INTEGRATION, AGGLOMERATION AND WELFARE[♣]

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ABSTRACT

This paper studies the social desirability of agglomeration, and the efficiency arguments for policy intervention in a simple, analytically tractable new economic geography model. The location pattern emerging as market equilibrium is 'bubble-shaped', i.e. it features dispersion both at high and low trade costs and stable equilibria with partial and full agglomeration for intermediate levels of trade costs. We show that the market equilibrium is characterized by over-agglomeration for high trade costs and under-agglomeration for low trade costs, and we work out analytically that a net pecuniary externality is the underlying cause of this market failure. One particularly noteworthy result is that the net pecuniary externality is positive at high levels of trade freeness. However, there is no market under-agglomeration unless this positive net pecuniary externality interacts with an additional congestion force originating in the (per se efficient) competitive housing market.

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1 Introduction

Spatial differences in real economic activity are pervasive in many countries and economic areas. These regional disparities are a concern of top priority for policy makers. In the European Union, for example, roughly one third of the annual budget is currently spent on cohesion and structural funds. Although regional policy is primarily motivated by equity considerations, among policy makers the belief seems to be widespread that a more equal spatial allocation of resources enhances efficiency as well (Martin [16]). Accordingly, the explicit goal of EU regional policy is not simply to redistribute income between rich and poor regions, but to attract production to peripheral locations.[1]

This paper studies the social desirability of agglomeration and efficiency arguments for policy intervention in a 'new economic geography' framework. The new economic geography has profoundly improved our understanding of why economic activity tends to agglomerate in space.[2] Its explanation focuses on the interaction of trade costs, increasing returns at the firm level, and factor mobility. Although this research program derives much of its appeal from the potential to throw light on economic policy (Neary [21]), it has remained silent on welfare issues and on policy, until very recently. Yet, the new economic geography is particularly well-suited to analyse whether the spatial pattern of economic activity is optimal from a social point of view.

We develop a new economic geography model which exhibits a particularly plausible location pattern, and which allows us to provide all results analytically at the same time. More specifically, we amend the simple economic geography model by Pflüger [26] where the agents are assumed to have a logarithmic quasi-linear upper tier utility function and introduce

[1] See e.g. the Second Cohesion Report of the EU-Commission [7]: "The Treaty [of the European Community], by making explicit the aim of reducing disparities in economic development, implicitly requires that EU policies, and cohesion measures in particular, should influence factor endowment and resource allocation and, in turn, promote economic growth. More specifically, cohesion policies are aimed at increasing investment to achieve higher growth and are not specifically concerned either with expanding consumption directly or with redistribution of income." (p.117)

[2] Overviews are Fujita et al. [9], Fujita and Thisse [10], Neary [21] and Ottaviano and Thisse [24].

housing costs in the spirit of Helpman [12] in order to capture an important congestion force that prevails in practice. The spatial equilibrium pattern is 'bubble-shaped'. Starting with a dispersion of economic activity, agglomeration is induced by falling trade costs due to supply and demand linkages. At low levels of trade costs, the relative importance of housing prices dominates the agglomeration forces, so that redispersion takes place. In contrast to the core-periphery model by Krugman [13] and related models which feature 'bang-bang' equilibria – either symmetry or full agglomeration in one of two regions –, there are stable equilibria with partial agglomeration in our framework. This appears to be more appealing than 'bang-bang' outcomes from the point of view of descriptive realism (Tabuchi and Thisse [31]).[3]

The market outcome is based on the location decision of skilled workers acting in their own interest. Their location choice affects prices and the well-being of other agents through market-mediated pecuniary externalities. These are neglected in private migration decisions. In perfectly competitive markets, pecuniary externalities do not matter for aggregate welfare. In such environments, price changes have distributive consequences, but no allocation effects. This insight holds true for the housing market that we consider as well. Yet, pecuniary externalities are known to matter for aggregate welfare in imperfectly competitive markets (Laffont [14], Ottaviano and Thisse [24]). Accordingly, in our model private location decisions concerning the monopolistically competitive manufacturing sector do affect total welfare. Comparing the market equilibrium with the allocation chosen by a social planner, who is assumed to maximize the utility sum of all agents, we show that there is over-agglomeration for high trade costs, and under-agglomeration for low trade costs. For trade costs which are very high, very low, or which lie in an intermediate range, the spatial equilibrium structure coincides with the optimal one. Hence, we diagnose different directions for an efficiency-oriented regional policy in the course of trade integration.

[3] Such a bubble shaped´ location pattern has also been established by Puga [27] and Fujita et al. [9], ch.14 in models with decreasing returns to scale in the outside (agricultural) sector. In the analytically tractable model by Tabuchi and Thisse [30] the 'bubble shape' results from heterogeneity of individuals in their migration behaviour.

Our paper is most closely related to a relatively small literature that addresses the welfare properties of market allocations in new economic geography models (Helpman [12], Ottaviano and Thisse [22], [23], Ottaviano et al. [25], Tabuchi and Thisse [30], Baldwin et al. [1], Charlot et al. [4], Robert-Nicoud [29]).[4] These models provide the general conclusion that the market equilibrium may not coincide with the social optimum. Our analysis adds on this literature in at least two respects. First, we show that the level of trade costs critically affects the efficiency of equilibrium and that the direction of an efficiency-improving policy intervention changes during the course of trade intervention. Second, and arguably most important, we precisely identify the source of market failure. In particular, we derive an analytical expression for the quantitative difference between the market's tendency to agglomerate and the social desirability of agglomeration which we term '*net pecuniary externality*'. A particular result which deserves to be highlighted is that this 'net pecuniary externality' turns positive at low trade costs, indicating that there might be too little agglomeration. However, unless interacted with an additional congestion force – rising prices in the per se efficient housing market – under-agglomeration does not obtain. The reason is that, without this additional congestion force, the agglomeration forces of the market are so strong that a corner solution of full agglomeration is already in place. Resorting to numerical simulations, Helpman [12] was the first to show that there is under-agglomeration at low trade costs in a new economic geography model with a housing sector. Our tractable model clarifies conceptually and analytically why this must be the case.

The structure of the paper is as follows. The next section introduces the model. Section 3 characterizes the location pattern of the market equilibrium. The socially optimal spatial pattern is derived in section 4. The comparison of the two allocations, an analysis of the

[4] Our paper is also more generally related to a literature that evaluates the performance of European regional policy (e.g. Braunerhjelm et al., [3], Boldrin and Canova [2], Midelfart-Knarvik and Overman [20], Puga [28]) and to works analyzing the effectiveness of different regional policy instruments (Martin and Rogers [18], Martin [16], [17], Midelfart-Knarvik [19], Dupont and Martin [6]).

source of market failure, and a discussion how our analysis relates to previous work are performed in section 5. Section 6 concludes.

2 The model

2.1 The basic set-up

Our theoretical analysis draws on Pflüger [26] who builds on the analytically tractable variant of Krugman’s standard core-periphery model developed by Forslid and Ottaviano [8]. The economy is composed of two regions, a 'domestic' and a 'foreign' one, which have identical tastes, technologies and (initial) factor supplies. There are two types of households, unskilled labor and skilled labor. They inelastically supply one factor unit each, thereby earning unskilled wages (W) and skilled wages (R), respectively. They derive utility from an aggregate of manufactures (X), an agricultural good (A), and from housing (H). We do not consider an explicit intra-regional spatial structure with differential land rent and commuting costs (as in Tabuchi [32]). Rather, we adopt the simplified notion of housing used in Helpman [12]. Housing is simply a non-traded and non-produced consumption good that is in fixed supply in every region. The housing stocks are assumed to be owned by citizens of an outside country. This assumption keeps the analysis simple, but it is inconsequential for our results.[5]

The agricultural good is homogeneous, traded without cost and produced perfectly competitively under constant returns with unskilled labor as the only input. This good serves as the numeráire. We make assumptions to ensure that this good is produced in both regions throughout the analysis (see footnote 6 below). The manufacturing aggregate consists of a large variety of differentiated products. Each variety is produced with unskilled and skilled labor. Unskilled labor is the only variable input, and the marginal input requirement c is

[5] Housing income is neutralized by this assumption. We could alternatively assume that the housing stock is equally owned by all citizens. Since the upper-tier utility is assumed to be quasi-linear in our model, this is inconsequential, because there is no feedback from income to consumption in the manufacturing sector.

constant. Skilled labor enters only the fixed cost. One skilled worker is needed to produce at all (e.g. for R&D or headquarter services). Trade in X is inhibited by iceberg costs.

Unskilled labor is assumed to be intersectorally mobile, but immobile and equally distributed across regions. Skilled workers are geographically mobile. We normalize the world population of skilled workers to one. The share of skilled workers locating in the domestic region is denoted by λ, and foreign region's share is given by ($1-\lambda$). For either region, the factor proportion parameter ρ relates the number of unskilled workers to the world population of skilled workers.

The following description is for the domestic region. All expressions for the foreign region are analogous. Foreign variables will be distinguished by an asterisk (*) from domestic ones.

2.2 Preferences and demand

Households' preferences are homogenous and characterized by the following quasi-linear, logarithmic upper tier utility function with CES sub-utility over manufacturing varieties.

$$U = \alpha \ln C_X + \beta \ln C_H + C_A \qquad C_X = \left(\int_{i=0}^{N} x_i^{\frac{\sigma-1}{\sigma}} di + \int_{j=N}^{N+N^*} x_j^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

$$\alpha > 0, \qquad \beta \geq 0, \qquad \sigma > 1$$

C_X is consumption of the manufacturing aggregate, C_H denotes the consumption of housing, and C_A is the consumption of the agricultural good. Per capita consumption of a domestic (foreign) variety is denoted by x_i (x_j). N and N^* are the number of varieties produced in the domestic and foreign region. The parameter σ expresses the constant elasticity of substitution between any two manufacturing varieties. The budget constraint is given by

$$PC_X + p_H C_H + C_A = Y\,, \qquad P = \left[\int_0^N p_i^{1-\sigma} di + \int_N^{N+N^*} \left(\tau p_j\right)^{1-\sigma} dj \right]^{\frac{1}{1-\sigma}}, \quad \tau > 1 \tag{2}$$

where Y denotes the household's income which is given by W for an unskilled worker and equal to R for a skilled worker. P is the perfect CES-price index for the manufacturing aggregate, p_i (p_j) is the producer price for a domestic (imported) variety, and p_H denotes the price of housing. Iceberg trade costs are formalized by the parameter τ. These imply that only $1/\tau$ of a unit of a variety shipped from another region arrives for consumption, and that the consumer price of an imported variety is τp_j.

Utility maximization yields the following demand functions and indirect utility V (we assume that $\alpha + \beta < Y$ in order to assure that both types of goods are consumed):

$$C_X = \alpha / P\,, \qquad C_H = \beta / p_H\,, \qquad C_A = Y - \alpha - \beta\,, \tag{3}$$

$$x_i = \alpha (p_i)^{-\sigma} (P)^{\sigma-1}, \qquad x_j = \alpha \left(\tau p_j\right)^{-\sigma} (P)^{\sigma-1}$$

$$V = Y - \alpha \ln P - \beta \ln p_H + \varepsilon \qquad \varepsilon \equiv \left[\alpha(\ln\alpha - 1) + \beta(\ln\beta - 1)\right] \tag{4}$$

2.3 The housing market

Equilibrium in the competitive housing market requires that demand aggregated from (3), $\beta(\rho+\lambda)/p_H$, be equal to supply H. Hence, equilibrium housing prices are given by

$$p_H = \frac{\beta(\rho+\lambda)}{H} \tag{5}$$

It follows from (5) that the domestic price of housing increases with the share of skilled workers, λ. The converse holds with respect to the other region.

2.4 Production and short-run market equilibrium

The agricultural good is produced under perfect competition with a unit input requirement of unskilled labor. Since this good is the numéraire, the unskilled wage rate is unity, $W = 1$.

Each manufacturing variety is supplied by a single firm. Market clearing for a domestic variety i is expressed by $X_i = (\rho + \lambda) x_i + (\rho + 1 - \lambda) \tau x_i^*$, where X_i is production, and x_i^* is the demand of the representative foreign household. Part of demand is indirect, caused by transport losses. With $W = 1$, marginal cost are given by the constant $c > 0$. There is a fixed cost, R, to compensate the skilled worker who is needed to produce at all. Profits of the representative domestic firm, Π_i, are then given by

$$\Pi_i = (p_i - c)(\rho + \lambda) x_i + (p_i^* - c)(\rho + 1 - \lambda) \tau x_i^* - R \tag{6}$$

Imposing the Chamberlinian large group assumption, each producer perceives an elasticity of demand equal to σ. Profit maximizing prices $\bar{p}$ are constant mark-ups over marginal costs

$$p_i = p_i^* = \frac{\sigma}{(\sigma - 1)} \cdot c \equiv \bar{p} \tag{7}$$

The skilled wage adjusts so as to ensure zero profits. Using the market clearing condition, firm scale X_i and fixed costs R are related in the following way

$$X_i = \frac{(\sigma - 1)}{c} \cdot R \tag{8}$$

For a given allocation of skilled workers between the two regions, λ, the wages accruing to skilled workers in the two regions, R and $R*$, can be determined by imposing the condition of zero profits on (6), together with the demand functions (3), the price level (2), and firm's optimal prices (7) (and the analogous conditions for the foreign region). This gives

$$R = \frac{\alpha}{\sigma}\left[\frac{\rho+\lambda}{\lambda+(1-\lambda)\phi} + \frac{\phi(\rho+1-\lambda)}{\phi\lambda+(1-\lambda)}\right] \qquad R^* = \frac{\alpha}{\sigma}\left[\frac{\phi(\rho+\lambda)}{\lambda+(1-\lambda)\phi} + \frac{\rho+1-\lambda}{\phi\lambda+(1-\lambda)}\right] \tag{9}$$

where $0 \le \phi \equiv \tau^{1-\sigma} \le 1$ is a parameter that captures the freeness of trade, which is inversely related to trade costs. With skilled wages determined by (9), firm scale X_i follows from (8), and all other endogenous variables can be derived straightforwardly. The X-sector employs $NcX_i = NR(\sigma-1)$ units of unskilled labor which we assume to be smaller than ρ in order to ensure that both sectors are active after trade.[6] On substituting (7) in (2), the CES-price indices for manufactured goods in the two regions can be derived as

$$P = \overline{p}\left[\lambda+(1-\lambda)\phi\right]^{\frac{1}{1-\sigma}} \qquad P^* = \overline{p}\left[\lambda\phi+(1-\lambda)\right]^{\frac{1}{1-\sigma}} \tag{10}$$

3 Market equilibrium in the long-run

In the long run, skilled workers move across regions in response to differences in indirect utilities. The adjustment process over time t is governed by the differential equation

$$d\lambda / dt \equiv \dot{\lambda} = \left(V - V^*\right)\cdot\lambda\cdot(1-\lambda) \tag{11}$$

The utility differential for skilled workers, $V - V^* = (R - R^*) - \alpha\ln(P/P^*) - \beta\ln(p_H/p_H^*)$, can be expressed analytically for general trade costs in the following way

$$V-V^{*}=\alpha\left[\frac{(1-\phi)}{\sigma}\left(\frac{\rho+\lambda}{\lambda+(1-\lambda)\phi}-\frac{\rho+(1-\lambda)}{\phi\lambda+(1-\lambda)}\right)+\frac{1}{\sigma-1}\ln\left(\frac{\lambda+\phi(1-\lambda)}{\lambda\phi+(1-\lambda)}\right)-\gamma\ln\left(\frac{\rho+\lambda}{\rho+(1-\lambda)}\right)\right] \quad (12)$$

where $\gamma \equiv \beta/\alpha \geq 0$ is a measure of the importance of housing relative to the bundle of manufacturing goods. A symmetric allocation of the mobile factor, $\lambda = 1/2$, is always a long-run equilibrium in this model (it is easily seen that $V-V^{*}=0$ in this case). However, due to two agglomerative forces, this equilibrium is not necessarily stable. As usual, the stability of the symmetric allocation can be addressed by evaluating the sign of

$$\left.\frac{\partial(V-V^{*})}{\partial\lambda}\right|_{\lambda=1/2}=4\alpha\left[\frac{(1-\phi)\left[\sigma(3\phi+1)-2\phi-2\rho(1-\phi)(\sigma-1)\right]}{\sigma(\sigma-1)(1+\phi)^{2}}-\frac{\gamma}{2\rho+1}\right] \quad (13)$$

If (13) is negative (positive), symmetry is a stable (unstable) equilibrium. Provided symmetry is unstable, the model might then exhibit stable equilibria with partial agglomeration (such that $V-V^{*}=0$ and $1/2<\lambda\leq 1$ or $0\leq\lambda\leq 1/2$), or full agglomeration in one of the two regions (such that $V-V^{*}>0$ and $\lambda=1$ or $V-V^{*}<0$ and $\lambda=0$).

The different agglomeration and dispersion forces that affect the stability condition (13) are analytically characterised in appendix A. Here we focus on their economic meaning. First, there is a supply linkage. The region with the higher share of the mobile factor has a larger manufacturing sector, and therefore a lower manufacturing price index. Second, there is a demand linkage. Increasing the share of the mobile factor in one region implies a larger local market. This raises the relative profitability of this market, and the skilled wage differential $(R-R^{*})$. A stabilizing effect stems from the fact that, shifting firms from the foreign to the

[6] This implies the parameter restriction $\alpha<\rho\sigma/(2\rho+1)(\sigma-1)$ as in Pflüger [26]. This coincidence follows from the fact that no labor input is needed for the housing sector.

domestic region, increases competition for given expenditures on domestic products, while lowering competition in the other region. The magnitude of these three forces varies with the level of trade freeness (see also appendix C). Finally, there is a further dispersion force which stems from rising housing prices. This force is independent of trade costs.

Fig. 1 illustrates how the magnitude of these forces is affected by trade costs. In order to clarify the effect of the housing sector, the first three forces are grouped together. The solid, inversely U-shaped curve maps the net agglomeration effect of the two linkages and the competition effect (eq. (A6) of appendix A). We label this curve '*private net agglomeration force*'.[7] When this curve is below (above) the abscissa the two linkages are weaker (stronger) than the competition effect. Without a housing sector (when $\gamma = 0$) agglomeration sets in at a level of trade freeness indicated by the intersection of the 'private net agglomeration force' with the abscissa (denoted by point A in the figure), and is maintained until trade is completely free. With $\gamma > 0$, the 'private net agglomeration force' must be stronger than the dispersion force deriving from housing congestion in order for symmetry to be an unstable equilibrium. The magnitude of the housing congestion force is independent of trade freeness as depicted by the horizontal line in fig. 1.[8] The intersection of this line with the 'private net agglomeration force' defines two critical levels of trade freeness, the 'market break point' ϕ_b^M, and the 'market redispersion point', ϕ_r^M. In between these, symmetry is unstable.

Fig. 1 about here

The analytical expressions for these two critical levels of trade freeness can be obtained by setting (13) equal to zero and then solving for ϕ. This yields

[7] This 'private net agglomeration force' comprises the three forces which are connected with the manufacturing sector. Clearly, the congestion force which is associated with rising housing prices could be netted out with these three forces, too. In order to keep the origin of these forces transparent, we abstain from doing so, however.

[8] This horizontal line is given by eq. A4 of appendix A which we have drawn negative in fig. 1.

$$\phi_b^M = \frac{(\sigma-1)\left[(2\rho+1)^2-\gamma\sigma\right]-(2\rho+1)\sqrt{1+4\sigma(\sigma-1)\left[1-\gamma(\sigma-1)\right]}}{(\sigma-1)\left[(2\rho+1)^2+\gamma\sigma\right]+(2\rho+1)(2\sigma-1)} \tag{14}$$

$$\phi_r^M = \frac{(\sigma-1)\left[(2\rho+1)^2-\gamma\sigma\right]+(2\rho+1)\sqrt{1+4\sigma(\sigma-1)\left[1-\gamma(\sigma-1)\right]}}{(\sigma-1)\left[(2\rho+1)^2+\gamma\sigma\right]+(2\rho+1)(2\sigma-1)} \tag{15}$$

In order to obtain meaningful solutions $0 \le \phi_b^M < \phi_r^M \le 1$, we impose two parameter restrictions. First, $1-\gamma(\sigma-1)>0$ is sufficient to obtain a real root in (14) and (15). In economic terms, this requires that the degree of increasing returns to scale is strong (i.e. σ low) relative to the importance of the housing sector in the expenditures of consumers (γ). This puts an upper bound on the housing congestion force.[9] Second, we rule out that the agglomerative forces become so strong that the symmetric equilibrium is unstable even at infinite trade costs. It is sufficient to require $\sigma/(\sigma-1)<2\rho$ for this 'no black hole-condition' to be fulfilled.[10] Hence, scale economies must not be too strong (σ not too low) relative to the dispersive force given by the relative stock of immobile workers (ρ). It is easily established that these two restrictions, and the one stated in footnote 6, are mutually consistent.

For levels of trade freeness $\phi < \phi_b^M$ or $\phi > \phi_r^M$, the symmetric allocation is stable. In the range between the market break and redispersion point ($\phi_b^M < \phi < \phi_r^M$), the symmetric equilibrium is unstable, and the market delivers either partial or full agglomeration. This can be verified

[9] In terms of fig. 1 this ensures that the horizontal curve is not above the maximum of the inversely U-shaped curve. The necessary condition is weaker and requires $1+4\sigma(\sigma-1)[1-\gamma(\sigma-1)]>0$.

[10] This follows from imposing $\phi_b^M > 0$. Strictly speaking, the inequality $[(\sigma/(\sigma-1))-2\rho][(2\rho+1)/\sigma)<\gamma$ has to be satisfied, so that with γ>0 the no black hole condition is weaker than stated in the text. The stronger condition is imposed to allow for the borderline case $\gamma=0$.

analytically[11], and illustrated graphically by depicting the utility differential (12) for different levels of trade freeness (as in fig. 2). Hence, the associated bifurcation diagram is bubble-shaped, as shown by the solid curve in fig. 3 (ignore the broken curve until further notice).

Fig. 2 and Fig. 3 about here

The comparative statics of the two bifurcation levels are straightforward to derive from (14) and (15). First, $\partial\phi_b^M / \partial\sigma > 0$ and $\partial\phi_r^M / \partial\sigma < 0$. Stronger economies of scale at the firm level, $1/\sigma$, foster agglomeration and enlarge the range of ϕ where symmetry is unstable. Second, $\partial\phi_b^M / \partial\gamma > 0$ and $\partial\phi_r^M / \partial\gamma < 0$. Larger housing expenditures imply a stronger dispersion force at all levels of trade costs and, thus, a smaller range of ϕ where agglomeration occurs. Finally, $\partial\phi_b^M / \partial\rho > 0$ and $\partial\phi_r^M / \partial\rho > 0$. Increasing the proportion of immobile workers bolsters up the competition effect, but reduces the housing congestion force (see equations A3 and A4). The former effect is stronger (weaker) than the latter at low (high) levels of ϕ. Hence, both agglomeration and redispersion obtain at higher levels of trade freeness.

4 Welfare analysis

4.1 The social welfare function

The spatial distribution of the manufacturing sector in the long-run market equilibrium is the result of the migration decision of independently acting skilled workers. In this section we analyze whether this location pattern is efficient from a social perspective. Unfortunately, the Pareto-criterion is insufficient to rank different spatial structures, because of conflicting

[11] Formally, the claim is established by noting that $\partial^3 \left(V - V^*\right) / \partial\lambda^3$, evaluated both at $\lambda = 1/2$ and $\phi = \phi_b^M$ and at $\lambda = 1/2$ and $\phi = \phi_r^M$, is unambiguously negative, thus, satisfying the formal condition for a 'supercritical pitchfork bifurcation' (Grandmont [11]).

interests among different groups of agents in this economy, as we show in section 4.3. Therefore, we are forced to use a different normative criterion. We have chosen a utilitarian concept where a social planner is assumed to maximize the un-weighted sum of individual utilities. This choice is due to two reasons. First, we have assumed that the preferences of the agents are quasi-linear. In some sense this assumption is restrictive, because it eliminates all income effects from manufacturing demand, giving our modeling strategy a partial equilibrium flavor. At the same time, however, the utilitarian concept of social welfare is reasonable with quasi-linear preferences, because all agents have a marginal utility of income equal to one so that income redistributions do not affect aggregate welfare. Second, the utilitarian concept has been used in other works which address the social desirability of agglomeration (e.g. Ottaviano and Thisse [23], Baldwin et al. [1]). Hence, our choice facilitates the comparison of our results with the existing literature (see section 5.3). We should nonetheless make it clear that, even if particularly well-suited for our analysis, the utilitarian concept has its limitations and is only one of various possible welfare criteria.[12]

In the following we let V_u and V_u* denote the indirect utility of an unskilled worker in the domestic and in the foreign region, respectively. We keep the symbols V and $V*$ to indicate the indirect utility that a mobile skilled worker derives in home and in foreign, respectively. Using (4), the utilitarian social welfare function is given by

$$\Omega(\lambda) = \lambda V + (1-\lambda)V* + \rho(V_u + V_u*) \tag{16}$$

$$= \lambda R + (1-\lambda)R* - (\rho+\lambda)(\alpha \ln P + \beta \ln p_H) - (\rho + 1 - \lambda)(\alpha \ln P* + \beta \ln p_H^*) + \xi$$

where $\xi \equiv 2\rho + \varepsilon(2\rho+1)$

[12] A case in point is the study Charlot et al [4] which studies the conflicts of interest that arise in the core-periphery model of Krugman [13]. This model assumes a Cobb-Douglas upper tier utility function which implies that the marginal utility of income depends on prices. Within this framework, Charlot et al. find that utilitarianism is biased toward agglomeration since it does not account for inequality across individuals.

There are two sources of inefficiency in our model. First, firms in the manufacturing sector have market power. Prices exceed marginal costs, and consumption is too low from a social perspective. Second, a skilled worker, faced with the decision whether to migrate or not, does not take into account the effects of her decision on prices, which affect the welfare of all other agents.[13] It is well-established that these pecuniary externalities, though inconsequential from a welfare point of view under perfect competition, do matter with imperfect competition (Laffont [14], Ottaviano and Thisse [22]).[14]

A first-best allocation results when the social planner is able (i) to enforce that manufacturing prices are at marginal costs, and (ii) to control the allocation of skilled workers across the two regions (λ). Marginal cost pricing implies zero wages for the skilled, $R = R^* = 0$, by (6). Hence, in the first-best the social planner pays lump-sum transfers to the skilled workers (financed by lump-sum taxes), to ensure that their production and consumption are as specified in (8) and (3). In the second-best, the social planner controls the allocation of the mobile factor but takes market prices as given by (7). In spite of this difference, it turns out that the social welfare functions for the first- and the second-best are identical in our model *except for a constant term* (i.e. a term independent of λ). Hence, the marginal conditions for a welfare maximum, and thus the optimal spatial structure chosen by the social planner, must coincide in these two allocations. However, aggregate welfare is higher in the first-best than in the second-best because manufacturing prices are lower.

This coincidence of the first- and second-best spatial structure follows for two reasons. First, the aggregate income of skilled workers is given by the exogenous transfer in the first-best. In

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[13] Another potential source of inefficiency in this model of monopolistic competition might arise from firm entry. However, it is well known from Dixit and Stiglitz [5] that the number of firms (varieties) in the market equilibrium coincides with the number in the constrained optimum in the special case with constant elasticity of substitution, on which we focus in this paper (see also Mankiw and Whinston [15] on this point). Hence, we can be sure that firm entry is efficient in our model.

[14] Although Krugman [13], in his seminal paper, focused on the positive side of these pecuniary externalities, he clearly noted their welfare relevance: "In competitive general equilibrium, of course, pecuniary externalities have no welfare significance (...). Over the past decade, however, it has become a familiar point that in the presence of imperfect competition and increasing returns, pecuniary externalities matter (p. 485).

the second-best, following from (9), it is given by $\lambda R + (1-\lambda) R^* = (1+2\rho)/\sigma$. This term is independent from λ, and, due to the assumption of quasi-linear preferences, it enters the social welfare function in additive separable form. As a consequence, both in the first- and the second-best, the social planner is concerned with the welfare effects that are transmitted through housing prices and manufacturing prices, but not through the wages of the skilled workers. Second, the demand functions for varieties have constant price elasticity due to the CES-specification of the manufacturing aggregate (see (3)). The first-best manufacturing price index with marginal cost prices then differs only by the multiplicative constant $(\sigma-1)/\sigma$ from the second-best price index (given by (10)). Price indices enter welfare (16), in logarithmic form, however. Moreover, housing prices enter the welfare functions of the first- and the second-best in exactly the same way. Hence, the difference in the welfare function amounts to a constant term only. In sum, the logarithmic quasi-linear upper tier utility in combination with the CES sub-utility function for manufacturing imply that the location pattern of the first-best and the second-best optimum coincide in our model.[15]

Because it is computationally simpler, we derive the optimal spatial allocation in terms of the second-best in the following, Substituting the expressions for R, R^*, P, P^*, p_H and p_H^* in (16) and collecting all constant terms in the parameter $\tilde{\xi}$, social welfare can be rewritten as

$$\Omega(\lambda) = \alpha \left[\frac{1}{\sigma-1} \ln \left(\frac{\left(\lambda + (1-\lambda)\phi\right)^{\lambda+\rho}}{\left(\phi\lambda + (1-\lambda)\right)^{-(1-\lambda+\rho)}} \right) - \gamma \ln \left(\frac{(\rho+\lambda)^{\lambda+\rho}}{(\rho+1-\lambda)^{-(1-\lambda+\rho)}} \right) \right] + \tilde{\xi} \qquad (17)$$

[15] This property is useful for the analysis below where we disentangle the sources of market failure. However, it should be emphasized that the coincidence of the first- and the second-best is not a general property of 'new economic geography'-models. For example, in Ottaviano and Thisse [23], the first- and the second-best fall apart because demand for varieties is not iso-elastic. In Baldwin et al. [1] they fall apart due to income effects in the demand for manufactures. On this, see also section 5.3.

The first term and the second term in square brackets show how the spatial distribution of the mobile factor, λ, affects aggregate social welfare through manufacturing price indices and through housing prices, respectively.

It is straightforward to show that the derivative $\partial\Omega/\partial\lambda$ always equals zero at $\lambda = 1/2$. However, $\lambda = 1/2$ can be a welfare maximum or a minimum. Moreover, the social welfare function may have further extrema at values of λ different from the symmetric distribution, i.e. at $\lambda \in \{[0,1], \lambda \neq 1/2\}$. By standard analysis one can show that the welfare function has at most five extrema (including the cases $\lambda = 0$ and $\lambda = 1$) and that no more than two of these may be welfare maxima[16]. Figure 4 illustrates the possible shapes of $\Omega(\lambda)$.

Fig. 4 about here

The upper graph in fig. 4 illustrates the case where the symmetric equilibrium ($\lambda = 1/2$) is a global welfare maximum. This requires $\partial^2\Omega/\partial\lambda^2\big|_{\lambda=1/2} < 0$. The bottom of fig. 4 illustrates the case where the symmetric equilibrium is a welfare minimum, and where the welfare optimum is a border solution of full agglomeration in one of the two regions (i.e. $\lambda = 1$ or $\lambda = 0$). The panel in the middle illustrates the third possible case. Symmetry is a local minimum, and the social optima are characterized by partial agglomeration. In the second and the third case, $\partial^2\Omega/\partial\lambda^2\big|_{\lambda=1/2} > 0$. In order to distinguish between these two cases it suffices

[16] This can be proven by noting that the second derivative of the social welfare function is a polynomial of fourth order which has four roots. It is straightforward if tedious to show that only two of these roots are economically meaningful (i.e. such that λ can fall in the unit interval). In the relevant range of λ, the social welfare function has at least one and at most two turning points. If the social welfare function has exactly two turning points, it could in principle exhibit a 'M-shape' or a 'W-shape'. However, one can rule out the 'W-shape' by contradiction. If $\Omega(\lambda)$ had three welfare maxima ($\lambda = 1/2$, $\lambda = 1$, $\lambda = 0$), three conditions would have to hold:

$$\text{(i)}\ \partial^2\Omega/\partial\lambda^2\big|_{\lambda=1/2} < 0, \quad \text{(ii)}\ \partial\Omega/\partial\lambda\big|_{\lambda=1} > 0 \quad \text{and} \quad \text{(iii)}\ \partial\Omega/\partial\lambda\big|_{\lambda=0} < 0.$$

However, these conditions can be shown to be inconsistent with the parameter restrictions imposed. Only the cases depicted in fig. 4 are consistent with these restrictions. Further details about this derivation are available upon request from the authors.

to evaluate $\partial\Omega / \partial\lambda\big|_{\lambda=1}$. If this derivative is positive, we are in the bottom case of fig. 4, and full agglomeration is optimal from a social point of view. If it is negative, the social optimum is characterized by partial agglomeration (middle panel of fig. 4).

4.2 The socially optimal spatial allocation

In order to discriminate between the cases where the social planner chooses symmetry and where she chooses (partial or full) agglomeration we evaluate the second partial derivative of Ω with respect to λ at $\lambda = 1/2$. This yields the following quadratic equation:

$$\left.\frac{\partial^2\Omega}{\partial\lambda^2}\right|_{\lambda=1/2} = 4\alpha\left[\frac{(1-\phi)\left[(3\phi+1)-2\rho(1-\phi)\right]}{(\sigma-1)(1+\phi)^2} - \frac{\gamma}{2\rho+1}\right] \tag{18}$$

The first term in square brackets has an ambiguous sign and captures the impact of manufacturing prices on the social desirability of agglomeration. We call this term '*social net agglomeration force*'.[17] It is the counterpart of the 'private net agglomeration force' in (13). The second term is unambiguously negative, showing that congestion in the housing market makes symmetry desirable from a social point of view. In the comparison of the market and planner allocation which follows below, we make extensive use of these two net agglomeration forces.

To find the critical values of trade freeness, eq. (18) must be set equal to zero and solved for ϕ. Two solutions are obtained for which the parameter restrictions spelled out above ensure that they fall in the feasible range of ϕ between zero and one.

[17] Here we proceed as in our analysis of the market equilibrium, i.e. we keep the influences which are connected with the manufacturing sector apart from considerations concerning the housing sector (cf. footnote 7).

$$\phi_b^S = \frac{(2\rho+1)\left[(2\rho+1)-2\sqrt{1-\gamma(\sigma-1)}\right]-\gamma(\sigma-1)}{(2\rho+1)(2\rho+3)+\gamma(\sigma-1)} \tag{19}$$

$$\phi_r^S = \frac{(2\rho+1)\left[(2\rho+1)+2\sqrt{1-\gamma(\sigma-1)}\right]-\gamma(\sigma-1)}{(2\rho+1)(2\rho+3)+\gamma(\sigma-1)} \tag{20}$$

We term these bifurcation points the 'social break point', ϕ_b^S, which occurs at the (low) level of trade freeness at which symmetry is no longer the social optimum, and the 'social redispersion point', ϕ_r^S, which is the (high) level of trade freeness at which the symmetric equilibrium re-emerges as the social optimum. It is easily seen that for $\gamma = 0$, the social redispersion is equal to one. Moreover, it can be shown that $\partial\phi_b^S / \partial\sigma > 0$, $\partial\phi_r^s / \partial\sigma < 0$, $\partial\phi_b^S / \partial\rho > 0$, $\partial\phi_r^S / \partial\rho > 0$, $\partial\phi_b^S / \partial\gamma > 0$, and that $\partial\phi_r^S / \partial\gamma < 0$. Hence, in a qualitative sense, the comparative statics of these bifurcation points mimic what we have found for the market equilibrium, and the basic intuition carries over.

To find out when the social planner chooses partial agglomeration rather than full agglomeration, we evaluate $\partial\Omega / \partial\lambda\big|_{\lambda=1}$. This gives:

$$\left.\frac{\partial\Omega}{\partial\lambda}\right|_{\lambda=1} = \alpha\left\{\gamma\ln\left(\frac{\rho}{1+\rho}\right)-\frac{1}{\sigma-1}\left[\ln\phi-(1-\phi)\left[1+\rho\left(1-\frac{1}{\phi}\right)\right]\right]\right\} \tag{21}$$

It can be shown that (21) is in fact negative if evaluated at ϕ_b^S and at ϕ_r^S. In between these two critical levels, there is a range of values of ϕ for which (21) is positive. Hence, the shift from dispersion to agglomeration and back, which obtains when trade freeness steadily rises, is a continuous process. The bifurcation diagram implied by the social planner's solution is *qualitatively* the same as the bifurcation diagram of the market.

4.3 Welfare analysis by group

Before turning to a comparison of equilibrium and optimum we analyze group welfare. This provides a foundation for the social planner's location choice, which is based on the utility sum of all groups. Moreover, this analysis reveals how the different groups fare in the process of trade integration, and it identifies conflicts of interest. The social welfare function (16) is composed of the welfare functions for the group of unskilled workers as a whole, denoted $\Omega_u = \rho\left[V_u + V_u *\right]$, and for the group of skilled workers, $\Omega_h = \lambda V + (1-\lambda)V *$. The group welfare function Ω_u can be disaggregated further into components for the groups of unskilled workers in home and foreign, respectively. This uncovers the conflicts of interest that arise *within* the group of unskilled workers.

Like the aggregate function, the welfare functions for both groups always exhibit an extremum at the symmetric allocation. Hence, we have to evaluate the second order derivative of these functions at $\lambda = 1/2$. This yields:

$$\left.\frac{\partial^2 \Omega_h}{\partial \lambda^2}\right|_{\lambda=1/2} = 4\alpha\left[\frac{(1-\phi)(3\phi+1)}{(\sigma-1)(1+\phi)^2} - \frac{\gamma(1+4\rho)}{(2\rho+1)^2}\right] \qquad (22)$$

$$\left.\frac{\partial^2 \Omega_u}{\partial \lambda^2}\right|_{\lambda=1/2} = 8\alpha\rho\left[\frac{-(1-\phi)^2}{(\sigma-1)(1+\phi)^2} + \frac{\gamma}{(2\rho+1)^2}\right] \qquad (23)$$

The first terms in square brackets in (22) and in (23) characterize the effects that derive from manufacturing prices on the group of skilled and unskilled workers, respectively, whilst the second terms capture the forces exerted by housing prices on these two groups. Note that (22) and (23) add up to (18) on which the social planner bases her optimal allocation.

In the absence of housing ($\gamma = 0$), the right hand side of (22) is unambiguously positive whilst the right-hand side of (23) is negative. Hence, absent housing, symmetry is always a welfare minimum for the group of skilled workers. In contrast, the group of unskilled workers as a whole always prefers dispersion. Yet, it is easy to show that the agglomeration of activity is beneficial for the unskilled workers who live in what becomes the centre, whereas it is harmful to unskilled workers who live in what becomes the periphery. The fact that dispersion is a welfare maximum for the group *as a whole* implies that the loss of the losers from a switch from dispersion to agglomeration outweighs the gain of the gainers.

Further trade-offs emerge when housing is taken into account ($\gamma > 0$). The negative second term in (22) shows that, for the group of skilled workers, housing works in favor of dispersion. The positive sign of the second term in (23) implies that housing has the opposite effect for the group of unskilled workers as a whole, i.e. it works in favor of agglomeration. However, it is easily established that there is again a conflict of interest within this group. The housing congestion is harmful for those who live in what becomes the centre (although they benefit from a fall in the manufacturing price index), whereas it is beneficial to those unskilled workers who live in what becomes the periphery.

These trade-offs are formally characterized in appendix B, where we derive critical levels of trade freeness, ϕ_u (ϕ_h) below (above) which the group of unskilled (skilled) workers as a whole prefer dispersion (agglomeration), and above which they choose agglomeration (dispersion). The planner balances the interests of these groups. The way she does this is revealed in the ranking $0 < \phi_b^S < \phi_u \leq \phi_h \leq \phi_r^S \leq 1$ (strict inequalities for $\gamma > 0$).

We can sum up this section by noting that it is not possible to Pareto-rank different spatial structures, because there are conflicts of interest involved between different groups in this economy, in general. Hence, the planner has to resort to some social welfare function, which we assume to be utilitarian.

5 Market equilibrium and the social optimum

5.1 The market solution and the social optimum compared

The comparison of the market equilibrium and the social optimum is at the centre of our analysis. It is covered in the following proposition

Proposition 1: *Under the parameter restrictions imposed, (i) the market break point is lower than the social break point (* $\phi_b^M < \phi_b^S$ *), and (ii) the market redispersion point is equal or lower (strictly lower for* $\gamma > 0$ *) than the social redispersion point (* $\phi_r^M \leq \phi_r^S$ *).*

Part (i) follows from subtracting the market break point from the social break point (as given by (14) and (19)), and noting that $\phi_b^S - \phi_b^M$ is unambiguously positive given the parameter restrictions which we have imposed. The switch from a symmetric equilibrium to agglomeration occurs at a higher level of trade freeness in the social optimum as compared to the market solution. Part (ii) analogously follows from subtracting the market redispersion point from the social redispersion point ((15) and (20)), which results in an unambiguously non-negative term. Proposition 1 implies that the market leads to over-agglomeration for low levels of trade freeness, and it yields under-agglomeration for high levels of trade freeness. At very high, very low, and intermediate levels the market equilibrium and the optimum coincide, qualitatively. This result is illustrated above in fig. 3, which superimposes the bifurcation diagrams of the market and of the social planner. Solid lines represent the equilibrium spatial structure of the economy, and broken ones the optimal spatial structure.

5.2 Exploring the sources of market failure

This section explores *why* the spatial equilibrium deviates from the socially optimal spatial structure for some ranges of trade freeness. We proceed in four steps.

(i) Recall that the first- and second-best optimum coincide, i.e. the same allocation obtains with or without marginal cost pricing. Hence, mark-up prices can not be the reason why there is divergence between equilibrium and optimum. Any discrepancy must be solely due to the second source of inefficiency, the fact that skilled workers do not take into account that their location choice affects the welfare of the other agents. Our tractable framework allows us to go much beyond this general statement, however.

(ii) It is important to observe that any inefficiency of the market equilibrium is entirely due to pecuniary externalities associated with the monopolistically competitive manufacturing sector. The housing sector per se does not add any further inefficiency. To see this, compare (13) and (18) which contain the forces which determine the location decisions of the mobile workers and of the social planner, respectively. These expressions have the same two-part structure. As explained above, the first term in square brackets in (13) is the 'private net agglomeration force', whereas the first term of eq. (18) is the 'social net agglomeration force'. The second terms in (13) and (18) capture the impact of the housing congestion force for the market and the planner allocation. This second term is identically given by $-\gamma/(2\rho+1)$ in both expressions. We can thus state

Proposition 2*: The congestion force associated with the housing sector is of identical strength in the market allocation and the social planner allocation.*

Any difference in the signs of eqs. (13) and (18), which signals a discrepancy between equilibrium and optimum, *must* be due to a difference concerning the first terms. Underlying this result is the fact that the housing market is competitive. For this reason, the pecuniary externality in the housing market is inconsequential from an aggregate welfare perspective. Hence, the source of market failure has to be sought in the manufacturing sector. Yet, as we explain later, the housing sector plays a crucial role for the under-agglomeration result stated in part (ii) of proposition 1.

(iii) To work out the difference between market equilibrium and social optimum, we abstract from housing until further notice (i.e. we assume $\gamma = 0$). The 'private net agglomeration force' for individual location decisions (the first term of (13)) is depicted as the inversely U-shaped solid line in fig. 1. The 'social net agglomeration force' in manufacturing (the first term of (18)) is graphically illustrated as the inversely U-shaped broken line. An analytical expression for the vertical difference between these two curves can be obtained by subtraction. This difference can be interpreted as the *net pecuniary externality* that is associated with the location decision of mobile skilled workers:

$$\left.\frac{\partial^2 \Omega}{\partial \lambda^2}\right|_{\lambda=1/2} - \left.\frac{\partial (V - V^*)}{\partial \lambda}\right|_{\lambda=1/2} = -\frac{8\alpha(1-\phi)\left[\rho(1-\phi)-\phi\right]}{\sigma(\sigma-1)(1+\phi)^2} \tag{24}$$

The difference in (24) is zero at $\hat{\phi} = \rho/(1+\rho)$ and at $\phi = 1$ whilst it is negative for $0 < \phi < \hat{\phi}$ and positive for $\hat{\phi} < \phi < 1$. The 'private net agglomeration force' is stronger (weaker) than the 'social net agglomeration force' for low (high) levels of trade freeness, indicating that the pecuniary externality is negative (positive). The net pecuniary externality is zero at zero trade costs ($\phi = 1$), since space is irrelevant in this case. It is also equal to zero at $\phi = \hat{\phi}$, because the demand linkage and the competition effect just offset each other at this level of trade freeness (cf. A5 in appendix A). Hence, the 'private net agglomeration force' coincides with the supply linkage. Moreover, at $\phi = \hat{\phi}$ the supply linkage happens to be equal to the aggregate impact of manufacturing prices on social welfare.[18] These results are illustrated in appendix C, where the location forces are depicted over the whole range of trade freeness, ϕ. Summing up, we have:

Proposition 3*: The net pecuniary externality in the manufacturing sector that is associated with the mobility of skilled workers is negative for* $0 < \phi < \hat{\phi}$*, positive for* $\hat{\phi} < \phi < 1$*, and zero at* $\phi = \hat{\phi} = \rho/(1+\rho)$ *and at* $\phi = 1$.

It is important to note that a non-zero net pecuniary externality does not imply that equilibrium and social optimum differ in a qualitative sense. For example, for levels of trade freeness below A in fig. 1, both the market and the social planner select a symmetric spatial allocation. At the same time, the 'social net agglomeration forces' is weaker than the 'private net agglomeration force'. However, this negative net pecuniary externality is not visible in the bifurcation diagram (fig. 3). The discrepancy between the equilibrium and the optimum is visible only for levels of ϕ, between the market break point and the social break point and between the marekt redispersion point and the social redispersion point. For all other values of ϕ, except at $\hat{\phi} = \rho/(1+\rho)$ and at $\phi = 1$, equilibrium and optimum coincide in a qualitative sense, although there are non-zero pecuniary externalities.

(iv) As a fourth and final step, we now show that the housing sector – which per se is no source of inefficiency in this model (see proposition 2) – is crucial for under-agglomeration of the market equilibrium at high levels of trade freeness (proposition 1). In contrast, at low levels of trade freeness, market over-agglomeration emerges even without housing.

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[18] The reason is that at $\phi = \hat{\phi}$ operating profits for any firm on both, the domestic and the foreign market turn out to be independent of λ, and thus $R = R^*$ holds irrespective of λ. Furthermore, at $\phi = \hat{\phi}$ the relative manufacturing price index matches relative population size, i.e. $P/P^* = ((\lambda + \rho)/(1 - \lambda + \rho))^{1/(1-\sigma)}$.

From fig. 1 and our previous analysis it is obvious that, without housing, there is never a redispersion of economic activity. Without housing, both the market and the social redispersion point coincide at $\phi = 1$. Yet, even if $\gamma = 0$, the market break point is below the social break point. This is visualized in fig. 1 by the fact that the 'private net agglomeration force' crosses the abscissa at a lower level of ϕ than the 'social net agglomeration force'. The negative net pecuniary externality which obtains for all values $0 < \phi < \hat{\phi}$ implies over-agglomeration in the range between the market break point and the social break point (it can be shown that $\phi_b^M < \phi_b^S < \hat{\phi} < \phi_r^M < \phi_r^S$). However, the positive net pecuniary externality, which obtains for all values $\hat{\phi} < \phi < 1$, leads to under-agglomeration only when the housing sector is reintroduced into the model ($\gamma > 0$). This follows from comparing the levels of trade freeness where the two U-shaped curves are crossing the horizontal housing congestion line: since the net pecuniary externality is positive in this range, it must be the case that the solid market curve crosses the horizontal line at a lower level of ϕ than the broken social planner curve. This insight is summarized in:

Proposition 4*: The positive net pecuniary externality which obtains for $\hat{\phi} < \phi < 1$ does not imply under-agglomeration unless $\gamma > 0$, i.e. unless the congestion force associated with crowding in the housing market is present.*

Proposition 4 clarifies why models that do not consider housing typically end up finding market over-agglomeration (e.g. Ottaviano and Thisse [23]). It is a merit of our tractable model that it allows us to show precisely that the net pecuniary externaliy which is negative and, hence, the cause of over-agglomeration at low levels of trade freeness, turns positive at high levels of trade freeness.

5.3 Discussion

This section puts our findings in perspective to the previous literature. In common with Helpman [12] we obtain the result that there is too little agglomeration at high levels of trade freeness. In Helpman this finding is based on a set of numerical simulations, whereas we derive it as a general analytical result. Even more importantly, we are able to clarify that under-agglomeration is due to the positive net pecuniary externality which is associated with the location choice of mobile skilled workers in the imperfectly competitive sector at high levels of trade freeness. This fact becomes visible only by interacting the net pecuniary externality with the congestion force associated with the housing market. Moreover, in contrast to the model we use, there is no constant returns sector and no immobile labor force in his framework. By eliminating immobile workers as a dispersion force, both the market, and the social planner prescribe agglomeration for low enough levels of trade freeness. Hence, there can be no divergence between the market and the social planner at low levels of trade freeness in Helpman's model.

The result of a tendency toward over-agglomeration in the absence of a housing sector and at early stages of trade integration was previously established by Ottaviano and Thisse [23], the underlying intuition being fairly similar. However, it should be noted that there are two main differences between their framework and the one we use. First, Ottaviano and Thisse [23] postulate a *quadratic* quasi-linear upper tier utility function. This implies that the indirect utility differential which drives the location decision of mobile workers is linear. Hence, their model does not feature stable equilibria with partial agglomeration, but only 'bang-bang-outcomes'. Their normative conclusions are thus restricted to a comparison of corner solutions. The quadratic quasi-linear utility framework also implies that the first- and the second-best allocation do not coincide, since the demand functions for individual varieties are linear, and hence, the price elasticity is not constant along the demand curve, in contrast to our model. Second, they do not consider housing or any other congestion force. Hence, there is no re-dispersion in their model. In the light of our results it is therefore plausible that they only diagnose over-agglomeration.

In an extension of this work, Ottaviano, Tabuchi and Thisse [25] assume that each region has a spatial extension involving a linear city with a central business district. Workers consume land and commute to the central business district at a cost. Adding such a spatial extension introduces a congestion force different from the one that we use. The comparison between the social optimum and the market equilibrium turns out to be less straightforward than in the absence of such urban costs. Ottaviano, Tabuchi and Thisse [25] provide simulations which show that the market equilibrium may yield either suboptimal agglomeration or dispersion, depending on the parameter values of the economy. However, they do not find that the welfare properties of the market allocation change *in the course of trade integration*, which we take to be one central novel insight of our analysis.

The nature of the dispersion force might be important for the comparison of the equilibrium and the optimum spatial structure. In our model we have considered a competitive housing market à la Helpman [12], which per se adds no inefficiency to the model (see proposition 2). This is useful because it has allowed us to focus on the inefficiency which derives from the net pecuniary externality associated with the mobility of agents in the monopolistically competitive manufacturing sector. It takes the special role of housing to uncover that this net pecuniary externality is positive at high levels of trade freeness (proposition 4). If we had alternatively considered a congestion force that imposes additional external effects on the agents (e.g. pollution or traffic jams), we would have to take those into account when analyzing the welfare implications of agglomeration.

Tabuchi and Thisse [30] introduce heterogeneity in migration behaviour rather than urban costs into the quadratic quasi-linear utility model. They show that such taste heterogeneity acts as a strong dispersion force. The relationship between trade costs and the spatial distribution of the industry is bubble-shaped, as in our analysis. A comparison of the optimum and the equilibrium turns out to depend on whether there is a differential in regional amenities or not. In the former case, Tabuchi and Thisse [30] show that the equilibrium configuration is more concentrated than the optimum when varieties are sufficiently differentiated and increasing returns are sufficiently high, and less concentrated if varieties are close substitutes and/or increasing returns are sufficiently low. In the latter case, depending on parameter values, the market outcome may be more dispersed or more agglomerated than the optimum.

In another set of works, welfare analyses are conducted for the standard core-periphery model or close descendants. In these models, households have preferences which are characterized by a Cobb-Douglas upper tier utility function. Hence, in contrast to our analysis, there are income effects in the demand for manufactured goods which affect the profitability of manufacturing firms across locations. These models have in common that they imply 'bang-bang' locational solutions. Baldwin et al. [1] use the analytically tractable model of Forslid and Ottaviano [8] to show that the market outcome provides excessive agglomeration if agglomeration forces are strong and the size of the immobile labor force is large relative to the size of the group of mobile skilled workers (p.262ff.). Excessive dispersion occurs if agglomeration forces are weak and the relative number of immobile workers is small. In contrast to us, they do not consider the interaction of the monopolistically competitive sector with a housing sector. The same holds true for Charlot et al. [4] who work out the conflicts of interest between various groups in the core-periphery model of Krugman [13], and who draw on different social welfare functions (cf. footnote 12).

In contrast to the works previously mentioned, Robert-Nicoud [29] considers a model where agglomeration is due to vertical linkages. On the basis of simulations, he also provides the result that the market may provide to much or too little agglomeration.

6 Conclusion

This paper addresses the welfare effects of agglomeration, and the efficiency arguments for regional policy intervention. Our analysis contrasts to, and extends previous work in several respects. The framework we consider remains analytically tractable, even though we add some realism by including housing scarcity as an additional centrifugal force implying a redispersion of economic activity at low trade costs. Thereby we are able derive a richer menu of normative results. In particular, we provide a clear-cut picture of the welfare properties of agglomeration as the economy undergoes a trade integration process. We show that the market equilibrium is characterized by over-agglomeration for high trade costs and under-agglomeration for low trade costs. For very high and very low levels and for an intermediate range of trade costs, the market equilibrium yields the socially optimal degree of agglomeration. Finally, we identify the source of inefficiency with analytical precision. The 'net pecuniary externality' that is associated with the location choice of mobile skilled workers is negative at low levels of trade freeness, but it becomes positive at high levels. This tendency of the market to under-agglomerate at high levels of trade freeness becomes visible only with the additional congestion force originating in the (per se efficient) housing sector.

Regional policy is often motivated by equity considerations, but policy makers seem to hope that a more equal spatial resource allocation also raises efficiency. Our analysis suggests that this hope is warranted for low levels of trade freeness, where the market delivers excessive agglomeration. However, from the perspective of allocative efficiency, it turns out that *more* agglomeration is socially desirable when trade integration has developed far enough.

It should be noted that these results are derived in a model with specific assumptions about utility and production functions, as well as trade costs. Of course, this holds true for the entire new economic geography literature. But this specificity commands that one should treat the results cautiously. Nonetheless, we believe that our analysis illustrates some fundamental insights for the class of new economic geography models, in general.

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APPENDIX A: Agglomeration and Dispersion Forces of the Market

The agglomeration and dispersion forces of the market are obtained by evaluating the components of the first derivative of (12) with respect to λ at $\lambda = 1/2$.

Supply Linkage

$$\left.\frac{d[\alpha \ln(P^*/P)]}{d\lambda}\right|_{\lambda=1/2} = \frac{4\alpha(1-\phi)}{(\sigma-1)(1+\phi)} > 0 \tag{A1}$$

Demand Linkage Keeping x_i, x_i^*, x_j, x_j^* fixed to isolate the market size effect

$$\left.\frac{d[R-R^*]}{d\lambda}\right|_{\lambda=1/2;(x_i, x_i^*, x_j, x_j^* \, fixed)} = \frac{4\alpha(1-\phi)}{\sigma(1+\phi)} > 0 \tag{A2}$$

Competition Effect Keeping the market size fixed and thus isolating the competition for demand x_i, x_i^*, x_j, x_j^*

$$\left.\frac{d[R-R^*]}{d\lambda}\right|_{\lambda=1/2;(marketsize\ fixed)} = -\frac{4\alpha(2\rho+1)(1-\phi)^2}{\sigma(1+\phi)^2} < 0 \tag{A3}$$

Housing Congestion:

$$\left.\frac{d[\beta \ln(p_H^*/p_H)]}{d\lambda}\right|_{\lambda=1/2} = -\frac{4\beta}{2\rho+1} < 0 \tag{A4}$$

Demand Linkage and Competition Effect together: (A2) + (A3)

$$\left.\frac{d[R-R^*]}{d\lambda}\right|_{\lambda=1/2} = -\frac{8\alpha(1-\phi)[\rho(1-\phi)-\phi]}{\sigma(1+\phi)^2} \tag{A5}$$

Note: (A5) is negative if $0 < \phi < \rho/(1+\rho)$, positive if $\rho/(1+\rho) < \phi < 1$, and zero if $\phi = \rho/(1+\rho)$ or $\phi = 1$.

Supply Linkage, Demand Linkage and Competition Effect together: (A1) + (A2) + (A3)

$$\frac{4\alpha(1-\phi)[\sigma(3\phi+1)-2\phi-2\rho(1-\phi)(\sigma-1)]}{\sigma(\sigma-1)(1+\phi)^2} \tag{A6}$$

This is the first term in the square brackets of (13) and describes the solid, inversely U-shaped curve depicted in fig. 1. Adding up the net agglomeration force (A6) and housing congestion (A4) yields eq. (13).

APPENDIX B: Welfare analysis by group: Critical thresholds

For the skilled workers, setting eq. (22) equal to zero and solving for ϕ yields one meaningful solution which is given by

$$\phi_h = \frac{2(2\rho+1)}{2(2\rho+1)-\sqrt{(2\rho+1)^2-(4\rho+1)\gamma(\sigma-1)}}-1 \qquad \text{(B2)}$$

The group of mobile workers prefers agglomeration for low levels of trade freeness and dispersion for high levels of trade freeness. Note that $\phi_h = 1$ when $\gamma = 0$.

Turning to the immobile, unskilled labor force as a whole, setting eq. (23) equal to zero and solving for ϕ yields one meaningful solution in the range $\phi \in [0,1]$. This critical level which we denote ϕ_u is given by

$$\phi_u = \frac{(2\rho+1)\left[2\rho+1-2\sqrt{\gamma(\sigma-1)}-\gamma(\sigma-1)\right]}{(2\rho+1)^2-\gamma(\sigma-1)} \qquad \text{(B1)}$$

For $\phi < \phi_u$, $\partial^2\Omega_u / \partial\lambda^2\big|_{\lambda=1/2} < 0$ and, hence, the symmetric equilibrium is a welfare maximum. For $\phi > \phi_u$, $\partial^2\Omega_u / \partial\lambda^2\big|_{\lambda=1/2} > 0$ and symmetry is a welfare minimum for this group. Hence, the unskilled workers as a whole prefer dispersion at low levels of trade freeness whilst they prefer agglomeration at high levels of trade freeness. Still, in general there is a conflict of interest *within* the group of unskilled workers. Furthermore, note that $\phi_u = 1$ when $\gamma = 0$.

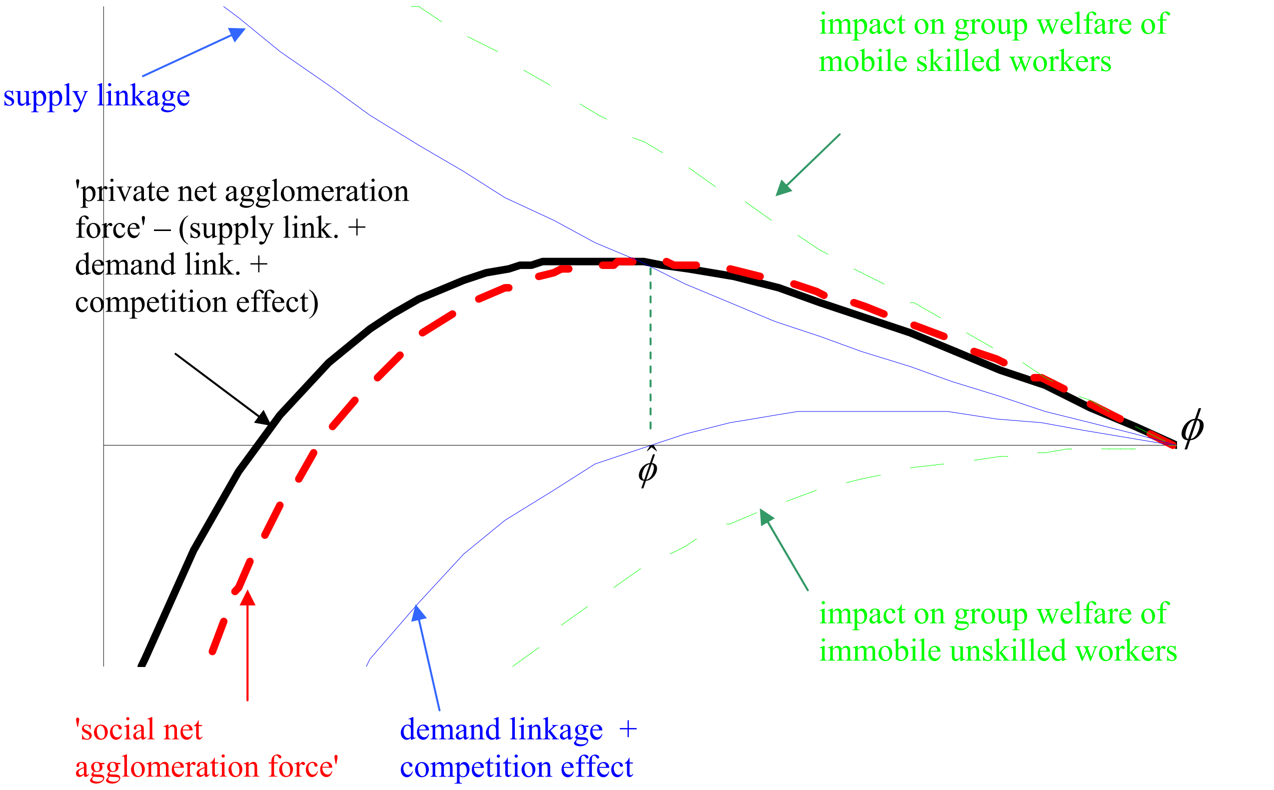
The critical levels ϕ_h and ϕ_u can be ranked and related to the break and redispersion points of the market and the social planner. Given the familiar parameter restrictions, it can be shown that the following ranking applies:

$$0 < \phi_b^M < \phi_b^S < \hat{\phi} < \phi_u \leq \phi_h \leq \phi_r^M \leq \phi_r^S \leq 1 \qquad \text{(B3)}$$

(with strict inequalities for $\gamma > 0$)

Except for the range $\phi_u < \phi < \phi_h$, there is a conflict of interests between the group of unskilled workers as a whole and the group of skilled workers. Furthermore there is generally a conflict of interest within the group of unskilled workers. Hence, a Pareto-ranking of different spatial structures is never feasible.

APPENDIX C: Forces underlying market and the planner allocation ($\gamma = 0$)



Note:	'private net agglomeration force':	eq. (A6); first term in eq. (13)
	supply linkage:	eq. (A1)
	demand linkage + competition effect:	eq. (A5)
	Note: The two thin solid lines add up to the bold solid U-shaped curve.	
	'social net agglomeration force':	eq. (18), first term
	impact on group welfare of mobile, skilled workers:	eq. (22), first term
	impact on group welfare of immobile, unskilled workers:	eq. (23), first term
	Note: The two thin broken lines add up to the bold broken U-shaped curve.	

Figure 1: Agglomeration and dispersion forces

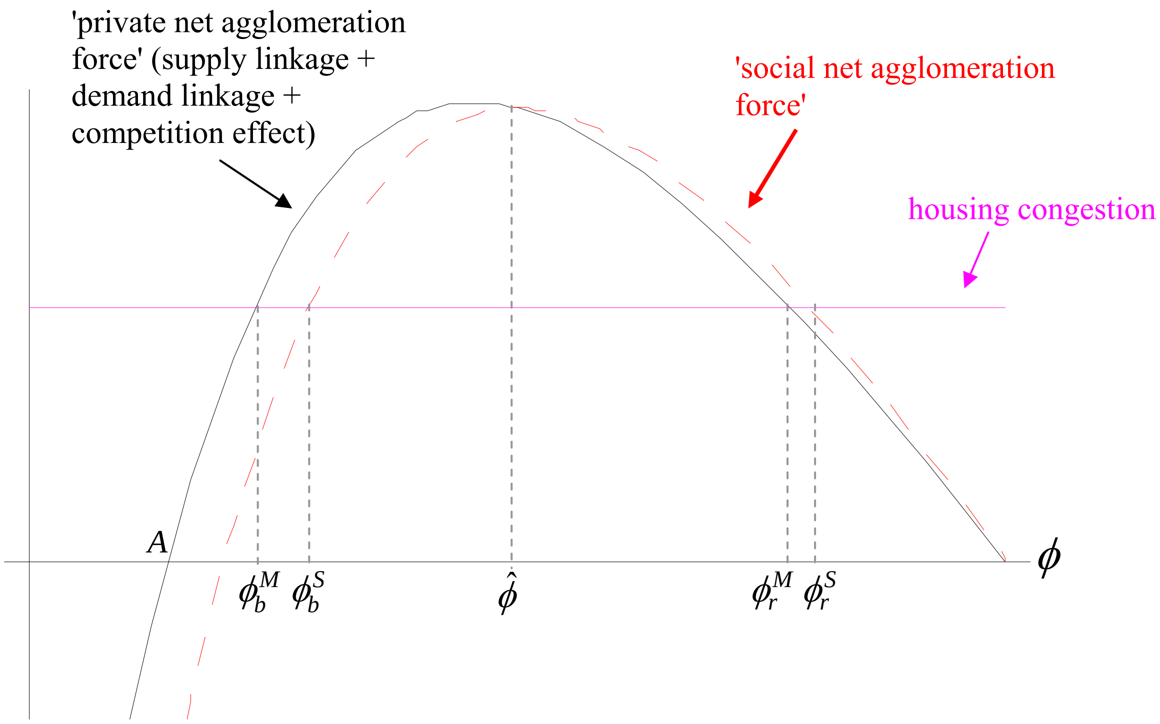


Figure 2: Indirect utility differential for the mobile skilled workers

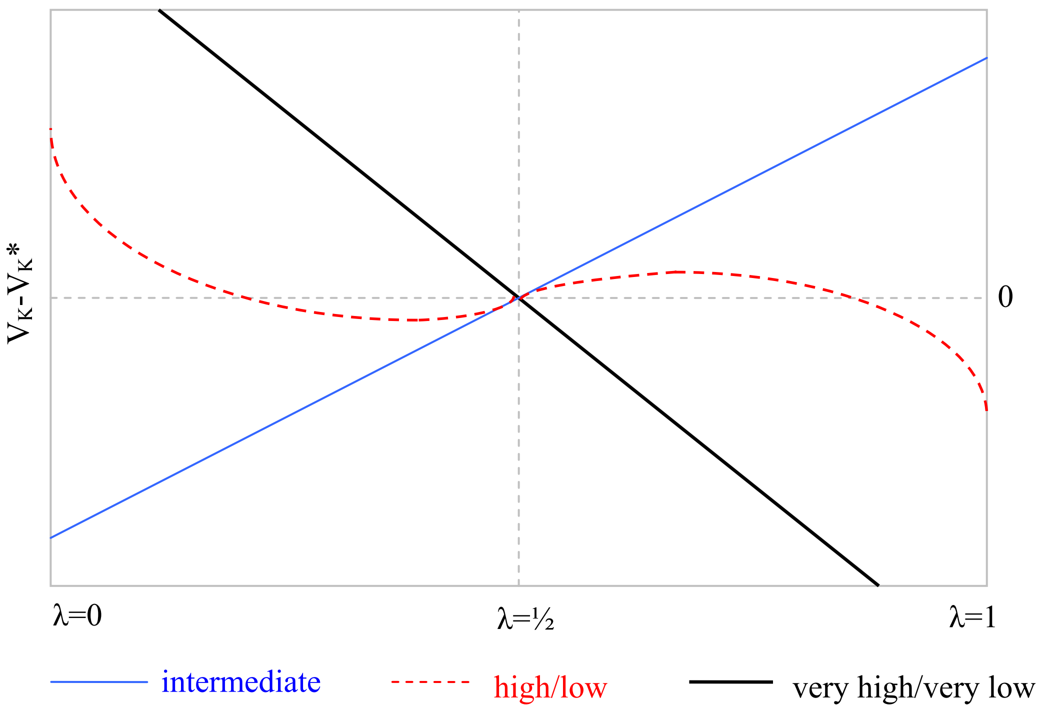


Figure 3: Market equilibrium and optimal spatial structure

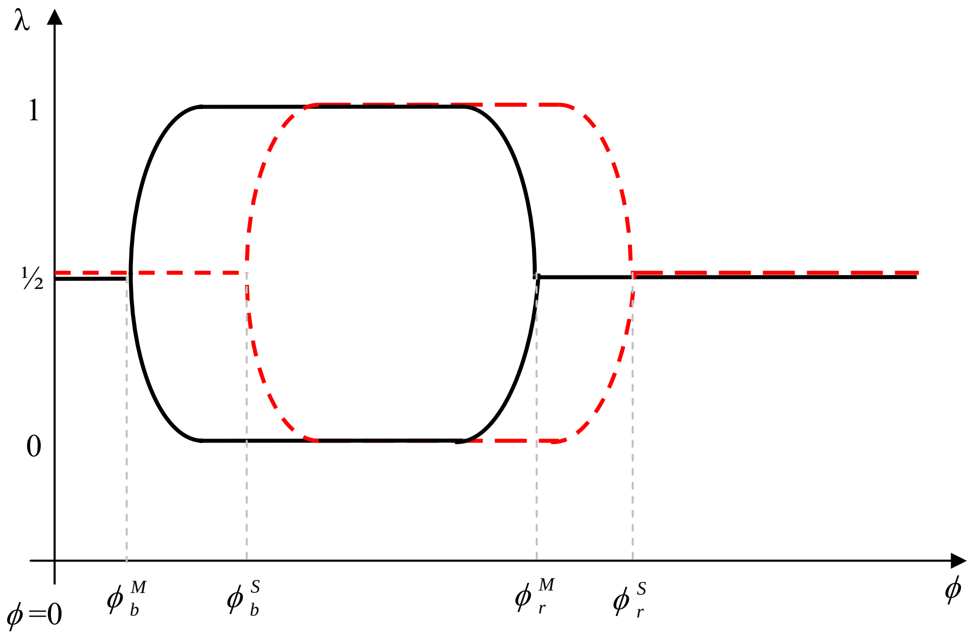


Figure 4: Shapes of the social welfare function