

Tax competition with agglomeration and unemployment

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Abstract

This paper studies the role of imperfect labour markets for tax competition in a fair wage constrained footloose capital agglomeration model. We find that unemployment renders the mobile factor more footloose. The reason is that capital exports due to higher taxes increase unemployment which stimulates further relocation of firms. Imperfect labour markets reduce Nash tax rates and hence, exert a similar effect as trade liberalisation.

JEL: F12, F15, F21, H87, R12

Keywords: Tax competition, economic geography, fair wage constraint, imperfect labour markets

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1 Introduction

Three features of economic activity in the developed countries attracted the attention of modern academic research: that labour markets are imperfect; that goods trade faces frictions; and that capital is mobile across jurisdictional borders (or, as we might say, it is *footloose*) relative to labour. These characteristics bring about three consequences: that the gap in factor rewards between capital and labour is smaller than with perfect labour markets, leading to unemployment of workers; that consumer demand faces a *home market effect* (Krugman, 1980; i.e., large regions produce manufactures more than proportionately) due to trade costs; and that production of manufactures agglomerates in the larger region due to capital mobility. In the developed part of the world, these features are ubiquitous not only at the international but also the interregional (intranational) level. Accordingly, it seems fruitful to ground a positive and normative analysis of economic policy in a framework which takes account of these characteristics. It is this paper's purpose to deliver an analysis of capital income tax competition in such a context.

Previous work on tax competition tended to account for subsets of the aforementioned elements in isolation. In particular, recent work in economic geography emphasised the role of industry agglomeration for tax policy. In contrast to the standard neoclassical framework, governments might tax mobile capital in the presence of agglomeration forces. The reason is that capital might earn agglomeration rents that might be taxed without causing capital outflows (see Ludema and Wooton, 2000, Kind et al., 2000, Baldwin and Krugman, 2004, or Borck and Pflüger, 2006). We depart from this work in two ways. First, following Baldwin et al. (2003), we employ a footloose capital (FC) framework instead of models in the fashion of Krugman's original core-periphery (CP) setting. The latter entails a stronger focus on partial agglomeration rather than full agglomeration versus full dispersion of economic activity here than in the mentioned work. Second and more importantly, we introduce imperfect labour markets to study the role of unemployment for tax competition in the presence of agglomeration forces. This aspect is novel in that literature.

However, there has been some work on tax competition and imperfect labour markets in the standard neoclassical approach finding mixed results. One strand of this literature concludes that imperfect labour markets imply lower Nash tax rates than with undistorted labour markets. The

reason is that capital exports due to higher tax rates not only generate a positive external effect for the target country, but also leads to lower labour productivity and hence, more unemployment at home, if wages cannot adjust to the market clearing level. As a consequence, governments try to compensate for *both* effects by reducing the tax (see Fuest and Huber, 1999, Ogawa et al., 2007). Leite-Montero et al.(2003) use the same argument via employment subsidies. But there is also the case for the opposite. Richter and Schneider (2001), for instance, conclude that governments may find it efficient to levy higher tax rates on capital if monopolies/ monopsonies dominate the labour market. Then, capital taxes serve as a means to countervail the distortion (second-best argument). This paper complements the former argument. We differ from this work by considering costly goods trade in differentiated manufactures. In contrast to the neoclassical literature this brings about the home market effect in the production of manufactures. The latter allows us to establish a link between the role of unemployment and trade frictions in tax competition among jurisdictions.

We incorporate labour market imperfection into the FC model by assuming that individuals possess fair wage preferences. Fair wages of workers are determined with respect to income of a reference group – capital owners in our approach. As long as capital owners earn more than workers (which we assume to hold throughout) and employees have some preference for fair wages, one can show that equilibrium is characterised by some positive level of unemployment. This approach has gained increasing support in the literature – especially in international trade (see Kreckemeier and Nelson, 2006, and Grossman and Helpman, 2007) – as it possesses (at least) two important advantages. First, it provides a simple tool to determine factor prices and unemployment rates endogenously in equilibrium. And second, the fair wage parameter can be interpreted as the degree to which institutions compress relative factor returns and generate unemployment. We claim that the fair wage mechanism pictures all types of labour market rigidities that work via this compression (like minimum wages or bargaining models). Hence, our results generalise to a large variety of labour market imperfections.

The central message of this paper is that unemployment raises the elasticity of mobile capital with respect to tax changes – even if countries neither differ in size nor the degree of labour market imperfection. A unilateral tax increase causes capital exports, but – due to the labour market constraint – also generates unemployment. This reduces (net) capital returns (further)

and leads to more relocation than with perfect labour markets. In other words, unemployment intensifies tax competition and thus works in the same direction as trade liberalisation.

The paper is organised as follows. Next, we present the FC model with taxes on capital income and labour market imperfection. Section 3 provides analytical results in the short run where capital mobility is ruled out and only trade in goods is possible. In Section 4, we analyse the impact of fair wage preferences for the equilibrium share of firms before we solve the model numerically for its Nash tax rates. Section 5 concludes.

2 The model

We employ a footloose capital (FC) model describing a world with two countries, two factors of production and two tradable goods. Capital K and labour L produce a composite industrial (M) and a homogeneous traditional commodity (Y) in each country unless capital has fully agglomerated in one region. The advantage of the FC model is its tractability so that we can solve the model analytically for its long-run spatial division of industry. This feature is rare in economic geography models and owed to the fact that both demand-linked and cost-linked circular causality are cut. This is achieved by assuming that as factor income earned abroad will always be repatriated and spent in the country of origin. Thereby, market size remains constant.¹ Despite these simplifications, the labour market imperfection constrains us to numerical solutions with respect to Nash tax rates in the long run.

With regard to industrial goods, consumers possess a Dixit-Stiglitz-type love for variety. The upper tier utility is quasi-linear so that

$$O_i = \mu \ln(C_{Xi}) + C_{Yi}, \quad C_{Xi} = \left(\sum_{i=1}^{n_i} x_{ii}^{\frac{\sigma-1}{\sigma}} + \sum_{j=1}^{n_j} x_{ji}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \quad \mu > 0, \quad \sigma > 1, \quad (1)$$

where C_Y and C_X denote aggregate demand for traditional and industrial goods, respectively. x_{ii} represents domestic demand for a single variety that is locally produced whereas x_{ji} is domestic demand for foreign varieties. There is a constant elasticity of substitution σ at which varieties can

¹In contrast, Krugman's core-periphery (CP) setup endogenises market size as mobile workers change their place of residency and hence spend their income where they are employed.

be substituted against each other. n_i (n_j) depicts the exogenous number of domestic (foreign) firms. We can use quasi-linear preferences here without loss of generality as the FC model abstracts from income effects anyway. This is due to the fact that capital owners always earn the world average return and foreign income is repatriated thus keeping market size exogenous. However, quasi-linear utility simplifies our analysis substantially.

Income in region i is determined by

$$E_i = P_i C_{Xi} + C_{Yi}, \quad P_i = \left[n_i p_i^{1-\sigma} + n_j \phi p_j^{1-\sigma} \right]^{\frac{1}{1-\sigma}}, \quad 0 \leq \phi \equiv \tau^{1-\sigma} \leq 1,$$

where P_i describes the price index of the composite industrial good. As firms set identical mill prices in equilibrium and trade in X is inhibited by iceberg trade costs $\tau > 1$, consumer prices of domestic and foreign varieties differ by τ (p_i for a domestic variety and τp_i for a foreign one). Utility maximisation yields demand functions for both the aggregates and single varieties:

$$\begin{aligned} C_{Xi} &= \frac{\mu}{P_i}, & C_{Yi} &= E_i - \mu, \\ x_{ii} &= \mu p_i^{-\sigma} P_i^{\sigma-1}, & x_{ij} &= \mu (\tau p_i)^{-\sigma} P_j^{\sigma-1}. \end{aligned} \tag{2}$$

As consumers have to bear the entire trade costs, it becomes obvious that demand for a domestically produced variety is lower abroad as long as $\tau > 1$. This feature is central for the home market effect because firms benefit from producing in the larger market where they face higher demand for their products and thus earn higher operating profits.

There is perfect competition in the traditional sector and we assume that one unit of labour is necessary to produce a single unit of the traditional good, so that $L_{Yi} = Y_i$. As trade in Y is not subject to any barriers and we focus on scenarios where both regions always produce Y , the price of the traditional good is unity everywhere. In the industrial sector, both capital K and labour L are necessary for production. We use the common assumption that one unit of capital is necessary for firm setup whereas labour serves as the variable input. Let c denote the variable input coefficient so that $X = L_X/c$. Fixed costs produce increasing returns to scale so that the number of varieties becomes exogenous. As labour is perfectly mobile between sectors but not internationally, wages are always equated on a national level. The same is true internationally as trade in Y is perfectly free, so that the choice of the traditional good as the numéraire ensures

that $w_i = w_j = 1$. Firms' profits are determined as

$$\pi = (p - c)X - r,$$

where r denotes the cost of capital every company has to incur as a fixed factor for firm setup.

The profit maximising price can be derived as a fixed mark up over variable costs,

$$p = \frac{c}{1 - 1/\sigma}.$$

Normalising c to $1 - 1/\sigma$ simplifies notation as $p = 1$ for each variety. In equilibrium, free entry of firms² drives down pure profits to zero such that

$$r_i = X_i/\sigma.$$

This means that the return to capital is the Ricardian residual equalling operating profits.

We assume labour markets to be imperfect due to fair wage preferences of individuals. There are several reasons why fair wages have gained increasing support in the literature. Apart from the fact that there is substantial (experimental) evidence for such preferences (Bewley, 2005, or Gächter and Fehr, 2002), the approach possesses at least two advantages. First, unemployment and factor price differentials can be determined endogenously in equilibrium. And second, the fair wage parameter can easily be interpreted to measure the rigidity of relative factor prices. Such a compression would be the consequence of binding minimum wages or wage bargaining with the common feature of equilibrium unemployment. Hence, we argue that our results should generally hold when labour market rigidity compresses relative factor prices.

The fair wage mechanism works as follows. If firms pay less than the fair wage, workers reduce their effort level in the production process proportionally to the gap between actual and fair wages. This is described by the following functional form

$$e_{Li} = \min\left(\frac{w_i}{w_i^*}, 1\right), \tag{3}$$

²Although capital supply is exogenous in our model, we should nevertheless think of this as a free entry equilibrium. Firms enter the market and compete with others until the price for this factor breaks even with operating profits. Under the Flam-Helpman assumption, this will occur exactly where $K_i = n_i$. By applying the zero-profit condition, we neglect the integer problem and treat firm numbers as continuous (see Baldwin, 1988).

where w_i^* denotes the fair wage and w_i the actual wage paid by the firm. Normal effort has been set to unity. In other words, workers do not want to be unfairly paid less than capital owners in our approach.³ The reduction in effort would bring about lower labour productivity and thus an increase in marginal costs. In fact, (3) implies that firms cannot influence their marginal costs by paying less than w_i^* . The fair wage is determined by

$$w_i^* = \beta r_i + (1 - \beta)(1 - U_i)w_i, \quad (4)$$

where $\beta \in [0, 1]$ is the fair wage preference parameter workers attribute to the income of the reference group – that is capital owners who earn r_i .⁴ U_i is the unemployment rate of workers (that is a worker's probability of being unemployed), and $(1 - U_i)w_i$ describes the expected wage of workers outside their firm. The latter term is weighted by $1 - \beta$. As in Akerlof and Yellen (1990) and Kreickemeier (2006), we assume that firms choose to pay the fair wage if doing so does not diminish their profits so that

$$w_i^* = w_i < r_i \text{ and } U_{Li} > 0, \quad (5)$$

unless $\beta = 0$. This implies that workers always provide normal effort. It is an important condition for this result that capital returns always exceed wages, which we assume to be true throughout. Inserting (5) into (4) yields the unemployment rate

$$U_i = \frac{\beta_i}{1 - \beta_i}(r_i - 1). \quad (6)$$

Since $0 \leq U_i \leq 1$, the return to capital is bound by $r_i \in [1, \beta^{-1}]$, where $w_i = 1$ has been taken into account.

Finally, we need to include government's preferences for the public good G and private consumption C such that

$$W = C + \ln(G).$$

³Of course, a similar effort function exists for capital owners. However, since we focus on cases where capital returns exceed those of workers, we may safely forgo its analytical exposition. At $r_i > w_i$ for all i , capital will always be fully employed.

⁴One can also argue that only workers in the industrial sector have an idea about r_i as they can observe operating profits (which are identically equal to r_i in equilibrium). Labour mobility across sectors and frictionless trade of the traditional good assures that wages are unity everywhere.

We also use a quasi-linear specification with respect to the public good to circumvent the problem of income effects. While standard assumptions exclude them from the FC model, taxation can re-introduce income effects because governments spend tax revenue from foreign owned capital domestically. Budgets are assumed to be equated at any time such that

$$G_i = t_i r_i K_i.$$

Our approach affords to distinguish between income groups, so that we cannot simply maximise utility of the representative consumer. Instead, we have to aggregate indirect utility of all households $K_i + L_i$. This brings

$$\begin{aligned} W = & L_i (1 - U_i) + 0.5 \bar{K} [s_n (1 - t_{K_i}) r_i + (1 - s_n) (1 - t_{K_j}) r_j] \\ & + (L_i (1 - U_i) + K_i) \mu (\ln \mu - 1 - \ln [(\phi + s_n (1 - \phi)) \bar{K}]) + (L_i + K_i) \ln (t_{K_i} r_i K_i). \end{aligned} \quad (7)$$

The first two terms denote net income for labour and capital. The third one captures the impact of changes in the price index on welfare. Finally, the last term measures utility from the provision of the public good. Before turning to the long-run allocation of firms and tax competition, we derive the equilibrium capital return in the short-run equilibrium. The short run is defined by absence of capital mobility whereas trade in both goods is possible.

3 Short-run equilibrium

Using the zero profit condition along with optimal demand for a single variety and the fair wage constraint, we get the capital return in country i as

$$r_i = \frac{K_i + \phi K_j}{\sigma (K_i + \phi K_j) + \mu \tilde{\beta}_i L_i} \left(\frac{\frac{L_i}{1 - \beta_i} + K_i}{K_i + \phi K_j} + \phi \frac{\frac{L_j}{1 - \beta_j} (1 - \beta_j r_j) + K_j}{\phi K_i + K_j} \right), \quad (8)$$

where $\tilde{\beta} = \beta / (1 - \beta)$. As wages have been normalised to unity, r_i also reflects the factor price differential. In order to get a first idea of how the model works, we take a look at the impact of fair wage preferences on the factor price differential and the unemployment rate. The result is summarised in Proposition 1:

Proposition 1. *A higher fair wage parameter β_i reduces capital returns both domestically and abroad by causing higher unemployment. While U_i unambiguously declines, the reduction in demand from country i for varieties produced in country j can partly be offset by higher employment levels there.*

Proof. See Appendix A. □

This proposition generalises the result by Egger and Seidel (2007) to asymmetric country size. The intuition can best be demonstrated by (4) which can only hold with a higher β_i if either r_i declines or U_i rises. However, we know from (6) that both variables are interdependent. In fact, unemployment exerts a negative impact on r_i by reducing demand for a single variety, which is defined as $X_i = (L_i(1 - U_i) + K_i)x_{ii} + (L_j(1 - U_j) + K_j)\tau x_{ij}$. As $r_i = X_i/\sigma$ in equilibrium, higher unemployment unambiguously reduces demand for variety i and thus operating profits. This effect also spills over to the other country as foreign firms face lower demand from country i .

While a higher fair wage parameter in country i unambiguously increases unemployment in country i , it improves employment in country j – unless trade costs are prohibitively high. The reason for this is that a reduction in r_j due to a higher β_i relaxes the fair wage constraint in country j allowing for a lower unemployment rate.⁵

4 Long-run equilibrium

It is straightforward to solve the model for its long-run equilibrium share of firms, s_n . We do so by substituting $K_i/\bar{n} = s_n$ and $K_j/\bar{n} = 1 - s_n$ (with \bar{n} being the aggregate number of firms/ capital stock) into the short-run capital return (8) and employing the location condition $(1 - t_i)r_i = (1 - t_j)r_j$. However, we restrict our comparative statics analysis to identical countries with respect to market size and fair wage constraint for two reasons. First, it allows us to derive the full set of analytical results and second, it suits better for explaining the long-run mechanism of

⁵See also Egger and Seidel (2007).

the model. Solving the location condition for s_n yields

$$s_n = \frac{1}{2} \left(1 - \frac{t_i - t_j}{2 - t_i - t_j} \left(\frac{1 + \phi}{1 - \phi} \right)^2 - \frac{2 \frac{\mu}{\sigma \bar{n}} \tilde{\beta} L (t_i - t_j)}{2 - t_i - t_j} \right). \quad (9)$$

We can illustrate several points by means of (9). First, we only observe a deviation from the symmetric distribution of firms if equilibrium taxes differ between countries. Second, it is straightforward to show that an increase in any tax rate clearly reduces the share of firms in that country unless the tax rate in the other region is unity,

$$\frac{\partial s_n}{\partial t_i} = - (1 - t_j) \frac{\left(\frac{1 + \phi}{1 - \phi} \right)^2 + 2 \frac{\mu}{\sigma \bar{n}} \tilde{\beta} L}{(2 - t_i - t_j)^2} \leq 0.$$

Third, the magnitude of this effect increases in ϕ ,

$$\frac{\partial^2 s_n}{\partial t_i \partial \phi} = - \frac{1 + \phi}{(1 - \phi)^3} \frac{4(1 - t_j)}{(2 - t_i - t_j)^2} \leq 0.$$

This mechanism is known from the literature (Baldwin et al., 2003) and also holds true with unemployment. Capital becomes more footloose if trade costs decline as it is more attractive for firms to serve the domestic market from abroad.⁶ Therefore, the FC model produces full agglomeration of industry for sufficiently low trade costs if countries differ in market size.

More importantly, however, we want to focus on the impact of the fair wage constraint on the equilibrium industry share s_n . Proposition 2 summarises our findings.

Proposition 2. *For countries that are identical with respect to endowments and fair wage preferences, an increase in the fair wage parameter β reduces (increases) s_n if $t_i > t_j$ ($t_j > t_i$). Moreover, it makes capital more elastic with respect to changes in taxes.*

Proof. It is straightforward to show that

$$\frac{\partial s_n}{\partial \beta} = - \frac{\mu}{\sigma \bar{n}} \frac{L}{(1 - \beta)^2} \frac{t_i - t_j}{2 - t_i - t_j} \begin{matrix} \geq 0 \\ < 0 \end{matrix}$$

⁶In fact, trade costs impede the mobility of capital in an indirect way as their level affects profits to different extents when relocating due to the *home market effect*. Hence, the effect of trade costs on capital flows is similar to that of costs of capital mobility. With respect to the latter, Razin and Sadka (1991) showed that higher impediments to/on capital mobility allow governments to set higher tax rates which enhance welfare.

and

$$\frac{\partial^2 s_n}{\partial t_i \partial \beta} = -\frac{2\frac{\mu}{\sigma n} \frac{L}{(1-\beta)^2} (1-t_j)}{(2-t_i-t_j)^2} \leq 0.$$

■

This implies that an increase in the symmetric fair wage parameter works in the same direction as trade liberalisation – the mobile factor becomes more footloose. What is the intuition for this result? Consider a situation in which both countries impose the same capital income tax, $t_i = t_j$. We know that an increase in t_i drives firms out of country i in order to equate net returns. This implies that $r_i > r_j$ in equilibrium because $t_i > t_j$. Increasing fair wage preferences in both countries now generates more unemployment in country i than in country j as the factor price differential is higher there. Hence, more unemployment needs to be generated to meet the fair wage constraint. This in turn depresses the factor price differential more in country i so that more firms relocate to country j .⁷

4.1 Tax competition

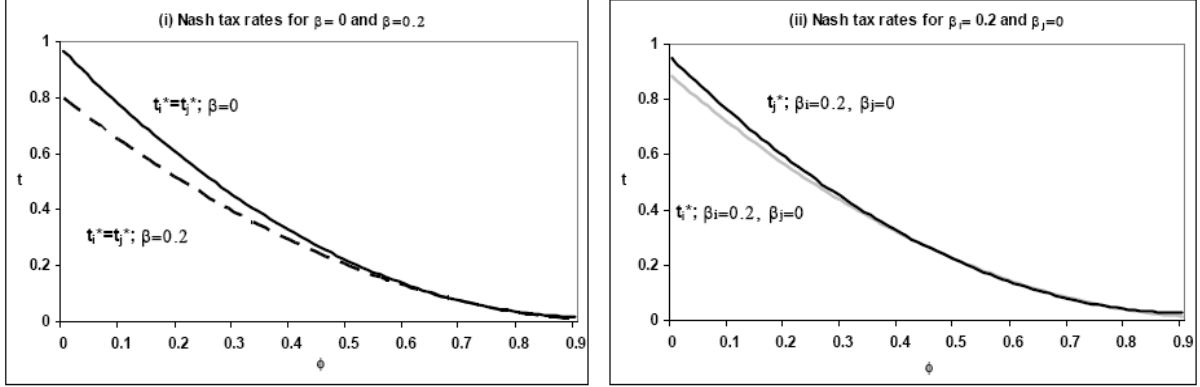
Let us now analyse the implications of fair wage preferences for tax competition. Unfortunately, an analytical treatment is infeasible, but we can explore the features of the model by means of numerical analysis. Since the equilibrium allocation of capital crucially depends on trade freeness ϕ , we need to determine equilibrium taxes and capital allocation at any level of ϕ . We do so by implementing a grid search over $t_i, t_j \in [0, 0.01, \dots, 0.99, 1]$ for each $\phi \in [0, 0.01, \dots, 0.99, 1]$. Hence, we search for Nash equilibrium tax rates and agglomeration patterns across $101^2 \cdot 100 = 1,020,100$ model solutions for each level of fair wage preference parameter β_i, β_j and labour endowment L_i, L_j chosen. In particular, our focus is on the impact of β_i, β_j on the Nash tax rate (and agglomeration).⁸

Figure 1(i) depicts Nash tax rates for countries of identical size and equal labour market imperfection. Due to symmetry, equilibrium tax rates are identical in both countries so that it suffices to plot the curves for one jurisdiction. The bold line represents perfect labour markets as a benchmark ($\beta = 0$), whereas the dashed line shows Nash taxes for $\beta = 0.2$. First, one

⁷We relegate the discussion of asymmetric country size to Appendix B.

⁸The discussion of parameter choice for our numerical exercise is relegated to Appendix B.

Figure 1: Identical country size



clearly observes a race to the bottom of tax rates when ϕ rises. This is in line with the reported result in Section 3 that capital becomes more footloose when trade freeness goes up.⁹ Second, an increase in the fair wage parameter β reduces Nash tax rates relative to the benchmark case while the race to the bottom in ϕ is preserved. We should expect this downward shift as we have shown that β increases the elasticity of capital additionally. In fact, capital mobility is restricted indirectly via trade costs. For high levels of trade costs it does not pay off for firms to serve consumers in both markets from abroad as profits would decline too much (the dispersion force is too strong). As ϕ increases, however, it becomes more attractive to relocate. So, capital becomes more mobile which should exert a downward pressure on equilibrium tax rates in both countries.

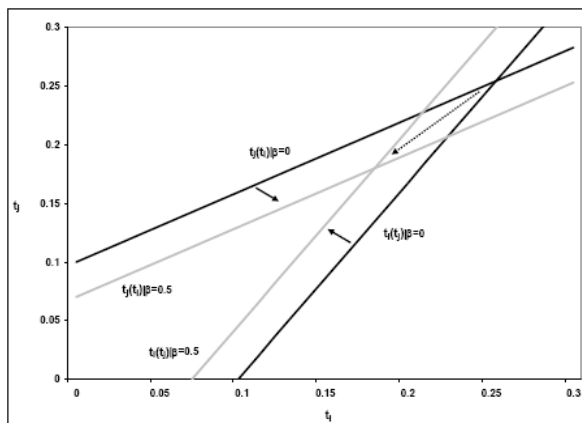
In Figure 1(ii) we allow for differences in labour market imperfection. While country i is assumed to possess a fair wage parameter of $\beta_i = 0.2$, country j 's labour market works perfectly. The more constrained country i chooses a lower Nash tax rate than country j . The reason for this is that unemployment already reduced the attractiveness of this location for firms. Hence,

⁹As indicated above, Baldwin et al. (2003) find that higher trade freeness increases the tax base responsiveness with respect to changes in tax. As a consequence of this, Nash tax rates recede with lower trade costs. This insight stems from the fact that it becomes more profitable for firms to serve consumers from the larger market as trade costs decline. These results remain true in our framework with unemployment. Trade costs also play a role in Haufler and Wooton (1999). They study tax competition between two countries of different size that try to attract a foreign-owned monopolist. Governments are willing to pay subsidies in order to attract the investment. In equilibrium, the home market effect ensures that the monopolist operates in the larger country.

a lower tax rate can partly offset this disadvantage. However, the tax rate is higher than with symmetrically constrained labour markets ($\beta = 0.2$) in panel (i). The intuition for this outcome is that overall labour market imperfection is lower so that capital does not react as sensibly to tax changes. Hence, it pays off to levy higher taxes.

Two more aspects need attention. First, the fact that countries choose very high Nash tax rates on capital for low trade freeness simply results from the specification of the model. For instance, governments do not take into account distributive aspects when maximising their preferences. Therefore, it makes sense to tax capital close to the possible maximum as long as it does not pay off to relocate. The revenues can be used to provide a public good which generates utility for both capital owners and workers alike. Reducing the number of workers relative to capital would clearly lower the optimal tax. What is more important in this analysis is that we observe a race to the bottom for all specifications. Second, there is no unique solution to Nash tax rates when industry is fully agglomerated in one country. Therefore, we have to restrict our simulations to interior equilibria which are guaranteed if ϕ does not become too large. This is especially relevant for asymmetric cases (Figure 1(ii) and in the further analysis below).

Figure 2: Reaction functions for $\phi = 0.5$

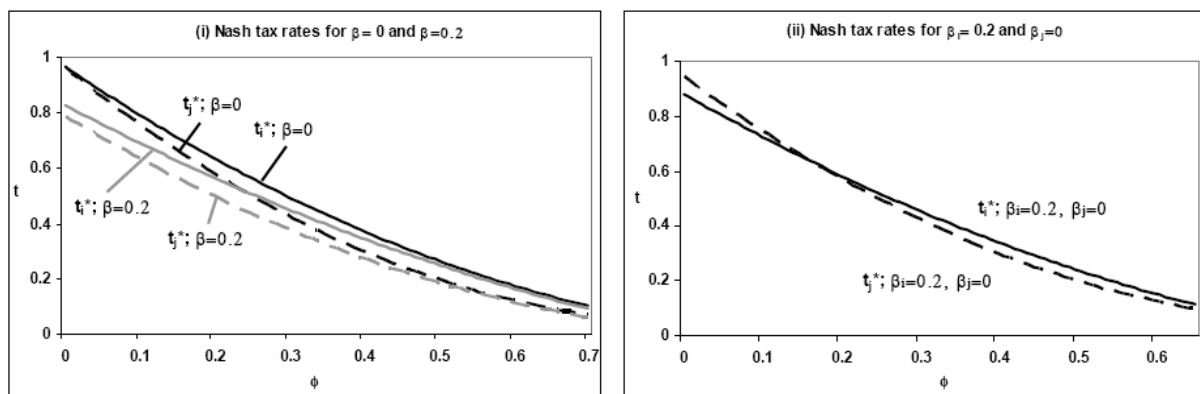


In a next step, we want to study how the labour market constraint modifies both countries' reaction curves. We choose a constellation with intermediate trade costs, $\phi = 0.5$, and compare perfect labour markets, $\beta = 0$, with identical fair wage constraints in both jurisdictions. For expositional reasons, we take a sufficiently high fair wage parameter, $\beta = 0.5$. Figure 2 illustrates

that unemployment rotates the reaction curve (anti-)clockwise for country i (j). This implies that both governments set a lower Nash tax rate in equilibrium – as demonstrated in the analysis above. On the one hand, imperfect labour markets reduce best response taxes as capital becomes more mobile with unemployment. On the other hand, the reaction curves are steeper because a marginal increase in country j 's tax allow country i to marginally increase its own tax rate more than with perfect labour markets. This is also due to the fact that the tax base reacts more elastically to tax changes.

Finally, we choose country i to be larger than country j to study the role of market size for tax competition when labour markets are imperfect. In Figure 3 we depict the same three fair wage scenarios as above. Figure 3(i) reports two scenarios. One in which labour markets are perfect ($\beta = 0$) and one in which both countries possess the same labour market constraint ($\beta = 0.2$). First, one observes that the larger country charges a higher tax rate in equilibrium. The tax differential reaches a maximum for intermediate levels of trade freeness because the advantage of hosting the larger market is maximal there. This result is in line with Bucovetsky (1991). Second, for equally rigid labour markets Nash tax rates are still lower relative to perfect labour markets because capital reacts more sensibly to changes in tax rates. However, the larger country i still charges a higher tax rate.

Figure 3: Different country size



Panel (ii) in Figure 3 links differences in market size to differences in fair wage preferences. Choosing a constellation in which the larger market also faces the higher labour market imper-

fection ($\beta_i = 0.2$ and $\beta_j = 0$), we find that unemployment dominates the market size effect for high trade barriers. Hence, Nash taxes fall short of their foreign counterpart. At some intermediate level of ϕ , however, the advantage of possessing the larger market allows country i to charge higher Nash tax rates than country j . Of course, this outcome is very sensitive to market size and fair wage preferences.

With respect to welfare, all simulations imply that for stronger fair wage preferences the sum of indirect utilities unambiguously declines. As in the standard neoclassical tax competition literature, harmonisation of tax policy would enhance welfare.

5 Conclusions

This paper has implemented a fair wage constraint into a footloose capital agglomeration model to study the impact of imperfect labour markets on tax competition. We showed that rigid labour markets exert a similar impact on the mobile factor as trade liberalisation – it becomes more footloose. As an immediate consequence of this, Nash tax rates fall with the degree of labour market rigidity and trade freeness. For asymmetric market size, we found that the larger country charges a higher tax so that this advantage can potentially offset the location disadvantage of having the more constrained labour market to some extent.

Appendix

A Proof of Proposition 1

Appendix A lays out the proof of Proposition 1.

$$\frac{\partial r_i}{\partial \beta} = \frac{\mu}{\sigma} \frac{\left(\phi K_i + K_j + \frac{\mu}{\sigma} \tilde{\beta} L_j (1 - \phi^2) \right) \frac{L_i}{(1-\beta)^2} (1 - r_i) + \phi (K_i + \phi K_j) \frac{L_j}{(1-\beta)^2} (1 - r_j)}{\left(K_i + \phi K_j + \frac{\mu}{\sigma} \tilde{\beta} L_i \right) \left(K_j + \phi K_i + \frac{\mu}{\sigma} \tilde{\beta} L_j \right) - \phi^2 \left(\frac{\mu}{\sigma} \right)^2 \tilde{\beta}^2 L_j L_i} < 0,$$

$\partial r_i / \partial \beta$ is unambiguously negative as both r_i and r_j must be larger than one by assumption. This result stems from the fact that both the direct domestic and the indirect foreign effect

point in the same direction:

$$\frac{\partial r_i}{\partial \beta_i} = \frac{\mu (1 - r_i)}{\sigma (1 - \beta_i)^2} \frac{(\phi K_i + K_j) L_i + \frac{\mu}{\sigma} L_i \tilde{\beta}_j L_j (1 - \phi^2)}{\left(K_i + \phi K_j + \frac{\mu}{\sigma} \tilde{\beta}_i L_i\right) \left(\phi K_i + K_j + \frac{\mu}{\sigma} \tilde{\beta}_j L_j\right) - \phi^2 \left(\frac{\mu}{\sigma}\right)^2 \tilde{\beta}_i L_i \tilde{\beta}_j L_j} < 0$$

and

$$\frac{\partial r_i}{\partial \beta_j} = \frac{\mu (1 - r_j)}{\sigma (1 - \beta_j)^2} \frac{\phi (K_i + \phi K_j) L_j}{\left(K_i + \phi K_j + \frac{\mu}{\sigma} \tilde{\beta}_i L_i\right) \left(K_j + \phi K_i + \frac{\mu}{\sigma} \tilde{\beta}_j L_j\right) - \left(\frac{\mu}{\sigma}\right)^2 \phi^2 \tilde{\beta}_i L_i \tilde{\beta}_j L_j} \leq 0.$$

Note that the latter effect can only be negative, of course, if trade is not restricted, that is $\phi > 0$.

Furthermore, we determine the impact of fair wage preferences on the unemployment rate U_i .

$$\frac{\partial U_i}{\partial \beta} = \frac{\left((K_i + \phi K_j) (\phi K_i + K_j) + (\phi K_i + K_j) \frac{\mu}{\sigma} \tilde{\beta} L_i\right) \frac{(r_i - 1)}{(1 - \beta)^2} - \phi \frac{\mu}{\sigma} \tilde{\beta} L_j (K_i + \phi K_j) \frac{(r_j - 1)}{(1 - \beta)^2}}{\left(K_i + \phi K_j + \frac{\mu}{\sigma} \tilde{\beta} L_i\right) \left(K_j + \phi K_i + \frac{\mu}{\sigma} \tilde{\beta} L_j\right) - \phi^2 \left(\frac{\mu}{\sigma}\right)^2 \tilde{\beta}^2 L_j L_i} \leq 0$$

The impact of a simultaneous rise in both β_i and β_j on home's unemployment rate is generally ambiguous. However, if both countries are symmetric, we know that $r_i = r_j$ so that the positive direct effect

$$\begin{aligned} \frac{\partial U_i}{\partial \beta_i} &= \frac{r_i - 1}{(1 - \beta_i)^2} + \tilde{\beta}_i \frac{\partial r_i}{\partial \beta_i} \\ &= \frac{r_i - 1}{(1 - \beta_i)^2} \frac{(K_i + \phi K_j) (\phi K_i + K_j) + (K_i + \phi K_j) \frac{\mu}{\sigma} \tilde{\beta}_j L_j}{\left(K_i + \phi K_j + \frac{\mu}{\sigma} \tilde{\beta}_i L_i\right) \left(\phi K_i + K_j + \frac{\mu}{\sigma} \tilde{\beta}_j L_j\right) - \phi^2 \left(\frac{\mu}{\sigma}\right)^2 \tilde{\beta}_i L_i \tilde{\beta}_j L_j} > 0 \end{aligned}$$

outweighs the indirect effect

$$\begin{aligned} \frac{\partial U_i}{\partial \beta_j} &= \tilde{\beta}_i \frac{\partial r_i}{\partial \beta_j} \\ &= -\frac{r_j - 1}{(1 - \beta_j)^2} \frac{\phi \tilde{\beta}_i \frac{\mu}{\sigma} (K_i + \phi K_j) L_j}{\left(K_i + \phi K_j + \frac{\mu}{\sigma} \tilde{\beta}_i L_i\right) \left(K_j + \phi K_i + \frac{\mu}{\sigma} \tilde{\beta}_j L_j\right) - \left(\frac{\mu}{\sigma}\right)^2 \phi^2 \tilde{\beta}_i L_i \tilde{\beta}_j L_j} \leq 0. \end{aligned}$$

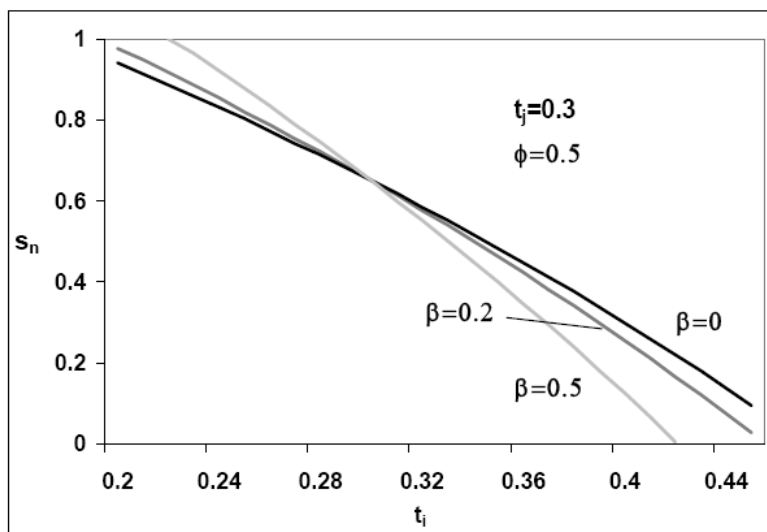
■

B Asymmetric countries

Appendix B sheds some light on the interaction between fair wage parameters and tax rates when countries differ in endowments. Here, we assume that country i is larger than country

j. Figure 4 indicates that our comparative statics results for symmetric countries also show up when market size differs. For $t_j = 0.3$ and $\phi = 0.5$ we see that equally constrained labour markets reduce the share of industry in country *i* relative to perfect labour markets ($\beta = 0$) if $t_i < t_j$ for different levels of β . The simulation exercise also confirms the finding that the tax base responsiveness to changes in tax increases with higher fair wage parameters.

Figure 4: Equilibrium industry share and tax rates



C Parameterisation of the simulations for the long run

We follow Pflüger (2004) in choosing the parameters $\mu = 0.6$ and $\sigma = 6$. To ensure that capital returns always exceed wages, we have to set a sufficiently high labour-capital ratio in each country. So, $L_i = L_j = 1500$ and $K_i = K_j = 100$. We compare positive fair wage parameters with $\beta = 0$ to detect the impact of unemployment. We choose $\beta = 0.2$ so that the change in Nash tax rates becomes visible in the diagrams. For asymmetric country size, we increased both labour and capital endowment of country *i* by ten percent and reduced it for country *j* by the same percentage.

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