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Endogenous Regional Policy in a Model of Agglomeration

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It is a widely observed fact that in many European countries, regions of low population density get subsidies that are not justified by their size. This paper throws some light on the effect of this phenomenon on location of manufacturing activities. Considering a simple two-region economic geography model enriched to allow for endogenously determined regional policy, we find that, once the political economics of regional policy is explicitly considered, region size has an ambiguous effect in determining the equilibrium regional subsidy, while it still plays a key role in the determination of the equilibrium share of industrial activities. In particular the final allocation of firms will depend both on the relative economic strength of the two regions, as predicted by more orthodox economic geography models, and by their relative political weight.

Endogenous Regional Policy in a Model of Agglomeration*

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Abstract

It is a widely observed fact that in many European countries, regions of low population density get subsidies that are not justified by their size. This paper throws some light on the effect of this phenomenon on location of manufacturing activities. Considering a simple two-region economic geography model enriched to allow for endogenously determined regional policy, we find that, once the political economics of regional policy is explicitly considered, region size has an ambiguous effect in determining the equilibrium regional subsidy, while it still plays a key role in the determination of the equilibrium share of industrial activities. In particular the final allocation of firms will depend both on the relative economic strength of the two regions, as predicted by more orthodox economic geography models, and by their relative political weight.

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1 Introduction

The attempt to avoid the de-location process associated with trade integration has been one of the main concerns of European policy makers during the last decade. State aids to rural regions in various European countries and the European Union's Structural Funds' allocation are issues tackled by hot political debates. In this context we often observe that interests of relatively small groups are given an exceptional weight if compared to the groups' size. It is widely recognized, for example, that rural population's concerns in developed economies receive an attention that is hardly explained by these groups' electoral force (e.g., farmers account for about only 5% of the French or Swiss populations). In the 1994-99 budget period, people living in "Objective 1" European regions, i.e. in regions whose per capita GDP is below the 75% of the EU's average GDP, were about the 25% of the total European population. Over the same period, the European Union's Structural Funds, which are mainly used to finance aids to poor regions, represented 1/3 of the EU total budget, coming second to the CAP only.

With the exception of a few recent examples, the existing literature on economic geography does not consider the political aspects of integration. When it does, it either treats the instruments of regional policy as exogenously determined (Baldwin and Robert-Nicoud 2000, Martin 1999, Martin and Rogers 1995, Ottaviano and Thisse 1999) or addresses the specific issue of tax-competition among different constituencies (Andersson and Forslid 1999, Baldwin and Krugman 2001, Kind, Midelfart-Knarvick and Schjelderup 2000, Ludema and Wooton 2000). The aim of the present paper is to address the issue of agglomeration during a process of regional integration with policy choices of the centralized government endogenously determined. In what follows, deepening integration has an impact on location of economic activities. Regional policy is designed in such a way that it can influence the agglomeration process. The level and the direction of the regional intervention is determined by the political economy game among agents. Before turning to the development of the model, we briefly discuss the main characteristics of the economic geography and of the political economy elements of our framework.

The economic model we propose is in the tradition of the so-called "new economic geography" *à la* Fujita, Krugman and Venables (1999). Particularly we will be working on a simplified version of the Flam-Helpman adaptation of the Dixit-Stiglitz monopolistic competition model. Firms of a two-asymmetric-region country produce a differentiated product using one unit of capital (the fixed cost) and a per-unit-of-output amount of labor (the variable cost). By assumption, capital is cross-regionally mobile, but capital owners are not, that is, if the capital owner does not live in the region where her unit of capital is used, then the reward on this unit is "repatriated" to the region where she lives. Labor is perfectly mobile only across sectors within a region.

The interaction of increasing returns to scale at the firm level and transportation costs gives rise to the traditional home market effect (Krugman 1980). As it is well-known, new economic geography models predict that, if a country has an idiosyncratic large demand for one type of good which is produced under increasing returns to scale and if trade of that good is not completely free, that country will attract a more than proportional share of the total industrial activity and will end up exporting the good, contrary to what the neoclassical literature on international trade would predict.

The fact that capital income is repatriated and that labor is immobile across regions breaks the "circular causality" processes typical of more general economic geography models. Consequently, our model will not feature any catastrophic agglomeration properties, allowing us to get analytical results once we endogenise regional policy. (As is well known, models that display catastrophic agglomeration in a context of asymmetric regions are typically not analytically solvable, even without adding any endogenous regional policy variable.)

State intervention at the regional level could take any form, from infrastructure spending to tax reduction and so on so forth. To be concrete we will focus on a location subsidy consisting in a per-firm fixed cost cut. As such, given that the fixed cost consists only of capital, the location subsidy is, in fact, a subsidy to capital (and, at equilibrium, to the level of production). Capital owners who set up their firm in the subsidized region will receive the subsidy independently on where they live. The interaction between the two regions at the political level will determine the direction and the amount of the regional subsidy.

Sectorial concerns are likely to be transmitted to the decision makers through lobbying activities (see e.g. Becker 1983, Grossman and Helpman 1995, Olson 1965). However, when we look at regional issues, as we do here, we see regions as spatial entities and not as sectors. Being often recognized as distinct entities in the political system, regions are more likely to influence the policy outcome directly, i.e. through elections. Hence, we will not rely on a lobbying approach in order to characterize the political game. Rather, we use a Hotelling-Downs probabilistic-voting model (Hinich 1977, Ledyard 1984).[1] In addition to the policy dimension that characterizes median-voter models, swing-voter models (as they are also referred to) feature a second, political, dimension: voters are endowed with non-policy preferences over the two parties ('ideology', say). The economic-policy dimension is, by assumption, orthogonal to 'ideology' and candidates know voters' preferences on the economic issue, but only their distribution over the political dimension.

Still with a median-voter kind of model in mind, this will shift the equilibrium policy variable in favor of the small region as the candidates now maximize a sort of weighted social welfare function (see Persson and Tabellini 2000, chapter 3). Moreover, we assume that the population in the urban region is more spread along the political dimension than in the small, rural one. We do so on the ground that in more urbanized regions economic activities and, hence, special interests are more variegated than in less urbanized ones (or, equivalently, that regional policy is less salient an issue).[2]

The fact that small groups have sometimes a disproportionate political power is not new in the literature. Alternative explanations exist. For instance, small groups can presumably circumvent the fee-rider problem in getting organized as pressure groups more easily (Olson 1965). Or, the electoral system might incite competing candidates to appeal on narrowly defined and specific groups rather than more broadly (Myerson 1993, Persson and Tabellini 2000, chapter 8).

In our geography model, this fact has interesting implications: once regional policy is considered as a political issue, if the rural region is politically over-represented, economic integration does not necessarily leads to agglomeration of industries in the larger region, as the orthodox geography model would predict. The location of economic activities, which is, indeed, the ultimate concern of the voters, will depend both on the economic home-market effect and on what we call the vote-market effect by analogy. For a low level of economic integration, we get some sort of dispersion (neither region attracts all firms); close to full integration, a core-periphery pattern emerges. Our key result is that, at the political economy equilibrium, the big region will attract the core if (and only if) its relative economic strength (due to

[1] See Coughlin (1992) for an exhaustive analysis of the probabilistic voting approach to representative democracy.

[2] This stylized fact - that larger cities tend to be more diversified - is one of many on city diversity and specialisation, as surveyed by Duranton and Puga (2000).

its larger size) overcomes its eventual relative political weakness (due to the higher dispersion of population along the political dimension). Finally, and interestingly, the direction of the equilibrium subsidy is ambiguous, being affected both by pure economic variables (via the home-market effect) and political ones (via the vote-market effect), even if the equilibrium spatial allocation of industry never is.

This is partly due to the fact that agglomeration is self-reinforcing, and so there are quasi-rents that can be taxed in the core without leading to re-location. There is a bunch of recent studies on this precise point (see references on tax competition above). Taking the geography as given, Ludema and Wooton (2000), for instance, show how competing constituencies set redistributive taxes to attract the mobile factor owners. Possibly justified by a median voter approach in which the immobile factor owners would represent the majority in each country, each government sets its tax rate non-cooperatively, maximizing its constituency's welfare. Interestingly, and by opposition to the classical approach to tax competition, they find that economic integration may reduce the intensity of tax competition, the reason being that loosing industry is less costly when integration is deep enough, as location has a lower impact on welfare. This effect is present in our model as well. We will see that a core-periphery structure necessarily emerges for some positive barrier to trade at the political-economy equilibrium, even though voters from the two regions still disagree on the preferred outcome.

Also in Persson and Tabellini (1992) two policy makers, each from a different region or country, compete for the mobile factor (capital) setting taxes. They consider how equilibrium redistributive policies are affected by economic integration in a more classical environment (i.e. they focus on public good provision in populations with heterogenous factor ownerships rather than on economic geography issues). By contrast, we assume that both regions belong to the same constituency and focus exclusively on the interaction between spatial redistribution politics and geography.[3]

Our major contribution is to assess the effects of politics on the spatial distribution of economic activity. More precisely, taking a laissez-faire equilibrium as a benchmark, we show how politics and economic integration interact both ways to speed up or slow down the agglomeration process that results from integration. In particular, and in this setting, our assumption

[3]Some extensions along the lines of Persson and Tabellini (2000, chapters 7-8) are briefly undertaken by one of the authors in Baldwin et al. (2001).

that the small, rural region is over-represented at the political equilibrium translates into a slowing down. It is interesting to compare these results with Martin (1999). The latter study suggests that current EU regional policies aimed at reducing income inequalities among regions are either not delivering or bad for aggregate growth and that only subsidies to innovation have a positive effect on both.

The rest of the paper is organized as follows. The next section introduces the basic economic model and solves it taking the policy variable as given. Section 3 presents the reduced form of the welfare functions and discusses how utility is affected by the policy choice, still exogenously given. In Section 4 the economic model is integrated into a political economy model and solved together. Section 5 discusses the results and section 6 concludes. The Appendix contains a guide to tedious calculations.

2 The Basic Economic Model

The model is based on the Flam-Helpman (1987) version of the Dixit-Stiglitz (1977) monopolistic competition.[4] We consider two potentially asymmetric regions, Urban (U) and Rural (R), belonging to the *same* country, endowed with two factors, labor (L) and capital (K), and each producing a homogenous good, Y, and a differentiated good, X. The production of the latter involves increasing returns to scale and its interregional trade is characterized by transportation costs. The interaction between increasing returns to scale and impediments to trade gives rise to the home market effect. In this sense, our is a new economic geography model.

2.1 Assumptions

Both labor and capital are used to produce the differentiated good X under increasing return to scale and monopolistic competition. Following Flam and Helpman, production of each X-variety involves a one-time fixed cost consisting of one unit of K and a per-unit-of-output cost consisting of a_x units of L.

The Y sector produces a homogenous good under constant return to scale and perfect competition using only labor as an input. This good is also chosen

[4] To our knowledge, Martin and Rogers (1995) were the first to use this kind of model in a new economic geography framework.

as the *numeraire*.

Labor is perfectly mobile across sectors, but immobile across regions. For simplicity, the mass of labor available at the country level is set equal to 1. The specific factor K is regionally mobile but capital owners are not, hence, capital income is fully repatriated to their region of residence.

Inter-regional trade of the differentiated good is subject to iceberg transportation costs. Thus, in order to sell one unit of X in the other region, $\tau > 1$ units need to be shipped. Y trade is costless.

The representative consumer in each region maximizes the following quasi-linear utility function:

$$u = \ln X + Y; \qquad X \equiv \left(\int_{i=0}^{N+N_R} c\left(i\right)^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

where $\sigma > 1$ is the constant elasticity of substitution among the X-varieties, and N and N_R stand for the number of firms in Urban and in Rural respectively, and, given the assumption on the market structure, also for the number of varieties of the differentiated good produced in each region.[5] Each consumer in the rural region owns one unit of labor and K_R/L_R units of capital; the typical individual in the urban region owns one unit of labor and K/L units of capital. Her budget constraint therefore is:

$$w + \rho K/L = T + \int_{i=0}^{N+N_R} c(i)p(i)di + Y, \tag{2}$$

where ρ is the capital reward *gross* of (locally specific) capital subsidies, and T are the per-capita taxes paid by the representative consumer in order to cover any policy intervention chosen by the government. Observe that these taxes are non-distortionary; other (potentially interesting) policy implications would be implied if distorting instruments were implemented. The same budget constraint holds, *mutatis mutandis*, for the rural region (with $T_R = T$). Note that variables pertaining to the rural region are subscribed with an R, while those pertaining to the urban one are un-subscribed, unless there is risk of confusion; in that case they will be subscribed with a

[5]The choice of a quasi-linear specification, which is fairly standard in the literature on public goods (e.g., see Persson and Tabellini 2000), is harmless: all results carry over if a Cobb-Douglas functional form is chosen instead (calculations are available from the authors). The logarithmic specification, on the other hand, is a handy assumption that helps us to get closed form solutions, as we shall see later.

U. Aggregate variables, i.e. variables referring to the nation as a whole, are indicated with the subscript C, for *Country.*

We assume that the intervention consists of a subsidy to firm's fixed costs. As such subsidies are independent of output and, given that the one-time fixed cost consists of one unit of K, they actually represent a subsidy to capital.[6] Let r be the *net* capital reward for entrepreneurs producing in region U, r_R the one for those producing in R, and $\theta = r/r_R$ their ratio, with $\theta \in \Re_{++}$. When rural production is subsidized, $\theta > 1$ and $\theta - 1$ is the *ad-valorem* subsidy given to capital owners who produce in that region, regardless of their origin. Under these circumstances, θr_R is the capital reward for producing in R and r is the capital reward for producing in U. When $\theta < 1$, $1/\theta - 1$ is the *ad-valorem* subsidy given to capital owners producing in region U. In this case, capital owners that set up their firms in Urban get r/θ, those setting up their firms in Rural get r_R. Clearly $\theta = 1$ means that capital is not subsidized anywhere and the lower is $|\theta - 1|$, the smaller is the subsidy. In what follows the location subsidy is determined implicitly as a result of the political game between the two regions. The fact that at most one region is subsidized at a time is a simplifying assumption. It is anyway possible to show that this would remain true in equilibrium even in the more general case in which both regions can be subsidized.[7]

2.2 Equilibrium conditions

As usual with quasi-linear utility functions, the quantity of Y consumed by the representative consumer is determined as a residual from (2). Standard utility maximization yields the following demand function for each variety of the differentiated good:

$$c(i) = \frac{p(i)^{-\sigma}}{\int_{j=0}^{N+N_R} p(j)^{(1-\sigma)} dj}. \tag{3}$$

Competition implies marginal-cost pricing in the Y sector, and, with Y as *numeraire*, $w = p_Y = 1$. Free trade in Y and perfect labor mobility between sectors guarantees labor reward equalization in both regions, namely

[6] Because of free-entry, though, at equilibrium this will be equivalent to a subidy to the value of sales (estimated at f.o.b. prices) and hence to the quantity of output.

[7] Calculations are available from the authors

$w = w_R = 1$, as long as neither specializes. For simplicity we rule out complete specialization, so that nominal wage equality always holds.[8]

We choose units such that $a_x = 1 - 1/\sigma$ and solve the first order conditions for Urban and Rural firms for equilibrium prices. Adopting the usual convention for which the first subscript indicates the region where the good is produced and the second the region where it is consumed, the standard monopolistic competition pricing equations are $p_{UU} = p_{RR} = 1$ and $p_{UR} = p_{RU} = \tau$.

Competition for K drives r up to the level where pure profits are eliminated, so K's reward in Urban is the operating profit of a typical Urban-based X-firm. A similar condition holds in Rural.[9] When production takes place in both regions, perfect capital mobility equalizes the gross rewards to capital across regions, i.e. $\rho = \rho_R$ in equilibrium. Due to subsidies, however, net rewards - namely r and r_R - can differ. In particular, when setting a firm in region R is subsidized (and, hence, $\theta > 1$) $\rho = \rho_R = r = \theta r_R$. When $\theta < 1$, namely when firms in Urban are subsidized, $\rho = \rho_R = r_R = r/\theta$.

Since X-firms need one unit of capital per variety, and capital is interregionally mobile (even though its reward is repatriated), capital's full-employment condition requires $N + N_R = K + K_R$.

As usual, monopolistic competition implies that operating profit (namely revenue less payment to labor) is $p_{UU}x/\sigma$ for a typical Urban firm and $p_{RR}x_R/\sigma$ for a typical Rural firm (making use of the fact that f.o.b. prices are the same for the units that are exported and those that are sold locally). The equilibrium size of a typical firm is therefore proportional to capital's reward, namely $x = r\sigma$ and $x_R = r_R\sigma$ (Flam and Helpman, 1987). The equalization of gross rental rates enforced by capital mobility implies that $\theta = x/x_R$ as well. Therefore, the equalization of equilibrium firm size holds if, and only if, $\theta = 1$. Moreover, the value of global X-sector output at producer prices must equal the value of global X-sector private expenditure. The market-clearing condition in U requires that $p_{UU}Nx = LNp_{UU}c_{UU} + L_R N p_{UR} c_{UR}$, where c_{UU} and c_{UR} are defined by equation (3). By the same token, the market-clearing condition in R is $p_{RR}N_R x_R = L_R N_R p_{RR} c_{RR} + LN_R p_{RU} c_{RU}$. Making use of equation (3) and substituting the appropriate optimal price, we obtain the

[8] In order to exclude complete specialization in production, it is enough to assume that the large region is not big enough to supply all the Y demand. In particular, a sufficient condition for that being true is that the biggest region's labor share, $s_L \equiv \frac{L}{L+L_R}$, is less that $1/\sigma$.

[9] Seeing K as the specific factor to sector X, capital receives the agglomeration (quasi-) rents.

following production scales for the Urban and the Rural representative firms:

$$x = \frac{L}{N + N_R\phi} + \frac{L_R\phi}{N\phi + N_R}, \quad x_R = \frac{L_R}{N\phi + N_R} + \frac{L\phi}{N + N_R\phi}, \tag{4}$$

where $0 \leq \phi \equiv \tau^{1-\sigma} \leq 1$ is a measure of *freeness* of inter-regional trade. ϕ ranges from zero, with infinite barriers, to unity, with zero barriers. As (4) also holds in autarchy (with $\phi = 0$ and $N = K$), the autarchy r is lower in the capital-abundant region.

With capital mobility, the number of varieties produced in a region may differ from the region's capital stock, so we also have to determine the equilibrium location of X-firms. The zero profit and the market clearing conditions can be used to find the equilibrium levels for N and N_R and, simultaneously, the equilibrium scales x and x_R. However, since the total number of X-firms is fixed at $K + K_R$, it is more convenient for our purposes to focus on the ratio $N/N_R \equiv \nu$ (rather than on levels). Having defined L/L_R as λ, therefore we get:

$$\nu = \frac{(1 - \theta\phi)\lambda - \phi(\theta - \phi)}{(\theta - \phi) - \lambda\phi(1 - \theta\phi)}. \tag{5}$$

Expression (5) holds for admissible values of ν, namely when parameters are such that $0 < \nu < +\infty$. Outside this parameter space, ν equals zero or $+\infty$ in an obvious manner. By inspection, U's share of firms (defined as $s_N = \frac{\nu}{1+\nu}$) is increasing in U's size (defined as $s_L = \frac{\lambda}{1+\lambda}$) and decreasing in its relative cost of capital, θ. Moreover, ν is larger than λ if $\lambda > 1 > \theta$ (not immediate, but true); these inequalities illustrate effects that will be recurrent in the sequel. Under the following working assumption, which will hold from now on, ν is also increasing with ϕ.

> *Assumption 1:* U is the largest region, i.e. $s_L > 1/2$ (or $\lambda > 1$). We will sometimes refer to λ as the relative *economic strength* of region U (or,equivalently, as the relative *economic weakness* of region R).

Expression (5) is the fulcrum of our analysis, so it is worth studying it in the absence of subsidies, i.e. when $\theta = 1$. In this case the equilibrium ratio of U's to R's firm share becomes:

$$\nu \mid_{\theta=1} = \frac{\lambda - \phi}{1 - \lambda\phi}. \tag{6}$$

When U is larger, making trade freer ($d\phi > 0$) results in a de-location of firms to the big region. This is consistent with other models in the same spirit. Note that $\nu \to \infty$ for $\phi = 1/\lambda < 1$ (*core-periphery* outcome for sufficiently low, though still positive, trade barriers) and that

$$\frac{\partial \nu}{\partial \lambda} \mid_{\theta=1} = \frac{1-\phi^2}{(1-\lambda\phi)^2} > 1 \tag{7}$$

for values of ϕ such that (5) yields an interior solution, i.e. for $\phi < 1/\lambda \equiv \phi^{CP}$ (*home market effect,* Krugman 1980).

In order to isolate the effect of a subsidy on the firm allocation share, we calculate the ratio ν at $\lambda = 1$ (equal sized regions) and take the first derivative with respect to $1/\theta$. Using (5), it is easy to show that $\frac{\partial \nu}{\partial (1/\theta)} \mid_{\lambda=1} > 1$. This says that one additional unit of subsidy given to U leads to a more than proportional change in de-location towards U. We call this property the *home subsidy effect*. Both the home market and the home subsidy effect will be used in the following sections to help boost intuition.

Equilibrium Y-sector output is determined as a residual from (2).

In order to close the model we need to specify a functional form for T, the per-capita tax level. We will deal with this issue at the end of the following section. We now turn to a brief discussion about the regional policy instrument we consider.

3 The Economic Effects of Regional Policy

In this section we analyze the economic effect of the regional subsidization taking its level as given. In the next section the regional policy will be endogenously determined.

The regional policy instrument implemented by the central government in order to affect inter-regional industrial location consists in giving a subsidy on the firms' fixed cost in *one* of the two regions.

To focus on the real-income, cross-regional distribution problem, we make the following additional assumption:

> *Assumption 2:* per-capita endowments of capital and labor are the same for each individual across regions, that is, $K_R/L_R = K/L$.[10] As a consequence, $\frac{K}{K+K_R} = s_L$ (or $K/K_R = \lambda$).

[10] By factor prices equalization, their nominal incomes are also equal.

Under this assumption, s_L is also region U's share of the country's nominal income and expenditure. Hence, *economic* agents differ only with respect to the region they live in, and have only one reason of disagreement: *ceteris paribus*, they all prefer the firms to locate where they live since the retail price is lower for goods produced at home than for goods imported from the other region (recall that the inter-regional transportation cost is fully passed on to the consumer).

Cross-factor distribution issues, which are at stake in the literature on tax competition (see, e.g., Ludema and Wooton's 2000), are left aside here, and taxation of the mobile factor does not influence income distribution across agents. Nevertheless, as in the tax competition literature, also here taxes on the mobile factor are set so as to affect location, and hence cross-region income distribution (through the cost-of-living, or price-index). The fact that for low trade costs, location looses salience as an issue, and hence raising taxes may still induce the mobile factor owners to move, but this is less costly as 'imports' are now cheaper, translates in our model into the fact that a core-periphery structure will necessarily emerge for some positive ϕ at the political-economy equilibrium, even though voters from the two regions still disagree on the preferred outcome.

3.1 Location effects

We first look at the effect of the policy parameter θ on the equilibrium location, s_N.

Let $\overline{\theta}$ and $\underline{\theta}$ be the values of θ such that s_N equals zero (all firms are located in Rural) or one (all firms are located in Urban) respectively.[11] From (5):

$$\overline{\theta} \equiv \frac{s_L + \phi^2 (1 - s_L)}{\phi} < \frac{1}{\phi}, \quad \underline{\theta} \equiv \frac{\phi}{(1 - s_L) + s_L \phi^2} > \phi. \tag{8}$$

Under Assumption 1, $\overline{\theta} > \underline{\theta}$ and $\overline{\theta} > 1$.

Figure 1 plots $\overline{\theta}$ (dashed curve) and $\underline{\theta}$ (solid curve) as a function of trade freeness for a given value of s_L. $\overline{\theta}$ shows the minimum level of Rural subsidization necessary to attract all firms to R. For values less than one, $\underline{\theta}$ shows

[11] Note that, when θ is smaller than $\underline{\theta}$ or bigger than $\overline{\theta}$, the usual relations $\rho = r = \theta r_{\mathsf{R}}$ and $\rho = r_{\mathsf{R}} = r/\theta$ do not hold anymore. In particular, for $\theta < \underline{\theta}$, all the firms are located in U and capital owners get $\rho = r/\theta$, independently on where they live. If $\theta > \overline{\theta}$, they get $\rho = \theta r_{\mathsf{R}}$.

the minimum subsidy to Urban which is necessary to make U the core; for values above one, $\underline{\theta}$ shows the maximum tax to U which is consistent with no firms leaving Urban.

Figure1 near here

As it is possible to see from the dashed curve, the freer is trade, the smaller is the subsidy required to attract all the firms to R (liberalization amplifies the effect of a subsidy). Note that, since $\overline{\theta} > 1 \ \forall \phi$, the minimum level of subsidy to industries in R that makes the rural region the core is always positive: a positive regional policy is necessary in order to offset the tendency to lose firms as ϕ rises in the small region, due to the home market effect.

The converse is not necessarily true, as a look at $\underline{\theta}$ (the solid curve) shows: the relationship between the level of subsidies to firms located in U which is necessary to keep all the firms in the same region and the level of trade integration is bell-shaped (by inspection of equation (8)). The reason is that the home-market effect works in favor of the large region, so that a small tax on firms there (or, equivalently, a small subsidy on potential firms in R) is ineffective in making any firm move to R for $\phi > 1/\lambda$.[12]

It is also instructive to consider the effectiveness of a given level of Rural subsidy along the integration path. In particular consider what the location effects would be at a raising ϕ with the level of θ fixed at θ_f in the diagram. When ϕ is relatively close to zero, there is some economic activity in both regions, since $\theta \in (\underline{\theta}, \overline{\theta})$. As the two regions become more integrated, for θ kept constant at θ_f, the home market effect starts dominating the subsidy effect. From point a on, the relative strength of the home market effect is so reinforced by an ongoing integration process that this level of subsidy to industrial activity in R is completely ineffective and Rural becomes the periphery region ($1 - s_N = 0$) in spite of the subsidy on offer. As ϕ continues to increase, the relative strength of the home market effect decreases and eventually, when point b is reached, some of the firms start leaving the core U (which is hence no longer a core). Things get even worse for U as transportation costs fall further: to the right of point c the core is in R. Again, if

[12] The fact that taxing capital in the Core does not necessarily lead it to relocate comes in sharp contrast to the classical results on tax competition, as Andersson and Forslid (1999), Baldwin and Krugman (2001), Kind et al. (2000) and Ludema and Wooton (2000) forcefully show.

we take the model literally, this shows how effective regional policy is when $\phi \to 1$: without any subsidy ($\theta = 1$), the core would be (and remain) in Urban from point a' onwards.

Lastly note that an increase in s_L makes the home market effect become stronger. As it is possible to see from equation (8), a higher value of s_L makes both $\underline{\theta}$ and $\overline{\theta}$ shift upward (see arrows in figure 1). The upward movement of $\overline{\theta}$ indicates that, given ϕ, in order to compensate the fact that firms are attracted by the big market, the minimum subsidy to R production needed to keep the core in Rural has now to be higher. Likewise, the upward shift of $\underline{\theta}$ implies that the minimum subsidy level needed to assure the core to U is now lower, and also that the range of trade freeness for which a small subsidy offered to location in R is still compatible with the core remaining in U is now wider.

To sum up, three conclusions arise from this analysis.

> *Result 1*: at a given subsidy level θ_f, potentially there exists a non-monotonic relationship between trade integration and equilibrium location.
>
> *Result 2*: when trade is highly integrated, location is very sensitive to policy.
>
> *Result 3*: as s_L increases, the home market effect becomes stronger; the same level of subsidies ensures $s_N = 1$ for smaller ϕ's and higher subsidies are needed in order to empty the big region.

3.2 Taxation and welfare effects

In the present model the central government's regional policy is financed exclusively by taxes. In order to understand how the direction and the level of the subsidy translates into individuals' welfare, we first need to define the per-capita level of taxes as a function of θ. When the subsidy is given to production plants located in region U, i.e. when $\theta < 1$, and remembering that $L + L_R \equiv 1$, each individual in the country pays:

$$T = (1/\theta - 1)\, Nr. \tag{9}$$

On the other hand, if the plants in R get the subsidy, $\theta > 1$ and:

$$T = (\theta - 1)\, N_R r_R. \tag{10}$$

N and N_R are given by (5) or by 0 and $K + K_R$ when relevant.

Plugging (2)-(4) and (9) or, alternatively, (10) into (1) and making use of the definition of ρ, of the relationship between the equilibrium sizes (x and x_R) and the operating profits (r and r_R), and of the pricing equations, we obtain the materialistic indirect utility functions of the two regions (see Appendix 1 for details). In particular, for $\theta \in \Theta \equiv [\underline{\theta}, \overline{\theta}]$:[13]

$$V_U(s_N(\theta); s_L, \phi) = \frac{\ln(s_N + (1 - s_N)\phi)}{\sigma - 1} + \frac{\ln(K + K_R)}{\sigma - 1} + \frac{1}{\sigma} \tag{11}$$

and

$$V_R(s_N(\theta); s_L, \phi) = \frac{\ln(s_N\phi + (1 - s_N))}{\sigma - 1} + \frac{\ln(K + K_R)}{\sigma - 1} + \frac{1}{\sigma}, \tag{12}$$

where s_N is given by (5) and $\partial V_U/\partial s_N > 0$, $\partial V_R/\partial s_N < 0$ and $\partial s_N/\partial \theta < 0$, so that, in the interval of interest, V_U (V_R) is always decreasing (increasing) in θ.

Figure 2 near here

Figure 2 shows the materialistic indirect utility functions in the two regions as a function of θ and for a given value of ϕ. Citizens get as capital owners what they pay as tax payers. Hence, an increase in θ has two opposite revenue effects that perfectly compensate each other. At the same time, citizens would also be made better off by a reduction of the price index, for the determination of which, given the presence of trade costs, firms' location turns out to be important. When subsidies belong to Θ and firms are still located in both regions it's not only the degree of liberalization that has welfare effects: affecting location, and hence, in turn, the price index, also the level of subsidies do influence welfare. Outside $\Theta \equiv [\underline{\theta}, \overline{\theta}]$, instead, θ has no influence on location anymore and the only thing that can lower the CES price index of the region that has become the periphery is an increase in freeness. The dashed curves show how welfare is affected by an increase in the degree of integration. When production happens in both regions, a deepening in freeness of trade positively affects both regions' welfare. When production is concentrated in one of the two regions, only the periphery benefits from a deepening in trade integration.

With the reduced form of the economic model at hand, we turn to the political model.

[13]Incidentally, note that Θ is a function of ϕ.

4 The Political Economy Model

Until now we have taken the policy variable, θ, as given. We now let it be endogenously determined by a specific political process. Recall that the regional policy instrument under analysis is a subsidy to setting up a firm in one of the regions. Both regions belong to the same country. All voters, whether living in region U or in region R, chose a candidate from the *same* set of candidates. This set is exogenously given for simplicity.

4.1 Assumptions

To model the political game we make use of a variant of the Hotelling-Ledyard model (see Ledyard, 1984) and assume that the policy space, $\Theta \equiv [\underline{\theta}, \overline{\theta}]$, is one-dimensional;[14] the set of candidates $\{A, B\}$ is fixed and finite; each candidate cares only about winning and is assumed to maximize her expected number of votes; the number of citizens, whose preferences are monotonic over Θ, is finite and equal to $L + L_R$; candidates simultaneously choose a position in Θ; having observed the candidates' platform, voters decide whether to vote or not and, if so, for which candidate. Voting is costless.

More precisely, our formulation of the probabilistic voting model follows Lindbeck and Weibull (1987).[15] Each of the two candidates competing for office belongs to a distinct, well established political party. Each party has a well known (by history) position, which is supposed to remain unchanged in the future, on several different issues (think of issues like EU membership, the role of trade unions, gun control, commitment to free-trade...). By hypothesis, candidates cannot deviate from their respective party's position on these issues, either because they share it or because the internal party structure makes it impossible to her to do so. Nevertheless, they have some leeway on other dimensions and any promise they make on these during the electoral campaign is credible either because parties are divided on them or because these issues are not too salient to them (winning is the only concern of the two candidates). In our framework we assume that the only dimension on which candidates can make a credible promise is the regional policy.

[14] The policy space could actually be any interval that encompass Θ, but, since any θ smaller than $\underline{\theta}$ or bigger than $\overline{\theta}$ yield the same location and the same materialistic utility levels of $\underline{\theta}$ and $\overline{\theta}$ respectively, we can restrict the policy space to Θ without loss of generality.

[15] See Persson Tabellini (2000, chapter 3) for a simplified version.

Each individual i is assumed to have an idiosyncratic preference of intensity ε_i for either candidate, with $\varepsilon_i > 0$ if i prefers B and $\varepsilon_i < 0$ if i prefers A. This is private information to i. However, in the two regions all ε_i are drawn from a symmetric, with mean zero cumulative distribution function, $\mathrm{F}_U(\varepsilon)$ in region U and $\mathrm{F}_R(\varepsilon)$ in R, that is known to anybody (in other terms there is no aggregate uncertainty). Presumably social and economic activities are more variegated and heterogeneous in the big region, implying that distinct socio-economic groups, each having distinct interests, are more numerous in Urban. This translates in a higher dispersion of the cumulative distribution around the mean in U. Hence, if μ^2 is the variance of $\mathrm{F}_U(\varepsilon)$ and η^2 the variance of $\mathrm{F}_R(\varepsilon)$, $\mu > \eta$.[16] We assume that F_U and F_R fulfill the sufficient conditions for a Nash equilibrium to exist (see Proposition 3 in the appendix).

Voters derive their utility both from consumption of good X - whose price is influenced by geography and hence by regional policy - and by the winning candidate's party traditional policies, assumed to be unrelated to consumption of good X for simplicity.[17] Hence, individual i's welfare is $V_j[s_N(\theta_B)]+\varepsilon_{ji}$ if candidate B wins and $V_j[s_N(\theta_A)]$ otherwise, with $j = U, R$.

4.2 The game

The two candidates announce their platforms, θ_A and θ_B, simultaneously and non-cooperatively, taking the platform of the opponent as given. The probability of winning for each of them is equal to 0, 1/2 or 1, respectively, whenever the expected vote share is smaller than, equal to, or larger than 1/2. In particular, given that an individual i in region j is indifferent between the two candidates if, and only if, $V_j[s_N(\theta_A)] - V_j[s_N(\theta_B)] = \varepsilon_{ji}$, candidate A maximizes

[16] Exactly the same results are obtained assuming that $\mathsf{F}_\mathsf{U}(\varepsilon)$ and $\mathsf{F}_\mathsf{R}(\varepsilon)$ are identical (or equivalently that the ε_i's are drawn from a common, symmetric, with mean zero cumulative distribution), but that agglomeration of industry is a more salient issue to those voters left behind in the periphery than to those living in the core, as it presumably is. In aggregate terms, these interpretations are equivalent, as pointed out by a referee.

[17] In other terms, the long term party political dimention and regional policy are orthogonal to each other. The presence of this other dimention leads to qualitative results that are quite different from the predictions of a uni-dimetional median voter model. See Persson and Tabellini (2000) or Coughlin (1992) for details.

$$\max_{\theta_A \in \Theta} \Omega(\theta_A, \theta_B^*) \equiv s_L F_U \left[V_U[s_N(\theta_A)] - V_U[s_N(\theta_B^*)]\right] + (1 - s_L) F_R \left[V_R[s_N(\theta_A)] - V_R[s_N(\theta_B^*)]\right] \quad (13)$$

the problem being symmetric for candidate B. Notice that, due to (5), maximizing with respect to θ is equivalent to maximizing with respect to s_N.

Given the way the problem has been set up, at equilibrium the two candidates will converge to the same platform. Therefore, the first order condition for the maximization problem in (13) is:

$$\left[s_L f_U(0) \frac{\partial V_U}{\partial s_N} + (1 - s_L) f_R(0) \frac{\partial V_R}{\partial s_N}\right] \frac{\partial s_N}{\partial \theta} = 0 \quad (14)$$

and the second order condition is satisfied by assumption. Notice that, due to standard statistical properties of probability distribution functions belonging to the same family, $\frac{f_R(0)}{f_U(0)} = \frac{\mu}{\eta} \equiv m$. The ratio m measures the relative political strength of the two regions.

In (14), $s_L f_U(0)$ and $(1 - s_L) f_R(0)$ represent the mass of *swing voters* respectively in U and in R, namely the mass of those voters that are marginally indifferent between the two candidates at equilibrium. This mass is increasing with the size of the electorate (s_L and $1 - s_L$) and inversely related to the spread of the population along the political dimension (μ and η).

We now have all the elements to discuss the equilibrium of the model as a whole.

5 The Equilibrium

Having plugged equations (11)-(12) and (5) in (14), and using the definition $m \equiv \frac{\mu}{\eta}$, the optimal value of θ satisfying the first order condition is

$$\theta^* = 1 + \frac{m - 1}{1 + \phi m}(1 - \phi) \quad (15)$$

for $\theta \in \Theta$. θ^* equals $\underline{\theta}$ or $\overline{\theta}$ in the obvious way otherwise.

Plugging θ^* back into (5) we find the corresponding equilibrium ratio of industry shares:

$$\nu^* = \frac{\lambda - m\phi}{m - \lambda\phi}. \tag{16}$$

Simple derivations give the expected signs for the following partial derivatives: $\frac{\partial \nu^*}{\partial \lambda} > 0$ and $\frac{\partial \nu^*}{\partial m} < 0$ (a region's share of industry increases with its sizes and political weight).

Many interesting results steam from equations (15) and (16). Since the ultimate concern of voters is to attract economic activities in the region where they live, let's focus first on ν^*. As it is clear from (16), once we introduce the political dimension as a determinant of the policy decision, the equilibrium industry share does not depend anymore only on the economic forces at work. Indeed,

> *Result 4:* The equilibrium share of industry of any region is increasing with its size (essentially an economic parameter) *and* its homogeneity (a socio-economico political parameter), which reflects the relative salience of the regional policy for those living in that region.

The first of these two effects is well known and is an alternative formulation of the standard home market effect. The second one is new and is dubbed here as *vote-market effect* by analogy. Recall that in the standard model (i.e. with $m = 1$) the home-market effect is defined as: $\frac{\partial \nu^*}{\partial \lambda} > 1$ if, and only if, $\lambda > 1$. Likewise, when the two regions have the same size ($\lambda = 1$), the vote-market effect is: $\frac{\partial \nu^*}{\partial \frac{1}{m}} = \frac{1-\phi^2}{(1-\phi\frac{1}{m})^2} > 1$ if, and only if, $m < 1$.

In order to determine what we define the *net-market effect*, i.e. the outcome when both the home-market and the vote-market effects interact, we introduce a new variable $\lambda_{SWING} = \frac{\lambda}{m}$, representing the overall relative force of the two regions. Particularly, λ_{SWING} is the ratio of the number of swing voters in U relative to the number of swing voters in R, namely $\lambda_{SWING} \equiv \frac{s_L f_U(0)}{(1-s_L) f_R(0)} = \frac{s_L \eta}{(1-s_L)\mu}$. It is easy to check that $\frac{\partial \nu^*}{\partial \lambda_{SWING}} = \frac{1-\phi^2}{(1-\phi\lambda_{SWING})^2} > 1$ if, and only if, $\lambda_{SWING} > 1$. In other terms,

> *Result 5*: the net-market effect works in favor of the region that has the largest number of swing voters.

To put it differently, in equilibrium, the big region U will end up attracting a more than proportional number of firms only if its economic strength

($\lambda > 1$) more than compensate its political weakness due to the higher dispersion of its population over the political dimension ($m > 1$). Conversely the economically small region can attract a more than proportional number of firms if it has enough political power, i.e. if it has a sufficiently large number of swing voters. Thus, when the vote-market effect is added to the basic model, predictions may differ from those induced by the standard *economic* home market effect and the political game may qualitatively reverse the *laissez-faire* outcome.

A final point deserves attention here. When trade barriers are sufficiently low, but still positive, our model too features a core-periphery outcome (unless $\lambda_{SWING} = 1$). In particular, all the economic activities concentrate in Urban whenever $\phi > \lambda_{SWING}$, while $s_N = 0$ and Rural becomes the core whenever $\phi > \lambda_{SWING}^{-1}$. The novelty of this analysis is that, when the political game is given the deserved attention, the definite prediction of the traditional models on the big region becoming the core does not necessarily hold anymore: it is not necessarily the large region that attracts all economic activities in the end. The political environment does matter in shaping the equilibrium geography.

Having analyzed the equilibrium location of economic activities, we can now turn to the analysis of the equilibrium subsidy level which delivers ν^*.

5.1 The Equilibrium Subsidy Level: Does Size Matter?

As expected, interior solutions for θ^* are increasing in m (see (15)). Candidates want to attract swing voters and the less dispersed group has a larger mass of such voters (ceteris paribus). Hence, the wider is the difference in the homogeneity degree of the two regions, the higher is the subsidy level the relatively more homogeneous region receives. Besides, θ^* is larger than unity and, hence, Rural is subsidized, if $m > 1$. This departure from a majoritarian result, which is due to the fact that regional policy is more salient to a minority of citizens, is one of the sources of non-majoritarian outcomes discussed in Besley and Coate (2000).

The attentive reader might have noticed that apparently regional size does not matter in determining the equilibrium subsidy θ^*. Observe that, indeed, the economic weight λ does not appear in (15) and the region that gets the subsidy is the more homogeneous one, independently from its size. This is clearly a knife-edge result that depends on the logaritmic transformation of the CES aggregate in the utility function (1). More generally, the relative size of the two populations matter, and the effect of an increase in λ on θ^* is ambiguous.[18] Size does matter in the expected way for the determination of the political equilibrium geography $s_N^* \equiv s_N(\theta^*, s_L)$, with $s_N(.)$ given by equation (5). The explanation goes as follows. An increase of s_L conceptually means that two different variables are rising: the size of the electorate in (14), which has a direct positive effect on s_N^*, due to a straightforward electoral competition effect, and the labor force size, which pushes s_N^* up due to the home market effect in (5). These two forces have opposite effects on θ^*.

On the one hand, if a larger fraction of the population lives in U, the equilibrium subsidy to the other region tends to be reduced as more voters favor a lower value of subsidies. On the other hand, due to the home-market effect, an increase in that region's size makes its equilibrium share of industry - hence, its real income - increase at any interior level of subsidy, and hence both candidates can afford setting a higher value of θ without altering individuals' welfare. To see this more formally, note that total differentiation of s_N^* gives $ds_N^* \equiv (\partial s_N/\partial\theta^*)d\theta^* + (\partial s_N/\partial s_L)ds_L$. Rearranging, $d\theta^*/ds_L = [ds_N^*/ds_L - \partial s_N/\partial s_L] / [\partial s_N/\partial\theta^*]$. Remember from (5) that the denominator of the right-hand side is negative. Also, from (16) and (5), we know the two terms in the square braquet to be positive. The difference of these two terms - and hence the sign of $d\theta^*/ds_L$ - is *a priori* ambiguous and depends on the specific functional form of the utility function. Clearly the fact that this expression equals 0 is not a general result. It is interesting to notice then that, when $\lambda_{SWING} > 1$, the big region becomes the core independently from the subsidy being bigger or smaller than 1.

5.2 Core-Periphery Outcomes

It is also very instructive to look closer at the corner solutions of θ^*. Corner solutions for θ occur when $\underline{\theta} = \underset{\theta\in\Theta}{\arg\max}\,\Omega(\theta)$ or $\overline{\theta} = \underset{\theta\in\Theta}{\arg\max}\,\Omega(\theta)$ respectively. It is possible to show (calculations are available from the authors) that

$$\theta^* - \underline{\theta} \geq 0 \Leftrightarrow \phi \leq \frac{m}{\lambda} \equiv \frac{1}{\lambda_{SWING}}, \tag{17}$$

[18]In Appendix 3, we show that the net effect is $d\theta^*/d\lambda \leq 0$ for functional forms of u more general than (1).

and that

$$\overline{\theta} - \theta^* \geq 0 \Leftrightarrow \phi \leq \frac{\lambda}{m} \equiv \lambda_{SWING}. \tag{18}$$

Consider first the case in which the *political strength* of voters in region R is not as strong as the *economic strength* of the voters in U, namely $m < \lambda$ (or, equivalently, the case in which the vote-market effect is weaker than the home-market effect). As the two regions become highly integrated and ϕ approaches unity, (17) tells us that the core is in U. In this case, the common wisdom according to which regional policy can only 'postpone the unavoidable', that is, the empty-ness of the small region, receives strong support. For $m > 1$, the *laissez-faire* solution would just anticipate the core-periphery outcome, being $\phi^{CP} < \frac{1}{\lambda_{SWING}}$.

Consider now the opposite case, in which the voters in R are so homogeneous that their *political strength* completely offsets their *economic weakness* (that is R has more swing voters than U). In such a case, $m > \lambda$, so that $\theta^* = \overline{\theta}$ for high degrees of freeness. In other words, as inter-regional trade is highly integrated, the core will end-up being in the small region, R.

In conclusion we can say that

> *Result 6*: whatever the relative strength of the two regions, whether economic or political, if ϕ increases over time and gets closer to unity, eventually, a core-periphery outcome does come out; where this will end up being depends on the overall strength of the two regions, and it will not necessarily be in the big region as the orthodox theory would predict.

5.3 Further results

As it is possible to see from (15), the equilibrium level of regional aid is decreasing with the degree of freeness ϕ. Even if it might seem counter-intuitive, this prediction is consistent with the observation that regional policy is more and more effective when transportation costs decrease (see Section 3) and when trade is sufficiently integrated, even a small subsidy can be enough to change industry location. Moreover, the fact that θ^* decreases with ϕ does not say anything about the *effectiveness* of these aids. Indeed, location becomes more and more sensible to policy as ϕ increases; as a consequence of this, the fact that θ^* is decreasing with ϕ does not necessarily mean that R gets less *effective* aid. The correct way to address this issue is to compare the *political economy* location equilibrium, ν^*, to the *laissez-faire* outcome, $\nu\mid_{\theta=1}$ (see equations (16) and (6)). From the rural region's point of view, the regional aid policy is meant to be *favorable* if the following holds:

$$\Delta_R \equiv \nu\mid_{\theta=1} - \nu^* = \frac{\lambda\left(1-\phi^2\right)(m-1)}{(\lambda\phi-1)(\lambda\phi-m)} > 0, \tag{19}$$

which is the case if, and only if, $m > 1$ (recall that for interior solutions $\phi < 1/\lambda < m/\lambda$). Besides,

$$\frac{\partial\Delta_R}{\partial\phi} = \frac{s_L}{(1-\phi)^2}\frac{m-1}{m+\lambda} > 0, \tag{20}$$

provided that $m > 1$. Hence,

> *Result 7*: taking the *laissez-faire* economic equilibrium as a benchmark, the introduction of an endogenous policy variable increases the number of firms in the politically strong region. This effect is even stronger with the deepening of the economic integration.

To conclude let us look briefly at the normative side of the model. As shown in the appendix, U's typical agent's welfare is maximized at $\underline{\theta}$, corresponding to the smallest, possibly negative, amount of subsidy to the plants located in the urban region such that U is the core. Conversely, in R welfare is maximized at $\theta = \overline{\theta}$, corresponding to the smallest amount of subsidy to plants in the rural region compatible with R being the core. Clearly, the interests of the two categories of the population are opposed. In particular, when $m > 1$, the larger region U is worse-off in comparison to the *laissez-faire* outcome, and the small one, R, is better-off .

Put differently, for any pair of payoffs $\{V_U(\theta), V_R(\theta)\}$, it is impossible to make everybody better-off without harming anyone. This is quite obvious since, in this setting, any variation in θ^* has opposite effects on the welfare of the two type of agents.[19] The instrument considered here, θ, is non-distortionary in that the political-economy outcome lies on the (second-best) Pareto frontier, defined as $\{(V_U(s_N)), (V_R(s_N)) : s_N \in [0,1]\}$.

[19] This is always true, of course, because $\theta^* \in \Theta$.

6 Summary and conclusion

Using a very simple model of economic geography enriched to allow for endogenously determined regional policy, this paper analyzes the impact on geography allocation of regional interventions. Two regions of the same country are considered: "Urban", the largest one, and "Rural", whose population is assumed to be ideologically more homogenous. Voters vote on national elections for candidates or parties which are not tied to any region in particular.

In spite of the simplicity of the framework, interesting results emerge. The size of the groups has an ambiguous effect on the equilibrium subsidy. On the one hand, if a larger fraction of the population - hence, of voters - lives in a given region, the equilibrium subsidy to the other region tends to be reduced as more voters favor a lower value of subsidies. On the other hand, due to the home-market effect, an increase in that region's size makes its equilibrium share of industry - hence, its real income - increase at any interior level of subsidy, and hence both candidates can afford setting a higher value of the subsidy without altering individuals' welfare: the very fact that they consist in the largest population makes people in Urban willing to accept larger "real taxes" (in the form of a loss in their economic welfare). The net effect of the relative population sizes is thus ambiguous.

The effectiveness of this aid in slowing down the agglomeration process that comes as a by-product of the regional integration process will depend on the relative size of the two populations: for a given amount of regional aid, the regional policy will be less effective in attracting the industrial activity in the small region if the relative size of the two regions is larger (this is a consequence of the well known (economic) home-market effect; Krugman, 1980). Thus, the political factor determines the amount of aid and the economic one decides its effectiveness.

The same existence of regional policy as a political issue may even reverse the regional specialization pattern predicted by economic theory. If the small region is much more homogenous compared to the large one, then regional policy might do even better than just slowing down the agglomeration-in-Urban process that goes along with the deepening of trade integration. Eventually the effects of the regional intervention can dominate the economic home-market effect and make the core end up in the small region, giving rise to what we call the vote-market effect. At the political economy equilibrium, integration fosters agglomeration in the big region if its relative economic strength overcomes its eventual relative political weakness. Thus the political effect may lead to predictions other than the ones induced by the standard economic home market effect.

Literally, then, economic as well as political variables determine the location outcome. Ceteris paribus, we should expect countries (or constituencies) with a prominent 'rural-versus-urban' issue to have lower levels of agglomeration at any point on the integration path. All the same, if we introduced some sort of labor mobility - in the form of rural exodus, say - this would speculatively make the urban regions even less homogenous (assuming it takes one generation for the newcomers to adapt fully to the new life-style) and hence feed back into a more aggressive regional policy, having a stabilizing impact.

Appendix

A1. Derivation of the indirect utility functions

As can be seen from (11) and (12), θ affects both V_U and V_R through s_N only. In particular, both the representative individual's net earnings $w + \rho(K + K_R) - T$ and expenditure on X are constant, as we now show.

Claim 1: The expenditure on the differentiated good X is constant.

Proof. Plugging the price equations into $p(i)c(i)$, where $c(i)$ is given by (3), and integrating over all varieties gives the (individual) expenditure on the X-good, we get:

$$\frac{N + N_R \tau \tau^{-\sigma}}{N + N_R \phi} = 1 \tag{A.1}$$

by definition of ϕ.

Claim 2: The net earnings of the typical individual are constant with respect to θ in both regions.

Proof. Take the case $\theta > 1$ (a symmetric reasoning would apply in the other case). Observe that $w + \rho(K + K_R) - T = 1 + (Nx/\sigma + N_R \theta x_R/\sigma) - (\theta - 1)N_R x_R/\sigma$. Using (4), this can be rewritten as:

$$w + \rho(K + K_R) - T = 1 + \frac{1}{\sigma}\left(\frac{N + \phi N_R}{N + \phi N_R} s_L + \frac{\phi N + N_R}{\phi N + N_R}(1 - s_L)\right) \tag{A.2}$$

which is identical to $1 + 1/\sigma$.

To get (11) and (12) in the text, note that $ln(N + \phi N_R) \equiv \ln(s_N + (1 - s_N)\phi) + \ln(K + K_R)$ and that utility derived from the consumption of good Y is identical to the net earnings minus expenditure of X by definition of (1). ■

A2. Existence and uniqueness of the Nash Equilibrium in the platform-setting game

A2.1 Uniqueness

We first recall the basic trade-off that faces any candidate: when increasing the value of θ, a candidate (say candidate A) expects to loose (to gain) the votes of the most indifferent voters in U (in R). Swing voters are more numerous the higher their density, the larger the population size, and the larger the change proposed. At equilibrium, the number of lost and gained votes must be equal:

$$L\frac{\partial V_U}{\partial \theta_A} f_U(\Delta_U(\theta_A,\theta_B)) + L_R \frac{\partial V_R}{\partial \theta_A} f_R(\Delta_R(\theta_A,\theta_B)) = 0, \tag{A.3}$$

where $\Delta_U(\theta_A,\theta_B) \equiv V_U(\theta_A) - V_U(\theta_B)$ and f_U and f_R are the densities of the distributions of ε_{Ui} and ε_{Ri} , respectively.

Since the problem is symmetric for candidate B, the two candidates converge on the same platform θ^*, and from (A.3) we can generalize (14) to

$$\frac{f_U(0)}{f_R(0)}\lambda = -\frac{\partial V_R/\partial\theta}{\partial V_U/\partial\theta}(\theta^*). \tag{A.4}$$

Proposition 1 *Restrict both candidates' strategy space to* Θ*. If* θ^* *identified in (A.4) - of which (14) in the text is a special case - is the equilibrium strategy, then the Nash equilibrium* (θ^*,θ^*) *is unique.*

Proof. Note first that the slope of the Pareto-frontier - the right-hand side of (A.4) - is equal to $-\frac{\lambda(1-\theta\phi)}{\theta-\phi}$. This term is negative on Θ. Monotonicity of the RHS of (A.4) implies the uniqueness of θ^*. ■

A2.2 Existence

Candidates A and B are assumed to maximize their expected plurality κ_A and $1-\kappa_A$ (respectively), where

$$\kappa_A = s_L F_U\left(\Delta_U(\theta_A,\theta_B)\right) + (1-s_L)F_R\left(\Delta_R(\theta_A,\theta_B)\right), \tag{A.5}$$

is derived from (13). In this section we will look for sufficient conditions such that the Debreu-Glicksberg-Fan theorem for the existence of a Nash-equilibrium in pure strategies holds (e.g. Theorem 1.2 in Fudenberg and Tirole (1991)). Conditions required by this theorem are (*i*) a non-empty, convex and compact strategy set Θ, (*ii*) payoff functions $\kappa_i : i = A, B$ continuous in (θ_A,θ_B), and (*iii*) quasi-concave in θ_i. The first two conditions are obviously met by definition of Θ and by inspection of (A.5). For (*iii*) to hold, it is sufficient that $F_j\left(\Delta_j(\theta_A,\theta_B)\right) : j = U, R$ are concave. The following lemma shows that this requirement is met.

Lemma 2 *Let* $g : S \to Z$ *be a concave function and* $h : \Theta \to S$ *a bijection, where both* Θ *and* Z *are compact subsets of* $\Re$*. Without loss of generality, assume that* $h' \leq 0$ *everywhere on* Θ*. Then* $\omega = g \circ h$ *is quasi-concave.*

Proof. Choose $\theta^{'}$, θ, $\theta^{''} \in \Theta$ such that $h(\theta^{'}) < h(\theta) < h(\theta^{''})$.

Then $\omega(\theta) = g[h(\theta)] = g[\alpha h(\theta^{'}) + (1-\alpha)h(\theta^{''})]$, some $\alpha \in (0,1)$
$\geq \alpha g[h(\theta^{'})] + (1-\alpha)g[h(\theta^{''})]$, by concavity of $g(\cdot)$
$\geq min\{g[h(\theta^{'})], g[h(\theta^{''})]\} = min\{\omega(\theta^{'}), \omega(\theta^{''})\}$.

Also, $\theta^{'} > \theta > \theta^{''}$ by the monotonicity of $h(\cdot)$; so $\omega(\cdot)$ is quasi-concave, as was to be shown. ■

Next, we show that $F_U(\cdot)$ and $F_R(\cdot)$ in the text trivially satisfy the second order conditions for the existence of a Nash equilibrium - conditions (A.6) and (A.7) below. (Indeed, any smooth, symmetric with mean zero pdf does.)

Proposition 3 *(Sufficient conditions) The Nash-equilibrium $(\theta_A, \theta_B) = (\theta^*, \theta^*)$, with θ^* as given by (A.4), exists if both of the following hold (using a slight abuse of notation):*

$$\lambda \left[f_U'(0) \left(\frac{\partial V_U^*}{\partial s_N} \right)^2 + f_U(0) \frac{\partial^2 V_U^*}{\partial s_N^2} \right] + \left[f_R'(0) \left(\frac{\partial V_R^*}{\partial s_N} \right)^2 + f_R(0) \frac{\partial^2 V_R^*}{\partial s_N^2} \right] \leq 0 \tag{A.6}$$

and

$$\lambda \left[f_U'(0) \left(\frac{\partial V_U^*}{\partial s_N} \right)^2 - f_U(0) \frac{\partial^2 V_U^*}{\partial s_N^2} \right] + \left[f_R'(0) \left(\frac{\partial V_R^*}{\partial s_N} \right)^2 - f_R(0) \frac{\partial^2 V_R^*}{\partial s_N^2} \right] \geq 0 \tag{A.7}$$

(This proposition is a restatement of theorem 2 in Lindberg and Weibull (1987, pp. 280-1).)

Proof. By lemma 2, it is sufficient to check that the RHS of (A.5) is concave in s_N, since s_N is decreasing in θ. The value of s_N at equilibrium is simply (s_N^*, s_N^*), with $s_N^* \equiv s_N(\theta^*)$. Fix $s^0 \in [0,1]$ and define $s_N(\epsilon) = s_N^* + \epsilon(s^0 - s_N^*)$, $\epsilon \in (0,1)$. By convexity of $[0,1]$, $s_N(\epsilon) \in int[0,1]$. Also, define $h(\epsilon, s^0) = \kappa_A(s_N(\epsilon), s_N^*)$ as A's expected vote share when she plays $s_N(\epsilon)$ and B plays her equilibrium strategy s_N^*. That is,

$$\begin{aligned} h(\epsilon, s^0) &= s_L F_U \left(V_U(s_N(\epsilon)) - V_U(s_N^*) \right) \\ &\quad + (1 - s_L) F_R \left(V_R(s_N(\epsilon)) - V_R(s_N^*) \right). \end{aligned} \tag{A.8}$$

First, we have that $\forall s^0 \in [0,1] : h'(0, s^0) = 0$ by Proposition 3 above. Next, for s_N^* to be an optimal strategy for A, it must be that $\forall s^0 \in [0,1]$: $h''(0, s^0) \leq 0$:

$$\begin{aligned} h''(\epsilon, s^0) &= s_L f'_U(\cdot)\left(\frac{\partial V_U}{\partial s_N}(s_N(\epsilon))\right)^2 (s^0 - s_N^*)^2 \\ &+ s_L f_U(\cdot)\left(\frac{\partial^2 V_U}{\partial s_N^2}(s_N(\epsilon))\right)^2 (s^0 - s_N^*)^2 \\ &+(1-s_L) f'_R(\cdot)\left(\frac{\partial V_R}{\partial s_N}(s_N(\epsilon))\right)^2 (s^0 - s_N^*)^2 \\ &+(1-s_L) f_R(\cdot)\left(\frac{\partial^2 V_R}{\partial s_N^2}(s_N(\epsilon))\right)^2 (s^0 - s_N^*)^2 \leq 0. \quad \text{(A.9)} \end{aligned}$$

Consequently, $h''(0, s^0) \leq 0$ if, and only if, (A.9) holds. A symmetric argument for candidate B shows that s_N^* is her strategy at equilibrium if (A.7) holds. ■

A3. When size does matter

Here we show how the functional form chosen for (1) shapes some of our results - Eq. (15) and (16) in particular. Rewrite (1) as $u = X^\alpha + Y$, $\alpha < 1$. The first order condition (14) now becomes

$$\frac{\lambda}{m} = \left[\frac{s_N^{**} + \phi(1 - s_N^{**})}{\phi s_N^{**} + 1 - s_N^{**}}\right]^{1-\alpha}. \quad \text{(A.10)}$$

With $\alpha \to 0$ we get the results (15) and (16) in the text, namely $s_N^{**} = s_N^*$ and $\theta^{**} = \theta^*$, the later independent of λ or s_L. With $\alpha > 0$, s_N^{**} (the equilibrium s_N) is larger than s_N^*. This can be seen by noting, first, that we have

$$\frac{\lambda}{m} > \left[\frac{s_N^* + \phi(1 - s_N^*)}{\phi s_N^* + 1 - s_N^*}\right]^{1-\alpha} \quad \text{(A.11)}$$

for all $\alpha \in (0, 1)$, and, second, that the RHS of (A.10) is increasing in s_N^{**}. Also, an increase in λ has a larger impact on s_N^{**} than on s_N^*. Because s_N is still given by (5), this implies that $\partial\theta^{**}/\partial\lambda < 0$, all $\alpha > 0$. In words, if Urban gets larger, the equilibrium subsidy to Rural gets smaller. The same result obtains if α is interpreted as the share of income spent on X in a Cobb-Douglas specification (see Baldwin et al. 2001). Clearly, choosing $\alpha = 0$, as we have done in the text, brings the convenience of getting explicit solutions for both s_N^* and θ^*. ■

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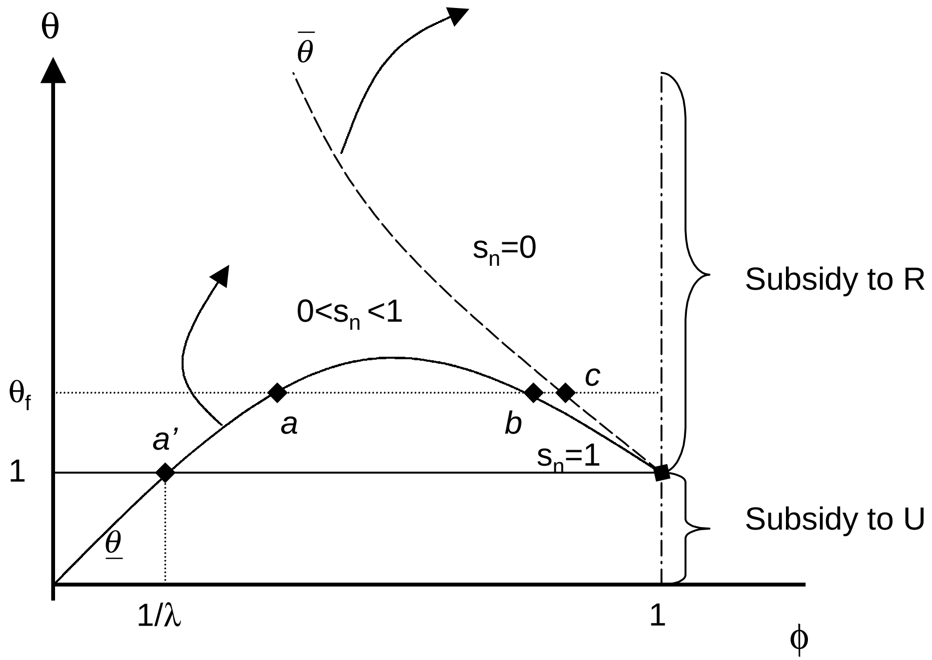

Figure 1: upper and lower bounds for θ.
When θ >1 production in *R* is subsidized; When θ <1 subsidy goes to production in *U*.
Arrows indicate how curves move for an increase in $s_{L.}$

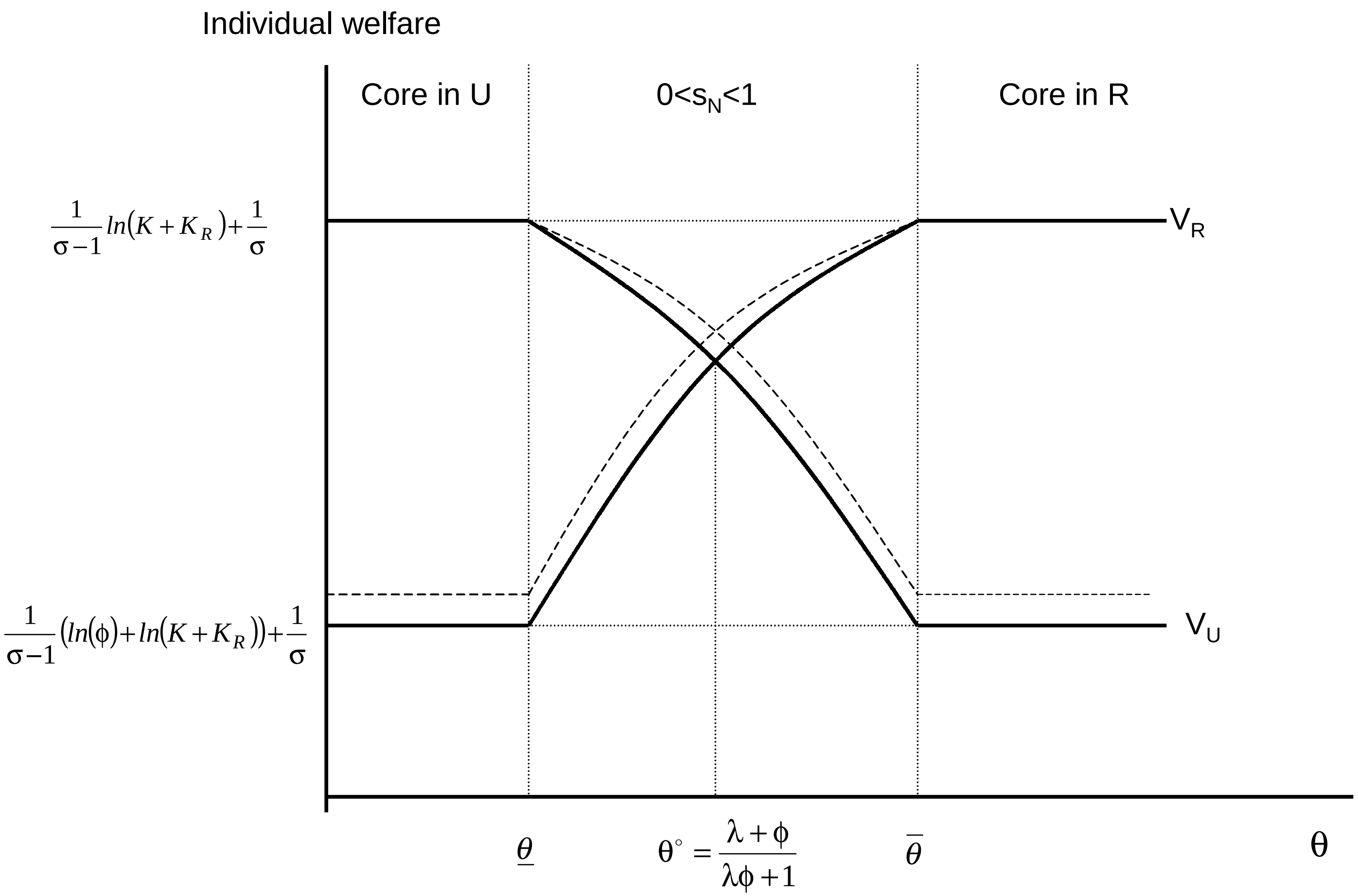

Figure 2: Materialistic indirect utility function.
Dashed: welfare effects of an increase in ϕ.