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Product Market Deregulation and Labor Market Outcomes

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Abstract

Recently, the interactions between product market structure and labor market outcomes have come under increased scrutiny. This paper considers the dynamic relationship between product market regulation and equilibrium unemployment and wages, both theoretically and quantitatively. The main elements of our model are Mortensen-Pissarides-style search and matching frictions, monopolistic competition in the goods market, multi-worker firms and barriers to entry. Our measure of competition has a strong impact on equilibrium unemployment rates and on equilibrium wages, indicating that product market competition does indeed have quantitatively significant effects on labor market outcomes. Most of the impact is achieved by moving from a monopoly to four to five competing firms per industry. Hence, a little bit of competition goes a long way. Competition is then linked to a specific regulatory institution, namely barriers to entry. Data on entry costs are used to compare labor market performance under two regimes: a high-regulation European regime and a low-regulation Anglo-American one. When firms are short-lived, greater European product market regulation can account for unemployment rates that are one to two full percentage points greater than the corresponding Anglo-American values.

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1 Introduction

A growing body of recent literature attempts to explain the divergent performance of European and US labor markets during the 80's and 90's, a phenomenon which has become known as the 'European Unemployment Puzzle'. Generally, the focus has been upon interactions of labor market institutions with other economic variables [cf. Ljungqvist and Sargent (1998,2002), den Haan, Haefke, and Ramey, 2001] and upon hiring and firing restrictions. However, except for Pissarides (2001), little attention has been paid to one of the primary ways in which US and European economies differ: the degree of product market regulation. To give an idea of the magnitudes involved, Figure 1 presents data on barriers to entry in the US and in the European Union, collected by Djankov, La Porta, Lopez-de Silanes and Shleifer (2002). The solid bars represent the time required to establish a standardized firm, ranging from 2 business days in Canada to a whopping 154 days in Austria. The population-weighted EU average of 88 days is an order of magnitude larger than the corresponding North American figures. Djankov, et. al. also report the cost of establishing a standardized firm in percent of per capita GDP of the respective country. Once again, the gulf between the Anglo-American world and Europe is striking: establishing a firm in the US costs about 1% of per capita GDP, while establishing the average EU firm costs 17% of per capita GDP. Once again, the European barriers to entry are an order of magnitude larger. It seems reasonable that such large differences in product market competition might translate into large differences in labor market outcomes.

Indeed, there is some empirical evidence to support the link between product market competition and job creation rates. Bertrand and Kramarz (2001) examine the impact of the Loi Royer of 1974, which regulated entry into French retailing. Betrand and Kramarz (2001) find that those regions [departements] which restricted entry more strongly, experienced slower rates of job growth. Boeri, Nicoletti and Scarpetta (2000), using an OECD index of the degree of product market regulation, also report a negative relationship between their regulation measure and employment. Moreover, the timing of US deregulation efforts, which began in the late 1970's, fits neatly into the picture of labor market performance which began to diverge in the early 80's. The most important pieces of US deregulation were put into place in the late 70's and early 80's. These measures were accompanied by an overall push to reduce "red tape". In contrast, European deregulation efforts are still incipient as of late 2002. Hence, product market deregulation is a sort of smoking gun for divergent US and European labor market performance, whose implications are worth investigating.

Little previous theoretical work has analyzed whether and how product market rigidities may affect equilibrium labor market outcomes. A notable exception is the seminal paper of Blanchard and Giavazzi (2002), who study labor market outcomes in a model with monopolistic competition. In a very stylized setting, they find that equilibrium unemployment is decreasing and equilibrium wages are increasing in the degree of product market competition. In a similar vein, Spector (2002) studies the effects of changes in the intensity of product market competition in a model with capital and concludes that product-market and labor-market regulations tend to reinforce each other. All papers in the literature so far consider static or two-period setups. We contribute to the product market/labor market debate by specifying a fully dynamic matching model which we believe to be very well suited for the study of product- and labor market issues. To this end we build on Blanchard and Giavazzi's (2002) work, by extending their framework in three key directions. First, we use a dynamic Mortensen-Pissarides-style labor matching setup to obtain equilibrium unemployment. This extension to a dynamic setting is necessary if we want to account for the typical structure of *long term employment relationships*. It also makes our framework particularly well-suited to quantitative analysis - a property which we will exploit. Secondly, we consider an alternative competition framework, based on Galí(1995). Blanchard and Giavazzi (2002) consider increases in inter-industry competition. In contrast, we consider increases in intra-industry competition, while still being able to vary industry-level market power. We then use the Djankov, et. al. data on barriers to entry to determine the degree of intra-industry competition endogenously [1]. This competition framework turns out to be remarkably tractable and flexible. This allows us to introduce heterogeneity across industries, in order to examine the differential impact on employment and wages in high and low-technology industries.

In qualitative terms, our results are quite similar to those of Blanchard and Giavazzi (2002). We coincide in finding that greater degrees of product market competition lead to lower equilibrium unemployment and higher real wages. One of the main contributions of this paper is to answer two quantitative questions. First, by how much does increasing product market competition decrease unemployment? We examine this issue by varying our measure for competition - the number of firms per industry - to assess the impact on key labor market variables. In our benchmark calibration, unemployment falls dramatically, from more than 20% to 4.6%, while real wages nearly double when the number of firms per industry is increased from one to four. Increasing the number of firms beyond four, however, has only negligible impact on labor market variables. Hence we conclude: a little bit of competition goes a long way.

Next, we relate the degree of product market competition to a specific regulatory institution. In particular, we focus on the impact of barriers to entry on competition. We use the data of Djankov, et. al. to define two regulatory regimes: high-regulation continental European and low-regulation Anglo-American. This allows us to answer our second quantitative question: By how much would reducing continental European barriers to entry to Anglo-American levels reduce unemployment? We find that both regimes lead to very large equilibrium industry sizes of more than twenty firms, a range where variation in entry costs has only negligible effects on employment. This negative result is, however, primarily due to the simplifying assumption of infinitely-lived firms. When firms have shorter horizons, entry costs may indeed play an important role for labor market outcomes.

Finally, we identify an interesting interaction between inter-industry and intra-industry competition. When industry-level market power is very high, then profits are relatively high for a wide range of industry sizes, so that barriers to entry do relatively little to deter entry, leading to high degrees of intra-industry competition. When industry-level market power is low, however, profits are also relatively low, so that the same barriers to entry may indeed have a strong detrimental effect on entry, leading to small industry sizes. Hence, it is precisely when intra-industry competition is relatively stiff that barriers to entry may become important.

The remainder of the paper is organized as follows: Sections 2 and 3 present the basic model, which is characterized by monopolistic competition in the goods market, search and matching in the labor market, multi-worker firms and barriers to entry. Sections 4 and 5 focus on quantitative analysis. Section 4 addresses our first quantitative question by relating industry size to labor and product market equilibria. Section 5 examines the impact of entry costs on equilibrium industry size, allowing us to address our second quantitative question. Section 6 extends the model to

[1] In specifying the entry cost to the market our approach is related to that of Pissarides (2001).

consider heterogeneous technologies and alternative competition and bargaining frameworks. Section 7 concludes.

2 The Basic Model

In this section we present the basic model. Its main elements are monopolistic competition in the goods market and Mortensen/Pissarides-style matching with multi-worker firms in the labor market. In the Mortensen-Pissarides framework, equilibrium unemployment is well micro-founded, allowing us to draw a precise link between the degree of competition in the goods market and the equilibrium level of unemployment. In addition, we will also be able to characterize the behavior of wages and profits as a function of the degree of competition.

2.1 Households

2.1.1 Search and Matching in the Labor Market

The labor market is characterized by a standard search and matching framework. Unemployed workers u and vacancies v are converted into matches by a constant returns to scale matching function $m(u,v) = u^{\eta}v^{1-\eta}$. Defining labor market tightness as $\theta \equiv \frac{v}{u}$, the firm meets unemployed workers at rate $q(\theta) = \theta^{-\eta}$, while the unemployed workers meet vacancies at rate $\theta q(\theta) = \theta^{1-\eta}$. Matches are destroyed at the exogenous rate χ.

In the basic model, firms are homogeneous so that all jobs are identical[2]. For each worker, the value of employment is given by V^E, which satisfies:

$$rV^E = w - \chi\left[V^E - V^U\right] \tag{1}$$

where χ is the separation rate. Hence, the asset value of employment is equal to the period nominal wage w, minus the capital loss due to unemployment. The value of unemployment is the same for all workers:

$$rV^U = bP + \theta q(\theta)\left[V^E - V^U\right] \tag{2}$$

where P denotes the aggregate price level and b real unemployment benefits.

2.1.2 Monopolistic Competition in the Goods Market

Households are both consumers and workers. As risk-neutral consumers, they have Dixit-Stiglitz preferences over a continuum of goods. Goods demand is derived from the household's optimization problem:

$$\max\left(\int c_{i,n}^{\frac{\sigma-1}{\sigma}}di\right)^{\frac{\sigma}{\sigma-1}} \tag{3}$$

subject to the budget constraint $I_n = \int c_i \frac{P_i}{P} di$ where I_n denotes real income of household n. In order to focus the dynamics on the labor market, there is no saving. This is a standard monopolistic-competition setting, which leads to aggregate demand for good i given by:

$$Y_i^D \equiv \int c_{i,n} dn = \left(\frac{P_i}{P}\right)^{-\sigma} I \tag{4}$$

[2] Allowing for heterogeneous firms is straightforward, and we will return to this issue in the extensions considered in Section 6.

where $I \equiv \int I_n \mathrm{d}n$ is aggregate real income. Hence, we obtain the standard monopolistic-competition demand function with elasticity of substitution between differentiated goods given by $-\sigma$.

2.2 Modeling Competition

In principle, there are two ways in which greater competition may manifest itself: as greater competition within existing industries or as greater competition among industries. The latter would lead to an industry-level decrease in market power, which implies an increase in the elasticity of substitution among goods σ, leading us to denote greater competition among industries as an increase in $\sigma-$competition. However, it is often argued that σ is a preference parameter rather than a measure of competition. We address this concern in the basic model by treating σ as a fixed preference parameter which determines how willing consumers are to substitute among differentiated goods. We will not rely on σ to model differing degrees of competition. Rather, we follow Galí(1995) in assuming that each differentiated good i is produced by an industry populated by n_i firms. An increase in the number of firms in each industry leads to an increase in the degree of competition within each industry. In the main model we will focus on increases in such intra-industry competition, which we call $n-$competition[3].

The firms within each industry compete by Cournot[4]. Under Cournot competition, firm j in industry i has output Y_{ij} which satisfies:

$$Y_{(i)} = Y_{ij} + (n_i - 1)\,\overline{Y}_{i,-j}, \tag{5}$$

where $Y_{(i)}$ is aggregate output of good i and $\overline{Y}_{i,-j}$ is the average output of its $n_i - 1$ competitors. From (4), firm j faces demand function

$$\frac{P_i\left(Y_{ij}|n_i, \overline{Y}_{-j}\right)}{P} = \left(\frac{Y_{ij} + (n_i - 1)\,\overline{Y}_{-j}}{I}\right)^{-\frac{1}{\sigma}}. \tag{6}$$

This leads to a definition of firm-level elasticity of demand as:

$$\xi_{ij} \equiv -\frac{\partial Y_{ij}}{\partial P_i} \cdot \frac{P_i}{Y_{ij}} = \sigma\left[1 + \frac{(n_i - 1)\,\overline{Y}_{-j}}{Y_{ij}}\right]. \tag{7}$$

When firms within an industry are symmetric, each firm faces a demand elasticity which depends only on the total number of firms present in the industry:

$$\xi_i = n_i\sigma. \tag{8}$$

In the basic model we will assume symmetric firms. In what follows we will label firms only by their industry[5] i.

The $n-$competition approach turns out to be very flexible and tractable. Equations (7) and (8) make clear that incorporating either heterogeneous firms within an industry or industries of heterogeneous size will affect demand elasticity in a straightforward way. Later, we will exploit this flexibility to examine the effects of heterogeneity across industries.

[3] We will examine $\sigma-$competition in the extensions.

[4] In the basic model, we focus on the collusion-free equilibrium of the dynamic Cournot game. Collusive equilibria would involve even greater output restriction, which would strengthen our results. We will return to the subject of collusive equilibria in section 5.

[5] To avoid confusion, we denote aggregate demand facing industry i by Y_i^D, while industry i's aggregate output is denoted $Y_{(i)}$ and the output of an individual firm in industry i is denoted Y_i.

2.3 Multiple-worker Firms

The standard Mortensen-Pissarides setup assumes one-worker firms. Under perfect competition in goods markets, this assumption is harmless, since the number and size of firms is indeterminate anyway. Under monopolistic competition, however, firms react to downward sloping demand by restricting output. With given technology and capital, the only way to vary output is to vary the amount of labor employed (either on the intensive margin as in Walsh (2002) or on the extensive margin as in our model). Hence, in order to make varying degrees of competition meaningful, it is necessary to provide firms with some margin of adjustment. Consistent with stylized facts we assume that firms adjust employment by varying the number of workers rather than the number of hours [6]. In fact, in our model the number of workers employed is determined endogenously, as a function of the elasticity of demand ξ_i.

Firms maximize the discounted value of future profits. The firm's key decision is the number of vacancies. Firms open as many vacancies as necessary to hire *in expectation* the desired number of workers, while taking into account that the real cost to opening a vacancy is Φ_V. In such a setup the vacancy posting cost of the one-worker firm turns into a linear hiring cost. Firm i's state variable is the number of workers currently employed, H_i, which may of course differ from the number of workers desired for the next period H_i'. The firm's problem becomes:

$$V^J(H_i) = \max_{H_i', v_i} \frac{1}{1+r} \left\{ P(Y_i) Y_i - w(H_i) H_i - \Phi_V P v_i + V^J(H_i') \right\} \tag{9}$$

subject to

$$\begin{aligned} \text{demand function:} \quad & \frac{P(Y_i)}{P} = \left(\frac{Y_i + (n_i - 1) \overline{Y}_{-j}}{I} \right)^{-\frac{1}{\sigma}} \\ \text{production function:} \quad & Y_i = A H_i \\ \text{transition function:} \quad & H_i' = (1-\chi) H_i + q(\theta) v_i \end{aligned}$$

where in the symmetric Cournot equilibrium $\xi_i = n_i \sigma$, as described above. Although the multi-worker firm problem may appear daunting at first glance, the first order condition is refreshingly simple:

$$\frac{\Phi_V P}{q(\theta)} = \frac{\partial V^J(H_i')}{\partial H_i'}. \tag{10}$$

By (10), the value of the marginal worker is equal for all firms, since its equilibrium value only depends upon aggregate variables. That is, the marginal value of an additional worker must equal the cost of searching for him/her, which is not firm-specific. In addition, the fact that all firms face the same linear vacancy-posting cost ensures that the equilibrium value of the marginal worker be independent of firm size H_i. Both of these properties help keep this model tractable.

Combining (10) with the envelope condition, using the definition of demand elasticity (7) and rearranging, yields a simple mark-up expression for the relative price of firm i's good:

$$\frac{P_i(Y_i)}{P} = \frac{\xi_i}{\xi_i - 1} \left\{ \frac{w(H_i)}{P} + \frac{\Phi_V}{q(\theta)} [r + \chi] + H_i \frac{\partial [w(H_i)/P]}{\partial H_i} \right\} \frac{1}{A} \tag{11}$$

Firms price their goods by taking a constant markup $\frac{\xi_i}{\xi_i - 1}$ on the marginal cost of producing the good. The mark-up is decreasing in the demand elasticity faced by the firm. The marginal cost of the good is the marginal cost of labor

[6] It is important to realize that in our model the standard equivalence between one-worker and multi-worker firms does not hold.

(the term in curly brackets) scaled by the firm's productivity A. In the labor-matching setup the marginal cost of labor has three terms: the unit labor cost $\frac{w(H_i)}{P}$, the search cost $\frac{\Phi_V}{q(\theta)}[r+\chi]$, and the effect on the wage from hiring another worker $H_i \frac{\partial[w(H_i)/P]}{\partial H_i}$. The final term reflects firms' anticipation that the result of wage bargaining will depend upon the number of workers hired. In addition, it is useful to note that (11) is an implicit labor demand curve which relates the firm's optimal employment choice to the wage.

2.4 Bargaining

In this section we generate wage curves and and complete the description of labor demand. In the basic model, we consider individual bargaining, based on Stole and Zwiebel (1996), and Cahuc and Wasmer (2001). By its very nature, individual bargaining involves bargaining over wages only. In contrast, in the collective efficient bargaining framework considered in Blanchard and Giavazzi (2002), workers and firms bargain over wages, employment and prices. In Section 6.3, we will also compare our results to those derived under efficient bargaining.

We rely on the structure provided by Stole and Zwiebel (1996b). The key assumption is that firms engage in pairwise negotiations with workers. If a worker leaves or joins the firm, resulting in a change in firm size, then all existing agreements become void, and pairwise negotiations begin anew with each member of the workforce. Within each bilateral bargain, this process can be understood as an alternate offer game (Binmore et al. 1986). Hence the result that we obtain for the wage curve in (15) can be obtained either by fully modeling the pairwise bargaining structure, or by solving a standard generalized Nash bargaining problem [7].

Here we take the shortcut via Nash. The standard Nash bargaining problem is given by $\max_w \left(V^E(w) - V^U\right)^\beta + \left(V^J(w) - V^V\right)^{1-\beta}$ where β stands for the bargaining weight of the workers. In the multi-worker firm context the firm's outside option is not entering the vacancy pool, but rather working with one worker less. This can be implemented in two ways, either by $V^J(H_i) - V^J(H_i - 1)$ or by taking the derivative of V^J with respect to H_i and considering this to be the contribution of the marginal worker. Following Cahuc and Wasmer (2001) we will use the latter approach, as it is consistent with the assumption of a continuum of worker/consumers. Hence, the multi-worker firm's bargaining problem becomes [8]:

$$\max_w \beta \ln\left(V^E - V^U\right)(1-\beta)\ln\frac{\partial V^J}{\partial H_i} \tag{12}$$

To obtain an expression for firm's surplus, take the envelope condition of the firm's problem (9), and recall that the first order condition (10) implies that $\frac{\partial V^J}{\partial H_i}$ be constant over time. This leads to:

$$\frac{\partial V^J}{\partial H_i} = \frac{1}{r+\chi}\left(\frac{\xi_i - 1}{\xi_i}A_i P_i(H_i) - \frac{\partial w}{\partial H_i}H_i - w(H_i)\right). \tag{13}$$

The worker's side is standard:

$$V_i^E - V^U = \frac{w_i - rV^U}{r+\chi}, \tag{14}$$

so that the reservation wage is given by the asset value of unemployment rV^U.

[7] See appendix A for an intuitive discussion.

[8] For constant union-membership and marginal V^J equal average V^J this would be equivalent to a right-to-manage setup.

We obtain the standard first order condition:

$$\beta \frac{1}{V_i^E - V^U} = (1-\beta)\frac{1}{\frac{\partial V^J}{\partial H_i}}.$$

Substituting in the expressions for worker's and firm's surplus (13) and (14) leads to a first-order linear differential equation in the wage.

$$w_i = (1-\beta)rV^U + \frac{\xi_i - 1}{\xi_i}\beta P_i(H_i)F_H(H_i) - \beta H_i w'(H_i)$$

with solution

$$\frac{w(H_i)}{P} = (1-\beta)rV^U + \beta\left(\frac{\xi_i - 1}{\xi_i - \beta}A\frac{P_i(H_i)}{P}\right). \tag{15}$$

Equation (15) is the wage curve for firm i. The impact of monopolistic competition is captured in two ways. First, the coefficient $\beta\frac{\xi_i-1}{\xi_i-\beta}$ represents the share of marginal revenue product which goes to workers. As competition increases, the worker's share of MRP also increases, shifting the wage curve up. However, ξ_i also determines the size of the MRP. As competition increases, the MRP shrinks, shifting the curve back down. The total impact is akin to gaining an increasing share of a shrinking pie.

Also, note that the wage curve is actually downward sloping: as the number of workers per firm increases, the bargained wage declines. The reason is once again shrinking MRP. Formally:

$$\frac{\partial w}{\partial H_i}\frac{H_i}{P} = -A\frac{\beta}{\xi_i}\left(\frac{\xi_i - 1}{\xi_i - \beta}\right)\frac{P_i}{P} < 0 \tag{16}$$

3 Equilibrium

We proceed to find equilibrium in three steps. First, we focus on firm-level behavior, by identifying the firm's optimal employment-wage pair when it takes aggregate variables as given. Then, we go on to find the quantities and prices which are consistent with market clearing. This will allow us to obtain expressions for all equilibrium variables as functions of the exogenous degree of competition. We call this second stage short-run general equilibrium. In Section 5 we will introduce entry costs, which will serve to endogenize the degree of competition. This last equilibrium will be referred to as long-run general equilibrium.

3.1 Firm-Level Equilibrium

First, we focus on the firm's optimal choices, taking aggregate variables as given. We already have a labor supply equation, the wage curve (15), which was derived from the wage bargaining. An expression for labor demand may be obtained by substituting (16) into the labor demand equation (11), yielding:

$$\frac{w(H_i)}{P} = A\frac{P_i(H_i)}{P}\left[\frac{\xi_i - 1}{\xi_i - \beta}\right] - \frac{\Phi_V}{q(\theta)}[r + \chi] \tag{17}$$

Equation (17) can also be interpreted as a job creation condition. As expected, it is downward sloping, both in the amount of labor demanded H_i and in labor market tightness θ.

Optimal employment for firm i may be computed implicitly as the intersection of the job creation condition (17) and the wage curve (15), solved for the firm's price:

$$\frac{P_i\left(H_i\right)}{P}=\frac{\xi_i-\beta}{\xi_i-1}\left(\frac{rV^U}{P}+\frac{\Phi_V}{q\left(\theta\right)}\frac{r+\chi}{1-\beta}\right)\frac{1}{A} \tag{18}$$

Equation (18) expresses the price as a markup over the good's equilibrium marginal cost (the term in parentheses), scaled by the firm's technology A. The marginal cost consists of the reservation wage plus a term which accounts for hiring costs. As expected, the markup is decreasing in competition ξ_i. We can compute optimal employment by combining (18) with the demand curve facing firm i (4) and solving for employment H_i conditional on aggregate output and labor market tightness:

$$H_i=\left(\frac{\xi_i-1}{\xi_i-\beta}\right)^{\sigma}\left(b+\frac{\beta}{1-\beta}\theta\Phi_V+\frac{r+\chi}{1-\beta}\frac{\Phi_V}{q(\theta)}\right)^{-\sigma}A^{\sigma-1}I-(n_i-1)\bar{H}_{i,-j} \tag{19}$$

where $\bar{H}_{i,-j}$ is the average employment of competing firms within industry i. All other things equal, equation (19) makes it clear that partial equilibrium employment is increasing in competition ξ_i. This goes back to first principles: firms wish to react to increased demand elasticity by increasing output and hence employment. Equation (19) also has the expected implication that higher unemployment benefits and higher vacancy posting costs lead to smaller firm size. Also, an increase in labor market tightness reduces firm size. Higher tightness means a smaller probability for a firm to find a worker, and hence higher overall hiring costs to fill an open position.

The partial equilibrium real wage can be found by substituting the equilibrium price (18) back into (17)

$$\frac{w}{P}=\frac{rV^U}{P}+\frac{\beta}{1-\beta}\frac{\Phi_V}{q(\theta)}(r+\chi). \tag{20}$$

In equilibrium, wages are equalized across jobs and across firms. As is standard in multiple-worker firm models [cf. Pissarides (2001)], the reason is that all workers have identical outside options, and that hiring costs are linear and equal for all firms[9]. After solving for the equilibrium reservation wage rV^U we can write:

$$\frac{w\left(\theta\right)}{P}=b+\frac{\beta}{1-\beta}\frac{\Phi_V}{q\left(\theta\right)}\left[r+\chi+\theta q\left(\theta\right)\right] \tag{21}$$

Note that although wages do not depend explicitly on demand elasticity ξ_i, wages do depend on competition indirectly, via equilibrium labor market tightness θ.

Figure 2 illustrates the partial equilibrium graphically in the wages-employment space. Optimal employment H_i is found at the intersection of the job creation curve (17) and the wage curve (15), where the demand facing firm i (19) has been substituted into both equations. The corresponding wage is that expressed by equation (21).

3.2 Short Run General Equilibrium

We distinguish between two kinds of economy-wide equilibria. First, we determine the 'short-run' general equilibrium, taking as given the number of firms present in each industry. In our setting, this is equivalent to pinning down all equilibrium variables as functions of the degree of competition ξ. This will allow us to determine the impact of

[9] In Section 6, we will show that equilibrium wages will still be equalized across firms and industries, even when we allow for heterogeneity.

increasing competition on equilibrium unemployment and wages. In section 5, we will determine the 'long-run' equilibrium, in which free entry also determines the number of firms present in each industry, and hence the equilibrium degree of product market competition.

The most economically accessible way to obtain the short-term general equilibrium condition would be to take the firm-level equilibrium derived in the previous subsection, and impose the aggregate resource constraint:

$$I = \int \frac{w(\theta)}{P} H_i df(i) + \int \frac{\pi_i(\theta)}{P} H_i df(i) + \Phi_V v \tag{22}$$

where Equation (22) simply states that aggregate income is equal to the sum of all wages and profits. However, we follow the more convenient route of imposing that individual prices aggregate up to the price index, which leads to the equilibrium condition:

$$A = \frac{\xi - \beta}{\xi - 1}\left(b + \frac{\beta}{1-\beta}\theta\Phi_V + \frac{\Phi_V}{q(\theta)}\frac{r+\chi}{1-\beta}\right) \tag{23}$$

The equilibrium condition (23) is monotonically increasing in θ, so that existence of equilibrium is guaranteed if

$$A \geq \frac{\xi - \beta}{\xi - 1} b. \tag{24}$$

When the economy approaches full competition, (24) reduces to the standard condition $A \geq b$ that workers' productivity be greater in employment than in unemployment.

Equation (23) is key, since it relates the degree of competition ξ and equilibrium labor market tightness θ. Imposing the symmetric Cournot equilibrium in each industry, so that $\xi = n\sigma$, allows us to determine the equilibrium as a function of industry size n. To emphasize this point, we will begin to express all equilibrium values as functions of n. Once we have $\theta(n)$, we can obtain the equilibrium unemployment rate from the Beveridge curve:

$$u(n) = \frac{\chi}{\chi + \theta(n)\, q[\theta(n)]} \tag{25}$$

It is straightforward to check that increasing our measure of competition - the number of firms per industry n - will lead to increased labor market tightness and to decreased unemployment. In addition, an increase in either vacancy posting costs Φ_V or unemployment compensation b reduces equilibrium labor market tightness, thereby increasing equilibrium unemployment. This is consistent with more conventional Mortensen-Pissarides style models. The effect of the bargaining power β is ambiguous.

Substituting (23) back into (21) allows us to find the equilibrium wage $w(n)$. Interestingly, the equilibrium wage turns out to be *increasing* in competition. This conclusion is the opposite of that drawn by the recent literature on wages and the sharing of monopoly rents (cf. van Reenen, 1996). The source of the disparity is that the rent-sharing papers typically look at only one isolated industry, while we consider broader increases in competition which affect *all* industries at once. The general equilibrium effect of greater competition is to increase vacancies in all sectors, making it easier for unemployed workers to find new jobs. This increases the value of the worker's outside option, thereby improving the worker's bargaining position and increasing his/her wage. This search channel of wage increases turns out to outweigh the diminishing monopoly-rent channel of wage decreases, so that the sum effect of increasing competition on wages is positive.

The remainder of equilibrium variables are found as follows: Given the total number of agents in the economy N, we can find equilibrium aggregate employment as $H(n) = N[1 - u(n)]$. With $H(n)$ in hand, we can find aggregate output and subsequently the equilibrium quantity of good i, and of course firm level employment $H_i(n)$, output $Y_i(n)$ and price $P_i(n)$, all in terms of the degree of $n-$competition. It will also be useful to find firm i's equilibrium profits $\pi_i(n)$.

4 Competition, Wages and Employment

We are now in a position to approach our first quantitative question: What is the impact of increasing $n-$competition on equilibrium employment and wages? Having found the equilibrium as a function of our competition measure n in the previous section, it remains to give sensible values to all parameters and then proceed to examine the impact of varying n on equilibrium employment and wages.

One **model period** is calibrated to correspond to one month. For simplicity, we normalize the **average level of technology** $\bar{A}$ to unity. Our choices for the interest rate r, unemployment benefits b and separation rate χ are standard. The latter implies that average job tenure be about 7 years. The baseline parameters are given in Table 1.

Many recent papers report estimates for **bargaining power** β in the range of 20%, among other Cahuc, Gianella, Goux and Zylberberg (2002). We report results for a benchmark specification of 20% as well as for $\beta = 50\%$.

Standard values for **labor market tightness** are around two to five percent. However, these measure actual vacancies over unemployment. The vacancies in our model should be considered as the number of job interviews that a firm undertakes in order to fill one 'regular' vacancy. Furthermore firms adjust the number of interviews for the likelihood of finding a suitable candidate. Hence we should adjust the standard notion of vacancies by the probability of being matched with a worker. Doing so yields a value for the **matching elasticity** of around $\eta = 0.25$.

We set **hiring costs** Φ_V so that equilibrium unemployment in the fully competitive baseline economy [with $n > 20$ firms] is about 4.0%. We consider three values for the **degree of substitutability** among goods σ, ranging from 1.5 to 5.0. In addition, we examine low and high **unemployment benefit** levels of 0.20 and 0.40.

Figure 3 presents the results of the baseline calibration. Figure 3a plots the equilibrium unemployment rate u against the number of firms per industry, our measure of competition. As intra-industry competition increases, the unemployment rate decreases. At low levels of substitutability [$\sigma = 1.5$], the impact of competition on unemployment is quite dramatic. By increasing the number of firms per industry from one to four, equilibrium unemployment is more than halved from 29.4% to about 4.6%. The decrease in unemployment can be attributed [via the Beveridge curve] to the increase in labor market tightness depicted in Figure 3b. Hence, the decrease in unemployment can be traced to the expansionary effect that competition has on vacancies. We identify two channels by which an increase in $n-$competition affects vacancies: (1) the output-expansion channel and (2) the wage-bargaining channel. The output-expansion channel is that already identified by Blanchard and Giavazzi (2002). When competition increases, firms facing more elastic demand respond by increasing output, leading to an increase in employment. The second channel is related to the properties of individual Nash bargaining over wages of our setting. Under individual bargaining, firms facing imperfectly elastic demand engage in over-hiring [10]. As competition increases, the over-hiring is diminished, placing downward pressure on employment. Our results indicate that the first effect prevails quite clearly, so that steady-state employment is indeed found to be increasing with competition. Steady-state employment is proportional to vacancies [by $v_i = \frac{\chi H_i}{q(\theta)}$], so that increased competition leads to increased vacancies v.

The impact of $n-$competition on equilibrium wages and profits is equally striking. Figures 3c and 3d show that equilibrium wages nearly double when the number of firms is increased from 1 to 4, while per-firm equilibrium profits drop to about 1/5th of their monopoly levels. That wages are increasing despite shrinking profits may seem surprising initially. It is useful to recall, however, that the equilibrium wage is the sum of two components: a share β of match surplus and the value of the worker's outside option. Figures 3e and 3f depict the behavior of each wage component as a function of n. Greater $n-$competition lead to higher equilibrium labor market tightness, so that unemployed workers find it easier to find a new job, raising the equilibrium value of unemployment - or equivalently the worker's outside option - which leads to an increase in the equilibrium wage. Although equilibrium match surplus increases slightly as well, it is this improvement in the worker's bargaining position which accounts for the vast majority of the increase in wages due to competition. Interestingly, this indicates that the puzzling combination of stagnant wages and high profits currently observed in Germany, may simply be consistent with low degrees of competition and/or high degrees of cartelization.

At moderate levels of substitutability among goods [$\sigma = 3.0$], the results are still striking, as demonstrated by Figure 4: increasing the number of firms per industry from one to five causes equilibrium unemployment to decrease by more than 30%, from 5.8% to 3.9%. Also, workers continue to benefit from the improved labor market conditions in wage terms as well, as they see real wages increase by nearly 50%. Once again the main source of wage increases is the worker's improved ability to find jobs when unemployed, improving his or her bargaining position.

Figures 5 to 8 show the impact of increasing competition on employment for several other scenarios. Figure 5 shows that unemployment reacts even more sharply to an increase in competition when unemployment benefits take their high value of 0.4, while their weaker reaction at low benefit levels of 0.20 is depicted in Figure 6. Figure 7 shows the impact of increasing worker's bargaining power to $\beta = 0.50$. Finally, Figure 8 exhibits labor market performance for moderate levels of substitutability $\sigma = 3.0$ and high benefits $b = 0.40$. Now, increasing the number of firms from one to four causes unemployment to drop from about 7.5% to 4.6%, a decline of nearly 40%. Hence, even at moderate degrees of substitutability among goods, increasing competition could have a substantial impact on both unemployment and wages.

In all parameter scenarios the quantitative message is clear: A little bit of competition goes a long way. The main benefits to competition for employment and wages are due to the transition between monopoly and oligopoly, not to the transition from oligopoly to perfect competition. Our results would be even stronger in the presence of collusion. A collusive equilibrium involves two or more firms acting as if they were one - leading to an effective firm size of one, and the resulting labor market implications. Hence, to the extent that small industry sizes makes collusion more likely, an increase from moderate to large industry sizes could also be beneficial for employment and wages.

[10] This is analogous to the results of Stole and Zwiebel (1996).

5 Barriers to Entry

In this section, we turn to our second quantitative question: By how much would lowering barriers to entry reduce unemployment? We approach this issue by first noting that introducing barriers to entry allows us to determine equilibrium industry size n^* endogenously. This forges a link between barriers to entry found in the data and equilibrium $n-$competition. We then use the results of the previous section to connect n^* to unemployment. This allows us to assess the impact of higher continental European barriers to entry on labor market performance, by comparing equilibrium unemployment to that under lower Anglo-American barriers to entry.

5.1 "Free Entry"

In order to enter the industry, firms must pay an entry cost Φ_E. Entry by firms will continue until profits net of entry costs within each industry have been competed down to zero. Hence, free entry in the presence of barriers to entry leads to equilibrium industry size n^*, which is defined implicitly by:

$$r\Phi_E = \frac{\pi_i (n^*)}{P} \tag{26}$$

where the firm's equilibrium profits per period are given by

$$\frac{\pi (n)}{P} = \frac{P_i (n)}{P} Y_i (n) - \frac{w (n)}{P} H_i (n) - v_i (n) \Phi_v \tag{27}$$

The free entry condition (26) states that the entry cost must be amortized by profits over the firm's infinite lifespan. Since equilibrium profits depend upon the degree of competition, free entry forges a negative link between barriers to entry and the number of firms. With the number of firms in hand, we can use the results of sections 3 and 4 to assess the impact of given levels of entry costs on equilibrium labor market performance.

5.2 European and U.S. Data on Entry Costs

The purpose of this subsection is to use the data on barriers to entry collected by Djankov, et. al. to calibrate the entry costs Φ_E. Djankov, et.al. give entry costs in two complementary forms: as the number of business days d it takes to setup the standardized firm, and as the percentage of per-capita GDP f required to pay the fees associated with setting up the standardized firm. Table 2 divides OECD countries into two groups. The Anglo-American countries are characterized by low entry costs, both in terms of fees and waiting periods. In contrast, the continental European group has much higher barriers to entry, which are greater by an order of magnitude. Continental European countries must wait an average of 88 days and pay fees of 17 percent of per capita GDP, compared to the corresponding population-weighted average for the Anglo-American group of 7 days and only 1 percent of per capita GDP in fees.

Djankov, et. al.'s definition of entry costs is quite conservative: their standardized firms are locally-owned [i.e. not subject to joint venture approval], do not engage in import or export [obviating import or export licensing requirements] and are not subject to any industry-specific health, safety or environmental regulation. Since a good part of any sample of firms is likely to be affected by at least one of these additional regulatory burdens, we must view Djankov et. al.'s data as posing a lower bound on entry costs. Also, the data on fees refers only to official fees, and does not include any lawyer's, accountant's or consultancy fees. As the entry process becomes more complex, it is reasonable to assume that entrepreneurs may need to engage such professional services, further pushing up the entry cost.

In order to use Djankov, et. al.'s data to calibrate our model, we combine the fee and waiting period measures to obtain a single quantification of barriers to entry[11]. The most straightforward method is to convert the waiting period into a pecuniary opportunity cost consisting of lost profits during the setup-period, plus the lost wages of one person who is charged with setting up the firm. This implies that a day of waiting is more costly in a high-profit and/or high-wage economy. Formally, we find the real cost of entry delay by multiplying d by the sum of monthly profits $\frac{\pi}{P}$ and monthly wages $\frac{w}{P}$, and then dividing by the average number of business days in a month, 20.8. [12]. Total barriers to entry for country m are then found by adding the cost of entry delay to the fees f:

$$\Phi_E^{(m)} = \left[\frac{d_m}{20.8}\left(\frac{\pi}{P}(n) + \frac{w}{P}(n)\right)\right] + f_m. \tag{28}$$

Combining the entry costs measured by (28) with the free entry condition yields the free entry condition for country m as:

$$r\left[\frac{d_m}{20.8}\left(\frac{\pi}{P}(n^*) + \frac{w}{P}(n^*)\right)\right] + rf_m = \frac{\pi}{P}(n^*)\,. \tag{29}$$

5.3 Barriers to Entry and Unemployment

We now consider two entry-cost regimes. The first is a long-waiting period, high-fee regime, which we call 'continental Europe'. d_{Euro} is obtained as the population-weighted average of the time it takes to establish a standardized firm in Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, Portugal and Spain, while f_{Euro} is the corresponding average for the fee-based entry costs. The second regime, which we call 'Anglo-American', is characterized by short waiting periods and low fees. d_{Anglo} is obtained as the population-weighted average of the delay for the United States, United Kingdom, Ireland and Canada, while f_{Anglo} is the corresponding figure for fees. Both (f, d) pairs are reported in Table 2.

In our basic setup, firms live forever. Hence, the entry costs can be amortized over the entire infinite firm lifespan, and then compared to per-period profits. Hence, entry costs must be very large in order to have a significant impact. When firms live forever, we find that both entry cost regimes lead to very large equilibrium industry sizes, as reported in Table 3. In both the Anglo-American and the continental European regimes industry size is greater than 20 in the baseline scenario, putting both model economies far in the flat part of the unemployment-competition schedule. This is illustrated in Figure 9 neither the European nor the Anglo entry-cost schedule meets the profit schedule at industry sizes up to 20. Hence, despite the striking differences in barriers to entry in Anglo-American and continental European economies, the differences in equilibrium labor market behavior of infinitely-lived firms is negligible.

[11] Pissarides (2001) instead captures the waiting period by a random probability of being granted the permission to open an establishment. In an interesting extension he then suggests this probability could be reduced by bribes.

[12] The equivalent annual calibration would involve multiplying d by annual profits $\frac{\pi}{P}$ and then dividing by the 250 business days in a year.

This negative result is due primarily to the strong assumption of infinitely-lived firms. It is well-known that firm exit rates are high. The picture improves considerably if we consider shorter-lived firms, who must amortize entry costs over a shorter timespan. We attempt to capture the effects of shorter firm lifespans in a back-of-the-envelope way by introducing a constant per-period probability of firm survival p.

To find reasonable values p, we consult the extensive literature concerned with firm survival rates. The one-year probability of firm survival varies between about 0.70 and 0.85, which corresponds to monthly probabilities of survival between 0.970 and 0.987. Dunne, Roberts and Samuelson (1988) examine several cohorts of U.S. manufacturing firms born between 1963 and 1977, and find 5-year survival rates averaging 0.387, which correspond to a constant monthly survival probability of 0.984. More recently, using a census of Portuguese manufacturing firms born in 1983, Mata and Portugal (1994) find a one-year survival rate of 0.776 and a four-year survival rate of 0.520, which corresponds to constant monthly rates of 0.979 and 0.986 respectively. Data collected by Wagner (1994) for manufacturing firms in the Lower Saxony region of Germany points to somewhat higher values near 0.99.

Several factors lead us to believe that firm survival rates may be even lower than those cited above. First, Mata and Portugal (1994) report that firm survival rates are increasing in initial firm size - and note that their dataset is likely to be underreporting the number of smallest firms with less than 5 employees. For example, Mata and Portugal report a one-year survival rate of firms with one to two workers of only 0.7045, compared to 0.9545 for firms with one hundred or more workers. Second, all datasets in the cited studies are composed exclusively of manufacturing firms. and there is reason to believe that non-manufacturing firms may have lower survival rates. Audretsch (1991) and Mata and Portugal (1994) report wide variation in firm survival rates across industries. Interestingly, the Portuguese industries with the lowest four-year survival rates were fish-preserving [0.250], pastry [0.347] and made-to-measure clothing [0.379]. All three are soft, workshop-style, labor-intensive industries, which are likely to share common characteristics with service-industries, and may be indicative of lower non-manufacturing survival rates. Perhaps most worryingly, Dunne, Robert and Samuelson (1988) note that most datasets do not differentiate between truly new firms and new plants of existing firms. Since the latter are likely to have somewhat greater survival rates, the survival rates of truly new firms may be overstated by undifferentiated datasets. Finally, all existing studies use data from the 80's, 70's or even 60's, leaving open the possibility that increased firm entry rates in the 90's may have been coupled with increased exit rates.

Guided by the empirical estimates and the concerns cited above, we examine the impact of monthly firm-survival rates ranging from 0.99 to 0.95. Since we are trying to assess the impact of a reduction in European entry costs, we choose the scenario most appropriate to Europe: high benefits and moderate degrees of substitution elasticity [13] $\sigma = 3.0$. Table 3 presents the results: we find that equilibrium industry size - and thus labor market performance - is quite sensitive to the firm survival rates. At the survival rates consistent with the data of 0.98 monthly, equilibrium unemployment is 10% lower in the Anglo regime than in the European one, while the still plausible value of 0.97 yields a 17% decrease in equilibrium unemployment, from 5.18 % to 4.28%. The wage increase due to the shift to the

[13] Actually, equilibrium industry sizes are smaller for higher degrees of substitutability σ. The reason is that higher values of σ lead to lower overall levels of profits, so that the profits and entry costs reach similar levels at smaller industry size.

Anglo entry-cost regime is equally substantial, 7% and 14% respectively.

As encouraging as these results are, we should emphasize that these figures fall short of providing fully satisfactory estimates of the impact of shorter firm lifespan. The reason is that steady-state firm entry and exit are not explicitly modeled here. Since incorporating firm exit and entry will have an effect on both the job creation and the job destruction margin, the net effect is likely to be small. Hence, although our estimates are rough, they are unlikely to be biased strongly in either direction.

6 Extensions

6.1 Heterogeneous Technologies

We extend the basic model to allow for heterogeneous technologies. We do this by allowing the technology A_i to vary across industries, allowing us to assess the differential impact of an increase in competition on employment in high- and low-technology sectors. This extension is quite straightforward. The firm's problem remains identical, except that the production function for industry i becomes:

$$Y_i = A_i H_i.$$

Workers take into account that they may be matched to firms in low or high technology industries, which may in principle lead to industry-specific wages w_i, so that values of employment and unemployment are given by:

$$\begin{aligned} rV_i^E &= w_i - \chi \left[V_i^E - V^U \right] \\ rV^U &= b + \theta q(\theta) \left[\overline{V}^E - V^U \right] \end{aligned}$$

where $\overline{V}^E = \int V_i^E d\nu(i)$ and ν is the distribution of vacancies across industries. Since the separation probability is constant and equal for all industries by assumption, the distribution of vacancies and the distribution of technologies will be identical. Working through the firm-level equilibrium, it is straightforward to confirm that the firm-level equilibrium wage is independent of the technology, so that all industries pay identical wages which are described by equation (21). It follows directly that output and employment for industry i are given by:

$$Y_i = A_i^{\sigma} \cdot p(\theta|\xi_i)^{-\sigma} Y, \tag{30}$$

$$H_i = A_i^{\sigma-1} \cdot p(\theta|\xi_i)^{-\sigma} Y. \tag{31}$$

Differentiating (30) and (31) makes it clear that both $\frac{\partial Y_i}{\partial \xi_i}$ and $\frac{\partial Y_i}{\partial \xi_i}$ are increasing in A_i, so that competition-induced output and employment expansion are strongest in high-technology sectors. The wage gains, however, are spread equally across high and low-technology sectors.

In addition, employment and output levels are increasing in technology, so that by (27), profits are also increasing in technology. Since the overall level of profits is greater in high-technology sectors, the same level of barriers to entry leads to larger industry sizes - involving greater degrees of intra-industry competition - in the high technology sectors.

6.2 $\sigma-$Competition

As mentioned earlier, there are two ways in which greater competition may manifest itself: as greater competition within existing industries or as greater competition among industries. Until now, we have been considering the impact of an increase in intra-industry competition. Now, we shift the focus to inter-industry competition. As is usual in the monopolistic competition, we will assume implicitly that each good is produced by a monopolist. An increase in competition is assumed to lead to an a decrease in the market power of each monopolist, which leads to an increase in the elasticity of substitution among goods σ. Hence, we call this competition setup $\sigma-$competition. [14]

Adapting the basic model to take $\sigma-$competition into account is very straightforward. The main difference is that the demand elasticity faced by each firm reduces to $\xi_i = \sigma$, since all firms are monopolists. Substituting in for ξ_i everywhere leads to the analog of crucial equation for equilibrium labor market tightness (23), which will lead us to an expression $\theta(\sigma)$. Accordingly, all equilibrium variables are now expressed as functions of σ rather than industry size n. Accordingly, the 'free entry' condition (26) will allow us to use barriers to entry to find the equilibrium value of σ itself:

$$r\Phi_E = \frac{\pi(\sigma)}{P} \tag{32}$$

Figure 11 shows how labor market variables adjust to differing levels of $\sigma-$competition. The results are strikingly similar to those under $n-$competition. This is not surprising, since the differences in the equilibrium equations are minimal. An increase in demand elasticity from 1.5 to 4.0 would decrease equilibrium unemployment from 29.4% to 5.01%, while also nearly doubling wages from 0.34 to 0.69. The main difference lies in the impact of barriers to entry on industry size. When barriers to entry from the Djankov, et. al. data are used to calibrate the model, in none of the scenarios are values of σ^* smaller than 20. This implies that barriers to entry have only a negligible effect on the labor market, even when allowing for shorter-lived firms.

6.3 Efficient Bargaining

As an alternative to individual wage bargaining we consider efficient bargaining. For simplicity we assume that union-membership is constant, so that the Nash bargaining problem becomes:

$$\max_{H,w} \beta \ln\left[H\frac{w - rV^U}{r+\chi}\right] + (1-\beta)\ln\left[\frac{H}{r}\left(P_i(H_i)A - w - \frac{\Phi_V P\chi}{q(\theta)}\right)\right]$$

where disagreement points are rV^U and 0 for union members and firms, respectively. The first order conditions for wage and employment are given by:

$$w = (1-\beta)rV^U + \beta\left(P_i(H_i)A - \frac{\Phi P\chi}{q(\theta)}\right) \tag{33}$$

$$w = \beta P_i(H_i)A + \frac{\xi-1}{\xi}(1-\beta)P_iA - \frac{\Phi_V P\chi}{q(\theta)} \tag{34}$$

which we can combine to express prices and wages as:

$$\frac{P_i(H_i)}{P} = \frac{\xi}{\xi-1}\left(\frac{rV^U}{P} + \frac{\Phi_V\chi}{q(\theta)}\right)\frac{1}{A} \tag{35}$$

[14]This is close to the competition setup in Blanchard and Giavazzi (2002).

$$\frac{w}{P} = \frac{rV^U}{P} + \frac{\beta}{\xi - 1}\left(\frac{rV^U}{P} + \frac{\Phi_V \chi}{q(\theta)}\right). \tag{36}$$

Together, equations (35) and (36) describe partial equilibrium employment and wages. Real profits per worker are independent of productivity and can be written as

$$\frac{\pi_i}{P} = \frac{1-\beta}{\xi - 1}\left(\frac{rV^U}{P} + \frac{\Phi_V \chi}{q(\theta)}\right) H_i.$$

To solve for short run general equilibrium, once again impose that the individual prices sum to equal the price index defined in Section 2. This yields an equation relating equilibrium labor market tightness θ to the value of unemployment:

$$\frac{rV^U}{P} = \left(b + \frac{\beta}{\xi - 1}\Phi_V \chi \theta\right)\left(r + \chi - \frac{\beta\theta q(\theta)}{\xi - 1}\right)^{-1}. \tag{37}$$

where equilibrium labor market tightness is given as the solution to

$$\bar{A} = \frac{\xi}{\xi - 1}\left(\frac{rV^U}{P} + \frac{\chi\Phi_V}{q(\theta)}\right). \tag{38}$$

To find the long run equilibrium with endogenous industry size, compute firm level profits according to (27) and find the profit level that equals annuitized entry costs. If we compare (38) to the equilibrium condition for efficient bargaining (23) we observe that the first ratio is here not diminished by β. This comes from the absence of the overhiring effect with efficient bargaining and implies that under an efficient bargaining mechanism for wage determination, equilibrium labor market tightness is unambiguously decreasing in union bargaining power β.

Whereas monopolistic competition typically suggests that output is too low, the results of Stole and Zwiebel (1996) suggest that firms that face decreasing marginal revenue product will overhire under individual bargaining. Under efficient bargaining, we would expect that the overhiring effect will be absent. This indeed turns out to be the case. In the bottom left panel of figure 10 we see that as intra-industry competition increases the unemployment rate falls. For efficient bargaining the impact is quite dramatic at any level of competition, for individual bargaining the equilibrium unemployment rate is not much affected after the number of firms per sector has exceeded 4. For any calibration, firm size with individual bargaining is strictly decreasing in competition, while for efficient bargaining we notice in the top left panel that firm size initially increases in competition and then drops. Finally in the bottom right panel of figure 10 we see that output increases much stronger in competition with efficient bargaining. We interpret this as evidence that the overhiring mentioned by Stole and Zwiebel (1996) actually counteracts the 'underproduction' typically found in monopolistic competition. In the next subsection we explore in more detail how the decentralized and the efficient bargaining regime affect social efficiency.

6.4 Social Efficiency

We now compare the distribution of monopoly rents in economies with centralized union bargaining (efficient bargaining), and decentralized bargaining at the individual worker level. This is important from a welfare point of view. Any setup where firms take their product market power into account will lead to underprovision of goods. At the same time firms in individual bargaining settings have an incentive to overhire and thus overproduce (Stole and Zwiebel, 1996) which can potentially counteract some of the monopoly distortions. Such a ‘self-regulation’ is absent in the efficient bargaining setup.

The main questions we ask here are:

1. Is the standard Hosios (1990) condition still relevant in a setting with monopolistic competition?

2. Is it possible to make welfare statements about allocative outcomes using decentralized and efficient bargaining?

3. Is aggregate employment too low or too high or is it ambiguous?

4. Does the ‘overhiring’ that is implicit in the decentralized approach make up for some of the monopoly distortion?

We have previously chosen a linear production function, so it was only the downward sloping demand function that determined optimal size of firms[15]. For the social planner economy we thus face indeterminate firm size and will simply consider industry-wide employment. Further, since all firms have identical technologies, all firms are identical. Thus total output of the economy can simply be written as $AH(1-u)$ where H is aggregate employment. Furthermore, given that all goods enter the utility function symmetrically they will be consumed in equal amounts and per capita consumption of the aggregate good is thus given by $A(1-u)$.

Vacancy posting costs are linear in vacancies. Using our definition of labor market tightness we can write economy wide per-period vacancy posting costs as $\Phi_V \theta u$ so that the per period social welfare function becomes $A(1-u) - \Phi_V \theta u$.

Under the assumption that the social planner is also subject to matching frictions the central planning problem becomes:

$$\max_{\{u_{t+1},\theta_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t \{A(1-u_t) - \Phi_V \theta_t u_t + \mu_t \left[u_{t+1} - u_t - \chi + \chi u_t + \theta_t q(\theta_t) u_t\right]\}$$

where μ_t denotes the shadow value of an extra vacancy. From the first order condition for labor market tightness we obtain

$$\mu_t = \frac{\Phi_V}{q(\theta_t)} \frac{1}{1+\eta(\theta_t)} \qquad \text{for all } t \tag{39}$$

where η denotes the elasticity of the matching function with respect to θ, i.e. $\eta = \frac{\theta q'(\theta)}{q(\theta)}$. Combining the first order conditions for θ_t and u_{t+1}, using the envelope condition and imposing the steady state condition that $\theta_t = \theta$ and $u_t = u$ we find an expression for labor market tightness similar to that in the decentralized economies:

$$A = \frac{1}{1+\eta} \left[-\eta\theta\Phi + \frac{\Phi}{q(\theta)}(r+\chi)\right] \tag{40}$$

6.4.1 Conditions for Social Efficiency

By comparing (40) to the equilibrium condition of individualized bargaining in (23) we find two necessary condition for social efficiency:

[15] Hiring costs are linear in vacancies.

1. $\beta = -\eta$ which is just the standard Hosios condition;

2. $\frac{\xi-\beta}{\xi-1} = 1$ which comes from the monopoly distortion. As $\xi \to \infty$ the distortion disappears, as expected.

This implies that if the Hosios condition holds the monopoly distortion could be eliminated by giving all bargaining power to the workers. This is an interesting angle because one intuition for the Hosios condition is that general wage-setting leaves out the unemployed. If wages were chosen by currently unemployed, the matching inefficiency would disappear.

6.4.2 Unemployment too high or low?

The RHS of both the socially efficient equilibrium condition (40) and its individual bargaining counterpart (23) are increasing in θ, β, and $-\eta$. We can infer that for $-\eta < \beta$ unemployment is clearly above the socially efficient level. This is composed of two effects, the trading externality and the monopoly distortion. The monopoly distortion (manifested by $\frac{\xi-\beta}{\xi-1}$) always implies underemployment. For $-\eta < \beta$ the trading externality also implies underemployment and thus unemployment is unambiguously too high in the decentralized solution. This is the case for our benchmark parameterization where $\beta = 0.3 > -\eta = 0.25$.

However, for $-\eta > \beta$ the trading externality implies overemployment whereas the monopoly distortion still suggests underemployment. Given that the two distortions work in opposite directions it is not clear, whether the level of unemployment will be too low or too high in the decentralized equilibrium as compared to the socially efficient outcome.

Notice that for simplicity we have ignored unemployment benefits b for these comparisons. However, they can be included rather easily. There is no effect on the social planner equilibrium condition because total consumption is still determined by aggregate production. However, in the decentralized solution b will increase the RHS of (23) and thus lead to more unemployment and fewer vacancies than otherwise. This is obvious because with risk neutral agents there is simply no role for unemployment insurance.

7 Conclusions

The main objective of this paper has been to study the relationship between product market regulation and labor market outcomes. Our main contribution is twofold. First, we develop a dynamic model with search frictions, multi-worker firms and imperfect competition, which is suitable for quantitative analysis. We then use our model to answer two quantitative questions: (1) What is the impact of increasing product-market competition on equilibrium employment and wages? and (2) By how much would lowering barriers to entry reduce European unemployment?

Our answer to the first question is clear and simple: a little bit of competition goes a long way. We find that moving from an economy populated by monopolists to one with five competitors per industry leads to a decrease in unemployment of more than 30%, accompanied by a doubling of real wages. Our answer to the second question turns out to depend crucially on firm lifespans and/or survival rates. When firms are infinitely-lived, entry costs may be amortized over an extended period, keeping entry profitable even at low levels of per-period profit. Hence, when firms are long-lived, both continental European and Anglo-American entry cost regimes lead to very large industry sizes, leaving little room for improved labor market performance. When, however, firms face shorter horizons or less-than perfect survival rates, then European industry sizes may become as low as 1.3, compared to industry sizes of more than 20 under the Anglo-American regime. This would imply a drop in equilibrium unemployment of fully two percentage points, from 6.3% to 4.3%. The crucial role that firm lifespan plays for our second set of quantitative phenomena motivates future research on endogenizing the firm lifespan.

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A Bargaining in the Large Firm

Here we discuss the bargaining foundation of our (individual) wage curve. Start out with only one worker. We assume that the bargaining weight is 1/2, i.e. firms and workers split surplus equally. This implies that that the surplus to the firm must equal the surplus that goes to the worker. In the lines below the surplus to the firms is on the LHS and the surplus to the worker is on the RHS. By $\underline{w}$ I denote the reservation wage.

One worker:

$$\begin{aligned} 1P_1 - w(1) &= w(1) - \underline{w} \\ w(1) &= \frac{1}{2}P_1 + \frac{1}{2}\underline{w} \end{aligned}$$

Two workers:

$$\begin{aligned} (2P_2 - 1P_1) - (2w(2) - w(1)) &= w(2) - \underline{w} \\ w(2) &= \frac{4}{6}P_2 - \frac{1}{6}P_1 + \frac{1}{2}\underline{w} \end{aligned}$$

Here the firm can now sell 2 items at price P_2 but of course cannot sell the one item at (higher) price P_1. Similarly for the wages. On the other hand each worker now receives $w(2)$.

Three workers:

$$\begin{aligned} (3P_3 - 2P_2) - (3w(3) - 2w(2)) &= w(3) - \underline{w} \\ w(3) &= \frac{9}{12}P_3 - \frac{2}{12}P_2 - \frac{1}{12}P_1 + \frac{1}{2}\underline{w} \\ w(3) &= \frac{1}{2}(P_3 + \underline{w}) - \frac{1}{12}(P_3 - P_1) - \frac{2}{12}(P_3 - P_2) \end{aligned}$$

Note that the coefficients of the P_i sum up to $1/2$. We can now generalize the expression to N and notice that the wage consists of two components: Half of the surplus and a 'compensation for the decrease in the monopoly rent'.

$$\begin{aligned} w(N) &= \frac{1}{2}(P_N + \underline{w}) + \frac{1}{N(N+1)} \sum_{i=1}^{N-1} i\,(P_N - P_i) \\ w(N) &= \frac{1}{2}(P_N + \underline{w}) + \frac{1}{N(N+1)} \sum_{i=0}^{N} i\,(P_N - P_i) \end{aligned}$$

This is very similar to the presentation in Stole and Zwiebel (1996). There the driving force is a decreasing marginal product to labor, while here it is the downward sloping demand curve.

Let's now try to heuristically obtain a continuous version of $w(N)$:

$$\begin{aligned} w(N) &= \frac{1}{2}(P_N + \underline{w}) + \frac{1}{N(N+1)} \sum_{0}^{N} i\,(P_N - P_i) \\ &= \frac{1}{2}(P_N + \underline{w}) + \frac{1}{N^2} \int_{0}^{N} i\,(P_N - P_i) \\ &= \frac{1}{2}\frac{\sigma - 1}{\sigma - \frac{1}{2}}P_N + \frac{1}{2}\underline{w} \end{aligned}$$

which is the analogon to equation (15) from the text with $\beta = 1/2$, $A_i = 1$, and $\Phi = 0$.

B Tables

Table 1: Baseline Parameters

σ	1.5; 3; 5	Substitution elasticity
$\bar{A}$	1	Average level of labor productivity
β	0.2; 0.5	Worker bargaining power
b	0.3; 0.1; 0.5	Real unemployment benefits
θ	4/100	Labor market tightness
Φ	5	Real vacancy posting cost
r	0.04/12	Annual interest rate
χ	1/80	Average tenure of seven years!
η	0.25	Elasticity of the matching function

Table 2: European vs. Anglo-American Barriers to Entry

	Days	% of p.c. GDP		Days	% of p.c. GDP
Country	**d**	**f**	**Country**	**d**	**f**
Austria	154	0.45	Canada	2	0.01
Belgium	42	0.10	Ireland	25	0.11
France	66	0.20	United Kingdom	11	0.01
Germany	90	0.09	United States	7	0.01
Greece	53	0.48			
Italy	121	0.25			
Netherlands	68	0.19			
Portugal	99	0.31			
Spain	83	0.13			
Euro Average	**88**	**0.17**	**Anglo Average**	**7**	**0.01**

Table 3: Firm-Survival and Equilibrium Labor Market Outcomes

$\mathbf{p}_{Surv}$	$\mathbf{n}_{Euro}$	$\mathbf{n}_{Anglo}$	$\mathbf{u}_{Euro}$	$\mathbf{u}_{Anglo}$	$\mathbf{\Delta u}$	$\mathbf{w}_{Euro}$	$\mathbf{w}_{Anglo}$	$\mathbf{\Delta w}$
0.95	1.3	$>$20	6.35	4.28	-32 %	0.68	0.88	+29 %
0.96	1.6	$>$20	5.70	4.28	-25 %	0.73	0.88	+21.%
0.97	2.2	$>$20	5.18	4.28	-17 %	0.77	0.88	+14 %
0.98	3.3	$>$20	4.75	4.28	-10 %	0.82	0.88	+7 %
0.99	8.0	$>$20	4.41	4.28	- 3 %	0.86	0.88	+2 %
1.00	$>$20	$>$20	4.28	4.28	0 %	0.88	0.88	0 %

C Figures

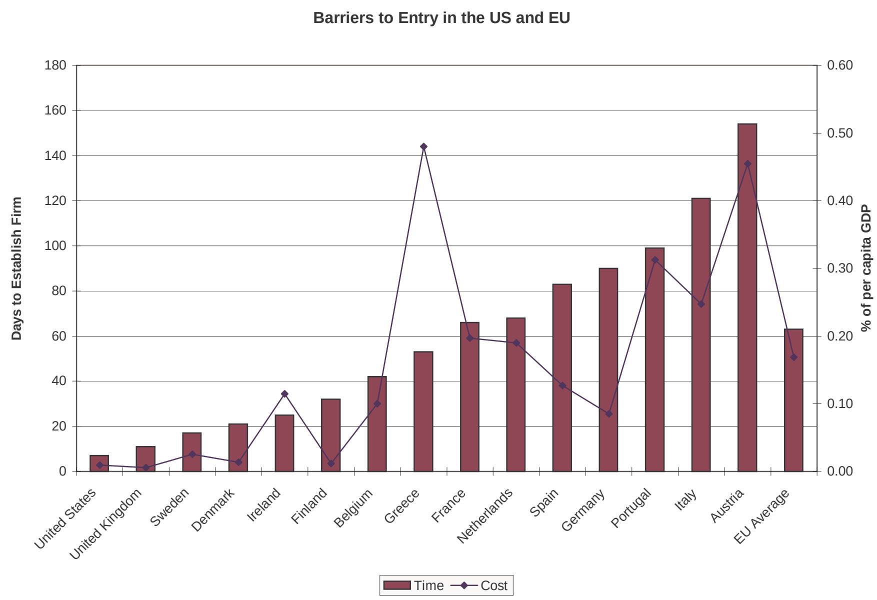

Figure 1: Barriers to Entry in Europe and North America.

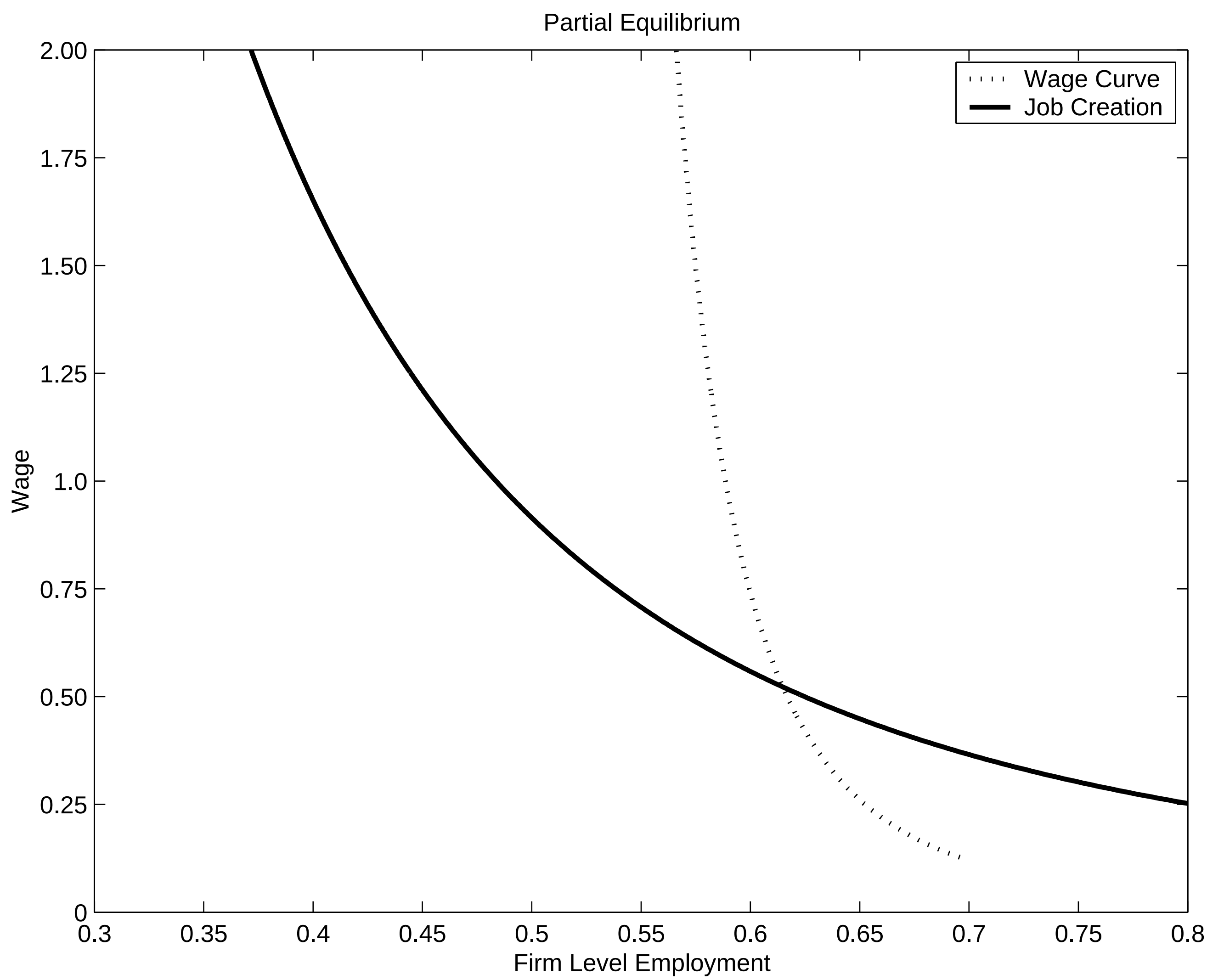

Figure 2: Partial Equilibrium.

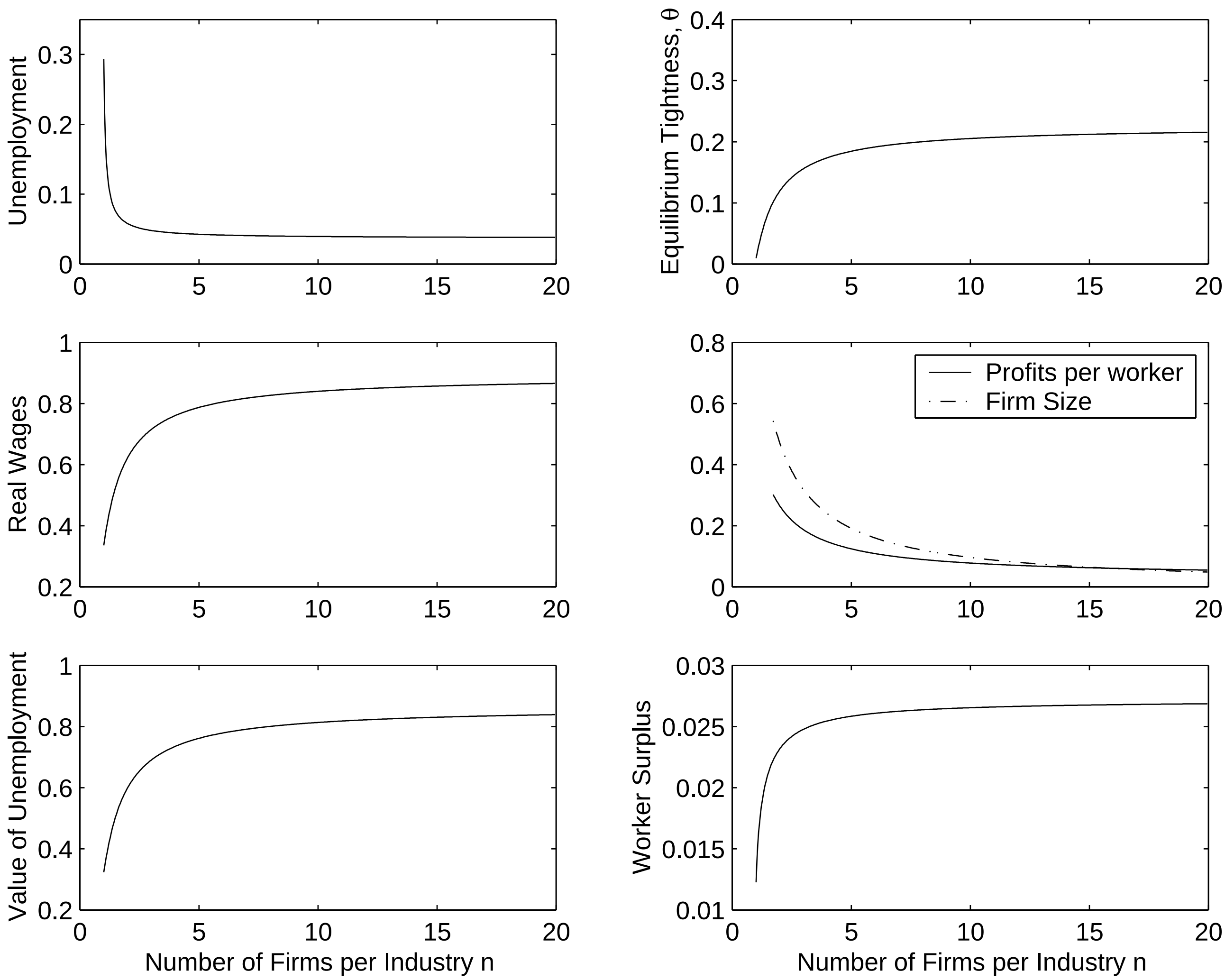

Figure 3: Competition and Labor Markets – Baseline Calibration.

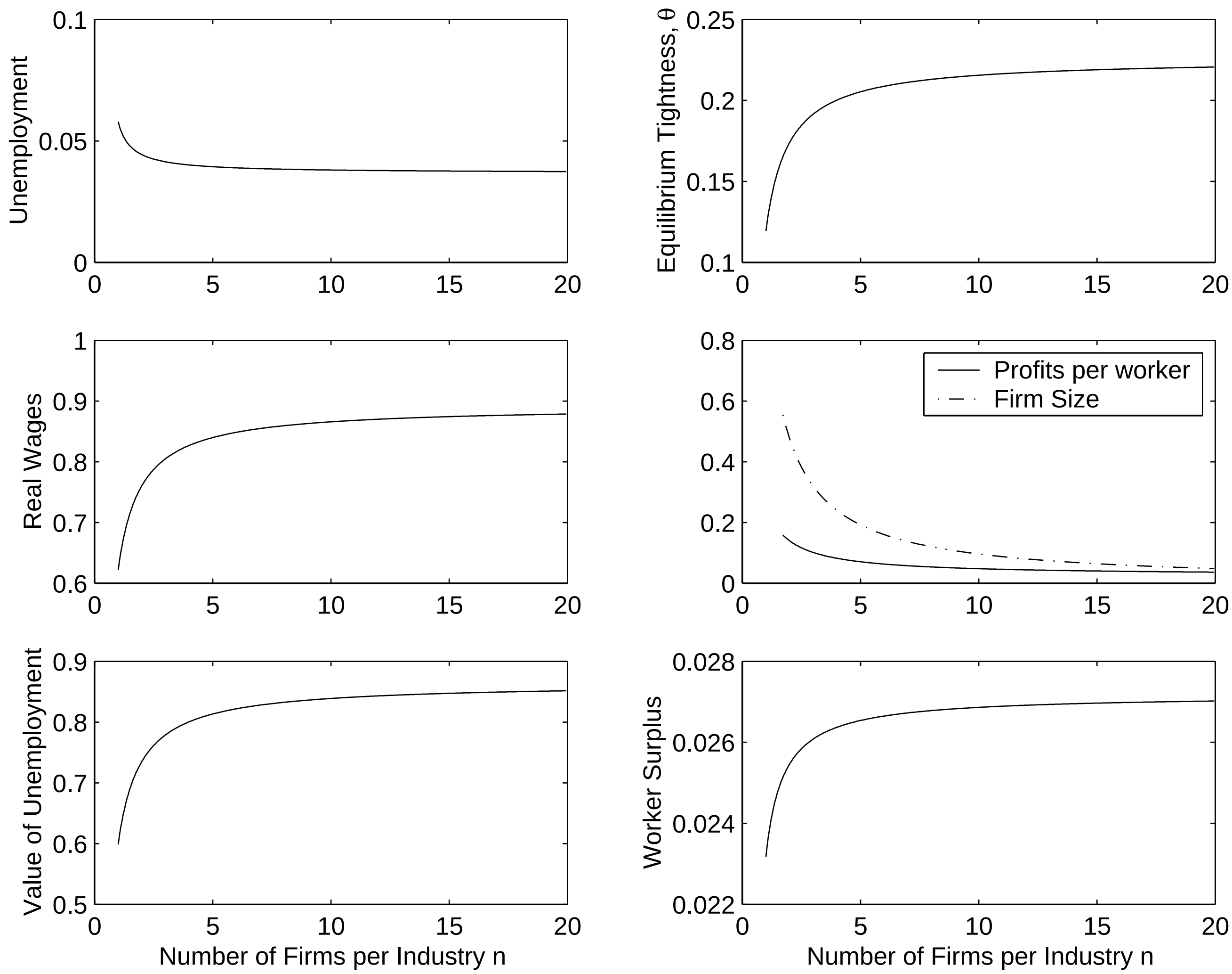

Figure 4: Competition and Labor Markets – $\sigma = 3$.

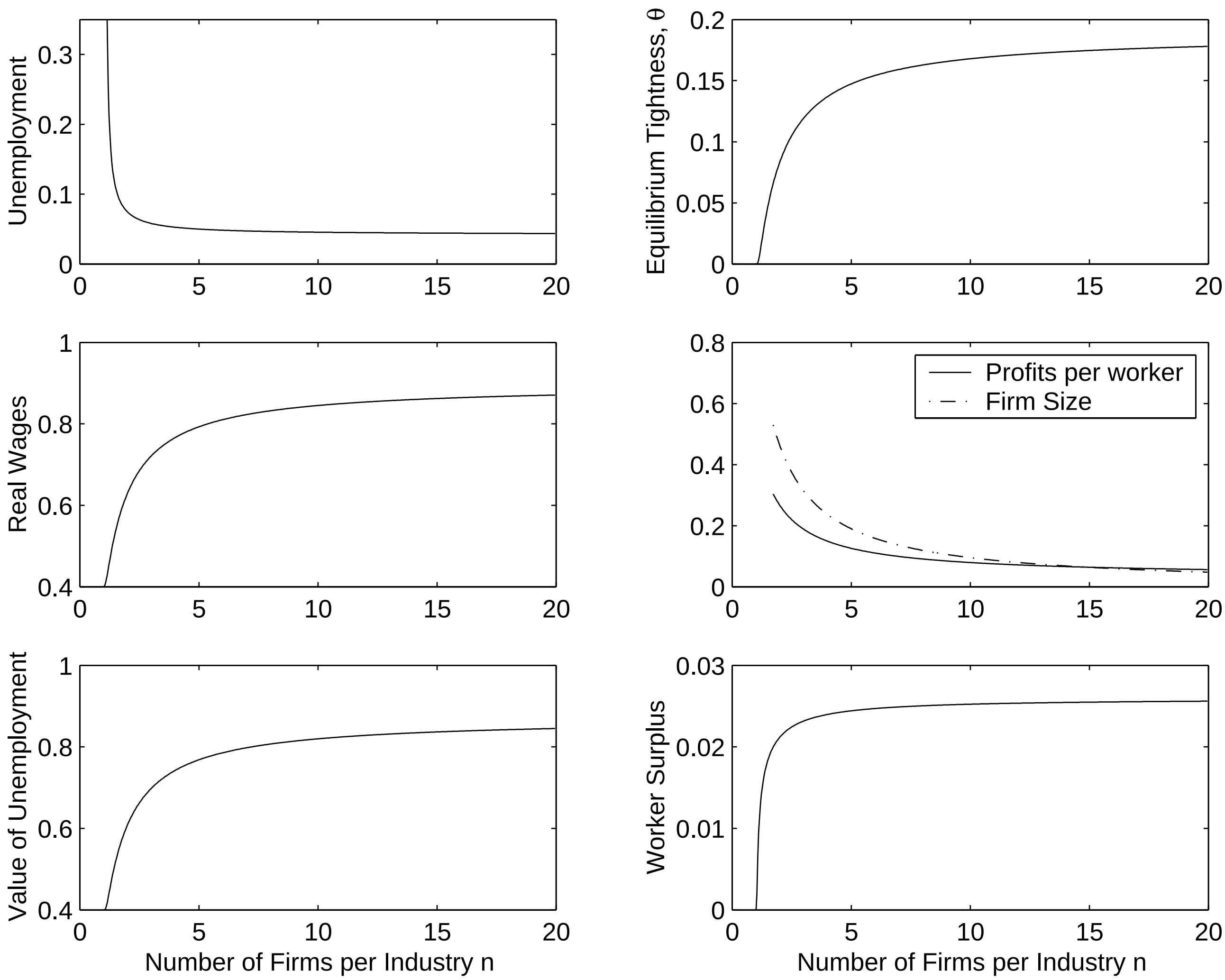

Figure 5: Competition and Labor Markets – $b = 0.4$.

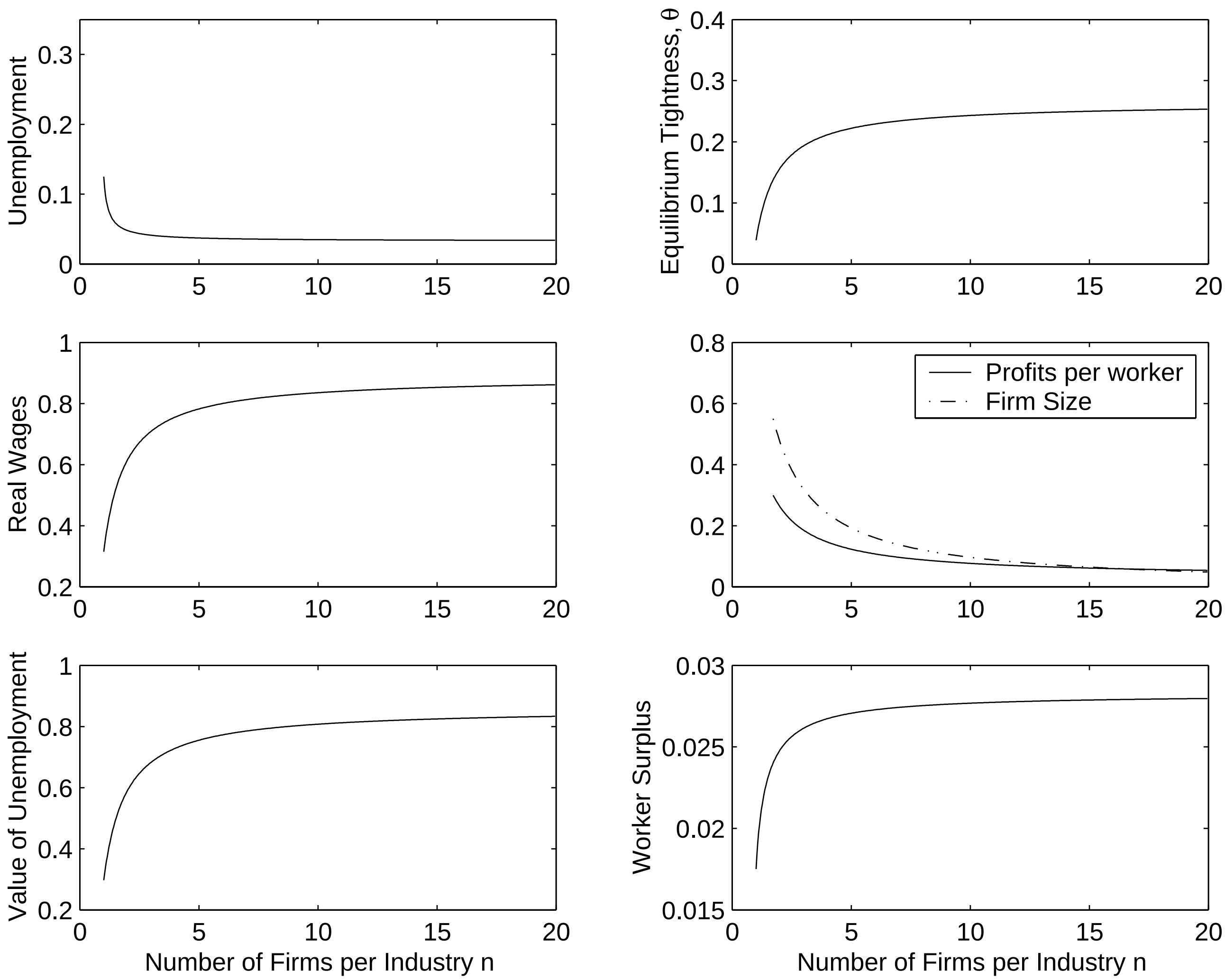

Figure 6: Competition and Labor Markets – $b = 0.2$.

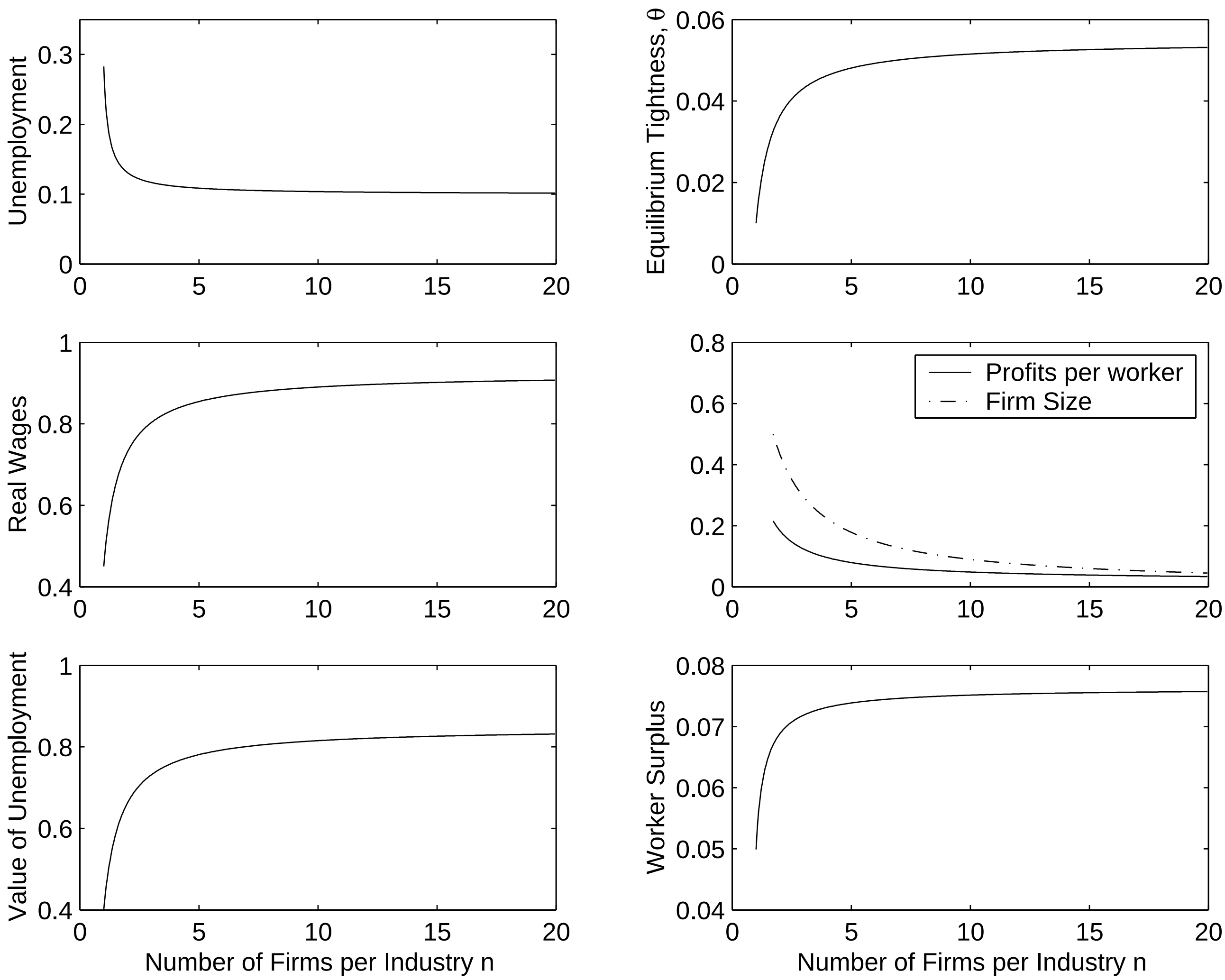

Figure 7: Competition and Labor Markets – $\beta = 0.5$.

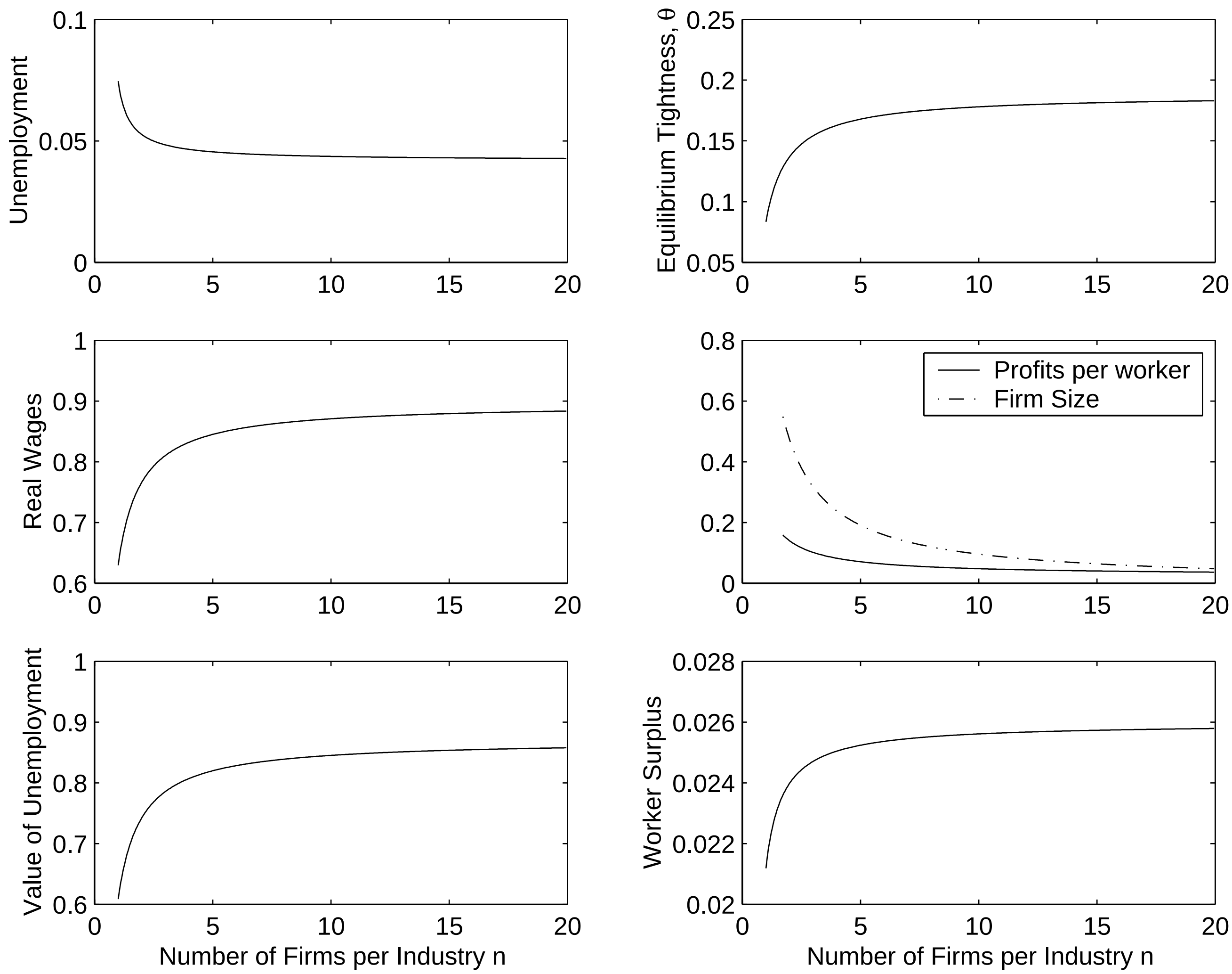

Figure 8: Competition and Labor Markets – $\sigma = 3$ and $b = 0.4$.

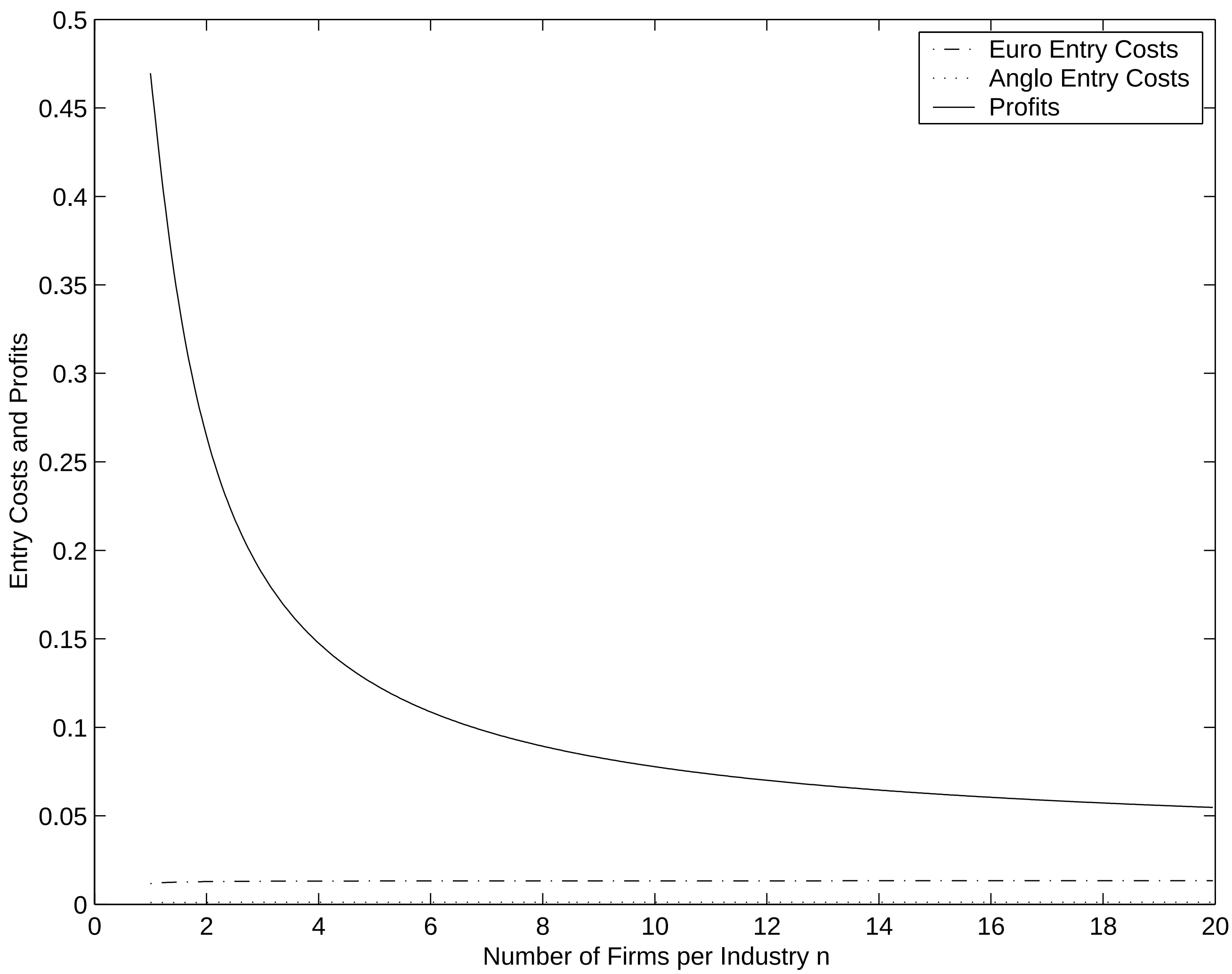

Figure 9: Long-Term General Equilibrium – Endogenous Industry Size

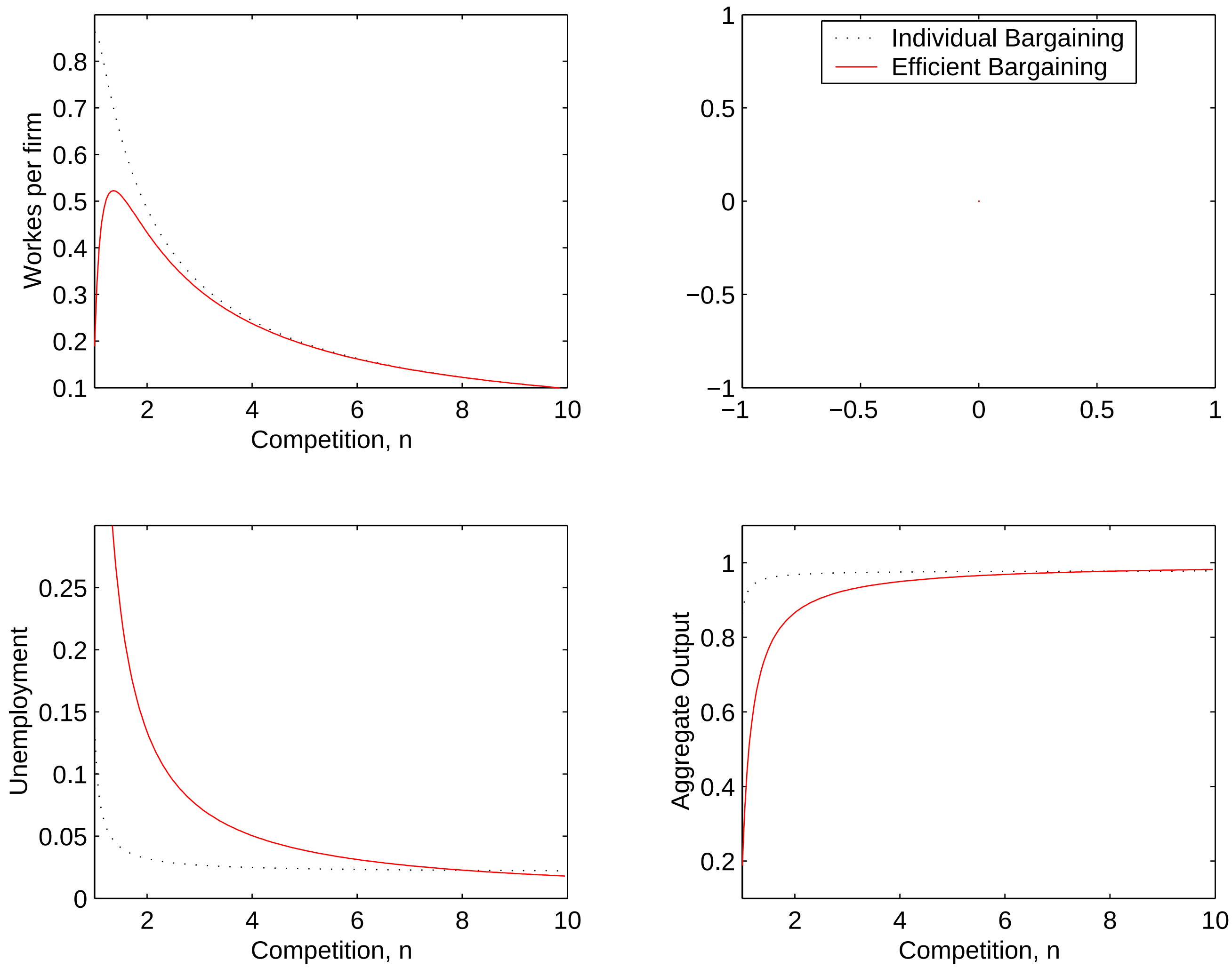

Figure 10: Comparing Decentralzied and Efficient Bargaining.

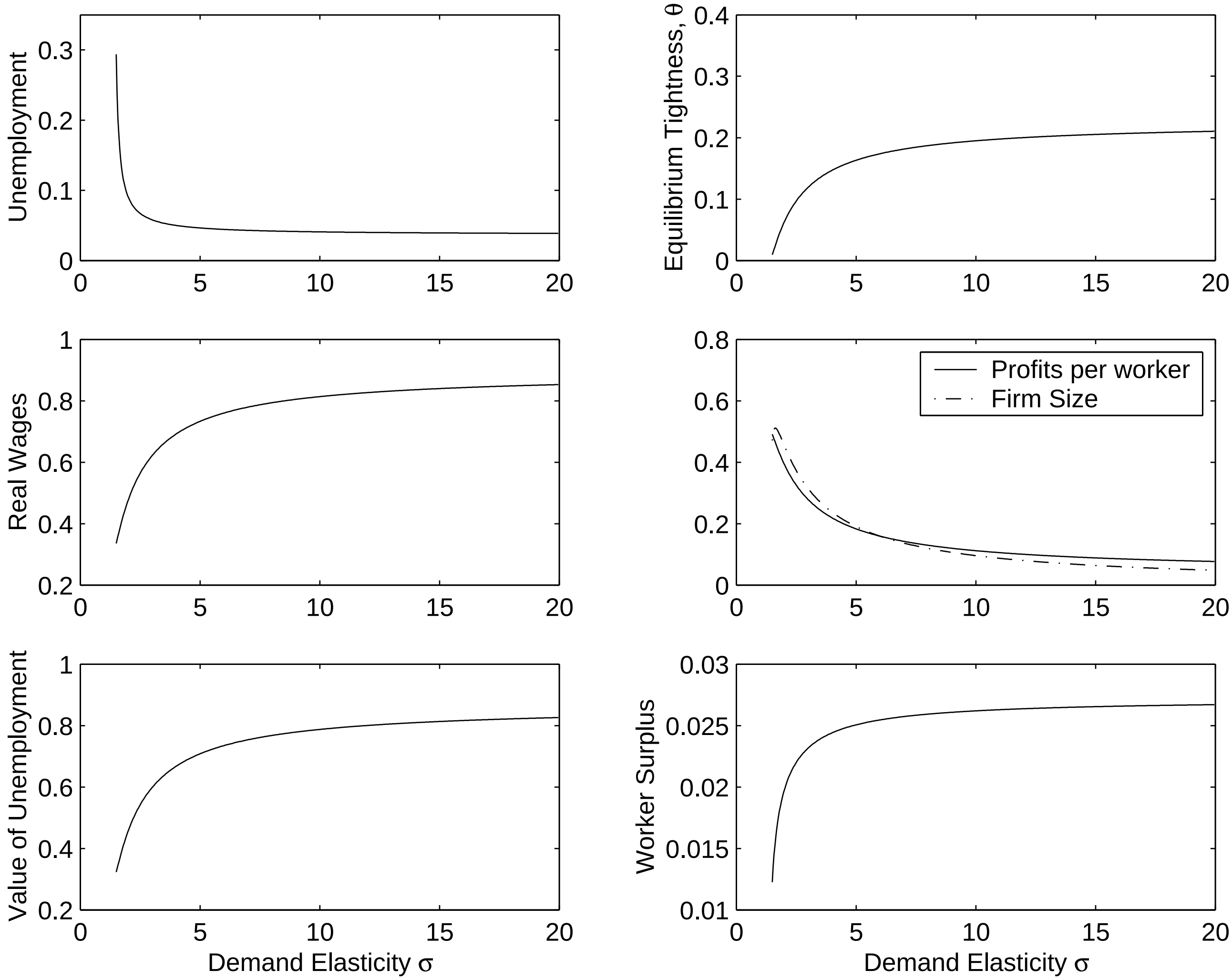

Figure 11: σ–Competition: Baseline Calibration.