation of labor by reducing competition.

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• regulations/frictions that raise entry costs for entrants but do not affect incumbents can be modeled as a higher \( \beta \).

This subsection makes the following points, which illustrate the interactions between the labor and product markets:

• lower costs of innovation raise growth and reduce unemployment;

• tougher price competition raises growth and has an ambiguous effect on unemployment;

• lower barriers to entry have an ambiguous effect on growth and reduce unemployment.

These results suggest that the details of the pro-competitive policy that a country adopts matter. In particular, reducing barriers to innovation is the best policy because it reduces at the same time barriers to entry and barriers to innovation within the firm. As a result, it fosters investment on both the intensive and the extensive margin and, more importantly, it exploits the positive relation between competition and growth. I now illustrate in detail these results.

**Proposition 3**  
Effects of the R&D productivity parameter, \( \alpha \).

(a) An economy with higher \( \alpha \) converges to a steady state with higher growth, a larger number of firms, higher employment and lower unemployment.

(b) In response to an increase in \( \alpha \), the economy converges to a steady state with higher growth, a larger number of firms, higher employment and lower unemployment. In response to a decrease in \( \alpha \), the economy jumps to a steady state with lower growth, the same number of firms, and the same levels of employment and unemployment.

**Proof.** Consider Figure 4. Point \( A \) is the steady state reached by an economy with low \( \alpha \); point \( B \) is the steady state reached by an economy with high \( \alpha \). Consider the economy at point \( A \). If \( \alpha \) increases, the economy jumps on the saddle path that converges to point \( A \). If \( \alpha \) returns to the original value, the economy is in the hysteresis region and the number of firms cannot fall. In other words, the temporary increase in \( \alpha \) locks in the larger number of firms. This means that when \( \alpha \) returns to its original value there are too many firms in the market and growth is lower. As a result, consumption rises, labor supply falls and, since employment is not affected, unemployment falls. This is a jump from point \( B \) to point \( C \) on the \((GG_{hysteresis})\) and \((UU_{hysteresis})\) loci. ■
Figure 4: The Effects of the Productivity of R&D, $\alpha$
The direct effect of the higher $\alpha$ is to shift up the $GG$ locus and thus increase growth. There are no other direct effects because the $YY$, $LL$, and $UU$ loci do not contain $\alpha$. The higher $\alpha$, on the other hand, implies that to keep the net rate of return equal to $\rho$ the number of firms must rise; see $(NN)$. The rise in the number of firms feeds back positively on employment, output and growth. Since output raises, growth and consumption can rise together. Labor supply falls with consumption. Combined with the rise in employment, this means that unemployment falls. The intuition for these results is that the higher $\alpha$ boosts productivity of investment on both the extensive and the intensive margin. Hence, the economy supports faster growth and a large number of firms, with all the benefits that follow for the labor market.

**Proposition 4** Effects of the elasticity of product substitution, $\epsilon$. (a) An economy with higher $\epsilon$ converges to a steady state with a smaller number of firms. If the direct effect of $\epsilon$ dominates over the indirect effect, growth and employment are higher and unemployment is lower in the economy with higher $\epsilon$. (b) In response to an increase in $\epsilon$, the economy jumps to a steady state with the same number of firms, higher growth and employment and lower unemployment. In response to a decrease in $\epsilon$, the economy converges to a steady state with a larger number of firms. If the direct effect of $\epsilon$ dominates over the indirect effect, growth and employment are lower and unemployment is higher in the new steady state.

**Proof.** Consider Figure 5. Point $B$ is the steady state reached by an economy with low $\epsilon$; point $A$ is the steady state reached by an economy with high $\epsilon$. Consider the economy at point $B$. If $\epsilon$ increases, the economy is in the hysteresis region and enters immediately a steady state with no entry whereby employment, output and growth are higher while unemployment is lower. This is a jump to point $C$. If $\epsilon$ returns to the original value, the economy returns to the original equilibrium configuration. Consider, in contrast, the economy at point $A$. If $\epsilon$ decreases, the economy jumps on the saddle path that converges to point $B$.

In the product market, the direct effect of tougher price competition is to raise output and growth. In the labor market, it is to raise employment and labor supply (because the consumption ratio falls). The increase in the firms’ scale of activity implies that to keep the net rate of return equal to $\rho$ the number of firms must fall. The intuition is that tougher price
Figure 5: The Effects of the Elasticity of Substitution, $e(N; \varepsilon)$
competition leads firms to spend more on R&D, which is a fixed cost that makes incumbency more costly. Firms, on the other hand, are less profitable because price-cost margins are lower. The fall in the number of firms feeds back negatively on growth and employment through the rivalry effect. It also raises the consumption ratio so that labor supply falls. The overall effects of $\epsilon$, thus, depend on the balance between its positive direct effect and its negative indirect effect through the number of firms. If the direct effect dominates, growth and employment increase while unemployment falls. The important mechanism here is that a higher $\epsilon$ yields a lower $N$, which partially offsets the effects of the elasticity of substitution on price competition.

**Proposition 5** Effects of the entry cost parameter, $\beta$.  
(a) An economy with higher $\beta$ converges to a steady state a smaller number of firms, lower employment and higher unemployment. If growth is very responsive to product market competition, it is lower in the economy with the smaller number of firms.  
(b) In response to a reduction in $\beta$, the economy converges to a steady state with a larger number of firms, higher employment and lower unemployment. If growth is very responsive to product market competition, it is higher in the new steady state. An increase in $\beta$ has no effects.

**Proof.** Consider Figure 6. Point $A$ is the steady state reached by an economy with high $\beta$. If $\beta$ falls, the economy jumps on the saddle path that leads to the new steady state, point $B$. If $\beta$ returns to the original value, the economy is in the hysteresis region and enters immediately a steady state with no entry. Thus, a temporary reduction in entry costs locks-in the economy at point $B$. If the economy starts out at point $B$ and $\beta$ raises, nothing happens because an increase in entry costs for an economy that is already in the hysteresis region is irrelevant since it does not affect any margin.

The lower cost of entry leads to a reduction in growth. This is due to the protection effect: incumbent firms protected by high barriers to entry are larger and do more R&D. In steady state, lower growth means higher consumption, which reduces labor supply and thus reduces unemployment since employment does not depend directly on $\beta$. The lower $\beta$ and the consequent fall in R&D spending imply that incumbency is cheaper and that the net rate of return is equal to $\rho$ if the number of firms rises. The larger number of firms raises employment and feeds back on growth through its effect on the firm’s scale of activity. Since output increases, the increase in growth does not require a fall in consumption, which would raise labor
Figure 6: The Effects of Barriers to Entry, $\beta$
supply. Overall, therefore, the indirect effects of the lower $\beta$, channelled by the increase in competition, raise growth and employment and reduce unemployment. Figure 6 illustrates these effects. In the upper panel, the lower $\beta$ shifts down the $GG$ locus. Since the number of firms raises, the effect on growth is ambiguous. This is due to the tension between the protection effect and the rivalry effect that work in opposite directions. On the other hand, the lower $\beta$ reduces unemployment. This captures the pro-competitive effect of lower barriers to entry, which is transmitted to the labor market through the condition that, given the wage, a reduction in firms’ market power requires an increase in the marginal cost of production, that is, an increase in output and employment and, therefore, lower unemployment. An important point that emerges from this discussion is that preferential treatment of incumbents in order to boost growth – a policy that can be modeled as a high $\beta$ – is self-defeating because faster growth, if it comes at all, comes at the cost of higher unemployment.

6.3 Joint Liberalization of the Labor and Product Markets

I now consider the effects of a policy package that liberalizes the labor and product markets. This can be modeled as a reduction of the parameters $\tau$ and $\sigma$ together with an increase in the parameter $\alpha$. In the phase diagram in Figure 7, the border of the $\dot{N} = 0$ region shifts up and the $\dot{c} = 0$ locus shifts to the right. Figure 7 depicts two transition paths: the lower one generated by the liberalization of the labor market alone; the upper one generated by the liberalization of both markets. Each path takes into account the positive feedback that each market enjoys through the other market. The important result is that liberalizing both markets leads to a larger increase in the number of firms and to a larger reduction in unemployment than liberalizing the labor market alone. There is no substitution between reforms: their effects add up. The lower panel of Figure 7 illustrates this point. Lower frictions in the labor market imply a shift down of the $UU$ locus; the pro-competitive effect implies a movement along the new, lower $UU$ locus. Liberalization of the product market implies a further movement down along the lower $UU$ locus. The growth effect of this policy package is positive because the $GG$ locus shift up and the number of firms rises.

Examination of the transition yields further interesting implications. There is an initial jump up in consumption and growth. This is feasible because employment and output raise due to the liberalization of the labor market. Moreover, with a predetermined number of firms, the jump up in output implies a jump up in production per firm, which triggers more R&D
Figure 7: A Policy Experiment: Reforming the Labor and Product Markets
spending per firm and thus faster growth. The jump up in consumption implies a drop in labor supply, which combined with the jump up in employment produces a drop in unemployment. Along the transition path, consumption and the number of firms rise. Accordingly, employment and output rise. Growth is subject to the upward pressure due to increasing competition and the downward pressure due to falling market shares. If the rivalry effect dominates the market share effect, growth rises throughout the transition. Unemployment is subject to the downward pressure due to the increase in employment resulting from the increase in competition and the effect of the change in labor supply resulting from the change in the consumption ratio. This is subject to two forces: the downward pressure due to increasing competition that pushes up R&D spending by firms, and the upward pressure due to the slowing down of investment in entry. Overall, labor supply is subject to forces that it is plausible to think cancel out. Hence, the dynamics of unemployment are determined by the rise in employment so that unemployment falls throughout the transition.

7 Conclusion

The view that unemployment is high in economies where the welfare state provides long-lasting unemployment benefits that are unrelated to the individual’s effort to find work, the labor force is organized in sectoral or firm-level unions that do not coordinate their activities, and taxation raises the cost of labor, is generally correct and supported by much of the available empirical evidence. It is, however, incomplete because it ignores the characteristics of the product market. There are good reasons, theoretical and empirical, to think that in addition to labor market frictions, unemployment depends on a broad class of factors that characterize the structure of the product market. An interesting implication of this argument is that there exists a relation between unemployment and growth. The reason is that growth is driven by firms’ R&D investments, which are affected by the structure of the product market.

In this paper, I discussed a model where unions have control over the wage and set it above the market-clearing level. Unemployment is thus generated by their exercise of market power. Because both the labor and product markets are imperfectly competitive, market power in the labor market interacts with market power in the product market. This interaction sheds new light on the effects of policy interventions on unemployment and growth. For example, labor market reforms that reduce labor costs
reduce unemployment and boost growth because they expand the scale of the economy and generate more competition in the product market. Moreover, the reduction in unemployment is larger than one would expect if the reforms’ effects in the product market were ignored. If such reforms are implemented jointly with a reduction of barriers to innovation an even larger reduction in unemployment is achieved.

8 Appendix: Proof of Proposition 2

Take logs and time derivatives of \( c \equiv \frac{C}{\sigma Z} \). Now use the saving schedule (5), the rate of return to investment (18), the growth strategy (17) and the output equation \( YY \) to obtain

\[
\frac{\dot{c}}{c} = \alpha \left[ \frac{\lambda \gamma^2 (e - 1)^2 1 - \tau}{\sigma} \right]^\gamma \frac{e - (1 + \gamma) (e - 1)}{(\beta - 1) e} - \rho;
\]

The output market clearing condition requires

\[
Y = C + NRZ + R_N.
\]

Since entry is non-negative, one has \( \dot{N} > 0 \) for \( Y > C + NRZ \) and \( \dot{N} = 0 \) otherwise. This condition identifies two regions in \((N, c)\) space: the entry region, where entry is profitable, and the hysteresis region, where entry is not profitable and the number of firms is fixed. Dividing through by \( Z \) and using the growth strategy (17) and the output equation \( YY \), I can write

\[
\dot{N} = \frac{\alpha}{\beta} \left[ N \left[ \frac{\lambda \gamma^2 (e - 1)^2 1 - \tau}{\sigma} \right]^\gamma \frac{e - (1 + \gamma) (e - 1)}{(\beta - 1) e} - \lambda c \right].
\]

The \( \dot{c} = 0 \) locus is

\[
\alpha \left[ \frac{\lambda \gamma^2 (e - 1)^2 1 - \tau}{\sigma} \right]^\gamma \frac{e - (1 + \gamma) (e - 1)}{(\beta - 1) e} = \rho
\]

and identifies the value \( N^* \) that I use in the text. The hysteresis region is identified by

\[
c \geq \left( \frac{N}{\lambda} \right)^{1 - \gamma} \left[ \frac{\gamma^2 (e - 1)^2 1 - \tau}{\sigma} \right]^\gamma \frac{\beta e - \gamma (e - 1)}{(\beta - 1) e}.
\]

Inside this region I have

\[
\frac{Y}{Z} = \lambda c + N R \Rightarrow g = \alpha \left( \frac{Y}{NZ} - \frac{\lambda c}{N} \right).
\]
The rate of return to R&D (15) alone pins down the rate of return to investment. The resulting Euler equation reads:

\[ \frac{\dot{c}}{c} = \alpha \frac{\lambda c}{N} - \frac{\alpha}{e} \left[ \frac{\lambda}{N} \frac{\gamma^2 (e-1)^2}{e^2} \frac{1-\tau}{\sigma} \right]^{\gamma} - \rho. \]

Setting \( \dot{c} = 0 \) yields

\[ c = \frac{\rho N}{\alpha \lambda} - \left( \frac{N}{\lambda} \right)^{1-\gamma} \left[ \frac{\gamma^2 (e-1)^2}{e^2} \frac{1-\tau}{\sigma} \right]^{\gamma} \frac{1}{e}. \]

The intersection of \( N^* \) and the border of the no entry region determines \( c^* \). Overall, the \( \dot{c} = 0 \) locus is the kinked line formed by the vertical line \( N = N^* \) and by the portion of the upward sloping line calculated above that lies to the right of \( N^* \). Consider now the phase diagram in Figure 3. In the entry region to the right of \( (N^*, c^*) \) there is a saddle path leading to that point. All points on the \( \dot{c} = 0 \) locus to the right of \( (N^*, c^*) \) are steady states. The stable manifold of the system is the union of the saddle path in the entry region and the portion of the \( \dot{c} = 0 \) locus inside the no entry region. Paths above the stable manifold eventually yield infinite \( c \) and violate the transversality condition for the firm’s optimal plan. Paths below the stable manifold eventually cross the horizontal axis and yield zero or negative \( c \). Hence, whenever \( N < N^* \) the economy jumps on the saddle path and converges to the steady state; whenever \( N \geq N^* \) the economy jumps on the \( \dot{c} = 0 \) locus and enters a steady state with no entry.

References


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