trade costs.[11] In any case, we note that in the previous phrase we used the word potential to qualify the equilibrium, because we remember that trade costs must be compatible to positive prices and quantities, which require expression (17) to be satisfied.

On the other hand, when $\lambda_r = 1/2$ the indirect utility differential in (28) is decreasing in $\lambda_r$, and therefore we have an equilibrium at $\lambda_r = 1/2$ only when

$$\left.\frac{\partial\left(\Delta V_H(\lambda_r,\rho)\right)}{\partial\lambda_r}\right|_{\lambda_r=1/2} = \frac{2M\left[\left(b_L+d_LM\right)\left(a_0(\rho)t^2+b_0(1/2,\rho)t\right)+c_0(1/2,\rho)\right]}{\left(2b_L+d_LM\right)^2}<0$$

Clearly, the previous inequality is true when the expression in square brackets is negative. We observe that, when $\rho < 1$, this expression is depicted by a concave parabola in $t$ with $a_0(\rho) < 0$, $b_0(0.5, \rho) > 0$ and $c_0(0.5, \rho) < 0$. Thus, the symmetric equilibrium is stable only for high and low trade costs, provided that (17) is satisfied, while it is unstable for intermediate trade cost values.[12]

# 4 The competition effect and the preference effect in detail

In order to more deeply discuss the findings in the previous section, we recall that Ottaviano et al. (2002) find that there are different effects which give rise to the agglomeration and dispersion forces, whose interplay defines the properties of the equilibrium outcomes. These forces are the dispersion force originated by the demand of immobile unskilled workers, and the agglomeration force originated from the fact that a greater number of firms in a region implies that fewer varieties are imported, and that equilibrium prices of all varieties sold in this region are smaller (*competition effect on prices*).

In this work, we show that these effects are partially modified and enriched by the additional force which is generated when $\rho \neq 1$. In particular, the centrifugal force generated by immobile

[11] In particular, with $\rho < 1$, when $\lambda_r = 1$ and $t = t^*$, we know that $\Delta V_H(1,\rho) > 0$ if $b_0(1,\rho)^2 > \frac{4a_0(\rho)c_0(1,\rho)}{(b_L+d_LM)}$.

[12] In particular, $b_0(0.5,\rho) = 2ad_LM + \frac{a[(4-\rho)L(L+2\rho H)+3H^2\rho^2]b_L}{(L+H\rho)^2}$ and $c_0(0.5,\rho) = -2a^2H(1-\rho)\left\{(L+H\rho)d_LM + \left[\left((2-\rho)L+(3-\rho)\rho H\right)L + H^2\rho^2\right]b_L\right\}L\frac{1}{(L+H\rho)^4}$

unskilled workers as well as the agglomeration force originated by the fact that fewer varieties are imported are still at work in our case. However, the result that a larger number of firms located in a particular region always implies lower equilibrium prices of all varieties sold in the same region is no longer true. This difference arises because when $\rho < 1$ we have an additional centrifugal force generated by the fact that equilibrium prices of all varieties sold in a region may increase, rather than decrease, when $\lambda_r$ increases because of the *preference effect on prices.* An increase in $\lambda_r$, therefore, has an ambiguous impact on prices of varieties sold in $r$, and the results of the trade-off generated by the two above mentioned effects is in favour of the preference effect when (19) is such that

$$\frac{\partial p^*_{zr}(\lambda_r, \rho)}{\partial \lambda_r} > 0 \tag{30}$$

with $z = r, s$. Expression (30) is true only when the share of skilled workers in region $r$, $\lambda_r$, is sufficiently low that

$$l_r \equiv (L + 2\lambda_r H\rho)^2 < \frac{4LaH(1-\rho)}{d_L Mt} \tag{31}$$

Note that we define the left hand side of (31) as $l_r$. Expression (31) tells us that, when $\rho < 1$, the prevalence of the dispersion force originated by an increase in the concentration of skilled workers in region $r$ can leave the predominance to the agglomeration force when the number of firms in the region, positively related to $\lambda_r$, becomes sufficiently high to reverse the inequality sign in (31).

Moreover, from (20) we are able to show that, when $\rho < 1$, there could be another dispersion force which could dominate because when the number of firms in a region increases, prices in the other region, in our example in region $s$, may decrease. In this case we would have the following result

$$\frac{\partial p^*_{zs}(\lambda_r, \rho)}{\partial \lambda_r} < 0 \tag{32}$$

with $z = r, s$. On the other hand, the opposite could be true when the competition effect prevails, with prices increasing as the number of firms decreases. Expression (32) is true when the share of skilled workers in region $r$, $\lambda_r$, is such that

$$l_s \equiv (L + 2(1 - \lambda_r)H\rho)^2 < \frac{4LaH(1-\rho)}{d_L M t} \tag{33}$$

Note that we define the left hand sides of (33) as $l_s$.

We can clearly observe that both (31) and (33) identify a unique threshold value in correspondence of which the inequality sign changes, which is given by

$$\varphi^* = \frac{4LaH(1-\rho)}{d_L M t} \tag{34}$$

We observe that $\varphi^*$ is increasing in $L$, $a$, $H$ and decreasing in $d_L$, $M$, $t$ and $\rho$. Moreover, we notice that the threshold $\varphi^*$ would be nil (negative) if $\rho$ were equal to 1 (larger than 1). In other words, the case of prices decreasing in the region in which the number of firms and workers increases would be absent not only when $\rho = 1$, as in Ottaviano et al. (2002), but also when $\rho > 1$, because in this specific case, skilled workers' preference for the consumption of the modern good and variety is weaker than for unskilled workers. Thus, increasing the number of workers in a particular region would reduce the aggregate preference for variety in that particular region and this fact, together with the stronger competition due to the increase in the number of firms, would end up by reducing prices even more and strengthening agglomeration forces. The additional increase in agglomeration forces is originated by the second addend which we found in the square brackets in (19).

Let us consider the case in which we are more interested; that is the case in which $\rho < 1$, because it is more likely that skilled workers are more willing to consume the modern differentiated good and more keen on having a greater variety in its consumption. In this case, a larger share of skilled workers in region $r$ may result either in higher or in lower prices of varieties sold in the same region. Thus, there is a trade off originated by an increase in the share of skilled workers in a region. In fact, on one hand this larger share is associated with a larger number of firms and, consequently, with a stronger competition that tends to reduce prices in $r$. On the other hand, when $\rho < 1$, the intensity of total demand for modern goods and differentiation in their consumption would also be stronger, and this tends to increase prices in $r$. The latter effect dominates only if $\lambda_r$ is sufficiently low that expression (31) is true, while the former dominates when $\lambda_r$ becomes too high. In the latter case, the larger share of skilled workers in $r$ would be associated with a sufficiently high number of firms located in the same region whose increased competition would reduce prices in $r$. Finally, we notice that the intensities of these two effects, that is the *competition effect* and the *preference effect* are, respectively, described by the two addends in the square brackets in expression (19).

Moreover, we may deduce from (33) that if a certain number of skilled workers leaves region $s$, there would be two other contrasting effects in region $s$. On one hand, fewer skilled workers in $s$ mean a reduced preference intensity for the modern goods which would imply lower prices in $s$. On the other, fewer skilled workers in $s$ mean also fewer firms and less competition between the firms left in the same region that would imply higher prices in region $s$. The result of these contrasting effects is an increase in prices in region $s$ when a certain number of skilled workers leaves the region only if the number of firms in $s$ is sufficiently low, that is only if $\lambda_r$ is already sufficiently high. Again, we point out that the intensities of these two effects, that is the *competition effect* and the *preference effect* are, respectively, described by the two addends in the square brackets in expression (20).

In summary, we may write that while the competition effect is already present in the original framework developed by Ottaviano et al. (2002), the preference effect obviously arises only once we allow for preference differences.

Let us continue with the case in which $\rho < 1$. We note that if a certain number of skilled workers moves toward region $r$ when $\lambda_r$ is sufficiently small that (31) and (33) are satisfied, both the phenomena of higher prices in the region of destination, $r$, and of lower prices in the region of provenience, $s$, are originated from the stronger preference that skilled workers have for the consumption of the modern good and for the variety in its consumption. On the contrary, when $\lambda_r$ is sufficiently high that (31) and (33) are not satisfied, both the phenomena of lower prices in the region of destination, $r$, and of higher prices in the region of provenience, $s$, are originated from the stronger (weaker) price competition that firms face in a region where their number is higher (lower).

Both $l_r$ and $l_s$ are convex parabola in the endogenous variable $\lambda_r$ which are plotted in Fig. 3 for the relevant range of $\lambda_r$, that is $[0,1]$. While $l_r$ is increasing in $\lambda_r$, $l_s$ is decreasing.[13] Moreover, $l_r$ and $l_s$ intersect only once for $\lambda_r \in [0,1]$, when $\lambda_r = 1/2$, and they have the same value when $\lambda_r = (1-\lambda_r)$, that is when $H_r = H_v$. This allows us, to concentrate on the description of what happens for $\lambda_r \in [1/2,1]$, because the opposite considerations are true for the other range $\lambda_r \in [0,1/2]$.

Insert figure 3 about here

In Fig. 3 we also plot different values of $\varphi^*$, which may vary according to many factors. In particular, when $\rho < 1$, we have the following four kinds of potential cases depending on the values of parameters in the models, which imply different effects of changes in $\lambda_r$ on local, $p^*_{zr}$, and foreign, $p^*_{zs}$, prices.

**Case 1** *When $0 \leq \varphi^* \leq L^2$, the competition effect on both local, $p^*_{zr}$, and foreign, $p^*_{zs}$, prices is always stronger than the preference effect, given that $l_r, l_s > \varphi^* \forall \lambda_r \in [1/2,1]$. Thus, an increase in $\lambda_r$ always results in a reduction in prices of varieties sold in $r$, with $\frac{\partial p^*_{zr}(\lambda_r,\rho)}{\partial \lambda_r} < 0$, and in an increase in prices of varieties sold in $s$, with $\frac{\partial p^*_{zs}(\lambda_r,\rho)}{\partial \lambda_r} > 0$.*

**Case 2** *When $L^2 \leq \varphi^* \leq (L+H\rho)^2$, the competition effect prevails on the preference effect for foreign prices, $p_{zs}$, only if $\lambda_r$ is not so high that $l_s < \varphi^*$, with $\frac{\partial p^*_{zs}(\lambda_r,\rho)}{\partial \lambda_r} > 0$. However, when the number of firms in region $s$ is sufficiently small to have $l_s < \varphi^*$, prices in $s$, $p^*_{zs}$, are decreasing in $\lambda_r$ because the small number of skilled workers in $s$ reduces the pressure of demand for manufacturing goods and differentiation in their consumption. On the other hand, when we consider prices of varieties sold in region $r$, $p^*_{zr}$, we note that $l_r > \varphi^* \ \forall \ \lambda_r \in [1/2,1]$. In this case, prices in region $r$ are declining in $\lambda_r$ because in this region the number of firms is always sufficiently high to mitigate the strength of the preference effect with respect to the stronger competition effect.*

**Case 3** *When $\varphi^*$ is higher, that is when it is such that $(L+H\rho)^2 \leq \varphi^* \leq (L+2H\rho)^2$, the preference effect on local prices, $p^*_{zr}$, prevails on the competition effect, but only provided that the share of skilled workers in $r$ is not too high to have $l_r > \varphi^*$. Vice versa, the competition effect on local prices, $p^*_{zr}$, prevails when the number of firms in region $r$ is sufficiently high that $l_r > \varphi^*$.*

[13] It is simple to verify that the minimum of (31) is for $\lambda_r = -L/(2\rho H) < 0$, and that the minimum of (33) is for $\lambda_r = (L+2H\rho)/(2H\rho) > 1$.

*On the other hand, when we consider foreign prices $p^*_{zs}$, the preference effect does always prevail on the competition effect because $l_s < \varphi^* \ \forall \ \lambda_r \in [1/2, 1]$.*

**Case 4** *Finally, when $\varphi^*$ is high enough that $\varphi^* > (L + 2H\rho)^2$, the preference effect is always stronger than the competition effect, either on local prices, $p^*_{zr}$, or on foreign prices, $p^*_{zs}$.*

Clearly, we may have many different situations. For instance, when $\varphi^*$ is low, this could either mean that skilled workers' preference for manufactured goods and the variety in their consumption is not that high (in other words $\rho$ is not too low), or that $L$, $H$ and $a$ are sufficiently low not to have the preference effect prevailing on the competition effect. Moreover, it could also mean that the number of goods produced, $M$, is sufficiently high to reduce the relevance of the preference effect.

Finally, we observe that while changes in $a$, $d_L$, $M$ and $t$ affect only the value of $\varphi^*$, changes in $\rho$ affect not only $\varphi^*$ but also $l_r$ and $l_s$.

It is particularly important to observe that when the level of economic integration between the two regions increases (trade costs fall), the value of $\varphi^*$ increases showing that the range of $\lambda_r$ for which the preference effect dominates increases, strengthening the new dispersion force which acts in the case in which $\rho < 1$.

In order to show how the final outcomes of all forces depend on the value of $\rho$, we plot in Fig. 4 the indirect utility differential, $\Delta V_H(\lambda_r)$, for different values of $\rho$, that is for $\rho = 0.96$ and $\rho = 0.94$. This allows us to underline that if $\rho$ decreases an otherwise unstable symmetric outcome may became a (stable) equilibrium because of the preference effect that, with $\rho < 1$, acts as a dispersion force.

Insert figure 4 about here

In the previous section we noted that economic integration, in the form of a reduction in trade cost levels, may lead to an equilibrium with full agglomeration of the economic activity, but this may happen only provided that trade costs are at intermediate levels. We also noted that, in any case, this would not be possible for sufficiently low trade costs. In Fig. 5.$a$ we plot the indirect utility differentials, $\Delta V_H(\lambda_r)$, for two different values of trade costs $t = 0.20$ and $t = 0.19$ when $\rho < 1$.[14] In both cases the economy is characterized by two (stable) equilibria of incomplete agglomeration and lower trade costs result in less agglomeration, because the weight of the preference effect, which acts as a dispersion force when $\rho < 1$, is reinforced by the reduction in $t$.

Insert figures 5.a-5.b about here

Moreover, Fig. 5.$b$ plots the "tomahawk diagram" which is used in NEG models to depict the properties of equilibria for different levels of trade costs. The diagram is drawn for the same parameters used to obtain Fig. 5.$a$ and it shows that the manufacturing sector is completely agglomerated in a particular region when trade costs are high. However, when $\rho < 1$ and trade costs decrease below $t_a$, the dispersion force generated by demand pressures can sufficiently increase manufactured good prices in the more populated region to prevent full agglomeration and to have asymmetric (stable) equilibria. Moreover, when trade cost decrease is much more sensible and $t < t_s$, then the action of the dispersion force will sustain the symmetric equilibrium characterized by an even distribution of the economic activity. If we compare our results with those which would be obtained by Ottaviano et al. (2002) with $\rho = 1$, we would get that, for the chosen parameters and for the range of $t$ values, full agglomeration would be the only possible kind of (stable) equilibria. Hence, we are able to capture a new dispersion force which enriches the analysis.

Effects on the balance between agglomeration and dispersion forces produced by the structure of preferences are described by Puga and Venables (1996), where, however, preferences are homogeneous across individuals.[15] They consider a new economic geography model where agents

[14] The graphics are drawn for the following parameter values: $H = 90$, $L = 50$, $a = 10$, $b_L = 0.03$, $d_L = 0.04$, $f = 5$ and $\rho = 0.96$. We remark that those parameters are compatible with positive prices and quantities. In particular, according to (17) to have positive exports from region $z$ to region $v$, we need to have $t < 26.47$.

[15] In Puga and Venables (1996), pecuniary externalities, which eventually induces firms to agglomerate in a region, are produced by forward and input linkages due to the input-output structure modeled as in Krugman and Venables (1995) and in Venables (1996).

consume a modern differentiated good and a homogeneous good. The latter good cannot be consumed below a subsistence level. The assumption of non homotetic preferences gives rise to a process of successive waves of industrialization in different countries when there are exogenous increases in the size of labor endowment. In fact, increases in labor endowments expand industry more than the homogeneous sector because of the increases in wages in the country in which industry is agglomerated. However, Puga and Venables (1996) use the particular version of the monopolistic competition model developed by Dixit and Stiglitz (1977) and the assumption of iceberg trade costs, with intersectorally mobile and internationally immobile workers. On the contrary, we use the solvable model by Ottaviano et al. (2002), where our results derive from heterogeneous preferences among different kind of workers and not by the assumption of quasi homotetic preferences. Moreover, we are able to capture changes of relative prices due not only to the competition effect but also to the specific heterogeneity in preferences.

Finally, we observe that, by considering the particular case of preference heterogeneity with $\rho < 1$, we are able to find another channel through which we may reproduce the results by Helpman (1997) or by Forslid and Wooton (2003). In fact, while in Helpman (1997) complete agglomeration may be prevented by the increase in prices of non-traded goods which leads to stable asymmetric equilibria, in Forslid and Wooton (2003) these equilibria arise for intermediate trade costs when comparative advantage dominates on NEG agglomeration force. In our case, asymmetric equilibria can be found because of the effects that we described which are strictly related to the properties of the demand side.

# 5 Conclusions

The dependence of equilibrium prices on the spatial distribution of consumers and workers has been stressed by research in spatial pricing theory which, as Ottaviano et al. (2002, p. 410) point out, "shows that demand elasticity varies with distance while prices change with the level of demand and the intensity of competition". In order to capture this evidence, Ottaviano et al. (2002)

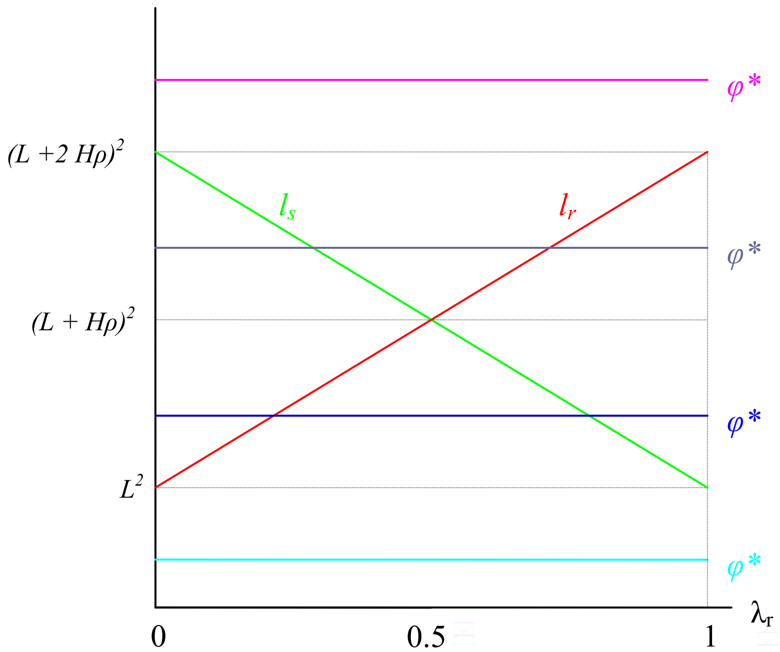


Fig. 3

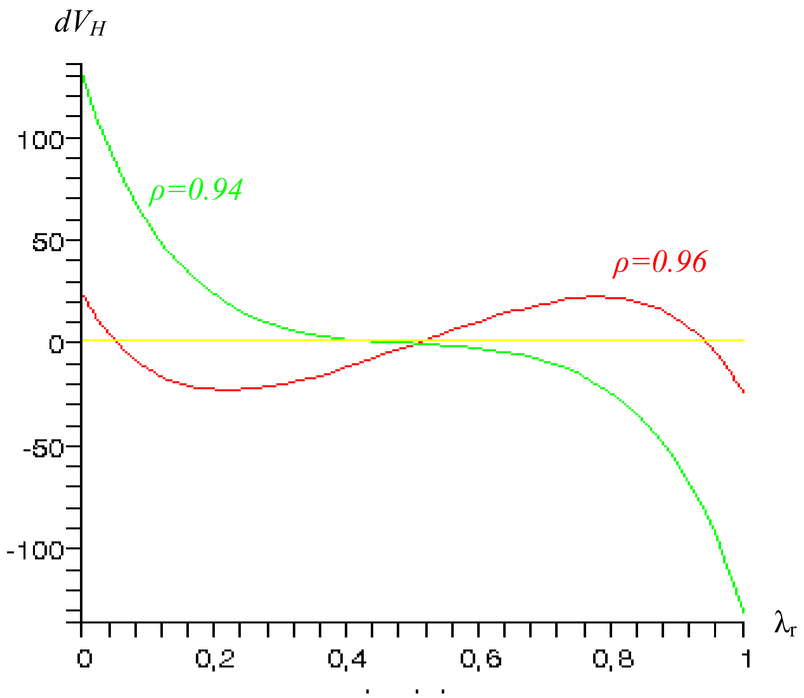


Fig. 4

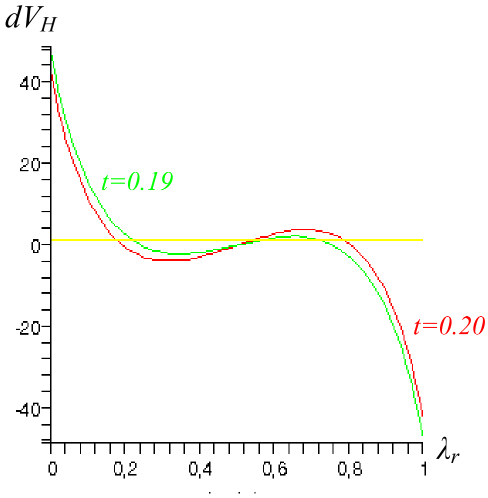

Fig. 5.a

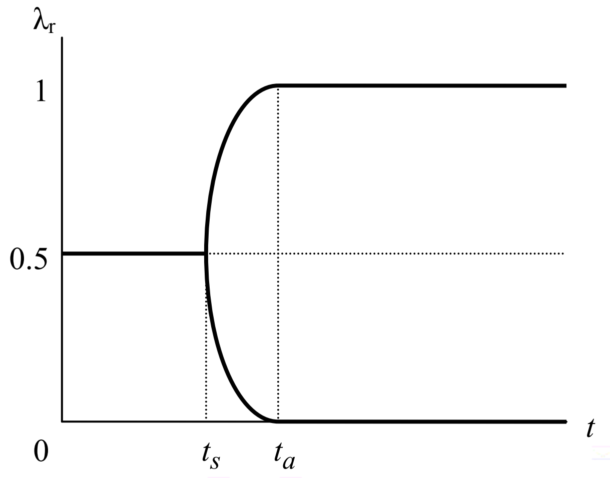

Fig. 5.b