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AGGLOMERATION AND GROWTH WITH ENDOGENOUS EXPEDITURE SHARES

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Agglomeration and Growth with Endogenous Expenditure Shares*

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Abstract

We develop a New Economic Geography and Growth model which, by using a CES utility function in the second-stage optimization problem, allows for expenditure shares in industrial goods to be endogenously determined. The implications of our generalization are quite relevant. In particular, we obtain the following novel results: 1) catastrophic agglomeration may always take place, whatever the degree of market integration, provided that the traditional and the industrial goods are sufficiently good substitutes; 2) the regional rate of growth is affected by the interregional allocation of economic activities even in the absence of localized spillovers, so that geography always matters for growth and 3) the regional rate of growth is affected by the degree of market openness: in particular, depending on whether the traditional and the industrial goods are good or poor substitutes, economic integration may be respectively growth-enhancing or growth-detrimental.

Key words: new economic geography, endogenous expenditure shares, substitution effect

JEL Classifications: O41, F43, R12.

1 Introduction

The recent Nobel Prize assigned to Paul Krugman "for his analysis of trade patterns and location of economic activity" witnesses the important role that the scientific community gives to the insights of the so-called New Economic Geography (NEG) literature. This field of economic analysis has always been particularly appealing to policy makers, given the direct link between its results

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and regional policy rules. For the same reason it is useful to deepen the analysis of its most important outputs by testing the theoretical robustness of some of its more relevant statements. This paper tries to offer a contribution in this direction by focusing on a particular sub-field of NEG literature, the so-called New Economic Geography and Growth (NEGG, henceforth), which basically adds endogenous growth to a version of Krugman's celebrated core-periphery model (Krugman 1991).

In this paper, we develop a NEGG model which deviates from the standard approach in two respects: 1) we explicitly consider the love of variety parameter separating it from the *intrasectoral* elasticity of substitution between the different varieties within the industrial sector; 2) we use a more general Constant Elasticity Function (henceforth CES) instead of a Cobb-Douglas utility function in the second-stage optimization problem, thereby allowing the elasticity of substitution between manufacture and traditional good (*intersectoral* elasticity henceforth) to diverge from the unit value.

The main effect of these departures is that the share of expenditure on manufactures is no longer exogenously fixed (as in the Cobb-Douglas approach) but it is endogenously determined via agents' optimization. By endogenizing the expenditure shares in manufacturing goods, we are able to test the robustness of several well-established results in the NEGG literature and we show that the validity of such results, and of the associated policy implications, crucially depends on the particular Cobb-Douglas functional form used by this class of models.

Our generalizations of the standard NEGG literature act at two different levels: a) the dynamic pattern of equilibrium allocation of economic activities and b) the equilibrium growth prospect. As for the first level, the main result of our analysis is the emergence of a new force, which we dub as the *expenditure share effect*. This force, which is a direct consequence of the dependence of the expenditure shares on the location of economic activities, is neutralized in the standard NEGG model by the unitary intersectoral elasticity of substitution. Our model "activates" this force and the associated new economic mechanism opens the door to a series of novel results. First we show that this expenditure share effect acts as an agglomeration or a dispersion force depending on whether the traditional and the differenciated goods are respectively good or poor substitutes. Then we analyze the implications of this new force and we show that, unlike the standard model, catastrophic agglomeration may always take place whatever the degree of market integration may be, if the expenditure share effect is strong enough. This result, which is a novelty in the NEGG literature, has important implications in two respects: first, policy makers should be aware of the fact that policies affecting the degree of market integration can affect the equilibrium location of economic activities only for a restricted set of values for the parameters describing the economy. Second, the emergence of the expenditure share effect suggests that the intersectoral elasticity of substitution has a crucial role in shaping the agglomeration or the dispersion process of economic activities.

As for the equilibrium growth prospect, results are even more striking. We show that, due to the endogenous expenditure shares: 1) the regional rate of growth is affected by the interregional allocation of economic activities even in the absence of localized spillovers, so that geography *always* matters for growth and 2) the regional rate of growth is affected by the degree of market openness: in particular, according to whether the intersectoral elasticity of substitution is larger or smaller than unity, economic integration may be respectively growth-enhancing or growth-detrimental. These results are novel with respect to the standard NEGG literature according to which geography matters for growth only when knowledge spillovers are localized and, moreover, trade costs never affect the growth rate in a direct way. This second set of results is characterized by even more important policy implications: first, our results suggests that interregional allocation of economic activity can always be considered as an instrument able to affect the rate of growth of the economy. In particular, when the average interregional expenditure share on industrial goods are higher in the symmetric equilibrium than in the core-periphery one, then each policy aiming at equalizing the relative size of the industrial sector in the two regions will be good for growth, and vice-versa. Second, each policy affecting economic integration will also affect the rate of growth and such influence is crucially linked to the value of the intersectoral elasticity of substitution.

As already anticipated, the literature we refer to is basically the so-called New Economic Geography and Growth (NEGG) literature, having in Baldwin and Martin (2004) and Baldwin *et. al* (2004) the most important theoretical syntheses. These two surveys collect and present in an unified framework the works by Baldwin, Martin and Ottaviano (2001) - where capital is immobile and spillovers are localized - and Martin and Ottaviano (1999) where spillovers are global and capital is mobile. Other related papers are Baldwin (1999) which introduces forward looking expectations in the so-called Footloose Capital model developed by Martin and Rogers (1995); Baldwin and Forslid (1999) which introduces endogenous growth by means of a q-theory approach; Baldwin and Forslid (2000) where spillovers are localized, capital is immobile and migration is allowed. Some more recent develpments in the NEGG literature can be grouped in two main strands. One takes into consideration factor price differences in order to discuss the possibility of a non-monotonic relation between agglomeration and integration (Bellone and Maupertuis (2003) and Andres (2007)). The other one assumes firms heterogeneity in productivity (first introduced by Eaton and Kortum (2002) and Melitz (2003)) in order to analyse the relationship between growth and the spatial selection effect leading the most productive firms to move to larger markets (see Baldwin and Okubo (2006) and Baldwin and Robert-Nicoud (2008)). These recent developments are related to our paper in that they introduce some relevant departures from the standard model.

All the aforementioned papers, however, work with exogenous expenditure shares. A first attempt to introduce endogenous expenditure shares in a NEGG model has been carried out by Cerina and Pigliaru (2007), who focused on the effects on the balanced growth path of introducing such assumption. The present paper can be seen as an extension of the latter, considering that we deepen the analysis of the implications of endogenous expenditure shares by fully assessing the dynamics of the model, the mechanisms of agglomeration and the equilibria growth rate.

We believe that the results obtained in this paper are important considering at least three different perspectives: 1) a purely theoretical one: a tractable endogenous expenditure share approach, being more general than an exogenous one, represents a theoretical progress in the NEG literature and enables us to consider the standard NEGG models as a special case of the one developed here; 2) a descriptive perspective: the endogenous expenditure share approach, by introducing some new economic mechanisms, might be empirically tested and it can be extended to several other NEG models in order to assess their robustness; 3) a policy perspective: our paper suggests that policy makers should not trust too much on implications drawn from standard NEGG models because of their limited robustness.

The rest of the paper is structured as follows: section 2 presents the analytical framework, section 3 deals with the equilibrium location of economic activities, section 4 develops the analysis of the growth rate and section 5 concludes.

2 The Analytical Framework

2.1 The Structure of the Economy

The model structure is closely related to Baldwin, Martin and Ottaviano (2001). The world is made of 2 regions, North and South, both endowed with 2 factors: labour L and capital K. 3 sectors are active in both regions: manufacturing M, traditional good T and a capital producing sector I. Regions are symmetric in terms of: preferences, technology, trade costs and labour endowment. Labour is assumed to be immobile across regions but mobile across sectors within the same region. The traditional good is freely traded between regions whilst manufacture is subject to iceberg trade costs following Samuelson (1954). For the sake of simplicity we will focus on the northern region[1].

Manufactures are produced under Dixit-Stiglitz monopolistic competition (Dixit and Stiglitz, 1975, 1977) and enjoy increasing returns to scale: firms face a fixed cost in terms of knowledge capital[2] and a variable cost a_M in terms of labour. Thereby the cost function is $\pi + wa_M x_i$, where π is the rental rate of capital, w is the wage rate and a_M are the unit of labour necessary to produce a unit of output x_i.

Each region's K is produced by its I-sector which produces one unit of K with a_I unit of labour. So the production and marginal cost function for the

[1] Unless differently stated, the southern expressions are isomorphic.

[2] It is assumed that producing a variety requires a unit of knowldge interpreted as a blueprint, an idea, a new technology, a patent, ora a machinery.

I-sector are, respectively:

$$\dot{K} = Q_K = \frac{L_I}{a_I} \quad (1)$$

$$F = wa_I \quad (2)$$

Note that this unit of capital in equilibrium is also the fixed cost F of the manufacturing sector. As one unit of capital is required to start a new variety, the number of varieties and of firms at the world level is simply equal to the capital stock at the world level: $K + K^* = K^w$. We denote n and n^* as the number of firms located in the north and south respectively. As one unit of capital is required per firm we also know that: $n + n^* = n^w = K^w$. As in Baldwin, Martin and Ottaviano (2001), we assume capital immobility, so that each firm operates, and spends its profits, in the region where the capital's owner lives. In this case, we also have that $n = K$ and $n^* = K^*$. Then, by defining $s_n = \frac{n}{n^w}$ and $s_K = \frac{K}{K^w}$, we also have $s_n = s_K$: the share of firms located in one region is equal to the share of capital owned by the same region[3].

To individual I-firms, the innovation cost a_I is a parameter. However, following Romer (1990), endogenous and sustained growth is provided by assuming that the marginal cost of producing new capital declines (i.e., a_I falls) as the sector's cumulative output rises. In the most general form, learning spillovers are assumed to be localised. The cost of innovation can be expressed as:

$$a_I = \frac{1}{AK^w} \quad (3)$$

where $A \equiv s_K + \lambda (1 - s_K)$, $0 < \lambda < 1$ measures the degree of globalization of learning spillovers and $s_K = n/n^w$ is share of firms allocated in the north. The south's cost function is isomorphic, that is, $F^* = w^*/K^w A^*$ where $A^* = \lambda s_K + 1 - s_K$. However, for the sake of simplicity, we focus on the case of global spillovers, i.e., $\lambda = 1$ and $A = A^* = 1$[4]. Moreover, in the model version we examine, capital depreciation is ignored[5].

Because the number of firms, varieties and capital units is equal, the growth rate of the number of varieties, on which we focus, is therefore:

$$g \equiv \frac{\dot{K}}{K}; g^* \equiv \frac{\dot{K}^*}{K^*}$$

Finally, traditional goods, which are assumed to be homogenous, are produced by the T-sector under conditions of perfect competition and constant returns. By choice of units, one unit of T is made with one unit of L.

[3] We highlight that our results on the equilibrium growth rate holds even in the case of capital mobility.

[4] Analysing the localised spillover case is possible, but it will not significantly enrich the results and it will obscure the object of our analysis.

[5] See Baldwin (1999) and Baldwin et al. (2004) for similar analysis with depreciation but with exogenous expenditure shares.

2.2 Preferences and consumers' behaviour

The preferences structure of the infinitely-lived representative agent is given by:

$$U_t = \int_{t=0}^{\infty} e^{-\rho t} \ln Q_t dt; \tag{4}$$

$$Q_t = \left[\delta \left(n^{w^{v+\frac{1}{1-\sigma}}} C_M \right)^{\alpha} + (1-\delta) C_T{}^{\alpha} \right]^{\frac{1}{\alpha}} ; \alpha \leq 1, v > 0 \tag{5}$$

$$C_M = \left[\int_{i=0}^{n+n^*} c_i^{1-1/\sigma} di \right]^{\frac{1}{1-1/\sigma}} ; \sigma > 1$$

where v is the degree of love for variety parameter, α is the elasticity parameter related to the elasticity of substitution between manufacture and traditional goods and σ is the elasticity of substitution across varieties.

Following Cerina and Pigliaru (2007), we deviate from the standard NEGG framework in two respects:

1) As in Benassy (1996) and Smulders and Van de Klundert (2003), the degree of love for variety parameter is esplicitly considered. In the canonical NEGG framework the love for variety parameter takes the form $\frac{1}{\sigma-1}$, being tied to the elasticity of substitution across varieties σ (*intrasectoral* elasticity henceforth). By contrast, in the present model v is not linked to σ but it is independently assessed[6].

2) We use a more general CES second-stage utility function instead of a Cobb-Douglas one, thereby allowing the elasticity of substitution between manufacture and traditional good (*intersectoral* elasticity henceforth) to diverge from the unit value: indeed the intersectoral elasticity is equal to $\frac{1}{1-\alpha}$ which might be higher or lower than unity (albeit constant) depending on whether α is respectively negative or positive. The main effect of this modification is that the share of expenditure on manufacture is no longer constant but it is affected by changes in the price indices of manufacture. This consequence is the source of most of the result of this paper.

Allowing for a larger-than-unity intersectoral elasticity of substitution, requires the introduction of a natural restriction on its value relative to the one

[6] Take an utility function $U(C_T.C_M)$ where $C_M = V_n(c_1, ..., c_n)$ is homogeneous of degree one, with n being the number of varieties. By adopting the natural normalization $V_1(q_1) = q_1$, we can define the following function:

$$\gamma(n) = \frac{V_n(c, ..., c)}{V_1(nc)} = \frac{V_n(1, ..., 1)}{n}$$

with $\gamma(n)$ representing the gain in utility derived from spreading a certain amount of expenditure across n varieties instead of concentrating it on a single one. The degree of love for variety v is just the elasticity of the $\gamma(n)$ function:

$$v(n) = \frac{n\gamma'(n)}{\gamma(n)}$$

In the standard NEGG framework $C_M = \left(\int_0^n c_i^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}$ hence $\gamma(n) = \frac{1}{\sigma-1}$.

of the intrasectoral elasticity of substitution. The introduction of two distinct sectors would in fact be useless if substituting goods from the traditional to the manufacturing sector (and vice-versa) was easier than substituting goods within the differentiated industrial sectors. In other words, in order for the representation in terms of two distinct sectors to be meaningful, we need goods belonging to different sectors to be poorer substitutes than varieties coming from the same differenciated sector. The formal expression of this idea requires that the intersectoral elasticity of substitution $\frac{1}{1-\alpha}$ is lower than the intrasectoral elasticity of substitution σ:

$$\frac{1}{1-\alpha} < \sigma$$

This assumption, which will be maintained for the rest of the paper, states that α cannot not be too high. It is worth to note that this assumption is automatically satisfied in the standard Cobb-Douglas approach where $\frac{1}{1-\alpha} = 1$ and $\sigma > 1$.

The infinitely-lived representative consumer's optimization is carried out in three stages. In the first stage the agent intertemporally allocates consumption between expenditure and savings. In the second stage she allocates expenditure between manufacture and traditional goods, while in the last stage she allocates manufacture expenditure across varieties. As a result of the intertemporal optimization program, the path of consumption expenditure E across time is given by the standard Euler equation:

$$\frac{\dot{E}}{E} = r - \rho \tag{6}$$

with the interest rate r satisfying the no-arbitrage-opportunity condition between investment in the safe asset and capital accumulation:

$$r = \frac{\pi}{F} + \frac{\dot{F}}{F} \tag{7}$$

where π is the rental rate of capital and F its asset value which, due to perfect competition in the I-sector, is equal to its marginal cost of production.

In the second stage the agent chooses how to allocate the expenditure between manufacture and the traditional good according to the following optimization program:

$$\begin{aligned} \max_{C_M, C_T} Q_t &= \ln \left[\delta \left({n^w}^{v+\frac{1}{1-\sigma}} C_M \right)^{\alpha} + (1-\delta) {C_T}^{\alpha} \right]^{\frac{1}{\alpha}} \\ s.t. P_M C_M + p_T C_T &= E \end{aligned} \tag{8}$$

By setting $v = \frac{1}{\sigma-1}$ and $\alpha = 0$ the maximization program boils down to the canonical CD case. As a result of the maximization we obtain the following demand for the manufactured and the traditional goods:

$$P_M C_M = \mu(n^w, P_M, p_T) E \tag{9}$$

$$p_T C_T = (1 - \mu(n^w, P_M, p_T))\, E \tag{10}$$

where p_T is the price of the traditional good, $P_M = \left[\int_{i=0}^{K+K^*} {p_i}^{1-\sigma} di\right]^{\frac{1}{1-\sigma}}$ is the Dixit-Stiglitz perfect price index and $\mu(n^w, P_M, p_T)$ is the share of expenditure in manufacture which, unlike the CD case, is not exogenously fixed but it is endogenously determined via the optimization process and it is a function of the total number of varieties (through v) and of the $M-$ goods price index (through α). This feature is crucial to our analysis.

The northern share of expenditure in manufacture is given by:

$$\mu(n^w, P_M, p_T) = \left(\frac{1}{1 + \left(\frac{P_M}{p_T}\right)^{\frac{\alpha}{1-\alpha}} \left(\frac{1-\delta}{\delta}\right)^{\frac{1}{1-\alpha}} \left({n^w}^{\frac{1}{1-\sigma} - v} \right)^{-\frac{\alpha}{1-\alpha}}} \right) \tag{11}$$

while the symmetric expression for the south is:

$$\mu(n^w, P_M^*, p_T^*) = \left(\frac{1}{1 + \left(\frac{P_M^*}{p_T^*}\right)^{\frac{\alpha}{1-\alpha}} \left(\frac{1-\delta}{\delta}\right)^{\frac{1}{1-\alpha}} \left({n^w}^{\frac{1}{1-\sigma} - v} \right)^{-\frac{\alpha}{1-\alpha}}} \right) \tag{12}$$

so that northern and southern expenditure shares only differ because of the difference between northern and southern prices of the manufacturing and traditional goods.

Finally, in the third stage, the amount of $M-$ goods expenditure $\mu(n^w, P_M, p_T)E$ is allocated across varieties according to the a CES demand function for a typical M-variety $c_j = \frac{p_j^{-\sigma}}{P_M^{1-\sigma}} \mu(n^w, P_M, p_T)E$, where p_j is variety j's consumer price. southern optimization conditions are isomorphic.

2.3 Specialization Patterns, Love for Variety and Non-Unitary Elasticity of Substitution

Due to perfect competition in the T-sector, the price of the agricultural good must be equal to the wage of the traditional sector's workers: $p_T = w_T$. Moreover, *as long as both regions produce some* T, the assumption of free trade in T implies that not only price, but also wages are equalized across regions. It is therefore convenient to choose home labour as numeraire so that:

$$p_T = p_T^* = w_T = w_T^* = 1$$

As a first consequence, northern and southern expenditure shares are now only functions of the respective industrial price indexes and of the total number of varieties so we can write:

$$\begin{aligned} \mu\left(n^w, P_M, 1\right) &= \mu\left(n^w, P_M\right) \\ \mu\left(n^w, P_M^*, 1\right) &= \mu\left(n^w, P_M^*\right) \end{aligned}$$

As it is well-known, it's not always the case that both regions produce some T. An assumption is actually needed in order to avoid complete specialization: a single country's labour endowment must be insufficient to meet global demand. Formally, the CES approach version of this condition is the following:

$$L = L^* < \left(\left[1 - \mu(n^w, P_M) \right] s_E + \left[1 - \mu(n^w, P_M^*) \right] (1 - s_E) \right) E^w \tag{13}$$

where $s_E = \frac{E}{E^w}$ is northern expenditure share and $E^w = E + E^*$.

In the standard CD approach, where $\mu(n^w, P_M) = \mu(n^w, P_M^*) = \mu$, this condition collapses to:

$$L = L^* < (1 - \mu) E^w.$$

The purpose of making this assumption, which is standard in most NEGG models[7], is to maintain the M-sector and the I-sector wages fixed at the unit value: since labour is mobile across sector, as long as the T - sector is present in both regions, a simple arbitrage condition suggests that wages of the three sectors cannot differ. Hence, $M-$ sector and I-sector wages are tied to T -sector wages which, in turn, remain fixed at the level of the unit price of a traditional good. Therefore:

$$w_M = w_M^* = w_T = w_T = w = 1 \tag{14}$$

Finally, since wages are uniform and all varieties' demand have the same constant elasticity σ, firms' profit maximization yields local and export prices that are identical for all varieties no matter where they are produced: $p = wa_M \frac{\sigma}{\sigma - 1}$. Then, imposing the normalization $a_M = \frac{\sigma - 1}{\sigma}$ and (14), we finally obtain:

$$p = w = 1 \tag{15}$$

As usual, since trade in the $M-$good is impeded by iceberg import barriers, prices for markets abroad are higher:

$$p^* = \tau p; \;\; \tau \geq 1$$

By labeling as p_M^{ij} the price of a particular variety produced in region i and sold in region j (so that $p^{ij} = \tau p^{ii}$) and by imposing $p = 1$, the $M-$goods price indexes might be expressed as follows:

$$P_M = \left[\int_0^n (p_M^{NN})^{1-\sigma} di + \int_0^{n^*} (p_M^{SN})^{1-\sigma} di \right]^{\frac{1}{1-\sigma}} = (s_K + (1 - s_K)\,\phi)^{\frac{1}{1-\sigma}} \, n^{w\,\frac{1}{1-\sigma}} \tag{16}$$

$$P_M^* = \left[\int_0^n (p_M^{NS})^{1-\sigma} di + \int_0^{n^*} (p_M^{SS})^{1-\sigma} di \right]^{\frac{1}{1-\sigma}} = (\phi s_K + 1 - s_K)^{\frac{1}{1-\sigma}} \, n^{w\,\frac{1}{1-\sigma}} \tag{17}$$

[7] See Bellone and Maupertuis (2003) and Andrés (2007) for an analysis of the implications of removing this assumption.

where $\phi = \tau^{1-\sigma}$ is the so called "phi-ness of trade" which ranges from 0 (prohibitive trade) to 1 (costless trade).

A quick inspection of condition (13) and expressions (16) and (17) reveals that the introduction of the no-specialization assumption in our model is sensibly more problematic than in the standard CD case and these difficulties are crucially linked to the role of the love for variety parameter v. In order to see this in detail, we need to dwell a little bit deeper on the role of the expenditure share and of the love for variety parameter.

2.3.1 Love of variety and expenditure shares

Substituting the new expressions for the $M-$goods price indexes in the northern and southern $M-$goods expenditure shares, yields:

$$\mu(n^w, s_K, \phi) = \left(\frac{1}{1 + \left(\frac{1-\delta}{\delta}\right)^{\frac{1}{1-\alpha}} \left(n^{w^{-\frac{v\alpha}{1-\alpha}}} \left(s_K + (1 - s_K)\,\phi\right)^{\frac{\alpha}{(1-\sigma)(1-\alpha)}} \right)} \right) \quad (18)$$

$$\mu^*(n^w, s_K, \phi) = \left(\frac{1}{1 + \left(\frac{1-\delta}{\delta}\right)^{\frac{1}{1-\alpha}} \left(n^{w^{-\frac{v\alpha}{1-\alpha}}} \left(\phi s_K + 1 - s_K\right)^{\frac{\alpha}{(1-\sigma)(1-\alpha)}} \right)} \right). \quad (19)$$

As we can see the shares of expenditure in manufactures now depends on the localization of firms s_K, the parameter ϕ and the overall number of firms in the economy n^w.

We can make a number of important observations from analysing these two expressions.

First, when the elasticity of substitution between the two goods is different from 1, (i.e. $\alpha \neq 0$), north and south expenditure shares differ ($\mu(n^w, s_K, \phi) \neq \mu^*(n^w, s_K, \phi)$) in correspondence to any geographical allocation of the manufacturing industry except for $s_K = 1/2$ (symmetric equilibrium). In particular, we find that[8]

$$\alpha > (<)\, 0 \Leftrightarrow \frac{\partial \mu}{\partial s_K} = \frac{\alpha\,(1-\phi)\,\mu\,(1-\mu)}{(1-\alpha)\,(\sigma-1)\,((s_K + (1-s_K)\phi))} > (<)\, 0 \quad (20)$$

$$\alpha > (<)\, 0 \Leftrightarrow \frac{\partial \mu^*}{\partial s_K} = \frac{\alpha\,(\phi-1)\,\mu^*\,(1-\mu^*)}{(1-\alpha)\,(\sigma-1)\,((s_K + (1-s_K)\phi))} < (>)\, 0 \quad (21)$$

Hence, when $\alpha > 0$, production shifting to the north ($\partial s_K > 0$) leads to a relative increase in the southern price index for the M goods because southern consumers have to buy a larger fraction of M goods from the north, which are more expensive because of trade costs. Unlike the CD case, where this phenomenon had no consequences on the expenditure shares for manufactures

[8] For simplicity's sake we omit the arguments of the functions μ and μ^*.

which remained constant across time and space, in the CES case expenditure shares on M goods are influenced by the geographical allocation of industries because they depend on relative prices and relative prices change with s_K.

Secondly, the impact of trade costs are the following:

$$\alpha > (<) 0 \Rightarrow \frac{\partial \mu}{\partial \phi} = \frac{\alpha(1-s_K)\mu(1-\mu)}{(1-\alpha)(\sigma-1)((s_K+(1-s_K)\phi))} > (<) 0 \quad (22)$$

$$\alpha > (<) 0 \Rightarrow \frac{\partial \mu^*}{\partial \phi} = \frac{\alpha s_K \mu^*(1-\mu^*)}{(1-\alpha)(\sigma-1)((s_K+(1-s_K)\phi))} > (<) 0 \quad (23)$$

so that, when the two kinds of goods are good substitutes ($\alpha > 0$) economic integration gives rise to an increase in the expenditure share for manufactured goods in both regions: manufactures are now cheaper in both regions and since they are good substitutes of the traditional goods, agents in both regions will not only increase their total consumption, but also their shares of expenditure. Obviously, the smaller the share of manufacturing firms already present in the north (south), the larger the increase in expenditure share for the M good in the north (south). The opposite happens when the two kinds of goods are poor substitutes: in this case, even if manufactures are cheaper, agents cannot easily shift consumption from the traditional to the differentiated good. In this case, even if total consumption on manufactures may increase, the share of expenditure will be reduced.

Finally, the impact of the number of varieties is the following:

$$\alpha > (<) 0 \Rightarrow \frac{\partial \mu}{\partial n^w} = \frac{\alpha v}{1-\alpha} \frac{(1-\mu)\mu}{n^w} \geq (\leq 0)$$

$$\alpha > (<) 0 \Rightarrow \frac{\partial \mu^*}{\partial n^w} = \frac{\alpha v}{1-\alpha} \frac{(1-\mu^*)\mu^*}{n^w} \geq (\leq 0)$$

Therefore, when goods are good (poor) substitutes ($\alpha > 0$), and individuals love variety $(v > 0)$, the expenditure share for the $M-$ goods in both regions *is an increasing (decreasing) function of the total number of varieties*. In the analytical context of the NEGG models, this result (which is a feature of the CES utility function we have chosen) has highly unwelcome effects from the viewpoint of the formal dynamics of the model. In particular, since along the balanced growth path the number of total varieties is increasing ($\frac{\dot{n}^w}{n^w} = g \geq 0$), the expenditure shares μ and μ^* will asymptotically approach to 1 or 0 according to whether α is positive or negative. This result is a consequence of the interplay between non-unitary intersectoral elasticity of substitution and love for variety. Consider the case when α is positive: when agents love variety, an increase in the number of total variety is sufficient to let their perceived price index for the manufactured goods decrease. As a consequence, because of the elasticity of substitution larger then 1, they will devote a larger share of total expenditure to the $M-$goods. Since the role of the M-goods expenditure shares is crucial in the NEGG models, their non-constancy has a series of important and correlated consequences. Some of them are the following:

1. The real growth rate of the two regions never reach a constant value in a finite time and might differ as the agglomeration process takes place.

2. Since when $\alpha > 0$, μ and μ^* go to 1, the no-specialization condition cannot hold forever: there comes a (finite) time when the expenditure shares for the traditional good become so small that a single country will be able to produce everything necessary to meet the global demand.

The first result is particularly relevant for policy implications. However, we will not focus on it: for a detailed analysis of this issue please refer to Cerina and Pigliaru (2007). The second result also triggers some new important mechanisms involving the role of wage differentials, but makes the analysis highly intractable.

Since the aim of this paper is to focus on the effects that "geography" (i.e.: interregional firms' allocation and trade costs) has on a NEGG model when a CES second-stage utility function is considered, we henceforth abstract from the two previous consequences by imposing $v = 0$, that is, we assume *no love for variety.* From now on, the second stage maximization program is then:

$$\begin{aligned} \max_{C_M, C_T} Q_t &= \ln \left[\delta \left(n^{w^{\frac{1}{1-\sigma}}} C_M \right)^{\alpha} + (1-\delta) C_T{}^{\alpha} \right]^{\frac{1}{\alpha}} \\ s.t. P_M C_M + p_T C_T &= E \end{aligned} \tag{24}$$

giving rise to the following expressions for the northern and southern expenditure shares:

$$\mu(s_K, \phi) = \left(\frac{1}{1 + \left(\frac{1-\delta}{\delta}\right)^{\frac{1}{1-\alpha}} \left((s_K + (1-s_K)\,\phi)^{\frac{\alpha}{(1-\sigma)(1-\alpha)}} \right)} \right) \tag{25}$$

$$\mu^*(s_K, \phi) = \left(\frac{1}{1 + \left(\frac{1-\delta}{\delta}\right)^{\frac{1}{1-\alpha}} \left((\phi s_K + 1 - s_K)^{\frac{\alpha}{(1-\sigma)(1-\alpha)}} \right)} \right) \tag{26}$$

where the influence of the argument n^w has been neutralized by the condition $v = 0$ so that μ and μ^* are only affected by firms' allocation (s_K) and by the freeness of trade (ϕ). Since the latters are constant along the balanced growth path, μ and μ^* are constant too.

What are the drawbacks of eliminating the love for variety on the descriptive relevance of our model? We believe they are not so significant for several reasons.

First, from the theoretical point of view, the assumption $v = 0$ is just as general as the standard NEGG assumption according to which $v = \frac{1}{\sigma-1}$.

Second, from an empirical perspective, there are several empirical analysis assessing a value for the v parameter lower than that assumed in standard NEGG models (see for instance Ardelean 2007). In this case the impact of the product variety on economic growth and industrial agglomeration is smaller than what is typically assumed and, therefore, closer to 0.

Third, several other NEGG studies abstract from the love for variety. Murata (2008) for instance uses a similar but more restrictive (because $\alpha = 0$) function utility to investigate the relation between agglomeration and structural change. This assumption can also be found in the "new Keynesian economics" literature (see Blanchard and Kiyotaki (1987), for example), which is another strand of literature based on the model of monopolistic competition by Dixit and Stiglitz (1977).

Fourth, from the point of view of the generality of our model, the introduction of the restriction according to which $v = 0$ is compensated by the introduction of the parameter α which, unlike the standard NEGG models, allows the elasticity of substitution to deviate from the unit value.

The analytical gains of introducing this restrictions are by contrast very relevant.

First, By eliminating the love for variety we are able to maintain a version of the typical assumption in NEGG models which states that a single country's labour endowment must be insufficient to meet global demand. We are entitled to do this because, when $v = 0$, both μ and μ^* cannot reach the unit value. The no-specialization condition should be modified as follows:

$$L < \left([1 - \mu(s_K, \phi)]\, s_E + [1 - \mu^*(s_K, \phi)]\,(1 - s_E) \right) E^w, \ \forall\, (s_K, \phi) \in (0,1) \subset \mathbb{R}^2. \tag{27}$$

Since s_E has to be constant by definition and even[9]:

$$E^w(s_E, s_K, \phi) = \frac{(2L - L_I - L_I^*)\,\sigma}{s_E\,(\sigma - \mu(s_K, \phi)) + (1 - s_E)\,(\sigma - \mu^*(s_K, \phi))} \tag{28}$$

is constant in steady state, (27) can be accepted without any particular loss of generality. Our analysis can be developed even without the no-specialisation assumption.

Second, by imposing $v = 0$, we are able to focus on the effect that a non-unitary value of the intersectoral elasticity of substitution has on the equilibrium outcomes of the model. By allowing for this elasticity parameter to deviate from the unit value, we obtain some novel results on the agglomeration and growth prospects of the model. In the next two session we will extensively describe these results.

3 Equilibrium and stability analysis

This section analyses the effects of our departures from the standard NEGG literature on the equilibrium dynamics of the allocation of northern and southern firms.

Following Baldwin, Martin and Ottaviano (2001), we assume that capital is immobile. Indeed, capital mobility can be seen as a special case of capital immobility (a case where $\frac{\partial s_E}{\partial s_K} = 0$). Moreover, as we shall see, capital mobility

[9] The expression for E^w can be found by using an appropriate labour market-clearing condition.

does not provide any significant departure from the standard model from the point of view of the location equilibria (the symmetric equilibrium is always stable). However, it should be clear that our analysis can be carried on even in the case of capital mobility. In particular, the results of the growth analysis developed in section 4 holds whatever the assumption on the mobility of capital.

In models with capital immobility the reward of the accumulable factor (in this case firms' profits) is spent locally. Thereby an increase in the share of firms (production shiftings) leads to expenditure shiftings through the permanent income hypothesis. Expenditure shiftings in turn foster further production shiftings because, due to increasing returns, the incentive to invest in new firms is higher in the region where expenditure is higher. This is the so-called *demand-linked circular causality.*

This agglomeration force is counterbalanced by a dispersion force, the so-called *market-crowding force*, according to which, thanks to the unperfect substitutability between varieties, an increase in the number of firms located in one region will decrease firms' profits and then will give an incentive for firms to move to the other region. The interplay between these two opposite forces will shape the pattern of the equilibrium location of firms as a function of the trade costs. Such pattern is well established in NEGG models (Baldwin, Martin and Ottaviano 2001, Baldwin at al. 2004, Baldwin and Martin 2004): in the absence of localized spillovers, since the symmetric equilibrium is stable when trade costs are high and unstable when trade costs are low, catastrophic agglomeration always occur when trade between the two countries is easy enough. That happens because, even though both forces decreases as trade costs become lower, the demand-linked force is lower than the market crowding force (in absolute value) when trade costs are low, while the opposite happens when trade costs are high.

By adopting the CES approach we are able to question the robustness of such conclusions. In particular our model displays a new force, that we call **expenditure share effect**. This force fosters agglomeration or dispersion depending on whether the T and the $M-$commodities are respectively good or poor substitutes. By introducing this new force, which acts through the northern and southern M-goods expenditure shares, we show that, depending on the different values of the intersectoral elasticity of substitution, the symmetric equilibrium might be unstable for *every* value of trade costs. These results have several implications. First, when the intersectoral elasticity of substituion is allowed to vary from the unit value, the location patterns of firms may not be affected by the market integration process: catastrophic agglomeration will or will not occur regardless trade costs so that policy-makers should not be concerned with the effect of market integration. Second, the intersectoral elasticity of substitution becomes a crucial parameter in the analysis of the location pattern of firms and, hence, on the relative welfare of northern and southern agents. We will now explore such implications in detail.

3.1 Tobin's q and Steady-state Allocations

Before analysing the equilibrium dynamics of firms' allocation, it is worth reviewing the analytical approach according to which such analysis will be carried on. As in standard NEGG models, we will make use of the Tobin q approach (Baldwin and Forslid 1999 and 2000). We know that the equilibrium level of investment (production in the I sector) is characterized by the equality of the stock market value of a unit of capital (denoted with the symbol V) and the replacement cost of capital, F. With E and E^* constant in steady state, the Euler equation gives us $r = r^* = \rho$. Moreover, in steady state, the growth rate of the world capital stock K^w (or of the number of varieties) will be constant and will either be common ($g = g^*$ in the interior case) or north's g (in the core-periphery case)[10]. In either case, the steady-state values of investing in new units of K are:

$$V_t = \frac{\pi_t}{\rho + g}; V_t^* = \frac{\pi_t^*}{\rho + g}.$$

Firms' profit maximization and iceberg trade-costs lead to the following expression for northern and southern firms' profits:

$$\pi = B(s_E, s_K, \phi)\frac{E^w}{\sigma K^w} \tag{29}$$

$$\pi^* = B^*(s_E, s_K, \phi)\frac{E^w}{\sigma K^w} \tag{30}$$

where $B(s_E, s_K, \phi) = \left[\frac{s_E}{s_K+(1-s_K)\phi}\mu(s_K,\phi) + \frac{\phi(1-s_E)}{\phi s_K+(1-s_K)}\mu^*(s_K,\phi)\right]$ and $B^*(s_E, s_K, \phi) = \left[\frac{s_E\phi}{s_K+(1-s_K)\phi}\mu(s_K,\phi) + \frac{1-s_E}{\phi s_K+(1-s_K)}\mu^*(s_K,\phi)\right]$. Notice that this expression differs from the standard NEGG in only one respect: it relies on endogenous $M-$good expenditure shares which now depend on s_E, s_K and ϕ.

By using (2), the labour market condition and the expression for northern and southern profits, we obtain the following expression for the northern and southern Tobin's q:

$$q = \frac{V_t}{F_t} = B(s_E, s_K, \phi)\frac{E^w}{(\rho+g)\,\sigma} \tag{31}$$

$$q^* = \frac{V_t}{F_t} = B^*(s_E, s_K, \phi)\frac{E^w}{(\rho+g)\,\sigma} \tag{32}$$

Where will investment in K will take place? Firms will decide to invest in the most-profitable region, i.e., in the region where Tobin's q is higher. Since

[10] By time-differentiating $s_K = \frac{K}{K^w}$, we obtain that the dynamics of the share of manufacturing firms allocated in the north is

$$\dot{s}_K = s_K\,(1-s_K)\left(\frac{\dot{K}}{K} - \frac{\dot{K}^*}{K^*}\right)$$

so that only two kinds of steady-state ($\dot{s}_K = 0$) are possible: 1) a steady-state in which the rate of growth of capital is equalized across countries ($g = g^*$); 2) a steady-state in which the manufacturing industries are allocated and grow in only one region ($s_K = 0$ or $s_K = 1$).

firms are free to move and to be created in the north or in the south (even though, with capital immobility, firm's owners are forced to spend their profits in the region where their firm is located), a first condition carachterizing *any interior equilibria* ($g = g^*$) is the following:

$$q = q^* = 1 \tag{33}$$

The first equality (*no-arbitrage condition*) tells us that, in any interior equilibrium, there will be no incentive for any firm to move to another region. While the second (*optimal investment condition*) tells us that, in equilibrium, firms will decide to invest up to the level at which the expected discounted value of the firm itself is equal to the replacement cost of capital. The latter is crucial in order to find the expression for the rate of growth but it will not help us in finding the steady state level of s_K. Hence, we focus on the former. By using (29), (30), (31) and (32) in (33) we find the steady-state relation between the northern market size s_E and the northern share of firms s_K which can be written as:

$$s_E = \frac{1}{2} + \frac{1}{2}\left(\frac{\mu^*(s_K,\phi)\left(s_K + (1-s_K)\,\phi\right) - \mu(s_K,\phi)\left(\phi s_K + (1-s_K)\right)}{\mu(s_K,\phi)\left(\phi s_K + (1-s_K)\right) + \mu^*(s_K,\phi)\left(s_K + (1-s_K)\,\phi\right)}\right) \tag{34}$$

The other relevant equilibrium condition is given by the definition of s_E when labour markets clear. This condition, also called *permanent income condition*, gives us a relation between northern market size s_E and the share of firms owned by northern entrepeneurs s_K:

$$s_E = \frac{E}{E^w} = \frac{L + \rho s_K}{2L + \rho} = \frac{1}{2} + \frac{\rho\,(2s_K - 1)}{2\,(2L + \rho)} \tag{35}$$

By equating the right hand side of these two equations we are able to find the relation between s_K and s_K that has to hold in every interior steady state:

$$\frac{\mu^*(s_K,\phi)\left(s_K + (1-s_K)\,\phi\right) - \mu(s_K,\phi)\left(\phi s_K + (1-s_K)\right)}{\mu(s_K,\phi)\left(\phi s_K + (1-s_K)\right) + \mu^*(s_K,\phi)\left(s_K + (1-s_K)\,\phi\right)} = \frac{\rho\,(2s_K - 1)}{(2L + \rho)} \tag{36}$$

so that the steady state level of s_K is one which satisfies the last condition.

It is easy to see that the symmetric allocation, $s_K = \frac{1}{2}$, is always an interior equilibrium. In this case, in fact, the latter condition becomes an indentity. In the appendix, we also show that the assumption according to which $\frac{1}{1-\alpha} < \sigma$, assures that the symmetric equilibrium is also the *unique* interior equilibrium.

As for the core-periphery equilibria, things are much simpler. We know that $\dot{s}_K = 0$ also when $s_K = 0$ or $s_K = 1$. For simplicity, we focus on the latter case keeping in mind that the other is perfectly symmetric. The core-periphery outcome is an equilibrium if firms in the north set the investment to the optimal level ($q = 1$) while firms in the south have no incentive to invest ($q^* < 1$).

To sum up, as in the standard CD approach with global spillovers, we only have three possible equilibria: a symmetric equilibrium ($s_K = \frac{1}{2}$) and two core-periphery equilibria ($s_K = 0$ or $s_K = 1$). We will now study the stability properties of such equilibria.

3.2 Stability Analysis of the symmetric equilibrium

Following Baldwin and Martin (2004) we consider the ratio of northern and southern Tobin's q:

$$\frac{q}{q^*} = \frac{B(s_E, s_K, \phi)}{B^*(s_E, s_K, \phi)} = \frac{\left[\frac{s_E}{s_K+(1-s_K)\phi}\mu(s_K, \phi) + \frac{\phi(1-s_E)}{\phi s_K+(1-s_K)}\mu^*(s_K, \phi)\right]}{\left[\frac{s_E\phi}{s_K+(1-s_K)\phi}\mu(s_K, \phi) + \frac{1-s_E}{\phi s_K+(1-s_K)}\mu^*(s_K, \phi)\right]} = \gamma\left(s_E, s_K, \phi\right) \tag{37}$$

Starting from an interior (and then symmetric) steady-state allocation where $\gamma(s_E, s_K, \phi) = 1$, any increase (decrease) in $\gamma(s_E, s_K, \phi)$ will make investments in the north (south) more profitable and thus will lead to a production shifting to the north (south). Hence the symmetric equilibrium will be stable (and catastrophic agglomeration will not occur) if a production shifting, say, to the north ($\partial s_K > 0$) will reduce $\gamma(s_E, s_K, \phi)$. By contrast, if $\gamma(s_E, s_K, \phi)$ will increase following an increase in s_K, then the equilibrium is unstable and catastrophic agglomeration becomes a possible outcome.

We remind that this method is the same employed by standard NEGG models. The only and crucial difference is that, in our framework, the northern and southern expenditure shares $\mu(s_K, \phi)$ and $\mu^*(s_K, \phi)$ play a crucial role because their value is not fixed but depends on geography and trade costs. The key variable to look at is then the derivative of $\gamma(s_E, s_K, \phi)$ with respect to s_K.evaluated at $s_K = \frac{1}{2}$. This derivative can be written as:

$$\left.\frac{\partial\gamma(s_E, s_K, \phi)}{\partial s_K}\right|_{s_K=s_E=\frac{1}{2}} = \frac{(1-\phi)}{(1+\phi)}\frac{1}{\mu\left(\frac{1}{2},\phi\right)}\left(\frac{\partial\mu}{\partial s_K} - \frac{\partial\mu^*}{\partial s_K}\right) - 4\left(\frac{1-\phi}{1+\phi}\right)^2 + 4\frac{\partial s_E}{\partial s_K}\frac{(1-\phi)}{(1+\phi)} \tag{38}$$

The stability of the symmetric equilibrium is then determined by the interplay of three forces given by:

- $\frac{(1-\phi)}{(1+\phi)}\frac{1}{\mu\left(\frac{1}{2},\phi\right)}\left(\frac{\partial\mu}{\partial s_K} - \frac{\partial\mu^*}{\partial s_K}\right)$
- $-4\left(\frac{1-\phi}{1+\phi}\right)^2$
- $4\frac{\partial s_E}{\partial s_K}\frac{(1-\phi)}{(1+\phi)}$

The last two forces are the same we encounter in the standard NEGG model and they are the formal representation of, respectively, the *market-crowding effect* and the *demand-linked effect*. In the standard model, the stability of the equilibrium is the result of the relative strenght of just these two forces. The first force represents the novelty of our model. In the standard case, where $\mu^*(s_K, \phi) = \mu(s_K, \phi) = \mu$ and then $\frac{\partial\mu}{\partial s_K} = \frac{\partial\mu^*}{\partial s_K} = 0$, this force simply doesn't exist. We dub this force as the **expenditure share effect** in order to highlight the link between the existence of this force and a non-unitary value of the intersectoral elasticity of substitution. As we will see in detail below, the expenditure share effect might be a stabilizing (when negative) or destabilizing one (when positive) depending on whether the manufactured and the traditional good are respectively poor ($\alpha < 0$) or good ($\alpha > 0$) substitutes.

But what is the economic intuition behind this force? Imagine a firm moving from south to north ($\partial s_K \geq 0$). For a given value of ϕ, this production shifting, via the home-market effect, reduces the manufactured good price index in the north and increases the one in the south. In the standard case, where the manufactured and the traditional goods are neither good nor poor substitutes, this relative change in the price levels has no effect on the respective expenditure shares. By contrast when the intesectoral elasticity of substitution is allowed to vary from the unitary value, the shares of expenditure change with the $M-$price index and hence with s_K. In particular, when the manufactured and the traditional goods are good substitutes ($\alpha > 0$), a reduction in the relative price level in the north leads to and increase $\left(\frac{\partial \mu}{\partial s_K} \geq 0\right)$ in the northern expenditure shares and a decrease $\left(\frac{\partial \mu^*}{\partial s_K} \leq 0\right)$ in the southern expenditure shares, then increasing the relative market size in the north and then providing an (additional) incentive to the southern firms to relocate in the north. The opposite ($\frac{\partial \mu}{\partial s_K} \leq 0$ and $\frac{\partial \mu^*}{\partial s_K} \geq 0$) happens when the manufactured and the traditional goods are poor substitutes ($\alpha < 0$): in this case, southern relative market size increases and this gives and incentive for the moving firm to come back home. This is why, when the M and the T goods are good substitutes the expenditure share effect acts as an destabilizing force, while the opposite happens when the M and the T goods are poor substitutes.

We can re-write (38) by using (20) and (21) which reveals that $\frac{\partial \mu}{\partial s_K} = -\frac{\partial \mu^*}{\partial s_K}$. Hence:

$$\left.\frac{\partial \gamma\left(s_E, s_K, \phi\right)}{\partial s_K}\right|_{s_K=s_E=1/2} = \underbrace{4\left(\frac{1-\phi}{1+\phi}\right)^2 \frac{\alpha\left(1-\mu\left(1/2,\phi\right)\right)}{\left(\sigma-1\right)\left(1-\alpha\right)}}_{\text{Substitution}} \underbrace{-4\left(\frac{1-\phi}{1+\phi}\right)^2}_{\text{Market-crowding}} \underbrace{+4\frac{\left(1-\phi\right)}{\left(1+\phi\right)}\frac{\partial s_E}{\partial s_K}}_{\text{Demand-linked}}$$

Where, using the permanent income condition (35), we have $\frac{\partial s_E}{\partial s_K} = \frac{\rho}{2L+\rho}$. The symmetric equilibrium will be stable or unstable according to whether the previous expression is positive or negative. Again, the only difference with respect to the standard case is the presence of the first term in the left-hand side, the expenditure share effect, which is in fact zero when $\alpha = 0$.

It is easy to show that, since $\frac{1}{1-\alpha} < \sigma$, we always have:

$$\underbrace{4\left(\frac{1-\phi}{1+\phi}\right)^2 \frac{\alpha\left(1-\mu\left(1/2,\phi\right)\right)}{\left(\sigma-1\right)\left(1-\alpha\right)}}_{\text{expenditure share effect}} \underbrace{-4\left(\frac{1-\phi}{1+\phi}\right)^2}_{\text{Market-crowding effect}} \leq 0 \text{ for any } \phi \in [0,1] \qquad (39)$$

so that the expenditure share effect will never offset the market-crowding effect[11]. Moreover, the expenditure share effect will decrease with the freeness of

[11] From this result, we can derive a corollary for the capital mobility case. In this case, s_n

trade when $\alpha > 0$ and will increase with it as $\alpha < 0$; however its absolute value will always be decreasing in ϕ. Hence, the dynamic behaviour of the agglomeration process as a function of ϕ will not be qualitatively different from the standard case: as ϕ decreases, each forces will reduce their intensity (in absolute value) but the decrease of the Demand-linked effect will be slower.

Nevertheless, the presence of our additional force will introduce the possibility of an additional outcome which was exluded from the standard CD case. In order to do that, we recall the notion of *break-point*, that is the value of ϕ above which the stability of the interior equilibria is broken, and then an infinitesimal production shifting in the north (south) will trigger a self-reinforcing mechanism which will lead to a core-periphery outcome. In the standard CD case, since $\alpha = 0$, we have that:

$$\left.\frac{\partial \gamma\left(s_E, s_K, \phi\right)}{\partial s_K}\right|_{s_K = s_E = 1/2} \geq 0 \Leftrightarrow \phi \geq \phi_B^{CD}$$

where $\phi_B^{CD} = \frac{L}{L+\rho}$ is the break-point level of the trade costs. Since $\phi_B^{CD} \in (0, 1)$, there is always a feasible value of the trade costs above which the interior equilibrium turns from stable to unstable and then agglomeration will take place.

In our model, it is not possible to calculate an explicit value for the break-point. That's because ϕ enters the expression for $\mu\left(1/2, \phi\right)$ as a non-integer power. Nonetheless, we can draw several implications from the existence of the expenditure share effect. Let's re-write the condition according to which the symmetric equilibrium is unstable $\left(\left.\frac{\partial \gamma(s_E, s_K, \phi)}{\partial s_K}\right|_{s_K = s_E = 1/2} \geq 0\right)$ in this way:

$$\frac{\alpha\left(1 - \mu\left(1/2, \phi\right)\right)}{\left(\sigma - 1\right)\left(1 - \alpha\right)} \geq \frac{2\left(L + \rho\right)}{\left(1 - \phi\right)\left(2L + \rho\right)}\left(\phi_B^{CD} - \phi\right) \tag{40}$$

We can notice that the sign of the left-hand side, as $\frac{2(L+\rho)}{(1-\phi)(2L+\rho)}$ is always non-negative, is completely determined by $\left(\phi_B^{CD} - \phi\right)$. First, note that in the standard case, when $\alpha = 0$, this condition reduces to:

$$\phi > \phi_B^{CD}$$

so that, by definition, the equilibrium is unstable when the freeness of trade is larger than the break-point level.

Secondly, note that in our model the right-hand side of (40) might be strictly positive or negative depending on whether α is positive or negative. That means that the break-point in our model (call it ϕ_B^{CES}) may be higher or lower than ϕ_B^{CD} depending on whether the intersectoral elasticity of substitution is larger or smaller than 1. Formally:

$$\begin{array}{rcl} \phi_B^{CES} & < & \phi_B^{CD} \Leftrightarrow \alpha > 0 \\ \phi_B^{CES} & > & \phi_B^{CD} \Leftrightarrow \alpha < 0 \end{array}$$

should not equal s_K and, above all, there is no permanent income condition so that $\frac{\partial s_E}{\partial s_n} = 0$. Hence the stability condition reduces to (39) and, just as in the standard case, the symmetric steady-state is always stable when capital is mobile.

In other words, and quite intuitively, the presence of an additional agglomeration force (the expenditure share effect when $\alpha > 0$), shifts the break-point to a lower level so that catastrophic agglomeration is more likely and it occurs for a larger set of values of ϕ. By contrast, when the expenditure share effect acts as a dispersion force ($\alpha < 0$), the break-point shifts to an upper level so that catastrophic agglomeration is less likely as it occurs for a smaller set of values of ϕ.

Thirdly, and most importantly, there is a set of parameters such that $\phi_B^{CES} < 0$ and so catastrophic agglomeration may always occur for any value of ϕ. To see this we should find two sets of parameters such that the symmetric equilibrium is unstable even for $\phi = 0$. That is, by rewriting (40) for $\phi = 0$ and using the fact that $\phi_B^{CD} = \frac{L}{L+\rho}$, this condition reduces to:

$$\frac{\alpha\left(1-\mu\left(1/2,0\right)\right)}{\left(\sigma-1\right)\left(1-\alpha\right)} > \frac{2L}{2L+\rho}$$

which, expressing it in terms of α, becomes:

$$\alpha > \frac{2L\left(\sigma-1\right)}{\left(1-\mu\left(1/2,0\right)\right)\left(2L+\rho\right)+2L\left(\sigma-1\right)} > 0$$

which is a possible outcome, provided that $\frac{2L(\sigma-1)}{(1-\mu(1/2,0))(2L+\rho)+2L(\sigma-1)} < \frac{\sigma-1}{\sigma}$ and so:

$$\mu\left(1/2,0\right) < \frac{\rho}{2L+\rho} = \frac{\partial s_K}{\partial s_E}$$

In this case, therefore, the symmetric equilibrium is unstable and then catastrophic agglomeration always takes place for any feasible value of ϕ.

For the sake of precision, note that we are not able to show the opposite, i.e., that when α is negative enough the break-point level of ϕ is larger than 1 and then agglomeration may never take place. To see this, just notice that the expenditure share effect ($4\left(\frac{1-\phi}{1+\phi}\right)^2 \frac{\alpha(1-\mu(1/2,\phi))}{(\sigma-1)(1-\alpha)}$) decreases with ϕ at the same speed as the market-crowding effect. Hence, for ϕ close enough to 1, the agglomeration force ($4\frac{\rho}{2L+\rho}\frac{(1-\phi)}{(1+\phi)}$) will always be larger in absolute value than the sum of the two dispersion forces because it decreases at a lower speed[12].

3.3 Stability analysis of the Core-Periphery Equilibrium

The northern share of firms is constant ($\dot{s}_K = 0$) even when $s_K = 1$ or $s_K = 0$. Since the two core-periphery equilibria are perfectly symmetric, we just focus

[12] For catastrophic agglomeration never to occur, we need that condition (40) never hold even when ϕ is very close to 1. Formally, this condition can be written as

$$\lim_{\phi\to 1} \frac{\alpha\left(1-\mu\left(1/2,\phi\right)\right)}{\left(\sigma-1\right)\left(1-\alpha\right)} < \lim_{\phi\to 1} -\frac{2\rho}{2L+\rho}\frac{1}{1-\phi} = -\infty$$

Which can never be true for any negative finite value of α because the left-hand side always takes a finite value.

on the first where the north gets the core. By following Baldwin and Martin (2004), for $s_K = 1$ to be an equilibrium, it must be that $q = v/F = 1$ and $q^* = V^*/F^* < 1$ for this distribution of capital ownership: continuous accumulation is profitable in the north since $v = F$, but $V^* < F$ so no southern agent would choose to setup a new firm. Defining the core-periphery equilibrium this way, it implies that it is stable whenever it exists. By using (35) and (32) we conclude that, at $s_K = 1$ implies:

$$\begin{aligned} q\left(s_K, s_E, \phi\right)\big|_{s_K=1} &= \frac{\left[\left(L+\rho\right)\mu(1,\phi) + L\mu^*(1,\phi)\right]}{\left(\rho+g\right)\sigma} = 1 \\ q^*\left(s_K, s_E, \phi\right)\big|_{s_K=1} &= \frac{\left[\left(L+\rho\right)\phi^2\mu(1,\phi) + L\mu^*(1,\phi)\right]}{\phi\sigma\left(\rho+g\right)} < 1 \end{aligned}$$

From the first we can derive the value of the growth rate of world capital in the core-periphery outcome g_{CP} which, in this case, coincides with north's capital:

$$g_{CP} = \frac{L\left(\mu(1,\phi) + \mu^*(1,\phi)\right) - \rho\left(\sigma - \mu(1,\phi)\right)}{\sigma} \tag{41}$$

By substituting in $q^* < 1$, this condition collapses to:

$$\phi > \frac{L}{L+\rho}\frac{\mu^*(1,\phi)}{\mu\left(1,\phi\right)} \tag{42}$$

The solution of this inequality yields the sustain point of our model (call it ϕ_S), i.e., the value of the freeness of trade ϕ above which the core-periphery equilibrium exists and it is stable. Even though this inequality cannot be solved explicitly, yet we can draw several useful observation by analysing it.

First notice that, when $\alpha = 0$, we have that $\mu^*(1,\phi) = \mu\left(1,\phi\right) = \mu$ and this condition reduces to:

$$\phi > \phi_S^{CD} = \frac{L}{L+\rho}$$

as in the standard case (where $\phi_S^{CD} = \phi_B^{CD} = \frac{L}{L+\rho}$).

Secondly, if we allow α to be different from 0, we conclude that:

$$\begin{aligned} \alpha &> 0 \Leftrightarrow \phi_S^{CES} < \phi_S^{CD} = \frac{L}{L+\rho} \\ \alpha &< 0 \Leftrightarrow \phi_S^{CES} > \phi_S^{CD} = \frac{L}{L+\rho} \end{aligned}$$

These results represent a confirmation of our previous intuitions related to the symmetric equilibrium. When the expenditure share effect behaves as an additional agglomeration force ($\alpha > 0$), then catastrophic agglomeration is more likely and the core-periphery equilibrium becomes stable for lower values of the freeness of trade. By contrast, when the expenditure share effect behaves as an additional dispersion force, then catastrophic agglomeration is less likely to occur and the core-periphery equilibrium becomes stable for higher values of the freeness of trade.

4 Geography and Integration *always* matter for Growth

A well-established result in the NEGG literature (Balwin Martin and Ottaviano 2001, Baldwin and Martin 2004, Baldwin et al. 2004) is that geography matters for growth *only* when spillovers are localized. In particular, with localized spillovers, the cost of innovation is minimized when the whole manufacturing sector is located in only one region. If this is the case, innovating firms have a higher incentive to invest in new units of knowledge capital with respect to a situation in which manufacturing firms are dispersed in the two regions. Thereby the rate of growth of new units of knowledge capital g is maximized in the core-periphery equilibrium and "agglomeration is good for growth". When spillovers are global, this is not the case: innovation costs are unaffected by the geographical allocation of firms and the aggregate rate of growth is identical in the two equilibria being common in the symmetric one ($g = g^*$) or north's g in the core-periphery one. Moreover, in the standard case, market integration have no direct influence on the rate of growth which is not dependent on ϕ. When spillovers are localized, trade costs may have an indirect influence on the rate of growth by affecting the geographical allocation of firms: when trade costs are reduced below the break point level, the symmetric equilibrium becomes unstable and the resulting agglomeration process, by lowering the innovation cost, is growth-enhancing. But even this indirect influence will not exist when spillovers are global.

In what follows, we will question these conclusions. We will show that in our more general context (i.e. when the intersectoral elasticity of substitution is not necessarily unitary), *geography and integration always matters for growth*, even in the case when spillovers are global. In particular we show that

1. *Market integration has always a direct effect on growth*: when the intersectoral elasticity of substitution is larger than 1, then market integration (by increasing the share of expenditures in manufactures) is always good for growth. Otherwise, when goods are poor substitutes, integration is bad for growth.

2. *The geographical allocation of firms always matters for growth*: the rate of growth in the symmetric equilibrium differs from the rate of growth in the core-periphery one. In particular, growth is faster (slower) in symmetry if the share of global expenditure dedicated to manufactures is higher (lower) in symmetry than in the core-periphery. If this is the case, then agglomeration is bad (good) for growth

4.1 Growth and economic integration

We now look for the formal expression of the growth rate in both the symmetric and the core-periphery equilibrium. As we have seen, the expression for the growth rate can be found by making use of the optimal investment condition

(33). By using (31), (32) we find that, in the interior equilibrium we should have:

$$g_S = B(s_E, s_K, \phi)\frac{E^w}{\sigma} - \rho = B^*(s_E, s_K, \phi)\frac{E^w}{\sigma} - \rho$$

In the symmetric equilibrium we have $s_K = s_E = \frac{1}{2}$, so that, by using (29) and (30) we know that $B(\frac{1}{2}, \frac{1}{2}, \phi) = B^*(\frac{1}{2}, \frac{1}{2}, \phi) = \mu\left(\frac{1}{2}, \phi\right)$ and therefore:

$$g_S = \mu\left(\frac{1}{2}, \phi\right)\frac{E^w}{\sigma} - \rho$$

Finally, we know that $E^w = 2L + \rho$ so that we can write:

$$g_S = \frac{2L\mu\left(\frac{1}{2}, \phi\right) - \rho\left(\sigma - \mu\left(\frac{1}{2}, \phi\right)\right)}{\sigma} \tag{43}$$

It is easy to see that:

$$\frac{\partial g_S}{\partial \phi} = \frac{\partial \mu\left(\frac{1}{2}, \phi\right)}{\partial \phi}\frac{2L + \rho}{\sigma}$$

and by (22) and (23) we conclude that:

$$\begin{aligned} \frac{\partial g_S}{\partial \phi} &> 0 \Leftrightarrow \alpha > 0 \\ \frac{\partial g_S}{\partial \phi} &< 0 \Leftrightarrow \alpha < 0 \\ \frac{\partial g_S}{\partial \phi} &= 0 \Leftrightarrow \alpha = 0 \end{aligned}$$

so that integration is good for growth if and only if the traditional and the manufacturing goods are good substitutes. In the standard approach, the special case when $\alpha = 0$, integration has no effect on growth.

In the core-periphery equilibrium, innovation takes place in only one region (say, the north) so that $s_K = 1$ and $g > g^* = 0$. The expression of the growth rate is the same we have encoutered in the previous section (41):

$$g_{CP} = \frac{L\left(\mu(1, \phi) + \mu^*(1, \phi)\right) - \rho\left(\sigma - \mu(1, \phi)\right)}{\sigma} \tag{44}$$

The relation between growth and integration is not qualitatively different from the symmetric equilibrium. In particular we have:

$$\frac{\partial g_{CP}}{\partial \phi} = \frac{L}{\sigma}\left(\frac{\partial \mu(1, \phi)}{\partial \phi} + \frac{\partial \mu^*(1, \phi)}{\partial \phi}\right) + \frac{\rho}{\sigma}\frac{\partial \mu(1, \phi)}{\partial \phi}$$

so that, similarly to the symmetric case:

$$\begin{aligned} \frac{\partial g_{CP}}{\partial \phi} &> 0 \Leftrightarrow \alpha > 0 \\ \frac{\partial g_{CP}}{\partial \phi} &< 0 \Leftrightarrow \alpha < 0 \\ \frac{\partial g_{CP}}{\partial \phi} &= 0 \Leftrightarrow \alpha = 0 \end{aligned}$$

We conclude that the relation between growth and market integration is not qualitatively affected by the geographical location of firms: both in symmetry and in core-periphery this relation is only affected by the value of α. In both equilibria, when α is positive, so that the intersectoral elasticity of substitution is larger than unity, the policy maker should promote policies towards market integration in order to maximize the (common) growth rate. By contrast, if we accept that the two kinds of goods are poor substitutes, then policies favoring economic integration are growth-detrimental and if the policy-maker is growth-oriented then he should avoid them. In any case, the growth rate in the standard case (where growth is unaffected by ϕ and is identical in the symmetric and core-periphery equilibrium) is obtained as a special case ($\alpha = 0$).

What is the economic intuition behind this result? We should first consider that growth is positively affected by the total expenditure share in manufacturing goods at the world level: an increase in this variable would increase manufacturing profits, raising Tobin's q and then incentives to invest. As a result, growth would be higher. Then, any policy instrument able to increase total expenditure on manufacturing goods at the world level will accelerate economic growth. The issue is then: what are the determinants of the total expenditure share on manufactures at the world level? From our previous analysis we know that, with CES intermediate utility function, northern and southern expenditure shares depend on the geographical location of firms (s_K) and on the degree of economic integration ϕ. We leave the first determinant aside for a moment and we concentrate on the second. A reduction in the cost of trade will always bring to a reduction in the price index for the manufacturing goods in both regions. However, this reduction will have opposite effect on $\mu(\cdot)$ and $\mu^*(\cdot)$ depending on whether the intersectoral elasticity of substitution is larger or smaller than 1. In the first case, since the traditional good (which is now relatively more expensive) can be easily replaced by the industrial goods, the expenditure shares on the latters will increase in both regions, and this will also increase the growth rate. By contrast, when the traditional good cannot be easily replaced by the industrial goods, a reduction in the price index of industrial goods may increase total expenditure but it will decrease their *share* of expenditure in both regions. As a result, any integration-oriented policy will also reduce growth.

4.2 Growth and firms' location

Since the only two possible kinds of equilibria are the symmetric and the core-periphery allocation, in order to find the relation between geographical location of firms and growth, we just need to compare (43) with (**??**). We then have:

$$g_S > g_{CP} \Leftrightarrow \mu\left(\frac{1}{2}, \phi\right) > s_E^{cp}\mu(1,\phi) + (1 - s_E^{cp})\,\mu^*(1,\phi) \tag{45}$$

where $s_E^{cp} = \frac{L+\rho}{2L+\rho}$ is the market size of the north when the whole industry is concentrated in this region ($s_K = 1$). In other words, growth in the symmetric equilibrium will be faster than in the core-periphery equilibrium if and only if the industrial-goods' expenditure share in manufactures in the symmetric equilibrium (which is common in the two regions), is larger than a weighted average of the industrial goods' expenditure share in the core-periphery equilibrium in the two regions, where the weights are given by the reciprocal regional market sizes. What is significant in this case is then the relative importance of the industrial goods in the consumption bundle at the world level. If at the world level the industrial good is relatively more important in the symmetric equilibrium than in the core-periphery one, then agglomeration is bad for growth and the policy-maker should promote policies which favor dispersion of economic activities. It is worth noting that this condition is not trivial at all since we have:

$$\begin{aligned}
\alpha &> 0 \Leftrightarrow \mu(1,\phi) > \mu\left(\frac{1}{2},\phi\right) > \mu^{*}(1,\phi) \\
\alpha &< 0 \Leftrightarrow \mu^{*}(1,\phi) > \mu\left(\frac{1}{2},\phi\right) > \mu(1,\phi)
\end{aligned}$$

A further analysis of condition (45), e.g. by using (25) and (26), will not provide any significant insight. The validity of condition (45) is highly dependent on the curvature of $\mu(\cdot)$ and $\mu^{*}(\cdot)$ with respect to s_K and its analysis does not provide any relevant economic intuition.

5 Conclusions

This paper is a first attempt to introduce endogenous expenditure shares in a New Economic Geography and Growth model. We do this by allowing the intersectoral elasticity of substitution to be different from the unit value and we show how this slight change in the model assumptions leads to different outcomes in terms of the dynamics of the allocation of economic activities, the equilibrium growth prospect and the policy insights.

Concerning the dynamics of the allocation of economic activities, our model displays three main results: 1) when the modern and the traditional goods are poor substitutes, the expenditure share effect acts as dispersion force, hence the agglomeration outcome can be reached for level of trade openness which are higher than the standard case; 2) when the traditional and the industrial goods are good substitutes, the expenditure share effects acts as an agglomeration force and agglomeration is reached for lower degrees of market openness; 3) there are values of parameters such that the degree of integration is irrelevant because agglomeration can be reached for whatever level of trade costs.

From the growth perspective, results are even more relevant: 1) unlike the standard NEGG models, the growth rate is influenced by the allocation of economic activities even in absence of localized knowledge spillovers and 2) the degree of economic integration always affects the rate of growth, being growth-detrimental if the intersectoral elasticity of substitution is lower than unity and being growth-enhancing in the opposite case. We are then able to provide a rationale for the rather counterintuitive conclusion according to which an integration-oriented policy rule is bad for growth.

The policy implications of our analysis are significant. A first message of our model is that policy makers should not blindly rely on standard NEGG models' suggestions because some of their main results are highly dependent on the underlying assumptions. A typical example is the well-established result stating that policy makers should not try to avoid the agglomeration of economic activities because the concentration of the innovative and the increasing returns sectors will increase growth at a global level when spillovers are localized. This conclusion does not take into account the fact that the incentive to invest in new units of capital (and thereby the growth rate) depends on the Dixit-Stiglitz operating profits of manufacturing firms, that in our model are influenced by the share of expenditure in the modern goods. If the average regional expenditure share in this sector is higher in the symmetric equilibrium than in the case of agglomeration, then firms' profits are higher when the economic activities are dispersed among the two regions and concentrating them in only one region will reduce economic growth.

A second message of our paper is that policies should take into account the crucial role of the intersectoral elasticity of substitution. To our knowledge, there are no empirical studies assessing the value of this parameter in the context of a NEG model. An empirical analysis of the intersectoral elasticity of subtstitution would be an expected follow-up of our analysis and would be highly needed in order to assess the relative empirical relevance of the theoretical results we have obtained.

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6 Appendix

Proposition 1 $s_K = \frac{1}{2}$ *is the only interior equilibrium.*

Proof. Consider the right-hand side of (36). The right hand side is a linear function $f(s_K)$ in s_K taking values from the real interval $[0,1]$ to the real interval $\left[-\frac{\rho}{2L+\rho}, \frac{\rho}{2L+\rho}\right]$ and having constant positive derivative given by $f'(s_K) = \frac{\rho}{2L+\rho} > 0$. In particular, this function is strictly positive when $s_K > \frac{1}{2}$, strictly negative when $s_K < \frac{1}{2}$ and is zero when $s_K = \frac{1}{2}$. Consider now the left hand side:

$$h(s_K) = \frac{\mu^*(s_K,\phi)(s_K + (1-s_K)\phi) - \mu(s_K,\phi)(\phi s_K + (1-s_K))}{\mu(s_K,\phi)(\phi s_K + (1-s_K)) + \mu^*(s_K,\phi)(s_K + (1-s_K)\phi)}$$

since the denominator of this function is always positive, the sign of $h(\cdot)$ is completely determined by the numerator. By substituting for the value of $\mu(s_K,\phi)$ and $\mu^*(s_K,\phi)$, the numerator of $h(\cdot)$ can be written as:

$$\left(\frac{1-\delta}{\delta}\right)^{\frac{1}{1-\alpha}} \left((\phi s_K + 1 - s_K)^{\frac{\alpha}{(1-\sigma)(1-\alpha)}+1} - (s_K + (1-s_K)\phi)^{\frac{\alpha}{(1-\sigma)(1-\alpha)}+1}\right) + (2s_K - 1)(1-\phi)$$

In order to study the sign of this expression, we now remind our additional restriction on the relative values of the intersectoral and intrasectoral elasticities according to which:

$$\frac{1}{1-\alpha} \leq \sigma$$

Thanks to this assumption, we are able to conclude that the previous expression is strictly negative when $s_K > \frac{1}{2}$, strictly positive when $s_K < \frac{1}{2}$ and zero when $s_K = \frac{1}{2}$. Hence $s_K = \frac{1}{2}$ is the unique interior equilibrium. ■

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