Fiscal Incentives and Industrial Agglomeration

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Abstract

In the transitional phase towards full economic integration, European countries have the possibility of re-shaping the continental geography of specialization. We use an Economic Geography model of industrial agglomeration to show how fiscal incentives can be critical in this phase. Differently from other work we concentrate on the role of indirect taxation, and sector specific state-aid, still important in the EU but little studied. While it is obvious that tax incentives could be used to attract some industries, it is not obvious that, in a general equilibrium analysis, such use of taxes is welfare improving. In the paper, we show that the optimal policy is to levy asymmetric taxes on the two sectors only during the phase of intermediate transport costs, when such a measure induces welfare improving agglomerations.

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1 Introduction

If the process of monetary unification in Europe, for the twelve countries in EMU, is close to achieve its final stage with the introduction of the Euro in 2002, the process of policy harmonization and coordination of European countries is still on its way. Particularly hard to achieve, due to strong oppositions within national countries, is any agreement on fiscal policies or on fiscal harmonization (see for example the first section of European Commission [7], entitled, not by chance, "Diversity of the Tax Systems"). Since the fiscal lever is the only instrument of macroeconomic policy left to governments, the resistance comes in part from the need of an instrument to mitigate national business cycles (within the limits dictated by the Pact for Stability and Growth). But there is more.

It is common perception that the gains at stake in this period of increasing integration of the European economy are very high. In a period of potential re-shaping of the continental geography of specialization and industrial agglomeration, many governments perceive this opportunity as unique. With the disappearance of any intra-European trade policy, governments are left only with fiscal incentives in this phase to establish or reinforce their specialization patterns in some industries. If Germany is able to take advantage of its leadership in the car sector and become the European supplier of cars, the reward for this will be long lasting. Similarly, France could become the European leader for the wine and cheese (food processing) industry and Italy for the fashion industry.

Our paper shows that fiscal incentives to stimulate industrial agglomeration are welfare improving for a country in the intermediate phase of globalization. This result is shown using the basic two-country two-sector model of industrial agglomerations developed in Fujita et al. [8], chapter 16 (FKV henceforth), enlarged to accommodate sales taxes and sector-specific state aid.

Our results can be summarized as follows. In the pre-globalization phase, where high transport costs (barriers) induce each country to produce in many different sectors rather than specialize, the optimal policy is to tax symmetrically all sectors so as to minimize distortions. In the fully global economy, each country is specialized and taxation could be relatively high in the agglomerated sector, but not exceeding the point where the pattern of agglomeration is reversed. The most interesting is the intermediate phase. Here, symmetric taxation is the worst policy in terms of welfare, while the best policy is to tax sectors asymmetrically in order to induce full specialization in one sector and benefit from its increased productivity due to agglomeration economies.

These results suggest that the pressure towards harmonization of tax rates and fiscal incentives, coming from the EU Commission and resisted by the single countries, could in fact be suboptimal during the intermediate phase of globalization. If a government is able to induce the agglomeration of one industry with the use of fiscal incentives, the welfare of its citizens improves. In fact, the best policy in this intermediate phase of the process of globalization is to reduce sales taxes on one sector relative to the other up to the point where the asymmetry in the incentives induces complete agglomeration in the favored industry. The pattern of specialization determined in this phase will remain in the subsequent period of complete international integration and the benefits of agglomeration will be long lasting.

In this intermediate phase, transport costs are low enough to ensure stability of agglomeration (once it arises) but still too high to endogenously generate it. To identify such a phase is ultimately an empirical issue. However, while the common market has gone some way in reducing the costs of factor mobility, Europe is still far from being a fully integrated market. Some studies, such as Amiti [2] and Brulhart and Torstensson [5], have found increasing specialization across European countries beginning in the late eighties. This is possibly a sign of the action of agglomeration forces due to the increased size of the common market. Nevertheless Europe is still far from the degree of industrial agglomeration which prevailed in the United States at its peak (see Krugman [10]). This evidence suggests that agglomeration forces may be already present in Europe, and gaining momentum for some industries, but not yet so pervasive as to endogenously generate a tendency to full agglomeration. Europe could very well be, therefore, in the phase in which well designed fiscal incentives are most effective.

The paper is organized as follows. Section 2 describes sector-specific fiscal incentives in the EU and reviews the recent literature on tax competition and economic geography. Section 3 presents the model, introducing taxation and state-aid, and solves for the equilibrium; Section 4 analyzes the effect of taxation on the pattern of specialization and section 5 considers the effect of government spending on specialization. Section 6 discusses optimal taxation and welfare with positive public spending and when the government taxes one sector to subsidize the other with zero public spending. Section 7 considers the strategic interaction between two governments and Section 8 concludes.

2 Fiscal Incentives in the EU

In spite of the efforts of the European Commission to promote harmonization of indirect taxes since the 70's (VAT and excise tax) and to discourage sector-specific state-aid, both form of fiscal incentives are in place and active across EU countries. The Report by the European Commission [7], pg. 10, shows that indirect taxes on consumption (mainly VAT and excise) provided the same revenue in 1997 for the EU governments as direct taxes (personal and corporate taxes). Not only, but the same Report (pg. 13 and pg. 19) shows large differences for VAT and excise taxes across EU countries, both in tax rates and in taxed goods. Similarly, sector-oriented state-aid to the manufacturing sector still represents more than 50% of total state aid in the EU, which is about 1% of GDP for most countries. Moreover, state aid targets very different sectors in different countries (see European Commission [6] for an account of this). Therefore, while being extremely important tools of fiscal policy, these forms of taxation and spending have been somewhat neglected in the economic analysis of European integration. Our paper wants to fill this gap, considering a positive and normative analysis of sector-specific tax and government spending and transfers (state-aid) during the process of economic integration across countries.

Some recent papers study tax competition in economic-geography models, but are mainly concerned with direct taxes, i.e. taxes on factors of production, rather than on sector-specific products. Ludema and Wooton [11] consider a two-country, two-sector model where only one of the two sectors, say the manufacturing one, consists of differentiated goods and can agglomerate; they find that tax competition is attenuated by a reduction in trading costs while it may rise or fall in response to increased factor mobility. Andersson and Forslid [1] and Kind et al. [9] also find that agglomeration creates rents for the mobile factor, as it can be taxed more in the country where it has agglomerated. Baldwin and Krugman [4] develop a model with the same feature and analyze the strategic interaction between the tax policies of the agglomerated country (north) and the non-agglomerated one (south). For intermediate values of the trading cost, the north is better off choosing a tax rate that maintains agglomeration; this tax rate cannot be too high, otherwise the mobile factor would migrate south, but it can be higher than the south's rate thanks to the agglomeration rents.

Our paper adds to this literature by looking more closely at the industrial structure of the manufacturing sector. More precisely, we consider a model where the manufacturing sector consists of several industries and where the government has fiscal tools (indirect taxes, state-aid) which could affect industries differentially. The car, the food-processing and the fashion industries are different and each one of them can agglomerate in a different geographical location. The emphasis of our work is on optimal taxation, as we study the tax policy that maximizes social welfare and how it varies with falling trade costs. Our results suggest that the optimal tax policy should be industry-specific in the sense that it should induce agglomeration in some industries while eliminating others. In this dimension, our results are different and new from those in the literature.

3 Model

We consider two countries, each with two industries, and a single factor of production, labor. The model is laid out for the Home economy; the Foreign economy is completely symmetric and, when it is necessary to distinguish it from the Home economy, we will do so by using the tilde character ˜ on top of the variables. As the model without taxation and public spending is basically identical to the one in FKV, we only sketch its main equations.

Each country is endowed with one unit of labor, which we assume is inelastically supplied by workers. Labor may be employed in either of the two industries, which we label industry 1 and 2, but it cannot move internationally.

Both industries 1 and 2 produce manufacturing goods and are monopolistically competitive. Both industries have a Cobb-Douglas technology that utilizes labor and intermediate goods both from their own industry and from the other industry. On the demand side, all consumers are identical with demand elasticity for each variety in either industry equal to σ. We first describe consumers' behavior, then we move to the producers' behavior, and then we introduce the government sector.

3.1 Consumers

Each consumer maximizes a utility function of the following type:

$$U = X_1^{\delta} X_2^{1-\delta} \tag{1}$$

where δ represents the expenditure share of industry-1 goods. For simplicity, we are going to assume that $\delta = 0.5$. The composite index X_i is defined by:

$$X_i = \left[\int_0^{n_i} x_i(j)^{\frac{\sigma-1}{\sigma}} d\, j \right]^{\frac{\sigma}{\sigma-1}}, \qquad \sigma > 1. \tag{2}$$

where $x_i(j)$ is the amount of each good j consumed, σ is the elasticity of substitution across goods within the same industry and n_i is the number of goods produced in industry i.

The price index for the composite consumption good produced in industry i is denoted by G_i, $i = 1, 2$ and it is equal to

$$G_i \equiv \left[\int_0^{n_i} p_i(j)^{1-\sigma} d\, j \right]^{\frac{1}{1-\sigma}}, \tag{3}$$

where $p_i(j)$ is the price of each manufactured good j produced in industry $i = 1, 2$. The demand function for the j-th variety produced in industry i, obtained maximizing the representative agent's utility is:

$$x_i(j) = x_i = \left[\frac{p_i(j)}{G_i} \right]^{-\sigma} X_i. \tag{4}$$

Under the assumption that $\delta = 0.5$, therefore, half of the total expenditure is channeled to the purchase of each of the composite goods.

As usual we assume that shipping goods between countries is feasible but entails an "iceberg" cost. More precisely, for each unit of shipped good, only the fraction $1/T$, with $T > 1$, of the good actually arrives at destination. We assume that the iceberg transport cost T is constant and that all shipped goods incur the same transport cost, independently of where the shipment originates.

3.2 Producer Behavior and Taxes

As pointed out earlier, industry 1 and 2 produce manufacturing goods and are monopolistically competitive. The production function for the good j in industry i requires a composite input "bundle" defined as Cobb-Douglas aggregate of labor, "own" intermediates and "cross" intermediates, with cost shares α, γ, β[1]. The "bundle" uses more intermediates from the own than the other industry ($\alpha > \gamma$) and this feature generates benefits from industrial agglomeration for transport costs below a certain critical level. The "bundle" to produce a good is required in a fixed amount F, independent of the total output, and in a variable amount with a constant marginal input requirement (c^m).

The profit function for variety j in industry i in the Home economy is as follows:

$$\pi_i(j) = p_i(j)(1-\tau_i)x_i(j) - c_i^u[\,c^m x_i(j) + F], \quad i = 1,2 \tag{5}$$

where c_i^u is the cost per unit of total input and c^m is the marginal input requirement. τ_i is a proportional sale tax levied by the Home government on the Home producers in industry i. We could have alternatively modeled taxes to be levied on consumers rather than producers,[2] but this would have not changed the results qualitatively: producers, who have zero profits, reduce wages to pay the sale tax and reduce consumers' real income, which is equivalent to levying the sale tax directly on consumers.

Each firm takes the prices G_1 and G_2, the wage w_i and taxes τ_i as given; profit maximization implies that the firms choose the after-tax price $p_i(1-\tau_i)$ to be a constant mark-up on marginal costs of production. Choosing the units of input requirements appropriately ($c^m = (\sigma-1)/\sigma$), we have :

$$p_i(1-\tau_i) = w_i^{\beta} G_i^{\alpha} G_{-i}^{\gamma} \tag{6}$$

where w_i is the wage rate paid in industry i. We suppose that there is free entry and exit in response to profits; hence, the zero-profit condition pins down the output for firm j in sector i, as $x^* = F\sigma$. By choosing the appropriate units for fixed F cost , so that $x^* = 1/\beta$, the total income to labor in industry i is given by

$$w_i l_i = n_i p_i(1-\tau_i) \tag{7}$$

where l_i is the labor share employed in industry i and $l_1 + l_2 = 1$. Substituting equations (6) and (7), into (3) we get the following two expressions:

$$G_1^{1-\sigma} = l_1 w_1^{1-\beta\sigma} G_1^{-\alpha\sigma} G_2^{-\gamma\sigma} \left(\frac{1}{1-\tau_1}\right)^{1-\sigma} + \tilde{l}_1 \tilde{w}_1^{1-\beta\sigma} \tilde{G}_1^{-\alpha\sigma} \tilde{G}_2^{-\gamma\sigma} \left(\frac{T}{1-\tilde{\tau}_2}\right)^{1-\sigma}, \tag{8}$$

[1] $\alpha + \gamma + \beta = 1$

[2] In this case, consumers would pay a price gross of the sale tax, $p_i(j)(1+\tau_i)$.

$$G_2^{1-\sigma} = l_2 w_2^{1-\beta\sigma} G_2^{-\alpha\sigma} G_1^{-\gamma\sigma} \left(\frac{1}{1-\tau_2}\right)^{1-\sigma} + \tilde{l}_2 \tilde{w}_2^{1-\beta\sigma} \tilde{G}_2^{-\alpha\sigma} s \tilde{G}_1^{-\gamma\sigma} \left(\frac{T}{1-\tilde{\tau}_1}\right)^{1-\sigma}, \tag{9}$$

Each price index depends on the wage rate paid in the economy where the industry is located, on the price indices of both industries in both countries (due to the use of intermediate goods that may be produced in each economy) and on the tax rates applied to the industry in the two countries. An analogous expression holds for the price index of industry 1 and 2 in the Foreign economy.

3.3 Government Spending

In each country there is a government that levies sale taxes or subsidies to finance its spending. The government levies industry-specific sale taxes and it spends a fraction ϕ of its revenues on the products of industry 1 and $1-\phi$ on the products of industry 2. For simplicity, we have assumed (see equation (1)) that public spending does not affect individual welfare directly. The budget constraint of the Home government is given by

$$\tau_1 \int_{j=0}^{n_1} p_1(j) x_1(j)\, dj + \tau_2 \int_{j=0}^{n_2} p_2(j) x_2(j)\, dj = G_1 g_1 + G_2 g_2, \tag{10}$$

where g_1 and g_2 are the amount of composite good X_1 and X_2, respectively, purchased by the government. In equilibrium, government revenues (the left-hand side of (10)) is

$$\frac{\tau_1 w_1 l_1}{\beta(1-\tau_1)} + \frac{\tau_2 w_2 (1-l_1)}{\beta(1-\tau_2)}.$$

Nominal expenditure on industry 1 in the Home economy is given by

$$E_1 = \left[\frac{w_1 l_1 + w_2 l_2}{2}\right] + \left[\frac{\alpha w_1 l_1 + \gamma w_2 l_2}{\beta}\right] + \frac{\phi}{\beta}\left[\frac{\tau_1 w_1 l_1}{1-\tau_1} + \frac{\tau_2 w_2 l_2}{1-\tau_2}\right], \tag{11}$$

and nominal expenditure on industry 2 in the Home economy is

$$E_2 = \left[\frac{w_2 l_2 + w_1 l_1}{2}\right] + \left[\frac{\alpha w_2 l_2 + \gamma w_1 l_1}{\beta}\right] + \frac{1-\phi}{\beta}\left[\frac{\tau_2 w_2 l_2}{1-\tau_2} + \frac{\tau_1 w_1 l_1}{1-\tau_1}\right]. \tag{12}$$

The first term on the right-hand side of (11) is the demand by consumers, who equally divide their labor income between the goods of industry 1 and 2; the second term on the right-hand side is the demand for intermediate goods originating from the industry 1 itself and from industry 2, respectively a fraction α and γ of industry's production.[3] The third term on the right hand side is the nominal expenditure by the government on industry 1, which is a fraction ϕ of its total tax revenues. A similar interpretation

[3]To obtain equation (11), we make use of (7).

holds for (12), which describes the expenditure on the goods produced by sector 2; notice that here the share of government spending on the sector is $1-\phi$.

At last, the market-clearing condition for industry 1 in the Home economy is

$$\left[\frac{w_1^{\beta} G_1^{\alpha} G_2^{\gamma}}{1-\tau_1}\right]^{\sigma} = \beta \left[E_1 G_1^{\sigma-1} + \tilde{E}_1 (\tilde{G}_1)^{\sigma-1} T^{1-\sigma}\right]. \tag{13}$$

By the Walras' law, the market clears for industry 2 in the Home country; a market-clearing condition similar to (13) holds for the Foreign economy.

4 Taxes and Agglomeration

4.1 General Results

In this section we study the equilibria supported by this model when the government levies sale taxes. The analysis simplifies substantially under the assumption that both the industries and the countries are symmetric. This implies studying an economy where the values of the endogenous variables for industry 1 in the Home economy are identical to the values for industry 2 in the Foreign economy and vice versa for industry 2. Now we assume that the two countries set symmetric tax rates; we relax this assumption and study the strategic interaction between the tax policies of the two countries in section 7.

The equilibrium conditions are spelled out in detail in appendix A; they consist of nine equations for the Home country and, of course, nine equations for the Foreign country. The nine equations for the Home economy are: the market-clearing condition (13) and the zero-profit condition (6), one for each industry; the equilibrium price index (8, 9), the spending equations (11) and (12); the government budget constraint (10); and a price normalization, which we have chosen as the wage in industry 1, i.e. $w_1 \equiv 1$. These nine equations determine nine endogenous variables: $w_2, G_1, G_2, p_1, p_2, g_1, g_2, E_1$ and E_2. The structure of our model plus the symmetry assumptions imply that

$$w_1 = \tilde{w}_2 \quad w_2 = \tilde{w}_1 \quad G_1 = \tilde{G}_2 \quad G_2 = \tilde{G}_1 \quad l_1 = \tilde{l}_2 \quad l_2 = \tilde{l}_1$$

$$g_1 = \tilde{g}_2 \quad g_2 = \tilde{g}_1 \quad E_1 = \tilde{E}_2 \quad E_2 = \tilde{E}_1.$$

Notice that labor mobility across industries within the same country implies that, in equilibrium, $w_1 = w_2$ if the country is not fully specialized, and the symmetry assumption implies that $w_1 = \tilde{w}_2$. Hence, nominal and real wages are identical in the two countries once labor has moved between industry in order to equalize wages. These two further conditions determine the equilibrium values of l_1, l_2. We will study equilibria of this model and their stability by plotting the function of real wages in each industry against the share of workers in industry 1. It is known that the comparison of the behavior of the two real wage functions at the equilibrium points gives the informal conditions for stability, which can be inspected graphically from the simulated plot. In spite of the fact that a fully dynamic model is needed to analyze formally the stability properties of equilibria, these properties are shown by Baldwin [3] to be, under some conditions, consistent with those found by the informal analysis.

Two sets of equilibria are of particular interest to us: equilibria with complete agglomeration and equilibria with diversification. With complete agglomeration, the Home economy has one industry and the Foreign economy has the other. Suppose the Home economy specializes in industry 1 and the Foreign economy in industry 2; then $l_1 = \tilde{l}_2 = 1$. Moreover, since industry 1 operates in the Home country only and vice versa for industry 2, the relationship between the price indices simplifies to $\tilde{G}_1 = TG_1$ and $G_2 = T\tilde{G}_2$.[4] The wage ratio in the Home country as a function of the parameters can be written as

$$\left(\frac{w_2}{w_1}\right)^{\beta} = T^{\gamma-\alpha}\left(\frac{1-\tau_2}{1-\tau_1}\right)\left\{\frac{T^{1-\sigma}}{2}\left[(1-\gamma+\alpha)(1-\tau_1)+2\phi\tau_1\right]\right. \tag{14}$$

$$\left.+\frac{T^{\sigma-1}}{2}\left[(1+\gamma-\alpha)(1-\tau_1)+2(1-\phi)\tau_1\right]\right\}^{\frac{1}{\sigma}}.$$

Agglomeration in industry 1 is sustainable only if industry 2 does not pay higher wages, that is if $w_1 \geq w_2$ and the wage ratio in (14) is greater than one. The first term on the right-hand side represents the backward linkages, namely the share of Home expenditure on industry 1 and 2. The third term on the right-hand side represents the forward linkages, namely the importance of domestic (with higher weight) and foreign (with lower weight) demand. The second term on the right-hand side contains the effect of taxes on the wage ratio. Taxes and the allocation of public spending have an important role on the sustainability of agglomeration. Higher taxes on industry 2, τ_2, reduce the wage ratio because firms in industry 2 pay lower wages to their workers. Higher taxes on industry 1, τ_1, raise the wage ratio if ϕ (the share of spending in sector 1 by the government) is small enough and reduce it otherwise.[5] The intuition for this result is that taxes on an industry have a direct negative effect on wage in the industry but an indirect positive effect via government spending that depends on the fraction of government revenues spent in the industry. An increase in ϕ, leaving taxes unchanged, increases the likelihood of agglomeration as the third term on the right-hand side of (14) declines. Appendix B describes the values for the variables G_1, G_2, E_1, E_2 in the fully agglomerated equilibrium.

The other set of equilibria that can emerge in this model implies some degree of diversification in the industrial structure: each country has both industries. If both

[4]Notice that the symmetry assumption about taxes is necessary for this result.

[5]More precisely, a sufficient condition for an increase in τ_1 to raise the wage ratio on the left-hand side of (14) is that $\phi < \alpha + \beta/2$.

industries are taxed equally ($\tau_1 = \tau_2 = \tau$) and government spending is equally divided on each industry ($\phi = 0.5$), our model delivers dispersion: each country has half of each industry. At this symmetric scenario:

$$E = \frac{1}{2\beta(1-\tau)}, \qquad G^{1-\sigma\beta} = \frac{1+T^{1-\sigma}}{2(1-\tau)^{1-\sigma}}.$$

The symmetric equilibrium is abandoned when transport costs fall enough to make agglomeration feasible and, after that, necessary. The level of transport cost at which agglomeration becomes feasible is

$$T^{\sigma-1} = \frac{(1-\tau)^{1-\sigma}[(\alpha-\gamma)^2+\rho]+(\alpha-\gamma)(1+\rho)}{(1-\tau)^{1-\sigma}[(\alpha-\gamma)^2+\rho]-(\alpha-\gamma)(1+\rho)}. \tag{15}$$

The higher the tax, the lower the transport cost at which agglomeration becomes feasible when $\alpha - \gamma > 0$.[6]

4.2 Simulation Results and Insight

To study further how taxes affect agglomeration, we simulate the economy for the parameter values:

$$\sigma = 6, \quad \alpha = 0.35, \quad \gamma = 0.05, \quad \beta = 0.6.$$

Figure 13 illustrates the Home country's real wages in each industry as a function of the share of labor force in industry 1, l_1; real wages are simply the nominal wages deflated by the price index and they measure also the utility level reached by agents working in sector i:

$$\omega_i = w_i(G_1 G_2)^{-\frac{1}{2}}.$$

In the present section we are going to consider the effect of asymmetric tax rates and public spending on the emergence of industrial agglomerations. With zero taxes and as transport costs decrease, the sustainability of the dispersed equilibrium (where each country produces both goods) becomes only local. The possibility of fully agglomerated equilibria arises in a virtuous circle, as increasing the size of the local market reduces cost of local production. As transport costs decrease even further, the agglomeration equilibria with full specialization for each country are left as the only stable ones. This is the typical result of this type of models; therefore, we refer to FKV for a discussion of the general results and to the appendix D for the simulation of the wage functions at three representative levels of transport costs: high, intermediate and low.

Referring to the cases with no taxes as the benchmark, we explore the effect of asymmetric taxation. The case we focus on is the intermediate phase in the passage from

[6]Notice that agglomeration is not feasible when $\alpha - \gamma < 0$.

high to low transport costs (in our simulation $T = 1.34$). In this case, agglomeration is sustainable; however, if the economy starts in the symmetric, dispersed equilibrium, the market sustains dispersion as long as transport costs remain high enough. In this situation, a tax/subsidy policy can induce welfare-improving agglomeration with higher wages for both countries.

When the government levies the same tax on both industries and equally divides its spending on the two industries, taxation simply reduces real wages and welfare: firms pay lower nominal salaries and public spending crowds out private spending. Figure 1 shows real wages for $\tau_1 = \tau_2 = 0.04, \phi = 0.5$ and $T = 1.34$, which is the same "intermediate" transport cost used in figure 14; the number and properties of the equilibria are the same as in figure 14 and the only difference is that both real wage curves have shifted down.

Asymmetric taxation, as well as asymmetric public spending, has important consequences on the industrial structure of the economy. In figure 2, we investigate the role of asymmetric taxation by setting $\tau_1 = 0.04, \tau_2 = 0.043, \phi = 0.5$ and $T = 1.34$. Higher taxes on industry 2 make real wages fall in industry 2 with respect to industry 1 and wage equalization between the two industries implies that a larger fraction of the work force will choose to work in industry 1. There are only three equilibria now: agglomeration in industry 1, partial diversification (with a bias toward industry 1 for Home and toward industry 2 for Foreign), and an intermediate equilibrium that is unstable. Agglomeration in industry 2 ceases to be sustainable because of higher taxes on the industry. Most importantly, taxation can bring agglomeration by taxing one industry more heavily than the other (or subsidizing one industry at the other's expenses) and making the diversified equilibrium unstable.

Figure 3 shows real wages for $\tau_1 = 0.04, \tau_2 = 0.045, \phi = 0.5$ and $T = 1.34$: the tax on industry 2 is now high enough to eliminate industry 2 at Home and generate agglomeration in industry 1, which is the only sustainable and stable equilibrium allocation in the economy. Of course, the welfare gains from agglomeration must be weighted against the welfare costs of taxation; however, a policy of taxation/subsidies may well be welfare improving. Consider, for example, the case of an economy whose industrial structure is dispersed, perhaps because transport costs or trade barriers were high in the past, but these costs have fallen so that agglomeration is sustainable; the government can levy higher tax on one industry and lower on another to achieve agglomeration (and the higher welfare associated with it). The transition involves adjustment costs, that we have not modeled at all here, as a fraction of the labor force must change jobs and these workers may suffer a real wage loss in the process; such losses are larger the more imperfect the labor market, the harder re-training, etc.

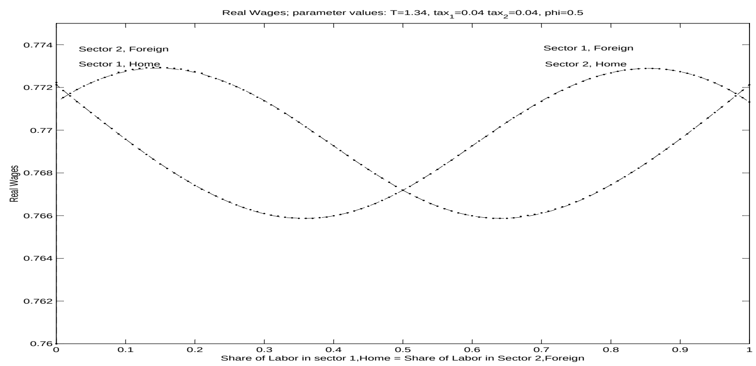

Figure 1: Real wages; T=1.34 and $\tau_1 = \tau_2 = 0.04$

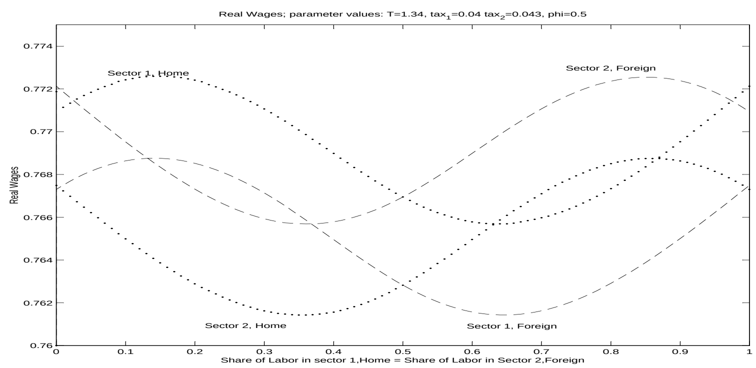

Figure 2: Real wages; T=1.34, $\tau_1 = 0.04$ and $\tau_2 = 0.043$

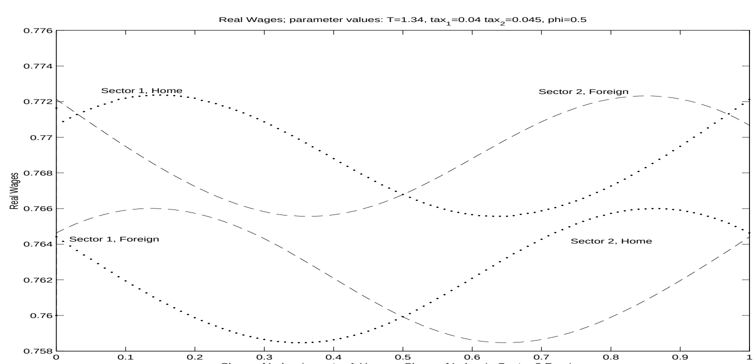

Figure 3: Real wages; T=1.34 , $\tau_1 = 0.04$ and $\tau_2 = 0.045$

5 Public Spending and Agglomeration

In the analysis of different policies, we have so far assumed that government spending is equally distributed between the two industries. This reproduces, in the government, the tastes of the private consumers who equally split their total expenditure between the two types of goods. The government is not giving any explicit impulse to either sector, while we have seen that it may be penalizing them asymmetrically by choosing different tax rates.

In this section we explore the possibility that the government may spend asymmetrically and spell out the consequences of this asymmetry on the patterns of specialization. The only difference, compared with the previous section, is that now we set the taxes to an equal rate in the two sectors ($\tau_1 = \tau_2 = 0.04$) and we allow the parameter ϕ to differ from 0.5. This introduces a bias in public spending in favor of one of the two sectors, as the total expenditure E_1 (see expression (11)) increases in the parameter ϕ.

Beginning, as usual, from the symmetric situation represented in figure 1, a shift in public spending towards the first type of goods ($\phi = 0.6$) increases the specialization of the Home country in sector 1 (see figure 4). This partially specialized equilibrium becomes unsustainable for ϕ high enough and at the value $\phi = 0.8$ the economy fully specializes in sector 1 (figure 5). Again, as in the previous case, by achieving complete agglomeration of one sector in one country, the government induces welfare gains for its citizens to be weighted against the welfare losses stemming from the existence of a public sector that, by spending, reduces citizens' income. If these decisions on taxes or spending are not perfectly symmetric between sectors, the government can generate a critical push towards welfare-improving specialization. This role will be particularly important in a phase of intermediate transport costs when agglomeration forces are not strong enough to ensure naturally arising agglomerations, but are already strong enough to make agglomeration socially desirable. From our simulation is also clear that the government needs to impose a larger asymmetric shift if it uses spending, rather than taxes, in generating agglomeration. A difference between the two tax rates equal to 12% of the tax itself is sufficient to induce full agglomeration, while we need a difference in spending of around 300% to generate agglomeration. This is due to our assumption that public demand is only a small fraction of total demand for each good and it therefore needs to be changed drastically to induce agglomeration.

The model tells us that, once we endogenize the pattern of specialization of one country by allowing for forward and backward linkages that will set into motion self-reinforcing agglomeration economies, there is a very critical period for determining the future specialization of a country. This period is the phase when transport costs are at an intermediate level: low enough to sustain full agglomeration but still too high to undermine the stability of the dispersed equilibrium. In this phase, specific economic policies in the form of taxing one sector rather than another or concentrating public spending in one sector might trigger the agglomeration process and ensure a long lasting

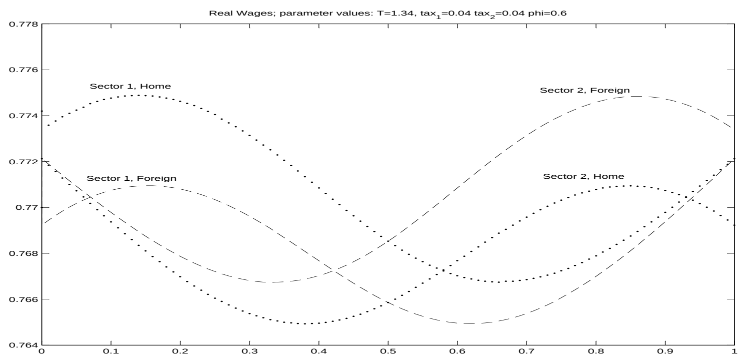

Figure 4: Real wages, $T = 1.34, \phi = 0.6$

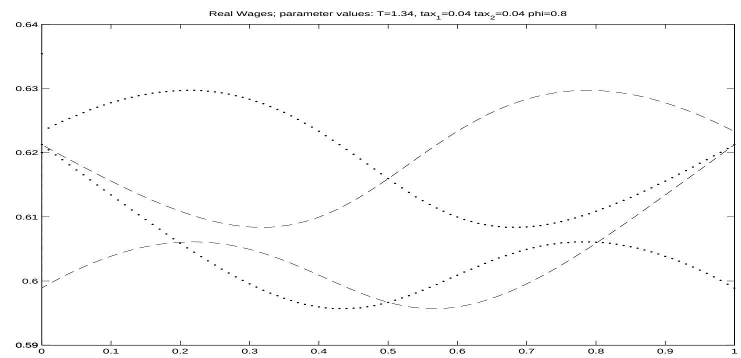

Figure 5: Real wages, $T = 1.34, \phi = 0.8$

specialization in the favored sector. In this sense, there may be an incentive for the government to direct its policies wisely in this phase, targeting one sector and inducing its agglomeration, rather than accepting the non-specialized equilibrium arising from the operating of the markets.

6 Optimal Taxation: Welfare Analysis

6.1 Positive Public Spending

In order to analyze the issue of optimal policy, although in a stylized context, we assume that the government collect taxes in order to finance an exogenously given level of public spending. Also, our exercise involves only comparative static and we do not consider transitional costs and frictions to move from one equilibrium to another. A benevolent government that maximizes the welfare of citizens should choose taxes in order to maximize their equilibrium real wages:

$$\omega_i = w_i(G_1 G_2)^{-\frac{1}{2}}, \tag{16}$$

subject to the constraint

$$\frac{\tau_1 w_1 l_1}{\beta(1-\tau_1)} + \frac{\tau_2 w_2 (1-l_1)}{\beta(1-\tau_2)} = \Theta, \tag{17}$$

where Θ is the (given) government spending.[7] Clearly the values of w_i, G_1, G_2 are those which prevail in the equilibrium that satisfies equations (8), (9), (11), (12) and (13). If an equilibrium without agglomeration exists, then we choose it as the starting equilibrium, as our hypothetical story begins with a de-specialized world, due to high transport costs. Only when full agglomeration arises as the unique solution, we assume that the economy will spontaneously converge to it. We use the same parameter values as in the simulations reported in the Appendix D: $\sigma = 6, \alpha = 0.35, \gamma = 0.05, \beta = 0.6$ and we choose $\Theta = 0.2$, which gives a public spending per capita equal to 20% of personal labor income in the home country. We report the values of ω_i as a function of the ratio (τ_2/τ_1).

In the case of high transport costs ($T = 1.4$, the pre-global phase) the utility function has a maximum in the symmetric tax arrangement $\tau_2/\tau_1 = 1$ (see Figure 6), confirming the intuition that, in this case, the best policy is to keep taxes symmetric and not distort relative prices. Symmetric taxes do not affect the incentives of workers to move between sectors and they ensure the second-best equilibrium from the social point of view (the first-best being the social optimum with zero taxes).

In the case of very low transport costs ($T = 1.2$, the fully-global case, represented in Figure 7) the utility of the agent does not depend on the tax levied in the sector which has disappeared and therefore, given the tax rate τ_1 that ensures the satisfaction of the budget constraint, utility is the same for any level of τ_2. There is nevertheless a minimum level of τ_2 which allows agglomeration to be sustained. In fact, if τ_2 falls below a threshold, derived in Appendix C, then the incentive to produce in sector 2 becomes very strong and agglomeration unravels. This result is the same as the one derived by models of "fiscal competition" with agglomeration economies and mobility of capital (see Baldwin and Krugman [4] or Kind et al. [9]): in taxing a sector (a factor in their case), a country can take advantage of the agglomeration externalities in place and levy higher taxes on the agglomerated sector. But beyond a certain point, the incentives reverse and agglomeration is destroyed. For our parameter values, the lower bound of the ratio τ_2/τ_1 is 0.9, with $\tau_2 = 0.10$ and $\tau_1 = 0.11$.

Finally, the intermediate phase ($T = 1.34$) shows the most interesting and counter-intuitive behavior of welfare as taxes become progressively asymmetric. Figure 8 shows

[7] The constraint (17) is the same as (10) with $\Theta = G_1 g_1 + G_2 g_2$.

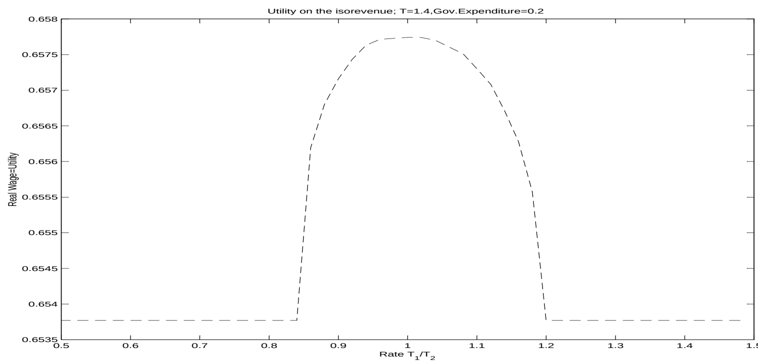

Figure 6: Agent's utiliy on the isorevenue, $T = 1.4$

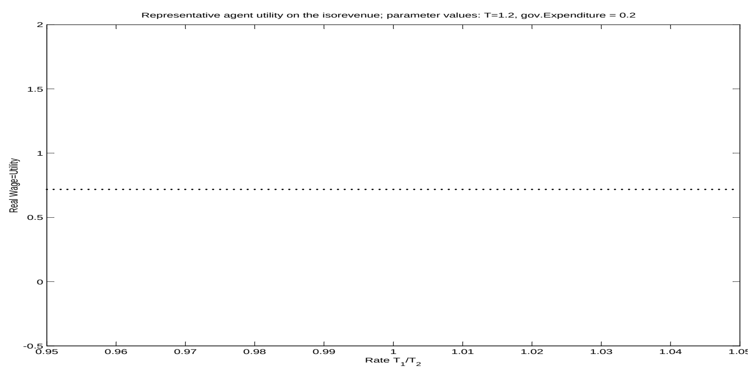

Figure 7: Agent's utiliy on the isorevenue, $T = 1.2$

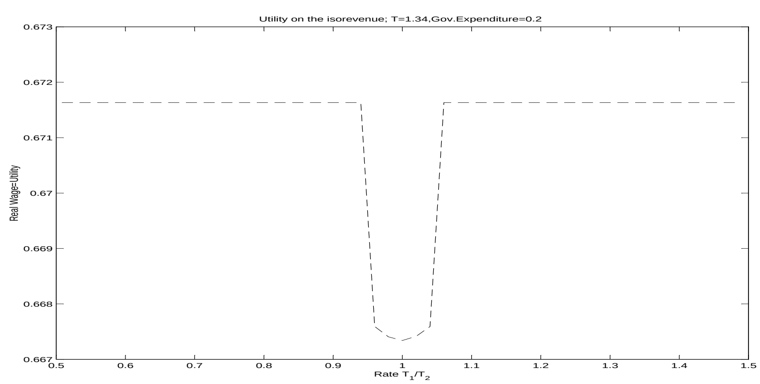

Figure 8: Agent's utiliy on the isorevenue, $T = 1.34$

the tax ratio τ_2/τ_1 on the horizontal axis and the representative agent's utility along the isorevenue on the vertical axis. Symmetric taxation delivers the lowest utility because the economy is non-specialized. As taxes become asymmetric, increasing specialization allows the backward linkages to step in and to benefit the productivity of the sector that becomes concentrated until full agglomeration is reached. Already at the ratio $\tau_2/\tau_1 = 0.9$ complete agglomeration has been reached and the full benefits of agglomeration have been exploited. In this intermediate phase, therefore, the government should actively pursue fiscal incentives that alter the relative price of the products of the two sectors in order to promote agglomeration and benefit from the backward linkages.

6.2 Subsidies with Zero Public Spending

So far we have assumed that the government has to insure a revenue to finance public spending. This spending, though, has no direct impact on people's utility. It is therefore natural to consider what happens, and in particular, what is the optimal fiscal policy when public spending is zero and the government taxes one sector to subsidize the other. This is the ideal setting to evaluate the effects of taxation on welfare via the agglomeration channel only: no resources are subtracted to the private sector due to public spending and the government simply redistributes between sectors via tax/subsidies on sales.

We assume now that government spending is zero, namely $\Theta = 0$, and τ_1 and τ_2 are chosen so as to balance the government budget (17). We represent the utility (real wage) of the worker for increasing values of τ_1 from 0 to 0.01 and let τ_2 to be determined endogenously in order to balance the budget. Again we assume that our world begins in a de-specialized equilibrium and therefore agglomeration arises only when that equilibrium becomes unstable.

Figures 9, 11 and 10 represent the behavior of real wages as a function of the tax rate in sector 1, for low, intermediate and high transport costs, respectively. Again, the economies in Home and Foreign are supposed to be in the dispersed equilibrium initially due to high transport costs. As before, we note the reversed behavior in the intermediate case, compared with the other two. With high ($T = 1.4$) and low ($T = 1.2$) transport cost, the tax rate that delivers highest utility is $\tau_1 = 0$. In the low transport cost case (figure 9), as we start from full agglomeration of sector 1,[8] an increase in the tax on sector 1 (and subsidy to sector 2) induces the unraveling of that agglomeration and, beyond the level $\tau_1 = 0.003$, agglomeration in the other sector arises. This corresponds to a welfare gain, as the country now specializes in the sector with the (endogenously) zero tax rate. As agglomeration in the other sector is reached, utility jumps back at the level reached for $\tau_1 = 0$ because the country specializes in sector 2 with $\tau_2 = 0$.

[8]Dispersion is not sustainable with low transport costs.

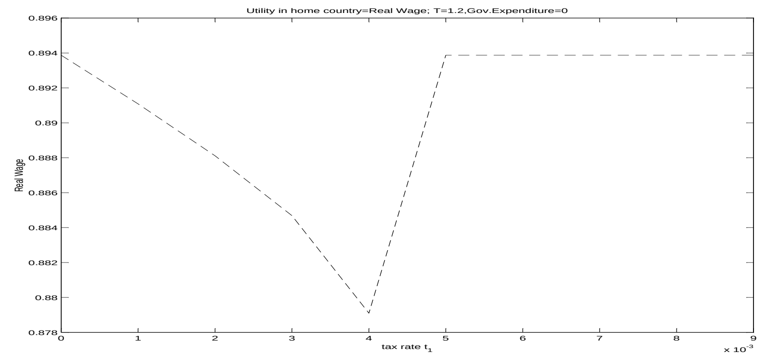

Figure 9: Real wages with $\Theta = 0,\ T = 1.2$

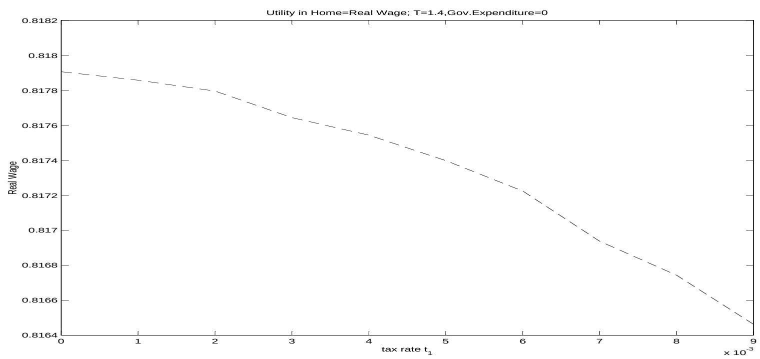

Figure 10: Real wages with $\Theta = 0,\ T = 1.4$

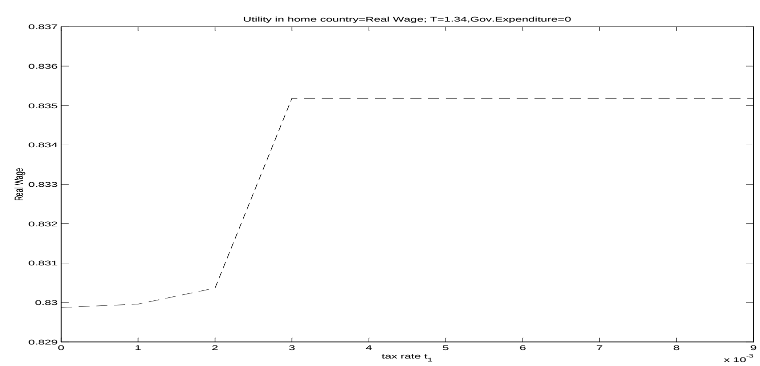

Figure 11: Real wages with $\Theta = 0,\ T = 1.34$

In the high transport cost case (figure 10), an increase in the tax on sector 1, starting from $\tau_1 = 0$, simply distorts incentives, decreases utility while progressively shifting specialization toward sector 2. Finally, and differently from the two previous cases, for the case with intermediate transport cost ($T = 1.34$ in figure 11), the choice of $\tau_1 = 0$ is the worst, while utility is maximized at the tax rates that induce agglomeration (in our case $\tau_1 \geq 0.3\%$). If we keep increasing τ_1 after that level, real wages do not change as sector 1 has disappeared. The benefits of agglomeration are fully appropriated at the lowest rate that generates such an outcome.

We assume that, whenever two tax schemes are indifferent, i.e. they generate the same real wage, the government will choose the one with the smaller (in absolute value) tax rates.[9] With this assumption, there is a well-defined optimal policy in each of the three scenarios. In the pre-and post global phases, the market does its job efficiently and no need arises for government intervention: the optimal scheme is $\tau_1 = 0, \tau_2 = 0$. In the intermediate stage, on the other hand, tax/subsidy policies may be welfare-improving. In particular, the lowest tax rate that is able to induce agglomeration in the subsidized sector is the optimal tax rate to be levied in this phase ($\tau_1 = 0.3\%, \tau_2 = 0$ in the case simulated above).

Before concluding this section, a few caveats are in place. First, we want to emphasize the comparative static nature of our exercise, which neglects the costs of reallocating resources from one sector to the other. In countries where frictions and rigidities are high, especially in the labor market, these benefits (net of costs) of specialization can be reduced (see Peri [12]). Second, while theoretically interesting the intermediate phase of globalization may be empirically hard to assess: what level of trade costs will trigger this phase? Probably though, the European Union, with its several waves of countries at different stages of their admission process, could provide an excellent test, to check if there is an intermediate, qualitatively different, phase in the process and how the policies of governments will try to take advantage of fiscal incentives in this phase.

7 Strategic Tax Game

So far we have assumed that a certain tax policy in one country was matched by the symmetric policy in the other country. More precisely, if Home chooses the tax scheme $(\tau_1 = x, \tau_2 = y)$ then Foreign chooses $(\tilde{\tau}_1 = y, \tilde{\tau}_2 = x)$, always with the restriction that the government budget is balanced. In this section we show that this is indeed the optimal strategy for each government in the setting considered so far. Then we extend our results to different settings.

[9] This result would arise in a model either with explicit dead-weight losses from taxation or with elastic labor supply.

As we know from the previous section, tax policy plays an important and relevant role in the intermediate phase of globalization ($T = 1.34$); hence, we concentrate on this specific phase. For simplicity, we continue to assume: [1] the economy starts in the symmetric dispersed equilibrium; [2] zero spending by both the Home and the Foreign government. We focus on the tax-subsidy game played by the two authorities.

As the benefits of positive tax come from agglomeration, while the costs come from the distortions generated before or after agglomeration, each government has the incentive to target a sector and achieve agglomeration in it via a subsidy to production. Two facts are worth emphasizing. First, asymmetric taxes distort relative prices and reduce welfare with incomplete agglomeration. Figure 11 shows that the welfare gains from agglomeration are achieved for $\widetilde{\tau}_2 = \tau_1 = 0.3\%$. With $\tau_1 = 0.3\%$, industry 1 disappears, industry 2 is agglomerated so that, in the new equilibrium, $\tau_2 = 0$ and there are no relative price distortions. Second, since agglomeration externalities are identical in the two industries, each country is indifferent as to which industry to agglomerate in. This implies that, given the strategy of Foreign (say, subsidize industry 2), the Nash strategy for the Home government is to target the industry that Foreign does *not* (say, subsidize industry 1) and set $\tau_1 = 0.3\%$ so as to guarantee full agglomeration. Hence, symmetric tax/subsidies are the optimal strategy for each government.

If the game is simultaneous, the two governments may need to coordinate their policies so as to avoid targeting the same industry, which would generate distortions without achieving agglomeration. The need to coordinate disappears in more realistic scenarios, such as if the game is sequential or there are costs from reallocating resources from one industry to another and the dispersed equilibrium is not completely symmetric.

If the agglomeration externalities are stronger in one of the two industries, the governments are no longer indifferent in which industry to agglomerate and may therefore compete to achieve agglomeration in the industry with the strongest agglomeration. In this situation, the costs of reallocating resources and initial asymmetries of the dispersed equilibrium are going to play an important role in determining which country wins the race to the preferred industry.

If resource reallocation is costly and takes time, the transition from a dispersed to the agglomerated equilibrium with intermediate transport costs occurs only if there are incentives to undertake such reallocation. One way is to levy a tax on one sector and provide a subsidy to the other, as we have seen earlier, with the other country implementing the symmetric policy; notice that, once agglomeration has been achieved, taxes/subsidies are no longer necessary. This equilibrium, however, implies that the transition to agglomeration is accompanied by relative price distortions for both countries. Each country would be better off by not levying a tax/subsidy if, and only if, the other country is already doing this: the country that is not levying any tax enjoys agglomeration without having to suffer the distortions in the transition. Hence, each country prefers the other to enact fiscal policies conducive to agglomeration and, in

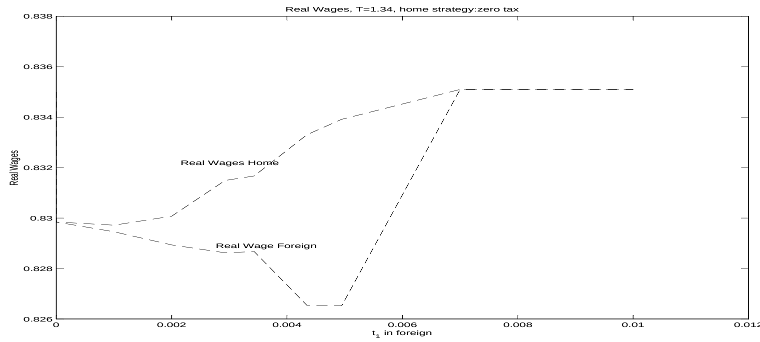

Figure 12: No Home response to Foreign subsidy with reallocation costs

response, just do nothing. This strategic game is similar to a prisoners' dilemma and may lead to welfare-reducing delays in achieving agglomeration.

Figure 12 illustrates the case. In figure 12 we have assumed that Home charges no taxes in response to the balanced budget policy of Foreign that subsidizes sector 2 and taxes 1; namely $(\tilde{\tau}_1 = y, \tilde{\tau}_2 = -y), (\tau_1 = 0, \tau_2 = 0)$. Remember that the transition to the new steady state is not immediate because there are reallocation costs. Up to the point where complete specialization is reached, Home asymmetrically receives larger advantages, due to increasing agglomeration without domestic taxes. At the agglomeration point, nevertheless, now reached for $\tilde{\tau}_1 = 0.006$, the utility reached by the two countries is the same and it is equal to the utility level reached for the symmetric case because now the tax on the agglomerated sector is endogenously 0.

This result raises two issues. First, the policies mandated by the EU Commission for eliminating EU state aid to specific sectors and harmonize indirect taxes are well-designed for the long run, but may be ill-conceived for the short run. To speed up industrial agglomeration, the EU countries may need to be able to use fiscal incentives. Second, while homogenization is sub-optimal, coordination among EU countries would be beneficial in the short run to avoid costly delays in agglomeration.

8 Conclusions

The model presented in this paper is a contribution to the analysis of the effect of fiscal policy on the emergence of the pattern of international specialization using the frame of the "new geography" models. Contrarily to well-known model of international fiscal competition, which focuses on the effect of direct tax on a mobile factor, this model considers the effect of sale taxes on international specialization among countries that become increasingly more integrated. The interesting and novel message emerging from the analysis is that there is a crucial phase, substantially different from the others, in terms of the consequences of optimal fiscal policy on the pattern of specialization.

We believe that this phase, which we call the “intermediate” phase of the globalization process, is the relevant one for Europe in the present years: technological increasing returns are strong enough to support agglomeration, but local barriers, still strong, prevent the agglomerations to arise endogenously. During this phase, the government can affect the pattern of specialization of a country by taxing less the sector in which it wishes to specialize. In so doing, the government ensures future specialization of the country in that sector and also improves, in the medium run, the welfare of its citizens by increasing the efficiency of production due to agglomeration economies.

National governments, therefore, have an unprecedented but perhaps brief opportunity to affect the geography of specialization of Europe. The key instruments to achieve agglomeration are not trade policies any more, long gone in the European Union, but fiscal policies, namely a policy of indirect taxation that favors some products against others.

A Appendix 1

The model we solve consists of the following nine equations for the Home country (and nine symmetric equations for the Foreign country):

$$w_1 = 1 \tag{18}$$

$$\left[\frac{w_2^{\beta} G_2^{\alpha} G_1^{\gamma}}{1-\tau_2}\right]^{\sigma} = \beta \left[E_2 G_2^{\sigma-1} + \tilde{E}_2 (\tilde{G}_2)^{\sigma-1} T^{1-\sigma}\right]. \tag{19}$$

$$p_1(1-\tau_1) = w_1^{\beta} G_1^{\alpha} G_2^{\gamma} \tag{20}$$

$$p_2(1-\tau_2) = w_2^{\beta} G_2^{\alpha} G_1^{\gamma} \tag{21}$$

$$G_1^{1-\sigma} = l_1 w_1^{1-\beta\sigma} G_1^{-\alpha\sigma} G_2^{-\gamma\sigma} \left(\frac{1}{1-\tau_1}\right)^{1-\sigma} + \tilde{l}_1 \tilde{w}_1^{1-\beta\sigma} \tilde{G}_1^{-\alpha\sigma} \tilde{G}_2^{-\gamma\sigma} \left(\frac{T}{1-\tilde{\tau}_2}\right)^{1-\sigma}, \tag{22}$$

$$G_2^{1-\sigma} = l_2 w_2^{1-\beta\sigma} G_2^{-\alpha\sigma} G_1^{-\gamma\sigma} \left(\frac{1}{1-\tau_2}\right)^{1-\sigma} + \tilde{l}_2 \tilde{w}_2^{1-\beta\sigma} \tilde{G}_2^{-\alpha\sigma} \tilde{G}_1^{-\gamma\sigma} \left(\frac{T}{1-\tilde{\tau}_1}\right)^{1-\sigma}, \tag{23}$$

$$E_1 = \left[\frac{w_1 l_1 + w_2 l_2}{2}\right] + \left[\frac{\alpha w_1 l_1 + \gamma w_2 l_2}{\beta}\right] + \frac{\phi}{\beta}\left[\frac{\tau_1 w_1 l_1}{1-\tau_1} + \frac{\tau_2 w_2 l_2}{1-\tau_2}\right], \tag{24}$$

$$E_2 = \left[\frac{w_2 l_2 + w_1 l_1}{2}\right] + \left[\frac{\alpha w_2 l_2 + \gamma w_1 l_1}{\beta}\right] + \frac{1-\phi}{\beta}\left[\frac{\tau_2 w_2 l_2}{1-\tau_2} + \frac{\tau_1 w_1 l_1}{1-\tau_1}\right], \tag{25}$$

$$\frac{\tau_1 w_1 l_1}{\beta(1-\tau_1)} + \frac{\tau_2 w_2 (1-l_1)}{\beta(1-\tau_2)} = G_1 g_1 + G_2 g_2, \tag{26}$$

B Appendix 2

The fully agglomerated equilibrium is characterized by the following values:

$$G_1 = \frac{T^{\frac{\gamma\beta}{\beta\sigma-1}}}{(1-\tau_1)^{\frac{1-\sigma}{1-\beta\sigma}}}, \qquad G_2 = TG_1, \tag{27}$$

$$E_1 = \frac{1}{2} + \frac{\alpha}{\beta} + \phi\frac{\tau_1}{\beta(1-\tau_1)}, \quad E_2 = \frac{1}{2} + \frac{\gamma}{\beta} + (1-\phi)\frac{\tau_1}{\beta(1-\tau_1)}. \tag{28}$$

C Appendix 3

From equation 14 we can find the condition that ensures the sustainability of the fully agglomerated equilibrium. This condition is that the right hand side of the expression is smaller than one, namely

$$\begin{aligned} T^{\gamma-\alpha}\left(\frac{1-\tau_2}{1-\tau_1}\right)\left\{\frac{T^{1-\sigma}}{2}\left[(1-\gamma+\alpha)(1-\tau_1)+2\phi\tau_1\right]\right. \\ \left.+\frac{T^{\sigma-1}}{2}\left[(1+\gamma-\alpha)(1-\tau_1)+2(1-\phi)\tau_1\right]\right\}^{\frac{1}{\sigma}} < 1. \end{aligned} \tag{29}$$

Isolating τ_2 on one side of the inequality we have that the lower bound for that parameter, still ensuring agglomeration in sector 1, is:

$$\tau_2 > \frac{B-1}{B} \tag{30}$$

where

$$\begin{aligned} B = T^{\gamma-\alpha}\left(\frac{1}{1-\tau_1}\right)\left\{\frac{T^{1-\sigma}}{2}\left[(1-\gamma+\alpha)(1-\tau_1)+2\phi\tau_1\right]\right. \\ \left.+\frac{T^{\sigma-1}}{2}\left[(1+\gamma-\alpha)(1-\tau_1)+2(1-\phi)\tau_1\right]\right\}^{\frac{1}{\sigma}}. \end{aligned} \tag{31}$$

D Appendix 4

Here we show the simulation for the parameter values described in section 4. Figure 13 has been drawn for no taxes and high transport costs $\tau_1 = \tau_2 = 0$, $T = 1.4$. In this case the unique equilibrium is at the intersection of the two curves, where $\omega_1 = \omega_2$ and $l_1 = l_2 = 0.5$. This can be called the dispersed equilibrium and it is stable because

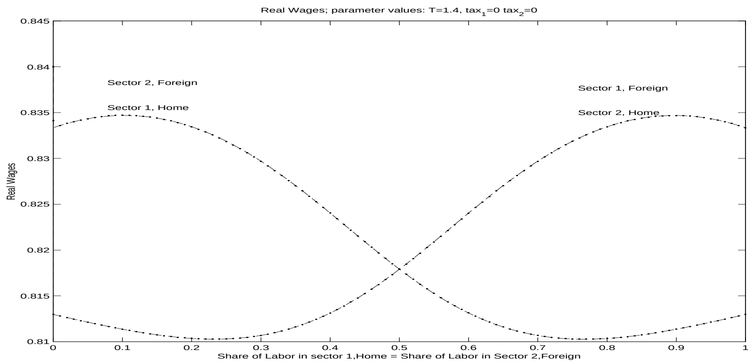

Figure 13: Real wages, $T = 1.4$

an increase in the labor force in industry 1 brings a reduction in the real wage in that industry. Agglomeration is not sustainable because shipping goods between countries would imply incurring high trade costs and reducing welfare; this can be easily double-checked in figure 13, which shows that $\omega_1 < \omega_2$ when $l_1 = 1$ and the Home economy is fully agglomerated in industry 1, and vice versa when the Home economy is fully agglomerated in industry 2. As transport costs fall and taxes remain unchanged (at zero level), agglomeration becomes sustainable and real wages increase.

Figure 14 depicts real wages for $\tau_1 = \tau_2 = 0, T = 1.34$. There are now five equilibria: agglomeration in industry 1, agglomeration in industry 2, dispersion, and two intermediate equilibria between dispersion and full agglomeration. The two intermediate equilibria are unstable whereas dispersion and full agglomeration in either sector are stable equilibria. Notice that not only is agglomeration sustainable ($\omega_1 > \omega_2$ at $l_1 = 1$ and $\omega_2 > \omega_1$ at $l_2 = 1$) and stable, but it is also welfare improving over dispersion, as the real wages at full agglomeration are higher than the real wages at dispersion. Intuitively, firms incur lower trade costs on intermediate products under agglomeration, thereby raising real wages and consumption for individuals. Hence, agglomeration is welfare improving at intermediate transport costs.

At low transport costs, industrial diversification becomes unstable and agglomeration becomes the only stable outcome. Real wages for $\tau_1 = \tau_2 = 0$, $T = 1.2$ are shown in figure 15: the equilibrium at $l_1 = l_2 = 0.5$ is now unstable, as a small increase in l_1 leads to an increase in ω_1. Because of the built-in symmetry of our model, the Home economy is indifferent and may specialize in either industry.

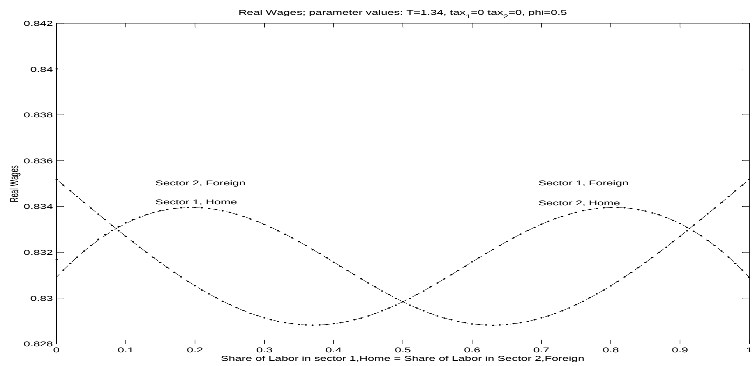

Figure 14: Real wages, $T = 1.34$

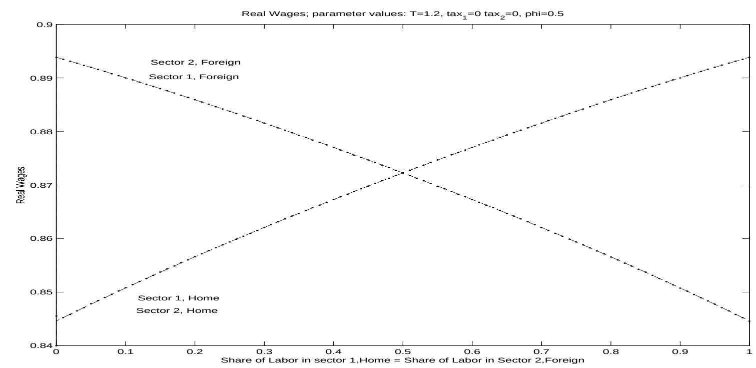

Figure 15: Real wages, $T = 1.2$

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