Trade integration, tax policies and labour market regimes

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Abstract

We introduce a minimum wage policy into a model of tax competition with imperfect competition and imperfect trade integration. We adopt a game-theoretic approach where governments choose non-cooperatively in the first stage the labour market regime (perfect competition or regulation through minimum wage) and in a second stage their tax policy. In a third stage, each firm chooses its location. Firstly, we show that the implementation of a minimum wage in both countries strengthens tax competition as compared with the case where both labour markets are competitive. Secondly, we show that the adoption of a minimum wage in only one country results in lower corporate taxation in this country. Finally, for a low enough level of minimum wage, the Nash-Pareto equilibrium is defined by the asymmetric scenario where one country adopts a minimum wage and the other one a competitive labour market. Above a given level of minimum wage, both countries adopt a competitive labour market at the Nash equilibrium but they would be better off if they had a different legislation.

Keywords: Tax competition, unemployment, location of firms, labour market regime.

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1 Introduction

Persistent unemployment can be considered as one of the major reasons why governments use their tax policy to attract firms. Unemployment would intensify tax competition in the sense that government would be more prompted to cut corporate taxes in order to protect or create jobs. The aim of our paper is to investigate the relationship between unemployment and tax competition with a particular focus on the role played by trade integration in this relationship.

Only few papers analyze the relationship between unemployment and tax competition despite the relevance of this issue. Ogawa et al. (2006) extend the model of Zodrow and Mieszkowski (1986) by introducing unemployment caused by a minimum wage. They show that if labour and capital are substitutes (resp. complements) so that a capital inflow reduces (resp. increases) the labour demand of firms, then governments choose a positive (resp. negative) capital tax to protect jobs provided that they can use a head tax on residents. Boadway, Cuff and Marceau (2004) assume a frictional unemployment, with economies of scale in the matching technology on the labour market. Moreover, they assume scale economies from production in the good market. These localization economies will affect the behavior of governments. They show that because of agglomeration economies in production, tax competition leads to inefficient levels of subsidies to firms which generally results in an inefficient spatial distribution of firms.

To summarize, these models emphasize that capital mobility fosters the links between the labour market outcomes and the tax policies. However, they ignore an other important channel of economic integration which could play an important role in this relationship, that is trade integration. With economic geography frameworks, Ludema and Wooton (2000), Baldwin and Krugman (2004), Ottaviano and Van Ypersele (2005), among others, have shown that trade integration, by affecting location incentives, can significantly affect tax policies. Nevertheless, all these papers assumes perfectly competitive labour markets and do not tackle the relationship between unemployment and tax competition. Moreover, it seems interesting to look at the the possible implications of this relationship on the labour market policies. Implications with respect to fiscal regime have been analyzed by Fuest and Huber (1999) who focus on the welfare effect of tax coordination in presence of unemployment caused by a wage bargaining process. They show that when governments take into account the effect of their fiscal policy on the labour market outcome, the welfare would be improved by a coordinated increase (resp. reduction) in the capital tax and the labour tax provided that the wage elasticity of labour demand is smaller (resp. greater) than one. However, to our knowledge, there is no paper analyzing how the tax policy outcomes can lead governments to adopt a more or less flexible labour market regime. In other terms, it seems important to assume that the degree of the public intervention on the labour market is not totally disconnected from the tax policy. This is a question that we investigate in this paper.
We develop a partial equilibrium model of tax competition between two countries. The private sector is characterized by oligopolistic competition, increasing returns and trade costs. Each national labour market is composed by mobile firms and immobile workers with an endogenous labour supply. Governments have two tax instruments: a unit tax on workers and a unit tax on profits made by firms. They also provide unemployment benefits. We adopt a game-theoretic approach where governments choose non-cooperatively the labour market regime (perfect competition or regulation through minimum wage) in the first stage and in the second stage the tax policy. In the third stage, each firm chooses its location.

Our main results can be summarized as follows. Firstly, we show that the implementation of a minimum wage rate in both countries strengthens tax competition as compared with the case where both labour markets are competitive. Hence, workers become the net-contributors of the public sector at an earlier stage of trade integration when both countries adopt a minimum wage. Secondly, we show that the adoption of a minimum wage in only one country results in lower corporate taxation in this country and the resulting tax gap is fostered (resp. reduced) by trade integration when the minimum wage is high (resp. low) enough. Moreover, a majority of firms locate in the country with unemployment when the minimum wage is low enough, despite the resulting weak fiscal advantage of this country. Finally, we show that the labour market regime chosen by governments at the Nash equilibrium depends on the minimum wage level. For a low enough level of minimum wage, the Nash-Pareto equilibrium is defined by the asymmetric scenario where one country adopts a minimum wage and the other one a competitive labour market. Above a given level of minimum wage, both countries adopt a competitive labour market at the Nash equilibrium but this situation is not Pareto-optimal because both countries would be better off if they had a different labour market regime.

The rest of the paper is organized as follows. The model is developed in the next section. From section 3 to section 5, we determine the fiscal policy choices of benevolent governments and their impact on the location of activities, considering as given the following labour market regimes: when both labour markets are competitive, when they are regulated through a minimum wage giving rise to unemployment, and when the labour market is competitive in one country while there is a minimum wage in the other one. Section 6 gives the labour market regime choice made by governments. The last section concludes.

2 Model

Our model is built on the economic geography framework of Ludema and Wooton (2000). We consider an economy made of two countries, labelled \(i = 1, 2\) with three types of actors: residents/workers, firms and national governments.

Each country is equally populated by \(L\) residents/workers who can be employed or
not in the single private sector of their country. There is a fixed number of $n$ firms in this sector which are assumed to be quantity setting (Cournot) oligopolists. They produce a homogeneous manufacturing product under increasing returns to scale, imperfect competition and trade costs. For a firm located in country $i$, the production of the manufactured good requires a fixed amount $f$ of labour units. Thus, for simplicity, the marginal cost of production is constant and equal to zero. Therefore, firms have a market power and will earn positive profits which will be taxed by governments at the rate $t_i$ on the source principle. To finish each firm incurs a unitary cost of $\tau$ to ship its good on the foreign market and choose to locate where they can earn the highest level of net profits.

Workers are immobile between countries, but the individual labour supply is endogenously determined. Moreover, each resident is endowed with an identical initial saving and owns an equal share of the total number of firms so that all the positive profits are equally distributed $^1$.

Finally, governments are benevolent and seek to maximize the total welfare of their residents by levying a per-unit tax on firms ($t_i$) and workers ($\rho_i$).

2.1 Private sector outcome

2.1.1 Consumption

Residents in country $i = 1, 2$ have the following quasi-linear utility function:

$$u_i = \left( a - \frac{x_i^d}{2} \right) x_i^d + z - \frac{\eta}{2} \left( t_i^s \right)^2$$

with $a > 0$. $x_i^d$ and $z$ are respectively the individual consumption level of the manufacturing good and a saving component. The individual labour supply is given by $l_i^s$, so that the last term of the right-hand-side denotes the desutility of labour, with the preference for leisure given by $\eta > 0$.

The budget constraint of a resident of country $i$ is:

$$y_i = x_i^d p_i + z$$

where $y_i$ is its net income given by

$$y_i = \bar{z} + w_i l_i^s + \frac{\pi_i n_i + \pi_j n_j}{L} - \rho_i$$ \text{if employed}$$

$$y_i = \bar{z} + \frac{\pi_i n_i + \pi_j n_j}{L} + T_i$$ \text{if unemployed}$$

with $\bar{z}$ the initial saving, $w_i$ the national wage rate of each labour unit, $\pi_i$ is the net profit made by firms located in country $i$ and $n_i$ the number of firms located in this country. Thus, $(\pi_i n_i + \pi_j n_j) / L$ denotes the income of each resident from firms’ ownership, while

$^1$Hence, we follow the same assumption as models of tax competition and unemployment (Ogawa et al., 2006, Sato, 2004) which assume that residents own the same share of capital, whatever their status on the labour market.
$w_i l_i^t$ is its income from labour. $p_i$ is then the labour income tax levied in country $i$ whose unemployed people are exonerated. Finally, $T_i$ is the unemployment benefits.

Inserting this budget constraint in the utility function and maximizing the resulting expression with respect to $x^d$ yields the following individual demand for manufactured goods in country $i$

$$x^d_i = a - p_i$$

with $p_i$ the price of the manufactured good in country $i$, so that the total demand for this good in this country is

$$X_i^d = (a - p_i) L$$

(4)

2.1.2 Production

The operating profits of firms located in country $i$ are given by

$$\Pi_i = p_i x_{ii} L + (p_j - \tau) x_{ij} L$$

(5)

where $x_{ii}$ is the quantity that a firm located in country $i$ supplies to domestic consumers and $x_{ij}$ is the quantity it sells to foreign consumers, $\tau$ being the unitary cost incurred by the firm to ship its good abroad. Thus, its net profits after taxation are given by:

$$\pi_i = \Pi_i - t_i - f w_i$$

(6)

where $t_i$ is the corporate tax imposed by the national government on the source principle. Maximizing (6) with respect to $x_{ii}$ and $x_{ij}$ yields the following quantity choices at the equilibrium:

$$x^*_i = L p_i$$

$$x^*_j = L (p_j - \tau)$$

(7)

Thus, the supply to the domestic market exclusively depends on the market size (constant in both countries) and on the price at which goods are sold in each market. Additionally, the supply to the foreign market decreases with the level of barriers to trade.

Finally, the market-clearing condition of the manufacturing sector requires that $X_i^d = n_i x_{ii} + n_j x_{ji}$. Imposing this condition on expressions (4) and (7) gives the equilibrium price in country $i$

$$p^*_i = \frac{a + \tau n_j}{1 + n}$$

(8)

where $n_i = \lambda_i n$ so that $\lambda_i = n_i/n$ is the share of firms located in country $i$. We make the assumption that the trade cost is non-prohibitive so that prices net of trade costs are positive whatever the spatial distribution of firms:

$$\tau < \tau_{trade} = \frac{a}{1 + n}$$

Moreover, the price level in country $i$ increases with barriers to trade because the local firms are more protected against foreign competition.
2.2 Labor market outcome

Now let us describe the labour market outcome. Observe that firms are mobile whereas workers are not. Thus, the labour market outcome is determined at the national level but national labour markets are interdependent through firms’ location choices. Moreover, there are two possible outcomes in each country, depending on whether the labour market is competitive or not.

2.2.1 Competitive labour market

Consider first that the labour market is competitive. The total demand of labour units, which depends on the requirement of labour and the number of firms, is given by $L_i^d = fn_i$. Now let us give the total labour supply. By inserting the budget constraint (2) in the resident’s utility function (1) and maximizing the resulting expression with respect to $l_i^s$, we get the following individual labour supply at the equilibrium in country $i$

\[ l_i^s = w_i / \eta \]  

so that the total supply of labour units is $L_i^s = Lw_i / \eta$.

Hence, the equilibrium wage permitting full-employment in country $i$ is given by the labour market clearing condition, which requires that total labour supply in this country equals total labour demand

\[ l_i^s L = fn_i \]  

Inserting (9) in (10) yields the following wage rate equilibrium in country $i$:

\[ w_i^* = \frac{fn_i}{L} \]  

Clearly, the competitive wage in a country is an increasing function of the number of firms located here and a decreasing function of the number of workers. This wage also increases with the labour requirement to produce the manufactured good and with the preference for leisure.

2.2.2 Minimum wage

Now consider that there is a wage rigidity because governments implement a minimum wage policy with a minimum threshold level $\omega$ higher than the competitive wage rate $w_i^*$ which would occur without this policy. This modelling assumption has for consequence to create unemployment. Precisely, the mass of employed workers is

\[ L_i^e = \frac{L_i^d}{l_i^s} = \frac{fn_i \eta}{\omega} \]

while the mass of unemployed workers is

\[ L_i^u = L - L_i^d / l_i^s \]  

(12)
Thus, the rate of unemployment increases with the minimum wage rate, while it decreases with the number of firms, the fixed requirement of labour and the preference for leisure.

2.3 Sequence of events

In this economy, the sequence of events consists of four stages. In the first stage, each government simultaneously and non-cooperatively chooses its labour market regime. Precisely, the public authorities have to choose if they impose a regulation through a minimum wage or promote a free labour market. In a second stage each government decides the level of its per-unit tax on labour and firms, taking as given the decision of the other government, and anticipating the resulting location equilibrium and private sector outcome. In the third stage, firms choose their place of production given the fiscal policy choices announced by the governments and anticipating the private sector outcome. In the last stage, firms and residents make their production, consumption and labour allocation choices, respectively, taking as given the level of taxes chosen by governments.

All players have a perfect information and the game is solved by a sub-game perfect equilibrium involving backward induction beginning with the last stage. To solve the first stage where each government set its labour market regime, we will have to solve the second and third stages in three different cases. First, we will study as a benchmark case the outcome when both labour markets are competitive. After that, we will assume that each national government implements a minimum wage policy giving rise to unemployment. Finally, we will analyze the outcome when the labour market is competitive in one country while there is a minimum wage in the other one.

3 Competitive labour market in both countries

In what follow, we solve stages 2 and 3 by assuming a competitive labour market.

3.1 Stage 3: Location for given taxes

The location of firms is governed by the spatial difference in net profits (6), in which we have introduced firms’ equilibrium quantities (7) and the resulting prices (8). In what follows, we focus on the most realistic case of an interior outcome where mobile activities are not fully agglomerated in a country.

Let \( \lambda \) denote the share of firms located in country 1, so that \( n_1 = \lambda n \) and \( n_2 = (1-\lambda)n \). A spatial equilibrium \( \lambda^* \) is such that no firm has an incentive to change location, conditional upon the fact that the product market clears at the equilibrium prices (8) and that labour markets clear at the equilibrium wages (11). Formally in the case where both labour markets are competitive, an interior equilibrium arises at \( \lambda^{cc} \in (0, 1) \) when

\[
\Delta \pi (\lambda) = (\Pi_1(\lambda) - t_1 - f w_1(\lambda)) - (\Pi_2(\lambda) - t_2 - f w_2(\lambda)) = 0
\]  

(13)
Such an equilibrium always exists because $\Delta \pi (\lambda)$ is a continuous function of $\lambda$. Solving (13) with respect to $\lambda$ gives the interior location equilibrium:

$$\lambda^{cc} = \frac{1}{2} - \frac{L (1 + n) (t_1 - t_2)}{2n (2L^2 + \eta f^2 (1 + n))}$$

(14)

Before going further, observe that the location equilibrium is mainly the result of two dispersion forces. The first one is standard and known as a "price competition effect". When a country hosts new firms, existing domestic firms face more competitors in their domestic market and fewer in the foreign market. Thus, from (8) it comes that the domestic price falls while the foreign one rises. Finally, as domestic sales generate more revenues than foreign sales because of the trade cost (see equ. 7), this competition effect acts as a dispersion force. The other dispersion force basically results from the pressure on the labour cost that agglomeration of firms induces on the labour market. Therefore, the single force being able to lead a country to host more firms than the other one is related to a tax advantage. Formally, a unilateral rise of the per-unit tax on firms in a country leads to a tax-base erosion effect, that is an outflow of firms from this country ($d\lambda^{cc}_i / dt_i < 0$). Moreover, the fall of trade costs exacerbates the sensitivity of firms’ location choice with respect to corporate taxes since $d^2\lambda^{cc}_i / dt_i d\tau > 0$. Thus, trade integration leads firms to become more and more sensitive to the fiscal policy rather than to the market forces.

Finally, observe that $d^2\lambda^{cc}_i / dt_i df > 0$. The sensitivity of the location choices to tax variations is weakened by the labour input requirement. To see the intuition, assume that country $i$ decreases its tax and that the technology of production requires a large amount of labour. In this case, the direct attractiveness effect of lower taxation will be largely weakened by the wage rise following the inflow of firms. In other words, the labour market counteracts the attractiveness effect of a tax cut through the upwards adjustment of the wage rate induced by the inflow of firms.

### 3.2 Stage 2: Nash tax equilibrium

In the first stage, governments choose simultaneously and non-cooperatively their lump-sum tax on workers ($\rho_i$) and on firms ($t_i$), anticipating the impact of their choices on the location and production decisions of firms and on consumption and labour supply decisions of residents.

We assume benevolent governments. Thus, each government maximizes the aggregate welfare of its residents:

$$W^c_i = \underbrace{L S_i}_\text{Consumers’ surplus} + \underbrace{\pi_i \lambda_i n + \pi_j \lambda_j n}_{\text{Net income from firm ownership}} + \underbrace{(w_i l_i^s - \rho_i) L}_{\text{Net income from labour}} - \underbrace{\frac{n}{2} (l_i^s)^2 L}_{\text{Desutility from labour}}$$

(15)

where $S_i$ denotes the consumer’s surplus given by

$$S_i^c = \frac{(a - p_i^s)^2}{2} = \frac{(an - \tau n_j)^2}{2(1 + n)^2}$$
Thus the national welfare is the sum of four components: the total consumers’ surplus \( (LS_i) \), residents’ income from firm ownership \( (\pi_i\lambda_i n + \pi_j\lambda_j n/2) \), the net income of workers \( ((w_i l_i^* - \rho_i)L_i) \), and their desutility from labour \( (-\eta (l_i^*)^2 L/2) \).

So as to abstract from the efficiency considerations of public goods provisions, we follow Persson and Tabellini (1992), Ludema and Wooton (2000) and Ottaviano and Van Ypersele (2005) by assuming that taxes exist only to redistribute income, that is:

\[
-\rho_i L = t_in_i
\]

Before proceeding further with the analysis, we can isolate how each component of the aggregate welfare react in response to a tax variation. Let first consider the effect of a variation of the corporate tax on domestic consumers’ surplus. By inserting the price equilibrium in the consumers’ surplus, we can easily show that in order to favour the decline of the price equilibrium in their domestic market and thus to increase the domestic consumers’ surplus, each government has the incentives to attenuate its taxation of firms. Formally, we get

\[
\frac{dS_i^* (\lambda^* (t_i, t_j))}{dt_i} < 0
\]

We can now evaluate the effect of the tax policy on the total income from firms’ ownership. Because, from the location stage we know that \( \pi_1 = \pi_2 \) at the spatial equilibrium, we have

\[
\pi_T = \frac{\pi_i\lambda_i n + \pi_j\lambda_j n}{2} = \frac{\pi_i n}{2}
\]

Hence,

\[
\frac{d\pi_T}{dt_i} = \left( \frac{d\Pi_i (\lambda^* (t_i, t_j))}{dt_i} - 1 - f \frac{dw_i (\lambda^* (t_i, t_j))}{dt_i} \right) \frac{n}{2}
\]

This term encapsulates three effects. Firstly, by inducing less competition among firms, a positive tax variation in a country has a positive effect on the operating profits. Secondly, an increase in \( t_i \) has a direct negative effect on the net profit. Finally, a positive variation of tax decreases the wage pressures and the labour cost. As a result, the net effect of a unilateral increase in tax on profits seems ambiguous. However, it can be easily shown that for initially harmonized taxation of firms among countries, a sudden rise of \( t_i \) has a negative net effect leading to an erosion of the income from firms ownership.

Now, we can investigate the effect of the tax policy on the labour market component of the welfare equation, that is the after-tax labour incomes and desutility of labour. After substitutions and simplifications, we get
\[
\frac{d(w_i t_i^*) L}{d t_i} + \frac{d(t_i \lambda^* n)}{d t_i} - \frac{\eta}{2} L \frac{d((t_i^*)^2)}{d t_i} = f^2 \eta n^2 \frac{d(\lambda^* (t_i, t_j))}{d t_i} + t_i \frac{d\lambda^* (t_i, t_j)}{d t_i} + \lambda^* n - \left(\frac{1}{2} f^2 \eta n^2 \frac{d(\lambda^* (t_i, t_j))}{d t_i}\right) \frac{d(\lambda^* (t_i, t_j))^2}{d t_i}
\]

The first term defines the effect of the corporate tax policy on the total labour income. This term contains two concomitant forces pushing governments to set low taxes. Both pass through the positive relation between \(\lambda^*\) and \(w_i\). Indeed, promoting the attractiveness of the country directly affects the individual wage on the one hand, and give more incentives for workers to increase their individual labour supply. The second and third terms describe the ambiguous effects of the corporate tax policy in terms of redistribution from firms to workers. Finally, the last term defines a negative relationship between a generous corporate tax policy and the desutility from labour.

Inserting (16) in the welfare function (15) and maximizing it with respect to the corporate taxes on firms, we get the following Nash tax equilibrium\(^2\)

\[
t^c = t^c = t^c = \frac{n L \tau [2a - \tau (2n + 3)]}{2 (1 + n)^2} \quad (17)
\]

Thus, taxes are identical across countries, and the resulting location equilibrium of firms at the Nash tax equilibrium is symmetric (\(\lambda^c = 1/2\)).

Moreover, observe that profit taxation describes a U-shaped curve with respect to \(\tau\) since we have

\[
\frac{\partial t^c}{\partial \tau} \leq 0 \text{ when } \tau \leq \frac{a}{2n + 3} = \tilde{\tau} < \tau_{\text{trade}}
\]

Hence, the corporate tax rate is a U-shaped function of the level of trade integration. Observe also that the tax on firms is negative for all \(\tau < 2\tilde{\tau} < \tau_{\text{trade}}\) and positive otherwise. Thus,

**Proposition 1** Starting from a high level of barriers to trade, trade integration leads governments to change the sense of their redistributive fiscal policy: they begin by taxing firms in order to subsidize workers and end by taxing workers to subsidize firms.

Finally, inserting Nash taxes and the resulting location equilibrium in (11), we get the equilibrium wage in each country

\[
w^c_1 = w^c_2 = w^c = \frac{f n \eta}{2 L}.
\]

\(^2\)The superscript \(cc\) refers to the case when both labour markets are competitive while \(mm\) refers to the case when there is a minimum wage in both countries.
4 Minimum wages in both countries

Now, assume that each government set an identical minimum wage rate $\omega$. We can define a threshold level for this minimum wage in order to avoid an implausible case. Indeed, we can assume that the minimum wage is higher than the competitive wage emerging from an even distribution of firms between countries so that

$$\omega > w_i^* \left( \lambda^* = \frac{1}{2} \right) = f \frac{1}{2} \frac{\eta}{L}. $$

4.1 Stage 3: Location for given taxes

The introduction of a minimum wage affects the relationship between net-profits and the spatial distribution of firms. Indeed, the wage adjustment following a change in the spatial distribution of firms disappears because of the wage rigidity. Thus, the location equilibrium is:

$$\lambda^{mm} = \frac{1}{2} - \frac{(1 + n) (t_1 - t_2)}{4nL_2^2} \tag{18}$$

Observe that as the labour cost is no more influenced by the location equilibrium, all tax advantage in a country gives rise to more agglomeration in this country compared with the competitive labour market case. Moreover, as in the benchmark case with competitive labour markets, a unilateral increase of the tax on firms yields an outflow of firms ($d\lambda^m_i/dt_i < 0$) and the sensitivity of location choices to variations of $t_i$ is magnified by trade integration.

4.2 Stage 2: Nash tax equilibrium

Now, when choosing its optimal level of taxation, each government faces with two categories of households depending on their position in the labour market. This affects its policy in two ways. Firstly, the labour tax is levied exclusively on employed residents. Secondly, we assume that each national government provides benefits $T_i$ to unemployed residents.

Thus, each government maximizes the following welfare expression

$$W^m_i = \underbrace{LS_i}_{\text{Consumers’ surplus}} + \underbrace{\pi_i \lambda_i n + \pi_j \lambda_j n}_{\text{Net income from firm ownership}}$$

$$+ \underbrace{(\omega l_i^s - \rho_i) L^u_i}_{\text{Net income from labour}} - \underbrace{\frac{\eta}{2} (l_i^s)^2 L_i^u}_{\text{Workers’ desutility from labour}} + \underbrace{T_i L_i^u}_{\text{Unemployment benefits}} \tag{19}$$

which is the sum of five components: the total consumers’ surplus ($LS_i$), the residents’ income from firms ownership ($\pi_i \lambda_i n + \pi_j \lambda_j n/2$), the net income of workers ($\omega l_i^s - \rho_i) L^u_i$), their desutility from labour ($-\eta (l_i^s)^2 L_i^u/2$), and the total amount of benefits distributed to unemployed residents ($T_i L_i^u$). The budget constraint is now given by

$$T_i L_i^u = \rho_i L_i^u + t_i n_i. \tag{20}$$
By introducing (20) in (19), we get the following simplified expression of welfare:

\[ W_{m_i} = L S_i + \frac{\pi_i \lambda_i n + \pi_j \lambda_j n}{2} + \omega l_i^e L_i^e - \frac{\eta}{2} (l_i^e)^2 L_i^e + t_i \lambda_i n \]

The influence of the two first components on the tax policy is not very different from the benchmark case. Both push the governments to set low corporate taxes. Nevertheless, observe that for reasons that we further detail, the intensity of this force differs as the introduction of a minimum wage changes the behaviour of firms face with a tax variation. That’s why also the sensitivity of the tax revenues from firms \( (t_i^c \lambda_i n) \) to the tax policy will be changed. At the opposite, wage rigidity strongly affects the incentives to tax passing through the labour market component. Indeed, the tax policy is no more an instrument by which government can modify the individual labour supply and the wage distributed to workers. These two mechanisms which were leading the governments to be generous with firms to increase the total labour income disappear. Therefore, the only way, governments can influence the aggregate welfare effects from the labour market consists in modifying the number of employed people \( L_i^e \) which is an increasing function of \( \lambda_i \).

By maximizing (19) with respect to taxes, we get the following Nash tax equilibrium:

\[ t_{1mm} = t_{2mm} = t_{mm} = \frac{1}{2} L n \tau \frac{\tau (2n + 3) - 2a}{(n + 1)^2} - \frac{1}{2} \omega f \]

A question of interest is whether the adoption of minimum wage change the relationship between trade integration and the sense of the redistribution between firms and residents. We have previously shown that below a given level of trade cost \( 2\tilde{\tau} \) workers subsidize firms that is \( t_i^c < 0 \). Now, the level of trade cost below which firms receive subsidies is given by the following positive root:

\[ \tau < \frac{2 L n a + 2 \sqrt{L n \left(f (2n + 3) (n + 1)^2 \omega + na^2 L \right)}}{2 (2 Ln^2 + 3 Ln)} \equiv \tilde{\tau} < \tilde{\tau}_{trade} \]

which grows with the level of the minimum wage. By comparing \( \tilde{\tau} \) and \( \tilde{\tau} \) we get

\[ \tilde{\tau} > 2\tilde{\tau} \]

Thus, the adoption of a minimum wage implies that the configuration where workers become the net-contributors of the public sector emerges earlier in the process of trade integration. Furthermore, it is clear that

\[ t_{mm} - t_{cc} = -\frac{1}{2} \omega f \]

To sum up

**Proposition 2** The introduction of a minimum wage rate in both economies strengthens tax competition. Therefore, workers become the net-contributors of the public sector at an earlier stage of trade integration.
This result of a more intensive tax competition with wage rigidities is mainly linked with the tax base sensitivity to taxation which differs depending on the labour market assumptions. It is straightforward to check that
\[
\frac{d\lambda_i^{mm}}{dt_i} < \frac{d\lambda_i^{cc}}{dt_i} < 0 \quad \forall i = 1, 2
\]
Put differently, firms are more sensitive to a given tax cut when wage rigidities prevail than when the labour market is perfectly competitive. In the last case, the inflow of firms which follows a decrease in taxation increases the wage pressure on the labour market. The resulting dispersion force does not exist for rigid wage rates. Thus, firms being more responsive to the tax policy, tax competition is strengthened when the labour markets exhibit rigidities. Nevertheless, it is interesting to observe that this force is strong enough to offset an opposite force passing through the maximization behaviour of the total labour incomes by governements. Precisely, when the labour market is perfectly competitive, governments have the incentive to set low taxes to increase the country’s attractiveness and generate a positive pressure on the wage rate. This incentive disappears when a wage rigidity prevails.

5 Asymmetric labour market regimes

Now turn to the case where countries choose different labour market regimes. Without loss of generality, we consider that country 2 adopts a minimum wage, while a perfectly competitive labour market prevails in country 1. In what follows, we observe how this legislation in country 2 combined with a competitive labour market in country 1 will affect the issue of the tax game.

5.1 Stage 3: Location for given taxes

In this asymmetric case, the interior location equilibrium arises when
\[
\Delta \pi (\lambda) = (\Pi_1(\lambda) - t_1 - f w_1(\lambda)) - (\Pi_2(\lambda) - t_2 - f \omega) = 0
\]
The resulting location equilibrium for given taxes is
\[
\lambda^{cm} = \frac{L_2 2L r^2 n + \omega f (n + 1) - (n + 1) (t_1 - t_2)}{4L^2 r^2 + f^2 \eta (n + 1)}
\] (21)
Thus, provided that the minimum wage is higher than the value of the competitive wage at symmetric location equilibrium, country 1 will host more firms at given taxes:
\[
\lambda^{cm} (t_1 = t_2) > \frac{1}{2} \text{ for all } \omega > \frac{f \eta}{2L}
\]
Finally, comparing the tax base sensitivity, under the three configurations, to a given variation of the domestic tax, gives:
\[
\frac{d\lambda_i^{mm}}{dt_i} < \frac{d\lambda_i^{cm}}{dt_i} < \frac{d\lambda_i^{cc}}{dt_i} < 0 \quad \forall i = 1, 2
\]
This inequality suggests that the mixed configuration moderates the tax base sensitivity to taxation in comparison with a case of wage rigidites in both countries. It is also interesting to note that the tax base reaction in the mixed configuration is perfectly identical among countries whatever their proper labour market regime choice.

5.2 Stage 2: Nash tax equilibrium

As the labour market legislation differs between countries, each national government has a different objective function and a different budget constraint. The objective function of country 1 is given by (15), whereas the objective function of the government of the country 2 which has to deal with unemployment is given by (19). Inserting the location equilibrium (21) in each of these objective functions, and maximizing them with respect to corporate taxes, we get the following Nash tax equilibrium:

\[
\begin{align*}
t_{cm1} &= \frac{A_1 L \tau^2 (2n + 3)}{4 (1 + n)^2 \left( f^2 (1 + n)^2 \eta + L^2 \tau^2 (4n + 5) \right)} - B \\
t_{cm2} &= \frac{A_2}{4L (1 + n) \left( \eta (1 + n)^3 f^2 + L^2 \tau^2 (4n + 5) (1 + n) \right)} - B
\end{align*}
\]  

with

\[
\begin{align*}
A_1 &= f (1 + n)^2 (fn\eta + \omega L) + 2L^2 \tau^2 n (4n + 5) \\
A_2 &= f^3 \eta (1 + n)^4 (f\eta m - 3\omega L) + 2L^4 \tau^4 n (2n + 3) (4n + 5) \\
&\quad + fL^2 \tau^2 (1 + n)^2 (3fn\eta (2n + 3) - \omega L (10n + 13)) \\
B &= nL\tau a / (1 + n)^2
\end{align*}
\]

Now we can compare \( t_{cm} \) with \( t^{mm} \) and \( t^{ax} \) to exhibit how the lack of harmonization on labour markets changes the tax incentives. First we focus on the comparison with the case in which countries choose a minimum wage. Formally, we get

\[
t_{cm1} \leq t^{mm} \quad \text{when} \quad \omega \leq \hat{\omega}
\]

After calculations, we can show that \( \omega^* \left( \lambda^* = \frac{1}{2} \right) > \hat{\omega} \). Thus the level of taxation in country 1 is always higher with an asymmetric regime.

For country 2, we get

\[
t_{cm2} \geq t^{mm} \quad \text{when} \quad \omega \leq \frac{\eta fn}{L} \equiv \bar{\omega}
\]

Therefore, it is clear that an asymmetric regime can modify the incentives to tax in an opposite sense depending on the regime adopted by each country. While country 1 which does not face with unemployment but with a reduced tax base sensitivity unambiguously rises its taxation, country 2 can make the opposite choice if the minimum wage prevailing in its economy is excessive. In this last case, the opportunity to rise taxation resulting
from the less responsive tax base is more than compensated by the disadvantage in terms of labour cost. This level of minimum wage \( \bar{\omega} \) is equal to the highest possible level of competitive wage in a country that is, the wage rate in a country in which all firms are agglomerated.

We turn now to the comparison with the Nash tax equilibrium emerging from a configuration in which both countries adopts a competitive wage. We get

\[
\begin{align*}
t_1^{cm} &> \bar{t} \quad \text{when} \quad \omega \geq \frac{n \eta f n}{L} = \bar{\omega} \\
t_2^{cm} &< \bar{t} \quad \forall \omega
\end{align*}
\]

These results still exhibits a great variability of the tax incentives to the labour market regimes. If country 2 adopts lower taxation when its government shifts from a competitive to a regulated labour market, such deviation can induce higher or lower taxation in country 1. Once again the level of the minimum wage adopted in country 2 will play a crucial role. Indeed, as \( t_1^{cm} \) is an increasing function of \( \omega \), there exists a level \( \bar{\omega} \) beyond which country 1 can sustain a higher tax burden than before the deviation. In this case, the labour cost disadvantage of country 2 is significant enough to cancel the incentive to set lower taxation passing through the more responsive tax base when mixed regimes emerge.

To sum up, provided that the minimum wage is not too high i.e \( \omega < \bar{\omega} \), we have \( t_1^{cc} > t_1^{cm} > t_1^{mm} \quad \forall \quad i = 1, 2 \), because the tax base erosion effect increases with the number of countries that adopt a regulated labour market. However, as soon as \( \omega > \bar{\omega} \), the labour cost disadvantage of the country with the minimum wage is so strong that it reinforces the pressure to set low tax in this country so that \( t_2^{cc} > t_2^{mm} > t_2^{cm} \) and at the same time it relaxes the budgetary constraint of the other country which leads to \( t_1^{cm} > t_1^{cc} > t_1^{mm} \).

**Proposition 3** Let assume three possible combinations of labour market regimes. When the minimum wage is high enough, among the three possible configurations, a mixed configuration leads to the highest (resp. lowest) level of taxation in the country with the competitive labour market (resp. with the minimum wage). Below a given level of minimum wage, the mixed configuration gives rise to intermediary taxation levels for both countries.

Finally, by comparing the Nash taxes, we get

\[
t_1^{cm} - t_2^{cm} = -\frac{f^2 \eta (n+1)^2 (\eta f n - 3L\omega) + 2nL^2 \tau^2 \eta (2n + 3) f - 4L^3 \tau^2 \omega (3n + 4)}{\eta (n+1)^2 f^2 + L^2 \tau^2 (4n + 5)}
\]

which is positive for all \( \omega > n \eta f / 2L \). Observe that the relationship between this positive tax gap and the level of trade integration is still non monotonous with respect to the level of minimum wage adopted in country 2. Indeed, we can easily show that beyond \( \bar{\omega} \), trade integration creates divergence in taxation as \( \partial (t_1^{cm} - t_2^{cm}) / \partial \tau < 0 \) while below this level it induces convergence.

To sum up
Proposition 4 In a mixed configuration, the country with the competitive labour market levies a higher tax. Provided that the minimum wage in the other country is low enough, trade integration promotes a tax convergence. Otherwise, decreasing trade costs leads to a tax divergence.

Finally, evaluating the location equilibrium (21) at the Nash taxes (22), we get:

\[
\chi^{cm}(t_1^{cm}, t_2^{cm}) = \frac{1}{4n} \frac{f (n+1)^2 (\eta fn + L\omega) + 2nL^2\tau^2 (4n+5)}{\eta (n+1)^2 f^2 + L^2\tau^2 (4n+5)} \geq \frac{1}{2} \text{ when } \omega \geq \bar{\omega}
\]

Thus, the country with the minimum wage hosts more (resp. less) than a majority of firms if its minimum wage rate is lower (resp. higher) than \(\bar{\omega}\). Thus, in what follows, if we consider that \(\omega > \bar{\omega}\), we will also have to assume that

\[
\omega < \omega_{CP} = 3\eta f n L + 2L\tau^2 n (5 + 4n)
\]

in order to focus on interior equilibria exclusively. If we consider instead that \(\omega < \bar{\omega}\) so that a majority of firms locate in country 2, it is straightforward to see that \(\chi^{cm}\) is always strictly positive. This result is interesting since it sheds light on a trade-off that a country adopting a minimum wage can be faced with. Indeed, if this kind of country has the purpose to increase its attractiveness for instance to promote employment, the choice of a relatively high level of minimum wage can be a good strategy as its relative fiscal advantage endogenously grows with \(\omega\). Nevertheless, the spatial distribution of firm resulting from the Nash tax equilibrium suggests that the opposite choice should lead to better results. Despite the fact that it gives rise to a more moderated fiscal advantage, choosing a lower minimum wage would give more guarantees in terms of attractiveness.

6 The labour market regime choice

In this section, we assume that governments non cooperatively choose their labour market regime by ranking the resulting welfare. In order to find the Nash equilibrium of the labour market regime, we have to compare the difference of welfare for a country for each labour market regime. To make the calculations easier we rewrite the exogenous minimum wage in the following manner:

\[
\omega = x \frac{\eta fn}{L}
\]

with \(x > 1/2\) as we have assumed that the minimum wage is higher than the competitive wage when nations host an equal share of firms.

Firstly, assume that both countries adopt a minimum wage and that a government (for instance government 1) decides to deviate by adopting a competitive regime. Thus, we have

\[
W_1^{mm} < W_1^{cm}
\]
Thus, according to this inequality, an individual deviation from regulation to a competitive regime results in a welfare gain. Moreover, it is worth noting that this gain from dismantling regulation grows with the level of the minimum wage prevailing in both countries. In other terms, the more governments adopts a high common norm of wage, the higher is the risk that a government unilaterally deviates and returns to no regulations.

Now, consider the polar case where both countries start from competitive regimes and a country individually deviates to adopt a minimum wage. We can show that

\[ W^{mc}_{1} - W^{cc}_{1} = \kappa \left[ (\Theta_1 x^2 + \Theta_2 (2x - 1)) \right] \]

whith \( \kappa \) a positive constant, \( \Theta_1 = -f^2 \eta (n + 1)^2 \left( L^2 \tau^2 (6n + 7) + 2f^2 \eta (n + 1)^2 \right) < 0 \) and \( \Theta_2 = 6\eta^2 (n + 1)^4 f^4 + L^2 \tau^2 \eta (38n + 47) (n + 1)^2 f^2 + 4L^4 \tau^4 (4n + 5)^2 > 0 \). There are two positive roots \( x_1 \) and \( x_2 \) for which \( W^{mc}_{1} = W^{cc}_{1} \) (see the appendix). Some calculations show that

\[ x_1 \in (1/2; 1) \text{ and } x_2 \frac{n \eta f}{L} > \omega^p \]

Since we consider exclusively interior equilibria, we assume that \( x < x_2 \). Thus, we get

\[ W^{mc}_{1} \leq W^{cc}_{1} \text{ when } x \geq x_1 \]

In other words, for a low enough level of the minimum wage, each country has an individual incentive to give up its competitive labour market and the resulting gain from this strategy decreases with the level of minimum wage until \( x = x_1 \). Above the corresponding level of the minimum wage, each country has incentives to keep a competitive labour market.

To summarize, we get

\[ W^{mm}_{1} < W^{cm}_{1} \text{ and } W^{mc}_{1} > W^{cc}_{1} \text{ when } x \in (1/2; x_1) \]
\[ W^{mm}_{1} < W^{cm}_{1} \text{ and } W^{mc}_{1} = W^{cc}_{1} \text{ when } x = x_1 \]
\[ W^{mm}_{1} < W^{cm}_{1} \text{ and } W^{mc}_{1} < W^{cc}_{1} \text{ otherwise} \]

and the symmetric inequalities hold for country 2.

Finally, to determine the Pareto-optimal Nash equilibria, we have to compare the welfare at the equilibrium for the two symmetric labour market regimes. We get:

\[ W^{mm}_{1} - W^{cc}_{1} = \frac{1}{8} (f \eta m - 2\omega L) n \frac{f}{L} < 0 \]

Hence, assuming that the minimum wage is always higher than the competitive wage emerging from an even distribution of firms between countries, the national welfare in each country is higher when both labour markets are competitive than when both implement the minimum wage policy. Moreover we can check that

\[ W^{cm}_{1} > W^{cc}_{1} \forall x \]
which means that a country with a competitive labour market is better-off if the other country adopts a minimum wage. Finally, we can check that

\[ W_1^{cm} - W_1^{mc} \neq 0 \]

Thus starting from an asymmetric configuration with different labour market regime, if each country changes its labour market regime, there is necessarily one country which is better-off and the other one whose welfare decreases, that is \( W_1^{cm} \leq W_1^{mc} \iff W_2^{cm} \geq W_2^{mc} \). Thus, the asymmetric configurations where each country chooses a different labour market legislation are the only Pareto-optimal configurations of the game.

From the previous inequalities, we can formulate the following proposition.

**Proposition 5** The Nash equilibria depend on the level of the minimum wage approximated by \( x \):

(i) when \( x \in (1/2; x_1) \), the Nash equilibria are given by the two asymmetric configurations where one country adopts a competitive labour market and the other a minimum wage and they are Pareto-optimal;

(ii) when \( x = x_1 \), there are three Nash equilibria: the two asymmetric scenario where one country adopts a competitive labour market and the other a minimum wage which are Pareto-optimal, and the symmetric scenario where both countries adopt a competitive labor market;

(iii) when \( x > x_1 \), the only Nash equilibrium is defined by the symmetric configuration where both countries adopt a competitive labor market but both countries would be better off if they had a different labour market regime.

### 7 Conclusion

Unemployment is one of the major reasons why governments try to attract firms through their fiscal policy. In this paper, we have explored the relationships between the labour market outcome and tax competition in a framework with imperfect trade integration and economies of scale. Our results can be summarized as follows. Firstly, we show that the implementation of a minimum wage rate in both countries strengthens tax competition as compared with the case where both labour markets are competitive. Secondly, we show that the adoption of a minimum wage in only one country results in lower corporate taxation in this country which will host more than a majority of firms provided that its minimum wage rate is low enough. Finally, we analyze the outcome when governments behave strategically with respect to the decision to regulate or not the labour market through the introduction of a minimum wage. We show that the Nash-Pareto equilibrium is defined by the asymmetric scenario where one country adopts a competitive labour market and the other one a minimum wage provided that the minimum wage is not too high. Above a given level of the minimum wage, the Nash equilibrium is defined by
the symmetric configuration where both countries choose the competitive labour market regime but they would be better off if they had a different labour market regime.
Appendix

The two roots for which $\Theta_1 x^2 + \Theta_2 (2x - 1) = 0$ are given by

$$x_1 = \frac{\Upsilon + 2\sqrt{\Phi}}{\Psi} \quad \text{and} \quad x_2 = \frac{\Upsilon - 2\sqrt{\Phi}}{\Psi}$$

with $\Upsilon = 4L^4 \tau^4 (4n + 5)^2 + f^2 \eta (n + 1)^2 \left( L^2 \tau^2 (38n + 47) + 6f^2 \eta (n + 1)^2 \right)$,

$\Psi = f^2 \eta (n + 1)^2 \left( L^2 \tau^2 (6n + 7) + 2f^2 \eta (n + 1)^2 \right)$,

$\Phi = \left[ 4L^4 (4n + 5)^2 \tau^4 + f^2 \eta (n + 1)^2 \left( L^2 \tau^2 (38n + 47) + 6f^2 \eta (n + 1)^2 \right) \right] \left( L^2 \tau^2 (4n + 5) + f^2 \eta (n + 1)^2 \right)^2$.

References


