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in the era of liberalization**

By

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# Efficient bargaining versus Right to manage in the era of liberalization

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**Abstract:** We compare product and labour market liberalization under the two trade union bargaining models: the Right- to- Manage (RTM) model and the Efficient Bargaining (EB) model. The vehicle is a dynamic general equilibrium (DGE) model that incorporates two types of agents (capitalists and workers), imperfectly competitive product and labour markets. The model is solved numerically employing common parameter values and data from the euro area. A key message is that product market deregulation is favourable under any labour market structure while opting for labour market deregulation one should provide special attention to the structure of the labour market such as the bargaining system of unions. If the prevailing way of bargaining is the RTM model then restructuring both markets is beneficial for all agents.

**Keywords:** trade unions, market structure, structural reforms

**JEL classification:** J5, I1

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## 1. Introduction

Product and labour market regulations have often been considered as major contributors to high levels of unemployment and poor labour market performance. After the 2008 financial crisis countries in the periphery of Europe (Greece, Italy, Portugal, Spain and Cyprus) have been strongly advised to pursue deregulation policies as a first aid response to the increased unemployment and the worsening economic conditions (OECD 2018, ILO 2015). In these countries despite a declining bargaining power, unions continue to be important players in the wage-employment negotiations, being able to generate a wage premium or ensuring employment of their members (Ivlevs and Veliziotis 2017) and often opposing structural reforms (da Campos Lima and Artiles 2011). The employment effects of liberalization attempts have been in the research agenda of economists and policy makers for more than a decade (IMF 2014, Bassanini and Duval 2006, Nicoletti and Scarpetta 2005) however, the differences in the structure of the various labour markets and their importance for the attempted reforms is an open and tricky issue which is still under researched and needs more exploration (Duval *et al.* 2018).

Our work builds on Fiori *et al.*, 2012 and Kolioussi *et al.*, 2017 and focuses on the interaction between labour market institutions such as the union bargaining system and product and labour market reforms. It sheds light to questions such as: are reforms that promise a more flexible product market influenced by the structure of the labour market? In other words, are these reforms different under the “right to manage bargaining” vis a vis the “efficient bargaining”? Are the reforms that promise a more flexible labour market influenced by the structure of the labour market? Do we have higher benefits in terms of employment, wages, income and inequality between the agents by reforming the product vis a vis the labour market? Are reforms in product market “economic substitutes” with the ones in labour market?

The vehicle is the rather standard dynamic general equilibrium (DGE) model that incorporates heterogeneous agents (entrepreneurs and workers) and imperfectly competitive product and labour markets. It is an enriched version of the model by Kolioussi *et al.* 2017 allowing the entrepreneurs to participate in the labour market too. The product market is not competitive and this generates monopolistic profits for entrepreneurs. The labour market is also non-competitive, because workers are represented by a trade union, modelled by two different ways: the right to manage model (RTM) and the efficient bargaining (EB) model.<sup>1</sup> Thus, we will first consider a world of Nash efficient bargaining solutions. There are two reasons for this. The EB concept allows wages to be bargained off the labour demand curve, which implies that an increase in wages could be achieved without an immediate decrease in employment and secondly there are some empirical studies (Walsh, 2012) arguing in favor of an EB model as the observed in some countries wage bargaining. Then we move to the RTM in which only the wage is subject to negotiation while employment is left to be determined by firms unilaterally. The lower power of unions in bargaining over employment is often observed since only wage contracts are legally binding in most labour markets and thus convincing firms to remain on the contract curve for employment too, needs appropriate punishment strategies (Petraakis and Vlassis, 2000, Fanti 2015) for a thorough analysis. We have also evidence that in the periphery of Europe trade unions so far have been mainly successful to maintain their strong

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<sup>1</sup> It is known that labour market institutions can be modeled in different ways and we have the RTM and EB, see Lawson 2010, Booth 1995.

position as wage setting institutions (Vogel, 2011). Since the case for structural reforms is particularly acute in the above countries, it is important to compare between product and labour market reforms under the RTM and EB set up.<sup>2</sup> The two models are solved numerically employing commonly used parameter values and fiscal data from European countries.

Our results show that when there is a product market liberalization both in the RTM and the EB models, wages and employment increase, the net income of workers, and net income of capitalists, increase and inequality falls.<sup>3</sup> Income and inequality is improved although to a lower extent in the EB.<sup>4</sup> In other words we verify that reforms in the product market are beneficial under any labour market structure. On top of that product market reforms are verified as “economic substitute” with labour market reforms since gains in employment, wages and the income distribution are found to be larger when workers bargaining power is initially high (Fiori *et al.* 2012, IMF 2014).

When we opt for labour market liberalization, we observe important differences. In the RTM model wages remain constant and employment increases while wages decrease and employment remains constant in the EB. Thus employment and wage gains depend strongly on the prevailing labour market institutions. On top of that workers are better off in terms of income only in the RTM model and inequality gets worse in both cases.<sup>5</sup> Thus if the RTM model could be considered the prevailing type of bargaining in countries like Greece, Italy, Spain, Portugal etc. the liberalization process of the labour market favors workers and capitalists in terms of income however, at a cost of higher inequality.

Comparing a deregulation in the product market with the corresponding deregulation in the labour market we observe that in both models the deregulation of the product market prevails quantitatively in both models. This verifies that greater competition in product markets reduces the rents available for redistribution for any type of union-firm bargaining process and then opposition to labour market reforms might decline and prepare the ground for further reforms (IMF, 2005). This is also consistent with (Blanchard and Giavazzi, 2003) stating that “...product market deregulation may trigger labor market deregulation. Intuitively, reducing rents in the goods markets reduces the incentives of workers to fight for a share of these rents.”

Finally, restructuring both markets the results are quantitatively better than those of product market liberalization leading to a “complementarity” between the two reforms. Assuming that the RTM is the prevailing bargaining structure in the countries like Greece, Italy, Spain, Portugal we verify the importance of both markets liberalization for all agents. However, this is not the case in the EB model and thus complementarity does not hold.<sup>6</sup> In other words, before the implementation of structural reforms in both markets policy makers should carefully examine the structure of the union bargaining system.

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<sup>2</sup> RTM could also be considered as the prevailing structure in the above countries see, Andersen 2003 ‘... inherent in the EU integration process are forces which tend to make wage less flexible which implies that more employment variability may follow...’

<sup>3</sup> The inequality index is measured as the ratio  $netY^k / netY^w$ . We have also approximated with the ratio of the consumptions of the agents i.e.  $C^k / C^w$ . However, this does not differentiate our results.

<sup>4</sup> This is mainly due to the fact that the efficient bargaining is less distortive and closer to the competitive equilibrium.

<sup>5</sup> Capitalists are as expected better off in any case.

<sup>6</sup> Similar results we get when we measure utilities.

To summarise, we verify the importance of product market deregulation since it is beneficial for wages, employment and income distribution under any labour market bargaining process. On the contrary, a policy maker opting for a liberalisation of the labour market should pay special attention to the structure of the labour market since the benefits strongly depend on the degree of rigidity of the market i.e. the way of bargaining.

The rest of the paper is organised as follows: section 2 presents and solves the theoretical models, section 3 includes baseline parameterization, section 4 studies their properties and finally, the last section concludes. An Appendix includes technical details.

## 2. The models

We next describe a model economy with imperfect competition in both labour and product markets. For simplicity, there is no uncertainty. The economy consists of infinitely lived households, firms, trade unions, and a government. Households are comprised of entrepreneurs and workers. Entrepreneurs can work and save in the form of physical capital and government bonds. They also own firms and receive profits. Workers, due to prohibitive transactions costs, do not participate in financial markets and thus, consume all their disposable income in each period. Both agents can spend part of their time endowment either employed or unemployed and receive unemployment benefits from the government when not working. All households are represented by firm-level trade unions which bargain with firms with the aim of maximising the average labour income of their members in two different setups a) over the wage rate (right-to-manage union model) and b) over the wage rate and the employment (efficient bargaining union model). Firms include both final and intermediate goods producers. Final goods producers are competitive. In contrast, intermediate goods producers have monopoly power in the product market and seek to maximise profits using capital, unionised labour and the given public infrastructure. Finally, the government issues new bonds and taxes consumption, labour income and interest income from physical capital and profits to finance: (1) unemployment benefits, (2) a uniform lump-sum transfer to each household, (3) public investment, which augments the stock of public infrastructure providing production externalities to intermediate firms, and (4) public consumption, which provides direct utility to households.

### 2.1 Population

Total population,  $N$ , is exogenous and constant over time with entrepreneurs and workers, respectively, being denoted as  $N^k$  and  $N^w$ . We also define the population share of entrepreneurs as:  $N^k / N \equiv n^k$ , and the workers share as  $N^w / N \equiv n^w = 1 - n^k$ . Finally, we assume that each entrepreneur owns one of  $N^i$  intermediate goods-producing firm, hence the number of those firms equals the number of entrepreneurs,  $N^i = N^k$ .

## 2.2 Households

Households are identical in the labour market since unions guarantee that their members have equal employment and wages.<sup>7</sup> Each household is randomly allocated to a union which bargains with a firm to determine, in the right- to- manage model, the wage rate and in the efficient bargaining model, the employment and the wage rate. We focus on heterogeneity that is driven by differences in asset ownership and hence we will work with a symmetric equilibrium in the labour market. Given that employment and the wage rate will be the same for all households, the allocation of households to unions does not matter.

On the other hand, as pointed out above, the households which populate the model have unequal access to the financial markets. This is motivated by imperfections in the asset markets that require agents to pay transactions costs to participate. These participation premia differ between the agents due to, for instance, past experience, socioeconomic background, networks, or firm ownership that gives an insider advantage in financial transactions. Therefore we distinguish among entrepreneurs and workers and assume that entrepreneurs and workers face, respectively, the minimum (zero) and maximum (infinity) participation costs in the financial markets (see e.g. Blanchard and Giavazzi, 2003).

The discounted sum of lifetime utility of each household  $j = k, w$  is:

$$\sum_{t=0}^{\infty} \beta^t u(C_t^j + \psi \bar{G}_t^c) \quad (1)$$

where  $\beta \in (0,1)$  is the time discount factor,  $C_t^j$  is household  $j$ 's private consumption at time  $t$ , and  $\bar{G}_t^c$  is the average (per household) public consumption goods and services provided by the government at time  $t$ . Thus, public consumption influences the private utility through the value of the parameter  $\psi \in [-1,1]$ .<sup>8</sup>

The instantaneous utility function is (strictly) increasing and (strictly) concave and is assumed to be of the form:

$$u(C_t^j + \psi \bar{G}_t^c) = \frac{(C_t^j + \psi \bar{G}_t^c)^{1-\sigma}}{1-\sigma} \quad (2)$$

where  $\sigma > 1$  is the constant coefficient of relative risk aversion (CRRA).

### 2.2.1 Entrepreneurs

A representative entrepreneur can save in the form of physical capital,  $I_t^k$ , and government bonds,  $D_t^k$ . She receives gross income from working,  $w_t^j e_t^j$ , net

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<sup>7</sup> Under unionised labour markets, a common assumption in the literature is that the unions insure their members against potential idiosyncratic employment risk (Maffezzoli 2001, Blanchard and Giavazzi 2003). Effectively, unions act as a substitute for a competitive insurance market and issue actuarially fair insurance to their members. This assumption guarantees that all labour market participants are the same in the labour market and thus allows us to focus on heterogeneity that is driven by unequal asset holdings, under imperfect product and labour markets.

<sup>8</sup> See also Christiano and Eichenbaum (1992).

unemployment benefit,  $\bar{G}_t^u$ , capital income,  $r_t^k K_t^k$ , and interest income from government bonds,  $r_t^b B_t^k$ , where  $e_t^i = 1 - u_t^i$  is the per capita employment rate (with  $u_t^i$  denoting the per capita unemployment rate) and  $w_t^i$  is the gross wage rate resulting from the bargain between union  $i$  and firm  $i$ ,  $r_t^k$  is the gross return to physical capital,  $K_t^k$ , and  $r_t^b$  is the gross return to government bonds,  $B_t^k$ .<sup>9</sup> Two additional sources of income are the profits of an intermediate goods-producing firm that are distributed in the form of dividends,  $\pi_t^k$ , and average (per household) net lump-sum government transfers,  $\bar{G}_t^l$ . The entrepreneur pays taxes on consumption and on income from working and capital earnings. Thus, the budget constrain of each entrepreneur at time  $t$  is given by:

$$\begin{aligned} (1 + \tau_t^c)C_t^k + I_t^k + D_t^k &= \\ &= (1 - \tau_t^w)w_t^i e_t^i + \bar{G}_t^u (1 - e_t^i) + r_t^k K_t^k - \tau_t^k (r_t^k - \delta^p) K_t^k + r_t^b B_t^k + (1 - \tau_t^k) \pi_t^k + \bar{G}_t^l \end{aligned} \quad (3)$$

where  $0 \leq \tau_t^c < 1$  is the tax rate on consumption,  $0 \leq \tau_t^w < 1$  is the tax rate on labour income,

$0 \leq \tau_t^k < 1$  is the tax rate on income from capital earnings and dividends, and  $\delta^p \in (0, 1)$  is

the constant depreciation rate of private capital stock.<sup>10</sup>

The law of motion of private capital and government bonds are:

$$K_{t+1}^k = (1 - \delta^p)K_t^k + I_t^k, K_0^k > 0 \text{ given} \quad (4)$$

$$B_{t+1}^k = B_t^k + D_t^k, B_0^k > 0 \text{ given} \quad (5)$$

Therefore, the entrepreneur's problem is to choose  $\{C_t^k, K_{t+1}^k, B_{t+1}^k\}_{t=0}^{\infty}$  to maximize Eqs. (1) and (2) subject to Eqs. (3)-(5), taking market prices  $\{r_t^b, r_t^k, w_t^i\}_{t=0}^{\infty}$ , the employment rate  $\{e_t^i\}_{t=0}^{\infty}$ , profits  $\{\pi_t^k\}_{t=0}^{\infty}$ , policy variables  $\{\tau_t^c, \tau_t^k, \tau_t^w, \bar{G}_t^l, \bar{G}_t^u\}_{t=0}^{\infty}$ , and initial condition for  $K_0^k$  and  $B_0^k$  as given.

The first order conditions include the constraints (3)-(5) and:

$$\frac{1}{(1 + \tau_t^c)} \frac{\partial u_t(\cdot)}{\partial C_t^k} = \beta \left[ \frac{1}{(1 + \tau_{t+1}^c)} \frac{\partial u_{t+1}(\cdot)}{\partial C_{t+1}^k} \left( (1 - \tau_{t+1}^k) (r_{t+1}^k - \delta^p) + 1 \right) \right] \quad (6a)$$

<sup>9</sup> For simplicity, we do not explicitly include taxes on unemployment benefits (see Ardagna, 2007).

<sup>10</sup> We assume capital taxes net of depreciation as Angelopoulos *et al.* (2013), and that the fiscal authority cannot impose a separate tax rate on profits and on interest income from private capital, since it is difficult, in practice, to distinguish these two sources of capital income (see e.g. Guo and Lansing, 1999). Also, we assume that returns on government bonds are not taxed.

$$\frac{1}{(1+\tau_t^c)} \frac{\partial u_t(\cdot)}{\partial C_t^k} = \beta \left[ \frac{1}{(1+\tau_{t+1}^c)} \frac{\partial u_{t+1}(\cdot)}{\partial C_{t+1}^k} (1+r_{t+1}^b) \right] \quad (6b)$$

where Eqs. (6a) and (6b) are the Euler equations for  $K_{t+1}^k$  and  $B_{t+1}^k$ , respectively. The optimality conditions are completed with the transversality conditions for the two assets, namely  $\lim_{t \rightarrow \infty} \beta^t \frac{\partial u_t(\cdot)}{\partial C_t^k} K_{t+1}^k = 0$  and  $\lim_{t \rightarrow \infty} \beta^t \frac{\partial u_t(\cdot)}{\partial C_t^k} B_{t+1}^k = 0$ .

### 2.2.2 Workers

Since workers are excluded from financial markets, their within period budget constraint is simply:

$$(1+\tau_t^c)C_t^w = (1-\tau_t^w)w_t^j e_t^j + \bar{G}_t^u (1-e_t^j) + \bar{G}_t^t \quad (7)$$

The worker does not save and given that her work hours also depend on the outcome of the firm - union bargaining, optimal consumption simply follows residually from the budget constraint in (7).

## 2.3 Firms

The production environment consists of two sectors: intermediate goods and final good. We follow e.g. Guo and Lansing (1999) in allowing for monopolistic power in the intermediate goods market. Hence, these producers can earn positive economic profits even though the final good sector of the economy is perfectly competitive. As owners of intermediate goods-producing firms, entrepreneurs receive profits in the form of dividends. Also, intermediate goods producers seek to maximise profits using capital, unionised labour and the given public infrastructure.

### 2.3.1 Final good producers

A unique final good,  $Y_t$ , is produced according to the following constant returns to scale technology:

$$Y_t = \left[ \sum_{i=1}^{N^i} \lambda^i (Y_t^i)^\theta \right]^{\frac{1}{\theta}} \quad (8)$$

where  $\sum_{i=1}^{N^i} \lambda^i = 1$  are weights attached to intermediate goods producers,  $i$ , and  $\theta \in (0,1]$  implies the degree of monopoly power of intermediate goods producers.<sup>11</sup>

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<sup>11</sup> When,  $\theta = 1$ , intermediate goods are perfect substitutes in the production of the final goods implying that intermediate goods producers have no power in the product market. In this case, prices are given for these producers and thus there is perfect competition.



Final goods producers behave competitively and choose intermediate inputs,  $Y_t^i$ , to maximize profits,  $\Pi_t$ , taking the relative prices of these inputs,  $P_t^i$ , as given:<sup>12</sup>

$$\Pi_t = Y_t - \sum_{i=1}^{N^i} \lambda^i P_t^i Y_t^i \quad (9)$$

The first-order condition for this problem yields:

$$P_t^i = \left( \frac{Y_t}{Y_t^i} \right)^{1-\theta} \quad (10)$$

The above expression represents the demand function for the  $Y_t^i$  intermediate good. Our assumption that the final good sector is perfectly competitive implies  $\Pi_t = Y_t - \sum_{i=1}^{N^i} \lambda^i P_t^i Y_t^i = 0$ , that is, final good producers earn zero profits in equilibrium.

## 2.3.2 Intermediate good producers

### 2.3.2.a Right-to-Manage Union Model

In the right-to-manage bargaining setup, each intermediate firm produces a homogeneous product,  $Y_t^i$ , by choosing two productive inputs, capital,  $K_t^i$ , and workers,  $L_t^i$ , and by using average (per firm) public capital,  $\frac{K_t^g}{N^i}$ . Its production function is:<sup>13</sup>

$$Y_t^i = A (K_t^i)^{\alpha_1} (L_t^i)^{\alpha_2} \left( \frac{K_t^g}{N^i} \right)^{\alpha_3} \quad (11)$$

where  $A$  is total productivity and  $\alpha_1, \alpha_2, \alpha_3 \in (0,1)$  denote the output elasticity of private capital, labour and public capital, respectively. We assume constant returns to all three inputs and specifically  $\alpha_1 + \alpha_2 + \alpha_3 = 1$ . Hence, the profits earned by the intermediate goods producer at time  $t$  are:<sup>14</sup>

$$\pi_t^i = P_t^i Y_t^i - r_t^k K_t^i - w_t^l L_t^i \quad (12)$$

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<sup>12</sup>  $P_t^i \equiv \frac{P_t^{\text{intermediate}}}{P_t^{\text{final}}}$  Relative price

<sup>13</sup> We include public investment, and hence public capital, because we wish to have as many fiscal policy instruments as possible and to be close to the data. See e.g. Lansing (1998) for a similar production function.

<sup>14</sup>  $r_t^k, w_t^l$  are in terms of final good, i.e.  $\frac{R_t^k}{P_t^{\text{Final}}}, \frac{W_t^l}{P_t^{\text{Final}}}$

Taking factor prices,  $r_t^k$  and  $w_t^i$ , final output,  $Y_t$ , and average public capital,  $\frac{K_t^g}{N^i}$ , as given, the intermediate firm chooses  $K_t^i$  and  $L_t^i$  to maximize profits, Eq. (12), subject to its production function, Eq. (11), and the demand function for its output, given by the optimality condition of the final goods producer, Eq. (10).

The first order conditions are:

$$\theta\alpha_1 \frac{(Y_t)^{1-\theta} (Y_t^i)^\theta}{K_t^i} = r_t^k \quad (13a)$$

$$\theta\alpha_2 \frac{(Y_t)^{1-\theta} (Y_t^i)^\theta}{L_t^i} = w_t^i \quad (13b)$$

which equate factor returns to marginal products.<sup>15</sup> Then, economic profits for the intermediate sector in right-to-manage case are given by

$$\pi_t^i = (1 - \theta\alpha_1 - \theta\alpha_2)(Y_t)^{1-\theta} (Y_t^i)^\theta \quad (14)$$

### 2.3.2.b Efficient Bargaining Union Model

In the efficient bargaining union model, each intermediate firm takes also labour  $L_t^i$  as given, and chooses only  $K_t^i$  to maximize profits. We assume the same production function as in the right-to-manage case and the first order condition for this problem is Eq. (13a). For economic profits for the intermediate sector in this case see below.

## 2.4 Trade Unions

### 2.4.1 Right – to – Manage Union Model

Following the literature, we employ the right-to-manage setup where unions and firms (intermediate goods producers) bargain over the wage rate. For simplicity, we assume that each union bargains with one firm to determine the wage rate (see e.g. Pissarides, 1998). Given that we will work with a symmetric equilibrium, this assumption is not important. Moreover, for tractability, and following e.g. Domeij 2005, and Koskela and von Thadden 2008, we make two simplifying assumptions regarding this bargaining process. First, we assume that unions are small enough so that they do not internalise the effects of the wage rate on capital accumulation and thus on future prices. Second, we assume that firms are also small enough so that they do not internalise the effects of the outcome of wage bargaining on capital accumulation.

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<sup>15</sup> Notice that because  $\theta > 0$ , the factor prices  $r_t^k$  and  $w_t^i$  are less than the corresponding social marginal products  $\alpha_1 \frac{Y_t^i}{K_t^i}$  and  $\alpha_2 \frac{Y_t^i}{L_t^i}$  implied by Eq.(11).

The above assumptions imply that unions and firms take capital as given when bargaining over the wage rate. This form of myopia allows for a technical simplification in that it effectively reduces the wage-bargaining problem to a series of static problems, as in e.g. Pissarides (1998). The union and the intermediate goods producer bargain over the wage rate to maximise a weighted average of labour income and profits:<sup>16</sup>

$$U_t^N = \left[ (1 - \tau_t^w) w_t^i n^k L_t^i + \bar{G}_t^u (1 - n^k L_t^i) - \bar{G}_t^i \right]^\phi \left[ \pi_t^i + r_t^k K_t^i \right]^{1-\phi} \quad (15)$$

subject to the labour demand function given by the intermediate firm's first-order condition for labour, Eq. (13b), and the intermediate firm's product demand function, Eq. (10), taking the capital stock,  $K_t^i$ , final output,  $Y_t$ , and the fiscal policy variables,  $\{\tau_t^c, \tau_t^k, \tau_t^w, \bar{G}_t^u, \bar{G}_t^i\}$ , as given.

In the above setup,  $n^k L_t^i \equiv e_t^i$  is the average employment rate, so that  $(1 - n^k L_t^i)$  is the unemployment rate and  $\phi \in [0, 1]$  describes the relative bargaining power of the union with  $\phi = 1$  representing the monopoly union case. Note that the union targets average labour income,  $(1 - \tau_t^w) w_t^i n^k L_t^i + \bar{G}_t^u (1 - n^k L_t^i)$ , while the firm targets average profits,  $\pi_t^i$ . The outside option for the union is the unemployment benefit,  $\bar{G}_t^u$ , while for the firm it is the sunk cost of capital,  $-r_t^k K_t^i$ <sup>17</sup>, which is a consequence of the assumption that the representative firm takes the average capital accumulation as given. It is important to note that while the agents involved in Nash-bargaining over the wage rate do not internalise the effects of the wage rate on capital accumulation, consistent with e.g. Domeij 2005, and Koskela and von Thadden 2008, they do internalise the effects of the wage rate on profits, via the monopolistic demand schedule.

The first order condition is:

$$(1 - \tau_t^w) \theta \alpha_2 (Y_t)^{1-\theta} (Y_t^i)^\theta = \frac{[\phi + (1 - \phi) \alpha_2 \theta]}{\theta \alpha_2} \bar{G}_t^u L_t^i \quad (16)$$

## 2.4.2 Efficient Bargaining Union Model

Next, we employ the efficient bargaining setup where unions and firms (intermediate goods producers) bargain over the wage rate and the employment to maximise Eq. (15), subject to the intermediate firm's product demand function, Eq. (10), taking the capital stock,  $K_t^i$ , final output,  $Y_t$ , and the fiscal policy variables,  $\{\tau_t^c, \tau_t^k, \tau_t^w, \bar{G}_t^u, \bar{G}_t^i\}$ , as given.

The union's first order conditions are:

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<sup>16</sup> Total labour income:  $(1 - \tau_t^w) w_t^i N^k L_t^i + \bar{G}_t^u (N - N^k L_t^i)$ , Total profits:  $N^k \pi_t^i$

<sup>17</sup> It is the profits, if there is no agreement i.e.  $\pi_t^i|_{L_t^i=0} = -r_t^k K_t^i$

$$\frac{[\phi(1-\theta\alpha_2)+\theta\alpha_2](Y_t)^{1-\theta}(Y_t^i)^\theta}{L_t^i} = w_t^i \quad (17a)$$

$$(1-\tau_t^w)\theta\alpha_2(Y_t)^{1-\theta}(Y_t^i)^\theta = \bar{G}_t^u L_t^i \quad (17b)$$

Substituting, Eqs. (13a), and (17a), in Eq. (12), the economic profits for the intermediate sector in efficient bargaining case are given by

$$\pi_t^i = [1-\theta\alpha_1 - \theta\alpha_2 - \phi(1-\theta\alpha_2)](Y_t)^{1-\theta}(Y_t^i)^\theta \quad (18)$$

## 2.5 Government

The government issues new bonds,  $B_{t+1}$ , and taxes consumption, labour income and interest income from physical capital and profits, at the rates  $0 \leq \tau_t^c < 1$ ,  $0 \leq \tau_t^w < 1$  and  $0 \leq \tau_t^k < 1$ , respectively, to finance: (1) total unemployment benefits  $N\bar{G}_t^u(1-e_t)$ , (2) total lump-sum transfers  $N\bar{G}_t^t$ , (3) total public investment  $N\bar{G}_t^i$  (where we define  $\bar{G}_t^i$  as the per capita public investment), which augments the stock of public infrastructure providing production externalities to firms, and (4) total public consumption  $N\bar{G}_t^c$ .

The aggregate government budget constraint (GBC) is:

$$\begin{aligned} N\bar{G}_t^c + N\bar{G}_t^t + N\bar{G}_t^i + N\bar{G}_t^u(1-e_t) + (1+r_t^b)B_t &= \\ = N^k\tau_t^k(r_t^k - \delta^p)K_t^k + N^k\tau_t^k\pi_t^k + N\tau_t^w w_t^i e_t^i + N^w\tau_t^c C_t^w + N^k\tau_t^c C_t^k + B_{t+1} \end{aligned} \quad (19)$$

If we define the per capita public capital as  $\bar{k}_t^g \equiv \frac{K_t^g}{N}$ ,  $K_t^g > \text{given}$ , then its law of motion is:

$$\bar{k}_{t+1}^g = (1-\delta^g)\bar{k}_t^g + \bar{G}_t^i \quad (20)$$

where  $\delta^g \in (0,1)$  is the depreciation rate of public capital.

If we divide the aggregate GBC, Eq. (18), with the total population number,  $N$ , then we have the per capita GBC:

$$\begin{aligned} \bar{G}_t^c + \bar{G}_t^t + \bar{G}_t^i + \bar{G}_t^u(1-e_t) + (1+r_t^b)\frac{B_t}{N} &= \\ = n^k\tau_t^k(r_t^k - \delta^p)K_t^k + n^k\tau_t^k\pi_t^k + \tau_t^w w_t^i e_t^i + n^w\tau_t^c C_t^w + n^k\tau_t^c C_t^k + \frac{B_{t+1}}{N} \end{aligned} \quad (21)$$

Thus, in each period, there are eight policy instruments  $(\tau_t^c, \tau_t^k, \tau_t^w, \bar{G}_t^u, \bar{G}_t^t, \bar{G}_t^c, \bar{G}_t^i, B_{t+1})$  out of which only seven can be set independently, with

the eighth following residually to satisfy the government budget constraint. Following most of the related literature, we assume that the adjusting instrument is the government transfers, so that the other eight policy instruments can be set exogenously by the government.

For convenience, concerning spending policy instruments, we work in terms of their GDP shares, namely:

$$s_t^c \equiv \frac{N\bar{G}_t^c}{N^k Y_t^i} = \frac{\bar{G}_t^c}{n^k Y_t^i}, s_t^i \equiv \frac{N\bar{G}_t^i}{N^k Y_t^i} = \frac{\bar{G}_t^i}{n^k Y_t^i}, s_t^u \equiv \frac{\bar{G}_t^u (N - N^k L_t^i)}{N^k Y_t^i} = \frac{\bar{G}_t^u (1 - n^k L_t^i)}{n^k Y_t^i} = \frac{\bar{G}_t^u (1 - e_t)}{n^k Y_t^i}$$

and

$$s_t^t \equiv \frac{N\bar{G}_t^t}{N^k Y_t^i} = \frac{\bar{G}_t^t}{n^k Y_t^i}.$$

## 2.6 Decentralized equilibrium

We solve for a symmetric decentralized equilibrium (DE) where  $Y_t^i = Y_t$ ,  $w_t^i = w_t$ ,  $e_t^i = e_t$ ,  $u_t^i = u_t$  and  $P_t^i = 1$  for all  $i$ . Given the exogenously set policy instruments  $\{\tau_t^w, \tau_t^c, \tau_t^k, s_t^u, s_t^t, s_t^c, s_t^i\}_{t=0}^{\infty}$ , and initial conditions for the state variables,  $K_0^k$  and  $B_0^k$ , a decentralized equilibrium is defined to be an allocation  $\{Y_t^i, C_t^k, K_{t+1}^k, C_t^w, e_t, \pi_t^k, \bar{k}_{t+1}^g, r_t^b, r_t^k, w_t, B_{t+1}^k\}_{t=0}^{\infty}$  such that (i) households, firms and unions undertake their respective optimization problems outlined above; (ii) all budget constraints are satisfied; and (iii) all markets clear, where in the labour market any deviation from full employment ( $e_t = 1$ ) is voluntary (see Appendix 1 for more details). This equilibrium is for any feasible policy. The nonlinear system of dynamic equations summarizing this symmetric DE, and the associated steady state, are presented in Appendices 2 and 3 respectively. In the long run, variables remain constant. Thus,  $x_{t-1} = x_t = x_{t+1} \equiv x$ , where variables without time subscript denote long run values.

## 3 Baseline parameterization and steady state solutions

### 3.1 Parameterization

Table 1 reports the baseline parameter values for technology and preference, as well as the values of exogenous policy variables, used to solve the above models economy. The time unit is meant to be a year. Regarding parameters for technology and preference, we use relatively standard values used by the business cycle literature. Public spending and tax rate values are those of data averages of the Eurozone economy over 1990-2008. The data are obtained from OECD, Economic Outlook, no. 90.

Let us discuss, briefly, the values summarized in Table 1. The labour share in the production function of the intermediate firm,  $\alpha_2$ , is set at 0.65. The public capital share,  $\alpha_3$ , is set equal to 0.02, which is public investment as share of output in the data, see e.g. Baxter and King, 1993 for the US. Given the values of  $\alpha_2$  and  $\alpha_3$ , the

private capital share is  $\alpha_1 = 1 - \alpha_2 - \alpha_3 = 0.33$ . We normalise the productivity parameter,  $A$ , to 1. We also use common values from the literature for the intertemporal elasticity of substitution,  $1/\sigma = 0.5$  or  $\sigma = 2$  and the rate of time preference  $\beta = 0.97$ . We assume that the depreciation rate for physical capital is 10%, which is the value calculated by Angelopoulos *et al.*, (2009), and also set the same depreciation rate for public capital. Note that the depreciation rates matter for the long run value of the investment share in GDP, but have little effect on near steady-state dynamics in this class of model (see, e.g. King and Rebelo, 1999, p.954). The parameter,  $\psi$ , which measures the degree of substitutability/complementary between private and public consumption in the utility function, is set equal to 0; as Christiano and Eichenbaum (1992) explain, this means that government consumption is equivalent to a resource drain in the macro-economy. We set the share of entrepreneurs,  $n^k$ , to 0.3. This is the share of households, as calculated by Angelopoulos *et al.*, (2013), who have savings above 10,000£. We choose a value for union power,  $\phi = 0.5$ , which is in the middle of the range (i.e. 0.4 to 0.6) of values typically used in the literature, and a value for market power in the product market,  $\theta = 0.9$ , implying that profits, in equilibrium, amount to 10% of GDP.<sup>18,19</sup> The effective tax rates on consumption, capital and labour are respectively  $\tau^c = 0.1936$  (Economides *et al.*, 2012),  $\tau^k = 0.3209$  and  $\tau^w = 0.3667$  (Ardagna, 2007). The data values of output share of public spending on consumption and unemployment benefits, are respectively  $s_i^c = 0.20$ , and  $s_i^u = 0.024$ . At steady state, the public debt to output ratio,  $B^k/Y^i$ , is set at 0.60 because it has been the reference value of the initial Maastricht Treaty. Total government transfers as a share of output,  $s_i^t$ , are allowed to follow residually in the long run of the status quo economy so as to match the above mentioned spending-tax data and the public debt to output ratio.

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<sup>18</sup> See e.g. Domeij (2005) for a discussion of the relevant studies and empirical evidence.

<sup>19</sup> This value approximates the magnitude typically employed in New Keynesian models to capture the price mark-up over marginal costs. See e.g. Faccini *et al.*, (2011) for the estimated price mark-up for the UK.

<b>Table 1: Baseline parameterization</b>		
<b>Parameters and policy instruments</b>	<b>Definition</b>	<b>Value</b>
$0 \leq \beta \leq 1$	Rate of time preference	0.97
$0 \leq \alpha_1 \leq 1$	Private capital share in production	0.32
$0 \leq \alpha_2 \leq 1$	Labour share in production	0.65
$0 \leq \alpha_3 \leq 1$	Public capital share in production	0.03
$0 \leq \delta^p \leq 1$	Depreciation rate on private capital	0.10
$0 \leq \delta^g \leq 1$	Depreciation rate on public capital	0.10
$0 \leq n^k \leq 1$	Population share of entrepreneurs	0.30
$\sigma > 1$	Relative risk aversion coefficient	2
$A$	TFP level	1
$-1 \leq \psi \leq 1$	Substitutability between private and public consumption in utility	0
$0 \leq \phi \leq 1$	Union power	0.5
$0 \leq \theta \leq 1$	Product market power	0.90
$0 \leq \tau^c \leq 1$	Consumption tax rate	0.1936
$0 \leq \tau^k \leq 1$	Tax rate on capital income	0.3209
$0 \leq \tau^w \leq 1$	Tax rate on labour income	0.3667
$s_t^t$	Public transfers to output ratio	0.227
$s_t^u$	Unemployment benefits to output ratio	0.0240
$B^k / Y^i$	Public debt to output ratio	0.6
$s_t^c$	Public Consumption to output ratio	0.2041
$s_t^i$	Public Investment to output ratio	0.03

### 3.2 The steady state solutions

Given the parameter and policy values in Table 1, the steady state solutions of the two model economies are reported in Table 2. More specifically, the steady state solution for the RTM model is reported in column 1 of Table 2 and the steady state solution for the EB model is reported in column 2 of Table 2.

Notice that the solutions are well defined. For instance, the solution for the key ratios, like consumption and private investment as shares of output, as well as the replacement rate, are very close to those in the data. These steady state solutions are what we shall call the “status quo” solutions. In the next section, departing from these status quo solutions, we will study the implications of various structural reforms.

<b>Table 2: Steady State Solutions</b>		
<b>Variable</b>	<b>Right to Manage Union Model (1)</b>	<b>Efficient Bargaining Union Model (2)</b>
$C/Y$	0.5759	0.5759
$I^k/Y$	0.2041	0.2041
$K^k/Y$	2.0406	2.0406
$K^g/Y$	0.2000	0.2000
$B^k/Y$	0.6000	0.6000
$s^l$	0.1312	0.1407
$s^u$	0.0240	0.0240
$s^c$	0.2000	0.2000
$s^i$	0.0200	0.0200
$\bar{G}^u/w$	0.4675	0.4675
$\tau^w$	0.3667	0.3667
$\tau^c$	0.1936	0.1936
$\tau^k$	0.3209	0.3209
$u=1-e$	0.0807	0.0608
$W$	0.7997	1.0833
$\tilde{w}$	0.5064	0.6861
$r^k$	0.1455	0.1455
$\tilde{r}^k$	0.0309	0.0309
$C$	0.7238	0.7394
$C^k$	1.1213	0.7918
$C^w$	0.5534	0.7169
$C^k/C^w$	2.0261	1.1045
$U^k$	-0.8918	-1.2629
$U^w$	-1.8070	-1.3949
$U^{Total}$	-1.5324	-1.3553
$Y$	4.1890	4.2794
$netY^w$	0.6606	0.8557
$netY^k$	2.1932	1.8184
$netY$	3.7345	3.8150
$netY^k/netY^w$	3.3202	2.1250
$K^k$	8.5482	8.7326
$\bar{k}^g$	0.2513	0.2568



## 4. Structural reforms in product and labour markets Efficient and Bargaining versus Right-to-Manage Bargaining

This section discusses the hypothetical reforms studied and then reports numerical results.

### 4.1 Discussion of structural reforms studied

We now study various structural reforms aiming at higher flexibility in product and/or labour markets. Firstly, we start with product market liberalization, while the labour market remains unionized (both RTM and EB). To obtain the solutions of these reformed economies, we use the baseline parameterization (see Table 1) allowing the product market parameter  $\theta$  to be set at 0.95. Secondly, we go to labour market liberalization i.e. we decrease the union's power,  $\phi$ , from 0.50 in our base calibration to 0.40, for the two trade union models.<sup>20</sup> Thirdly, we consider a scenario of reforms in both the product and labour markets.

### 4.2 Results

We compare steady state solutions of product and labour market liberalization under the two trade union bargaining models: the Right- to- Manage (RTM) model and the Efficient Bargaining (EB) model. In these steady state solutions, we use the share of government transfers to output,  $s_t^t$ , as the residually determined public financing instrument.

Table 3 gives the effects of an increase in firm's power,  $\theta$ , from 0.90 to 0.95, on wages,  $w$ , employment rate,  $(1-u)$ , net income of workers,  $netY^w$ , net income of entrepreneurs,  $netY^k$ , and inequality measured by the ratio  $netY^k / netY^w$ , for the two trade union models.<sup>21</sup> Our results show that by reforming the product market towards a more competitive set up both in the RTM and the EB models, wages and employment increase, the net income of workers and entrepreneurs increase and inequality, falls.<sup>22</sup> Inequality is improved although to a lower degree in the EB model too. This is mainly due to the fact that the EB model is less distortive and closer to the competitive equilibrium and thus the benefits from product market liberalization lower.<sup>23</sup> As we notice in this table, when reforming the product market only we have beneficial results irrespectively of the labour market structure which is consistent with evidence regarding the importance of product market deregulation (Nicoletti and Scarpetta 2005, IMF 2014). On top of that product market reforms could be considered as "economic substitutes" with labour market reforms since gains in employment, wages and the income distribution are found to be larger when workers bargaining power is initially high (Fiori *et al.* 2012).

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<sup>20</sup> The firm's power in the product market remains as in the base calibration, i.e.  $\theta = 0.90$ .

<sup>21</sup> The union's power in the labour market remains as in the base calibration, i.e.  $\phi = 0.50$ .

<sup>22</sup> We have also approximated inequality with the ratio of the consumptions of the agents, i.e.  $C^k / C^w$ . However, this does not differentiate our results.

<sup>23</sup> Inequality decreased by 5.5% in the RTM model and 2.1% in the EB model.

	$\theta = 0.90$		$\theta = 0.95$	
<b>Variable</b>	<b>RTM</b>	<b>EB</b>	<b>RTM</b>	<b>EB</b>
$w$	0.7997	1.0833	0.8676 (8.5%)	1.1363 (5.3%)
$u$	0.0807	0.0608	0.0744 (-7.8%)	0.0578 (-4.9%)
$netY^w$	0.6606	0.8557	0.7047 (6.7%)	0.8892 (3.9%)
$netY^k$	2.1932	1.8184	2.2108 (0.8%)	1.8492 (1.7%)
$netY^k / netY^w$	3.3202	2.1250	3.1373 (-5.5%)	2.0796 (-2.1%)

When we opt for a labour market liberalization i.e. a decrease in union's power in the labour market,  $\phi$ , from 0.50 in our base calibration to 0.40, we observe important differences in the two models. Table 4 gives the effects of labour market reforms on wages,  $w$ , employment rate,  $(1-u)$ , net income of workers,  $netY^w$ , net income of entrepreneurs,  $netY^k$ , and inequality  $netY^k / netY^w$  for the two trade union models.<sup>24</sup> In the RTM model wages remain constant, at 0.7997 and unemployment falls from 8.07% to 7.68% while in the EB model wages decrease, from 1.0833 to 1.0266 and unemployment remains inflexible at 6.08%. In addition, in the RTM workers are better off in terms of income while this is not the case for the EB model. Capitalists are as expected better off in any case and inequality in both models remains constant or increases. Thus, when the policy makers opt for a labour market deregulation, the structure of the market matters a lot. Assuming that in the periphery of Europe trade unions so far have been mainly successful to maintain their strong position as wage setting institutions (Vogel, 2011) as in the RTM model the liberalization process of the labour market favors workers and entrepreneurs in terms of income however, at a cost of higher inequality.

Comparing the deregulation in the product market with the corresponding process in the labour market, see Tables 3 and 4, we observe that in both models liberalization of the product market is more beneficial in terms of wages, employment, income of workers, income of entrepreneurs and inequality verifying that greater competition in product markets reduces the rents available for redistribution for any type of union-firm bargaining process and thus product market reforms should be a top priority and might open the way for flexibility in the labour market too (IMF, 2005).<sup>25</sup>

<sup>24</sup> The firm's power in the product market remains as in the base calibration, i.e.  $\theta = 0.90$ .

<sup>25</sup> Wages increase by 8.5% and 5.3% in RTM and EB models respectively when the product market becomes more flexible, while remain constant and decrease by 2.7% in RTM and EB models respectively when the labour market become more competitive. Unemployment decreases by 7.8% and 4.9% in RTM and EB models respectively when the product market becomes more flexible, while decreases by 4.8% and remains constant in RTM and EB models respectively when the labour market become more competitive. Net income of workers increases by 6.7% and 3.9% in RTM and EB models respectively when the product market becomes more flexible, while increases only by 0.4% and decreases by 4.2% in RTM and EB models respectively when the labour market become more competitive.

<b>Table 4: Union power <math>\phi</math> in the labour market</b>				
	$\phi = 0.50$		$\phi = 0.40$	
<b>Variable</b>	<b>RTM</b>	<b>EB</b>	<b>RTM</b>	<b>EB</b>
$w$	0.7997	1.0833	0.7997 (0%)	1.0266 (-2.7%)
$u$	0.0807	0.0608	0.0768 (-4.8%)	0.0608 (0%)
$netY^w$	0.6606	0.8557	0.6634 (0.4%)	0.8195 (-4.2%)
$netY^k$	2.1932	1.8184	2.2025 (0.4%)	1.9028 (4.6%)
$netY^k / netY^w$	3.3202	2.1250	3.3202 (0%)	2.3218 (9.3%)

Finally, table 5 gives the impact on wages,  $w$ , employment rate,  $(1-u)$ , net income of workers,  $netY^w$ , net income of entrepreneurs,  $netY^k$ , and ratio  $netY^k / netY^w$  when both markets are liberalized. In the RTM model wages, employment and net income of workers and capitalists increase and inequality falls. One should mention here that the above results are quantitatively better than those of product market liberalization leading to a “complementarity” between the two reforms. Assuming that the RTM is the prevailing bargaining structure in the countries like Greece, Italy, Spain, Portugal we verify the importance of both markets liberalization for all agents. However, this is not the case in the EB model. Here, wages and unemployment fall, the income of workers slightly decrease and those of entrepreneurs increase, inequality increases and thus complementarity does not hold.<sup>26</sup> In other words, before the implementation of structural reforms in both markets policy makers should carefully examine the structure of the union bargaining system.

<b>Table 5: Union power <math>\phi</math> in the labour market and firm power <math>\theta</math> in the product market</b>				
	$\phi = 0.50$ and $\theta = 0.90$		$\phi = 0.40$ and $\theta = 0.95$	
<b>Variable</b>	<b>RTM</b>	<b>EB</b>	<b>RTM</b>	<b>EB</b>
$w$	0.7997	1.0833	0.8676 (8.5%)	1.0826 (-0.06%)
$u$	0.0807	0.0608	0.0711 (-11.9%)	0.0578 (-4.9%)
$netY^w$	0.6606	0.8557	0.7072 (7.1%)	0.8549 (-0.01%)
$netY^k$	2.1932	1.8184	2.2186 (1.2%)	1.9295 (6.1%)
$netY^k / netY^w$	3.3202	2.1250	3.1373 (-5.5%)	2.2571 (6.2%)

<sup>26</sup> Similar results we get when we measure utilities.

To summarise, we verify that product market deregulation is favourable under any labour market structure and in countries like Greece, Italy, Spain, Portugal can be considered as “economic substitute” with labour market reforms. Opting for labour market deregulation only the structure of the market is of crucial importance. Comparing a deregulation in the product market with the corresponding process in the labour market we verify that product market flexibility can be considered as top priority under any bargaining set up. Finally, flexibility in both markets in countries with a bargaining system like the RTM can benefit both agents.

## **5. Conclusions**

In this paper, we compare product and labour market liberalization under the two trade union bargaining models: the Right- to- Manage (RTM) model and the Efficient Bargaining (EB) model. The vehicle is the rather standard dynamic general equilibrium (DGE) model that incorporates heterogeneous agents (entrepreneurs and workers) and imperfectly competitive product and labour markets. We verify the importance of product market deregulation since it is beneficial for wages, employment and income distribution under any labour market bargaining process. On the contrary, a policy maker opting for a liberalisation of the labour market should pay special attention to the structure of the labour market since the benefits strongly depend on the degree of rigidity of the market. Possible extension include: a short run analysis focusing on the gains or losses of the agents during the transition period, other forms of rigidities in the labour market such as employment protection legislation and unemployment benefits, and finally treatment of the rigidities in the two markets in an endogenous way.

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## APPENDICES

### Appendix 1: Market clearing conditions

The market clearing conditions for capital, government bonds and dividends are respectively:

$$\sum_{k=1}^{N^k} K_t^k = \sum_{i=1}^{N^i} K_t^i \Rightarrow N^k K_t^k = N^i K_t^i \xrightarrow{N^k=N^i} K_t^k = K_t^i \quad (\text{A.1a})$$

$$\sum_{k=1}^{N^k} \pi_t^k = \sum_{i=1}^{N^i} \pi_t^i \Rightarrow N^k \pi_t^k = N^i \pi_t^i \xrightarrow{N^k=N^i} \pi_t^k = \pi_t^i \quad (\text{A.1b})$$

$$B_{t+1} = \sum_{k=1}^{N^k} B_{t+1}^k \Rightarrow B_{t+1} = N^k B_{t+1}^k \quad (\text{A.1c})$$

$$\begin{aligned} \sum_{j=1}^{N^k+N^w} e_t^j &= \sum_{i=1}^{N^i} L_t^i \Rightarrow (N^k + N^w) e_t^j = N^i L_t^i \Rightarrow \\ \frac{(N^k + N^w) e_t^j}{N} &= \frac{N^i L_t^i}{N} \xrightarrow{N^k=N^i, N^k+N^w=N} \frac{N e_t^j}{N} = \frac{N^k L_t^i}{N} \Rightarrow e_t^j \equiv e_t^i = n^k L_t^i \end{aligned} \quad (\text{A.1d})$$

Finally, in the goods market, the economy's per capita resource constraint is:

$$n^k Y_t^{1-\theta} (Y_t^i)^\theta = n^k C_t^k + n^w C_t^w + n^k [K_{t+1}^k - (1-\delta^p) K_t^k] + \bar{G}_t^c + \bar{G}_t^i \quad (\text{A.1e})$$

### Appendix 2: The Decentralized Equilibrium

#### Appendix 2.1: The Decentralized Equilibrium in Right - to - Manage Union Model

In RTM case the DE consists of the following equations:<sup>27</sup>

The entrepreneur's Euler condition with respect to private capital:

$$\frac{(1 + \tau_{t+1}^c) (C_{t+1}^k + \psi s_{t+1}^c n^k Y_{t+1}^i)^\sigma}{(1 + \tau_t^c) (C_t^k + \psi s_t^c n^k Y_t^i)^\sigma} = \beta \left[ 1 + (1 - \tau_{t+1}^k) (r_{t+1}^k - \delta^p) \right] \quad (\text{A.2.1a})$$

The equality of net returns of private capital and bonds:

$$r_{t+1}^b = (1 - \tau_{t+1}^k) (r_{t+1}^k - \delta^p) \quad (\text{A.2.1b})$$

<sup>27</sup> Note that relying on Walras's law, we drop the budget constraint of the entrepreneur from the DE.



The worker's budget constraint:

$$(1 + \tau_t^c)C_t^w = (1 - \tau_t^w)w_t e_t + s_t^u n^k Y_t^i + s_t^t n^k Y_t^i \quad (\text{A.2.1c})$$

The intermediate firm's first order condition for labour:

$$\theta \alpha_2 \frac{n^k Y_t^i}{e_t} = w_t \quad (\text{A.2.1d})$$

The intermediate firm's first order condition for private capital:

$$\theta \alpha_1 \frac{Y_t^i}{K_t^k} = r_t^k \quad (\text{A.2.1e})$$

The profit function of the intermediate firm:

$$\pi_t^k = (1 - \theta \alpha_1 - \theta \alpha_2) Y_t^i \quad (\text{A.2.1f})$$

The production function of the intermediate firm:

$$n^k Y_t^i = A (n^k K_t^k)^{\alpha_1} (e_t)^{\alpha_2} (\bar{k}_t^g)^{\alpha_3} \quad (\text{A.2.1g})$$

The union's optimality condition for the wage rate:

$$(1 - \tau_t^w) \theta \alpha_2 = \frac{[\phi + (1 - \phi) \alpha_2 \theta]}{\theta \alpha_2} \frac{s_t^u e_t}{1 - e_t} \quad (\text{A.2.1h})$$

The Government's Budget Constraint (GBC):

$$\begin{aligned} (s_t^c + s_t^t + s_t^i + s_t^u) n^k Y_t^i + n^k (1 + r_t^b) B_t^k &= \\ = n^k \tau_t^k (r_t^k - \delta^p) K_t^k + n^k \tau_t^k \pi_t^k + \tau_t^w w_t e_t + n^w \tau_t^c C_t^w + n^k \tau_t^c C_t^k + n^k B_{t+1}^k \end{aligned} \quad (\text{A.2.1i})$$

The law of motion of public capital:

$$\bar{k}_{t+1}^g = (1 - \delta^g) \bar{k}_t^g + s_t^i n^k Y_t^i \quad (\text{A.2.1j})$$

The resource constraint of the economy:

$$n^k Y_t^i = n^k C_t^k + n^w C_t^w + n^k [K_{t+1}^k - (1 - \delta^p) K_t^k] + s_t^c n^k Y_t^i + s_t^i n^k Y_t^i \quad (\text{A.2.1k})$$

Therefore, the DE is a system of eleven non-linear difference equations in the paths of  $Y_t^i, C_t^k, K_{t+1}^k, C_t^w, e_t, \pi_t^k, \bar{k}_{t+1}^g, r_t^b, r_t^k, w_t, s^t$ . This equilibrium is given the paths of the other seven tax-spending policy instruments  $\tau_t^w, \tau_t^c, \tau_t^k, s_t^u, s_t^c, s_t^i, B_{t+1}^k$ .

## Appendix 2.2: The Decentralized Equilibrium in Efficient Bargaining Union Model

In EB case the DE consists of the following equations:

The entrepreneur's Euler equation with respect to private capital:

$$\frac{(1 + \tau_{t+1}^c)(C_{t+1}^k + \psi s_{t+1}^c n^k Y_{t+1}^i)^\sigma}{(1 + \tau_t^c)(C_t^k + \psi s_t^c n^k Y_t^i)^\sigma} = \beta \left[ 1 + (1 - \tau_{t+1}^k)(r_{t+1}^k - \delta^p) \right] \quad (\text{A.2.2a})$$

The equality of net returns of private capital and bonds:

$$r_{t+1}^b = (1 - \tau_{t+1}^k)(r_{t+1}^k - \delta^p) \quad (\text{A.2.2b})$$

The worker's budget constraint:

$$(1 + \tau_t^c)C_t^w = (1 - \tau_t^w)w_t e_t + s_t^u n^k Y_t^i + s_t^l n^k Y_t^i \quad (\text{A.2.2c})$$

The intermediate firm's first order condition for private capital:

$$\theta \alpha_1 \frac{Y_t^i}{K_t^k} = r_t^k \quad (\text{A.2.2d})$$

The profit function of the intermediate firm:

$$\pi_t^k = \left[ 1 - \theta \alpha_1 - \theta \alpha_2 - \phi(1 - \theta \alpha_2) \right] Y_t^i \quad (\text{A.2.2e})$$

The production function of the intermediate firm:

$$n^k Y_t^i = A (n^k K_t^k)^{\alpha_1} (e_t)^{\alpha_2} (\bar{k}_t^g)^{\alpha_3} \quad (\text{A.2.2f})$$

The union's optimality condition for the wage rate:

$$\frac{[\phi(1 - \theta \alpha_2) + \theta \alpha_2] n^k Y_t^i}{e_t} = w_t \quad (\text{A.2.2g})$$

The contract curve:

$$(1 - \tau_t^w) \theta \alpha_2 = \frac{s_t^u e_t}{1 - e_t} \quad (\text{A.2.2h})$$

The Government's Budget Constraint (GBC):

$$\begin{aligned}
& (s_t^c + s_t^t + s_t^i + s_t^u) n^k Y_t^i + n^k (1 + r_t^b) B_t^k = \\
& = n^k \tau_t^k (r_t^k - \delta^p) K_t^k + n^k \tau_t^k \pi_t^k + \tau_t^w w_t e_t + n^w \tau_t^c C_t^w + n^k \tau_t^c C_t^k + n^k B_{t+1}^k
\end{aligned} \tag{A.2.2i}$$

The law of motion of public capital:

$$\bar{k}_{t+1}^g = (1 - \delta^g) \bar{k}_t^g + s_t^i n^k Y_t^i \tag{A.2.2j}$$

The resource constraint of the economy:

$$n^k Y_t^i = n^k C_t^k + n^w C_t^w + n^k [K_{t+1}^k - (1 - \delta^p) K_t^k] + s_t^c n^k Y_t^i + s_t^i n^k Y_t^i \tag{A.2.2k}$$

Therefore, the DE is a system of eleven non-linear difference equations in the paths of  $Y_t^i, C_t^k, K_{t+1}^k, C_t^w, e_t, \pi_t^k, \bar{k}_{t+1}^g, r_t^b, r_t^k, w_t, s_t^t$ . This equilibrium is given the paths of the other seven tax-spending policy instruments  $\tau_t^w, \tau_t^c, \tau_t^k, s_t^u, s_t^c, s_t^i, B_{t+1}^k$ .

### Appendix 3: The Steady State

#### Appendix 3.1: The Steady State in Right - to - Manage Union Model

The DE system of equations for the RTM case in the long run is:

$$1 = \beta [1 + (1 - \tau^k)(r^k - \delta^p)] \tag{A.3.1a}$$

$$r^b = (1 - \tau^k)(r^k - \delta^p) \tag{A.3.1b}$$

$$(1 + \tau^c) C^w = (1 - \tau^w) w e + (s^u + s^t) n^k Y^i \tag{A.3.1c}$$

$$\theta \alpha_2 \frac{n^k Y^i}{e} = w \tag{A.3.1d}$$

$$\theta \alpha_1 \frac{Y^i}{K^k} = r^k \tag{A.3.1e}$$

$$\pi^k = (1 - \theta \alpha_1 - \theta \alpha_2) Y^i \tag{A.3.1f}$$

$$n^k Y^i = A (n^k K^k)^{\alpha_1} e^{\alpha_2} (\bar{k}^g)^{\alpha_3} \tag{A.3.1g}$$

$$(1 - \tau^w) \theta \alpha_2 = \frac{[\phi + (1 - \phi) \alpha_2 \theta]}{\theta \alpha_2} \frac{s^u e}{1 - e} \tag{A.3.1h}$$

$$\begin{aligned} & (s^c + s^t + s^i + s^u) n^k Y^i + n^k r^b B^k = \\ & = n^k \tau^k (r^k - \delta^p) K^k + n^k \tau^k \pi^k + \tau^w w e + n^w \tau^c C^w + n^k \tau^c C^k \end{aligned} \quad (\text{A.3.1i})$$

$$\delta^g \bar{k}^g = s^i n^k Y^i \quad (\text{A.3.1j})$$

$$(1 - s^c - s^i) n^k Y^i = n^k C^k + n^w C^w + n^k \delta^p K^k \quad (\text{A.3.1k})$$

Which is a system of 11 equations in  $K^k, \bar{k}^g, \pi^k, e, C^k, C^w, r^b, r^k, w, Y^i, s^t$

### Appendix 3.2: The Steady State in Efficient Bargaining Union Model

The DE system of equations for the EB case in the long run is:<sup>28</sup>

$$1 = \beta \left[ 1 + (1 - \tau^k)(r^k - \delta^p) \right] \quad (\text{A.3.2a})$$

$$r^b = (1 - \tau^k)(r^k - \delta^p) \quad (\text{A.3.2b})$$

$$(1 + \tau^c) C^w = (1 - \tau^w) w e + (s^u + s^t) n^k Y^i \quad (\text{A.3.2c})$$

$$\theta \alpha_1 \frac{Y^i}{K^k} = r^k \quad (\text{A.3.2d})$$

$$\pi^k = \left[ 1 - \theta \alpha_1 - \theta \alpha_2 - \phi(1 - \theta \alpha_2) \right] Y^i \quad (\text{A.3.2e})$$

$$n^k Y^i = A (n^k K^k)^{\alpha_1} e^{\alpha_2} (\bar{k}^g)^{\alpha_3} \quad (\text{A.3.2f})$$

$$\frac{\left[ \phi(1 - \theta \alpha_2) + \theta \alpha_2 \right] n^k Y^i}{e} = w \quad (\text{A.3.2g})$$

$$(1 - \tau^w) \theta \alpha_2 = \frac{s^u e}{1 - e} \quad (\text{A.3.2h})$$

$$\begin{aligned} & (s^c + s^t + s^i + s^u) n^k Y^i + n^k r^b B^k = \\ & = n^k \tau^k (r^k - \delta^p) K^k + n^k \tau^k \pi^k + \tau^w w e + n^w \tau^c C^w + n^k \tau^c C^k \end{aligned} \quad (\text{A.3.2i})$$

$$\delta^g \bar{k}^g = s^i n^k Y^i \quad (\text{A.3.2j})$$

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<sup>28</sup> For  $\frac{\pi^k}{Y^i} > 0$ , we need  $\phi < 1 - \frac{\theta \alpha_1}{1 - \theta \alpha_2}$ .

$$(1 - s^c - s^i) n^k Y^i = n^k C^k + n^w C^w + n^k \delta^p K^k \quad (\text{A.3.2k})$$

Which is a system of 11 equations in  $K^k, \bar{k}^g, \pi^k, e, C^k, C^w, r^b, r^k, w, Y^i, s^t$ .