Financial Development and Agglomeration

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Abstract

The New Economic Geography (NEG) literature has paid little attention to the role of the banking industry in affecting where firms decide to locate their business. Within the framework of the NEG, this paper aims to fill this gap by studying the impact of the degree of regional financial development on the spatial distribution of economic activity.

In order to explore this issue, we modify the standard Footloose Entrepreneur (FE) model by introducing a banking sector, while preserving all the other usual assumptions. We show that the existence of a banking sector enhances the agglomeration forces; so that, when regions are symmetric, a Core-Periphery outcome is more likely. When regions are characterised by different levels of financial development this result is reinforced and entrepreneurs are more likely to migrate towards the region where the banking sector is characterized by a higher degree of competition / lower degree of concentration and the interest rate is lower.

Keywords: Local financial development, Banks, Agglomeration, Firm location

JEL classification: G10, G21, R12, R51

1 Introduction

The recent events related to the financial crisis have shown how the impact of the global credit crunch on regional economic activities has been different according to the specific features of local credit markets. The New Economic Geography (NEG) framework represents a suitable tool of analysis to explore these issues;

nevertheless, until now, the NEG literature has paid little attention to the role of the banking industry in affecting the spatial distribution of economic activity.[1] This paper aims to fill this gap by analysing how the degree of regional financial development could affect where firms decide to locate their business.

In a context where the world capital market becomes more integrated this could seem an irrelevant issue; in fact, if a rise in the international capital mobility and the homogeneity of law regulation promotes a rise in the uniformity of credit conditions across regions, then the regional financial development would not affect firms' locational choice. However, empirical evidence mostly supports the opposite view: for example, Guiso et al. (2004) shows that the likelihood of starting a new business or the number of firms per inhabitant are positively correlated with local financial development; where the degree of financial development is measured by firms' accessibility to external funds.

Among factors determining this finding, we think that geographical distance plays a key role, since it prevents to equalize credit conditions across regional financial markets. On the whole, empirical results mostly support this view with geographical distance that adversely affects credit availability for firms; in Agarwal and Hauswald (2010) the negative influence comes from the "operational distance", that is, the distance between a firm and a bank branch, while in Alessandrini et al.(2009a, 2009b) this negative impact comes from the "functional distance", that is, the physical, economic, social, and cultural proximity between a local branch, where information is collected and lending relationships are established, and its headquarter, where ultimate decisions are typically taken. Notice that geographical distance also adversely affects the default rate on loans; Bofondi and Gobbi (2006) show that the expected default rate is lower for incumbent banks with a large market share and with branches than for entrant banks without branches. The main reason explaining these results are information costs, that consist of the time and effort spent by a potential lender to assess and monitor a potential borrower; these costs increase in the geographical distance and negatively affect credit availability for firms.[2] Moreover, geographical distance not only affects credit decisions of banks, but also their decisions to enter in a new market by opening a new branch; Felici and Pagnini (2008) show that the empirical evidence is consistent with a strong negative correlation between geographical distance and entry decisions.[3] Based on the above considerations, we can consider geographical distance as a factor that promotes segmentation of local credit markets, through its impact on information costs; in our analysis below, we take this into account when we define the characteristics of regional credit markets.

This paper focuses on the relationship between different degrees of financial development across regions and the spatial distribution of economic activity. In order to explore this issue, we modify the standard Footloose Entrepreneur

[1] See Martin (2011).

[2] Also Degryse and Ongena (2005) put forward a similar view, but the authors draw the attention to the role of trasportation costs.

[3] Felici and Pagnini (2008) also show a declining role over time of the distance in determining entry behaviour mainly for the advent of information and comunication technologies.

(FE) model[4] by introducing a banking sector, while preserving all the other usual assumptions.

The banking industry is characterised as follows: first, firms borrow from banks their working capital due to frictions in the payment system of the economy: workers cannot buy goods before receiving wages, while firms cannot pay wages before selling goods; so that entrepreneurs borrow financial resources from banks to anticipate wage payments. Within a neoclassical model of an open economy, Neumeyer and Perri (2005) make a similar assumption to justify the working capital need of firms. Thus interest payments should also be taken into account in the analysis. Second, banks cannot move from one region to another and cannot lend to firms located in other regions, that is, we do not allow for inter-regional/international bank mobility and/or for inter-regional/international financial capital mobility. We are aware that this is a strong simplification on the effect of distance on banking activities, but it allows to focus on the main aspects of the relationship between the degree of the regional financial development and the spatial distribution of economic activity; moreover, the empirical evidence supports the view that geographical distance and information costs work for the segmentation of local credit markets.[5] Third, banks operate in an oligopolistic market; particularly, we implement the standard model of oligopolistic competition among banks developed by Klein (1971) and Monti (1972) as reported in Frexias and Rochet (1999). An important outcome of this model is that interest rates charged on loans are negatively related to the demand elasticity and negatively (positively) related to the degree of competition (concentration) in the banking sector. Empirical evidence abundantly supports these results;[6] particularly, Corvoisier and Gropp (2002) show that the concentration degree in credit markets is statistically different across euro area countries and positively affects interest margins of banks for short-term loans. Notice that the latter evidence is perfectly consistent with the assumption of segmentation of regional credit markets.

In our analysis, the degree of competition in the banking industry affects firms' locational choice. When we consider the case of regions with the same degree of financial development and therefore with the same characteristics of the credit market – translating into indentical interest rates on loans –, a symmetric increase in the regional interest rates strenghtens the agglomeration forces and full agglomeration of manufacturing activities in one region could emerge as the most likely long-run equilibrium. When the regions have different degrees of financial development, the manuacturing activity is attracted towards the region that enjoys a higher degree of competion in the banking sector and a lower interest rate. Finally our analyis also shows a hysteresis effect in the locational choice of firms: a temporary shock that increases competition in the

[4] See Ottaviano (1996), Forslid (1999), Forslid and Ottaviano (2002), Baldwin et al. (2003).

[5] For the empirical evidence, see Felici and Pagnini (2008), Agarwal and Hauswald (2010), Alessandrini et al. (2009a; 2009b), Bofondi and Gobbi (2006).

[6] See Berger and Hannan (1989; 1992), Neuberger and Zimmermann (1990), Corvoisier and Gropp (2002); for an opposite view, see Jackson (1992). For a review of the literature, see Berger et al. (2004).

banking industry in one region may cause migration of manufacturing firms towards that region that is not reversed when the shock is removed.

The paper is organized as follows. Section (2) introduces the model framework. Section (3) describes the characteristics of the short-run equilibrium. Section (4) presents the fully dynamical model, while sections (5)-(6) study the properties of the long-run equilibrium, respectively, in the symmetric and asymmetric case with respect to the level of financial development. Section (7) draws some conclusions.

2 The Basic Framework

We modify the FE model by introducing a banking sector, while preserving all the other assumptions of the standard FE model. The economy consists of two trading regions ($r = 1, 2$), three sectors: Agriculture (A), Manufacturing (M), and Banking (B); and three factors of production: unskilled workers (L), entrepreneurs (E), and bank capital (K). E is mobile accross regions, whereas L is inter-regionally immobile but freely mobile across sectors. Each bank owner is endowed with one unit of bank capital, so that K represents both the overall number of capital owners and the overall bank capital of the economy; finally, bank owners cannot move from one region to the other and cannot lend to firms located in the other region.

The two regions are symmetric in terms of tastes, technology, transport costs, number of unskilled workers, but might differ in the number of entrepreneurs. Concerning the degree of regional financial development, we deal first with the case of equal distribution of bank capital units; and then we consider the case of different regional degrees of financial development.

2.1 Consumers

Consumers, that is, unskilled workers, entrepreneurs and bankers, show identical tastes. They've got Cobb-Douglas preferences over a homogeneous agricultural good and a quantity index represented by a CES utility function of the manufactured varieties:

$$U = C_A^{1-\mu} C_M^{\mu} \tag{1}$$

where μ is the costant income share devoted to the consumption of a basket of manufactured varieties (C_M), while $1-\mu$ is that one devoted to the consumption of the agricultural good (C_A). C_M corresponds to a CES function:

$$C_M = \sum_{i=1}^{n} c_i^{\frac{\sigma-1}{\sigma}}$$

where $\sigma > 1$ defines the constant elasticity of substitution between the manufactured varieties, the lower is σ, the greater the consumers' taste for variety; c_i is the consumption of one manufactured variety, while $i = 1...n$ denotes one specific variety.

2.2 The Agricultural Sector

The Agriculture sector produces a homegeneous good under perfect competition and costant returns; specifically, the production requires one unit of unskilled labour for ech unit of output. The standard assumption of the the so-called non-full-specialization condition holds, so that neither region has enough unskilled workers to satisfy the demand of the agricultural good of the overall economy and both regions always engage in agricultural production.

2.3 The Manufacturing sector

The Manufacturing sector produces differentiated goods / varieties under standard Dixit-Stiglitz monopolistic competition and incresing returns. The production of each manufactured variety requires a fixed input of one entrepreneur and β units of unskilled labour services for each additional unit of output. Since the entrepreneur has to advance wages to the unskilled workers by borrowing the correspoding amount, marginal costs have to include interest payments; therefore, the total costs of firm i ($TC_{i,t}$, with $i = 1...N$) are the following:

$$TC_{i,t} = F + w(1 + i_{r,t})\beta q_{i,t}$$

where F is the remuneration of the entrepreneur, w is the wage of unskilled workers, i_r is the interest rate prevailing at time t in region r, and $q_{i,t}$ is the output of a specific variety produced by firm i. Given consumers' preference for variety and increasing returns, firm i produces a variety which is different from those produced by the other firms, so that the number of varieties, n, is equal to the number of firms, N, and to the number of entrepreneurs, $n = N = E$. By denoting the share of entrepreneurs located in region 1 at time t by $0 \leq \lambda_t \leq 1$, the number of varieties produced at time t in the first and second region are $n_{1,t} = \lambda_t N$ and $n_{2,t} = (1 - \lambda_t)N$, respectively.

2.4 The banking industry

The banking industry provides the working capital to firms under standard Monti-Klein oligopolistic competition. Due to frictions in the payment system, workers cannot buy goods before receiving wages while firms cannot pay wages before selling goods, entrepeneurs have to borrow financial resources from banks in order to anticipate wage payments. The model does not allow for inter-regional/international bank mobility and inter-regional/international capital mobility, so that banks cannot move from one region to another and cannot lend to firms located in the other region. We assume a banking industry technology with a fixed set up cost h, that, for example, consists of those costs connected with data collection or data retrieving or, more generally, with those 'front' or 'back office' technologies involving some type of sunk cost (see Berger 2003); h is relatively small for banks that would lend to firms located in the same region, but prohibitive for banks that would lend to firms located in the other region or that would move in the other region.

The demand for loans of the representative firm located in region $r = 1, 2$ corresponds to

$$m^d_{r,t} = w\beta q_{i,t},$$

the payment for the amount of unskilled labour necessary to produce the quantity $q_{i,t}$; to be interpreted as the firm's working capital requirement. The demand for loans in one region is given by the demand for loans of the representative firm times the number of firms located in that region:

$$M^D_{r,t} = n_{r,t} m^d_{r,t} = n_{r,t} w\beta q_{i,t}$$

The supply for loans in region r is

$$M^S_{r,t} = k_r m^s_{r,t}$$

where $m^s_{r,t}$ is the supply for loans of a representative bank and $0 < k_r < K$ denotes the number of banks located in region r. k_r, which is exogenously given, measures the degree of concentration/competition in the banking industry.

2.5 Transport costs

The products of both sectors are traded between the regions. Transportation of the agricultural good is costless; whereas transportation of the manufactured goods is characterised by iceberg trade costs: if one unit of good is shipped between the regions only the fraction $1/T$ arrives at destination, where $T \geq 1$. Trade freeness is defined by $\phi = T^{(1-\sigma)}$, where $0 < \phi \leq 1$, with $\phi = 1$ representing no trade costs and $\phi \to 0$ prohibitive trade costs.

3 Short-run General Equilibrium

Given the spatial allocation of entrepeneurs across the region, λ_t, the short-run general equilibrium in period t is characterized by equilibrium in the agricultural good market, in the markets of the manufactured goods and in the loan market; moreover, as a result of the Walras's law, simultaneous equilibrium in all these markets also implies equilibrium in the regional labour markets.

Under perfect competition, costant return and no trade costs, the optimizing behaviour of firms implies that the price of the agricultural good, p_a, is the same in both regions and equal to the wage of unskilled labour. By setting the the agricultural price equal to 1, it becomes the numéraire in terms of which the other prices are defined, we have then:

$$p_a = w = 1$$

From the optimization problem of the representative consumer, total expenditures on the agricultural product is $(1 - \mu) Y_{W,t}$, where $Y_{W,t} = Y_{1,t} + Y_{2,t}$ is total income given by the sum of the income in region 1, $Y_{1,t}$, and in region 2, $Y_{2,t}$. The non-full-specialization condition requires that $(1-\mu) Y_{W,t} > \frac{L}{2}$, so that both regions produce the agricultural good.

Under Dixit-Stiglitz monopolistic competition, increasing returns and a wage of 1, the symmetric behaviour of firms determines for each variety the same mill price given as a mark-up on marginal costs:

$$p_{r,t} = (1 + i_{r,t}) \frac{\beta\sigma}{\sigma - 1} \tag{2}$$

Note that the interest rate, $i_{r,t}$, and the elasticity of substitution parameter, σ, have a similar effect on the price: a decrease in σ, that is, an increase in the degree of competition in the manufacturing sector, rises $p_{r,t}$ like an increase in $i_{r,t}$. By taking into account that the effective price paid by consumers for a variety produced in the other region is $p_{r,t}T$, the regional manufacturing price indices facing consumers, respectively, in region 1 and in region 2, are given by:

$$P_{1,t} = \left[n_1 p^{(1-\sigma)} + n_2 p^{(1-\sigma)} T^{(1-\sigma)}\right]^{\left(\frac{1}{1-\sigma}\right)} = \Delta_{1,t}^{\frac{1}{1-\sigma}} N^{\frac{1}{1-\sigma}} p \tag{3}$$

$$P_{2,t} = \left[n_1 p^{(1-\sigma)} T^{(1-\sigma)} + n_2 p^{(1-\sigma)}\right]^{\left(\frac{1}{1-\sigma}\right)} = \Delta_{2,t}^{\frac{1}{1-\sigma}} N^{\frac{1}{1-\sigma}} p \tag{4}$$

with $\Delta_{1,t} \equiv \lambda_t + \phi(1-\lambda_t)$ and $\Delta_{2,t} \equiv \phi\lambda_t + (1-\lambda_t)$. Since workers, entrepreneurs, and bankers have the same tastes, income redistribution per se has no direct impact on product demands; therefore total expenditure on manufactured varieties is $\mu Y_{W,t}$ and the regional demands per variety, respectively, in region 1 and in region 2, are:

$$d_{1,t} = \left[\mu Y_{1,t} P_{1,t}^{\sigma-1} + \phi\mu Y_{2,t} P_{2,t}^{\sigma-1}\right] p^{-\sigma} = \left[s_t P_{1,t}^{\sigma-1} + \phi\left(1-s_t\right) P_{2,t}^{\sigma-1}\right] \mu Y_{W,t} p^{-\sigma} \tag{5}$$

$$d_{2,t} = \left[\phi\mu Y_{1,t} P_{1,t}^{\sigma-1} + \mu Y_{2,t} P_{2,t}^{\sigma-1}\right] p^{-\sigma} = \left[\phi s_t P_{1,t}^{\sigma-1} + \left(1-s_t\right) P_{2,t}^{\sigma-1}\right] \mu Y_{W,t} p^{-\sigma} \tag{6}$$

where $s_t \equiv \frac{Y_{1,t}}{Y_{W,t}}$ denotes the share of income of region 1 in total income. Short-run general equilibrium in period t involves that the supply of a manufatured variety must be equal to its demand, so that for each variety the following equilibrium condition holds:

$$q_{r,t} = d_{r,t} \tag{7}$$

From (2), the short-equilibrium operating profits per variety / entrepreneur in region r can be expressed as:

$$\pi_{r,t} = p_{r,t} q_{r,t} - (1 + i_{r,t})\beta q_{r,t} = \frac{p_{r,t} q_{r,t}}{\sigma} \tag{8}$$

According to (8) profit is proportional to the value of sales and it is not directly affected by the interest rate on loans. We now turn to the determination of the equilibrium value of the latter variable.

Under Monti-Klein oligopolistic competition, the optimizing behaviour of bankers allows to determine the regional interest rate $i_{r,t}$. In order to simplify the analysis as much as possible we do not consider the deposit market and assume that banks are financed by the monetary authority or, alternatively, that only bankers own the appropriate technology to satisfy firms requirements of working capital. The demand for loans in region r is negatively related to the interest rate, $i_{r,t}$:

$$M^D_{r,t} = n_{r,t}\Lambda_{r,t}\frac{\mu}{N}\frac{\sigma-1}{(1+i_{r,t})\sigma} \tag{9}$$

with

$$\begin{aligned}\Lambda_{1,t} &\equiv \frac{Y_{1,t}}{\lambda_t+\phi(1-\lambda_t)}+\frac{Y_{2,t}}{\phi\lambda_t+1-\lambda_t}\phi \\ \Lambda_{2,t} &\equiv \frac{Y_{1,t}}{\lambda_t+\phi(1-\lambda_t)}\phi+\frac{Y_{2,t}}{\phi\lambda_t+1-\lambda_t}\end{aligned}$$

For convenience, from (9) we derive a relationship between the interest rate, i_r, and the demand for loans, $M^D_{r,t}$:

$$i_{r,t} = \frac{n_{r,t}}{N}\Lambda_{r,t}\frac{(\sigma-1)}{M^D_{r,t}\sigma}-1 \tag{10}$$

Considering that in equilibrium the demand for loans has to be equal to the supply, $M^S_{r,t} = M^D_{r,t}$, the objective function of bankers is

$$\pi_{k,t} = \left[\frac{n_{r,t}}{N}\Lambda_{r,t}\frac{(\sigma-1)}{M^S_{r,t}\sigma}-1\right]m^s_{r,t}-h$$

where $\pi_{k,t}$ denotes the profits of a single bank and $\left[n_{r,t}\frac{\Lambda_{r,t}}{N}\frac{(\sigma-1)}{M^S_{r,t}\sigma}-1\right]m^s_{r,t}$ corresponds to the revenues. The optimal amount of loans is:[7]

[7] In general, the bank's optimization problem corresponds to:

$$\max \pi_{k,t} = \left[1+i_{r,t}\left(M^S_{r,t}\right)\right]m^s_{r,t}-(1+i)\,D-h$$

Profits are given by revenues (loans plus interests on loans) minus variable costs (deposits plus interests on deposits) and fixed costs. We assume that the amount of loans is equal to deposits $\left(m^s_{r,t}=D\right)$ and that rate of interest on deposits is equal to zero ($i=0$), so that the above expression reduces to:

$$\max \pi_{k,t} = i_{r,t}\left(M^S_{r,t}\right)m^s_{r,t}-h$$

The optimization problem is solved by differentiating with respect to the amount of loans.

$$m^s_{r,t} = \frac{n_{r,t}\Lambda_{r,t}\mu\left(\sigma-1\right)}{\sigma N}\frac{\left(k_{r,t}-1\right)}{\left(k_r\right)^2} \tag{11}$$

By replacing (11) into (10), we obtain the equilibrium solution for the interest rate:

$$i_{r,t} = \frac{k_r}{k_r-1} - 1 = i_r \tag{12}$$

The interest rate therefore only depends on the given number of local banks. k_r can be interpreted as a measure of the degree of competition in the banking industry. Note that (12) is meaningless for $k_r = 1$, when the oligopolistic structure of the banking industry collapses to a monopoly. This result follows from the specific shape of the demand for loans that, in turns, depends on the assumptions of the FE model.

Regional incomes include wages, profits and bank revenues:

$$Y_{1,t} = \frac{L}{2} + \lambda_t N\pi_{1,t}(\sigma-1)\frac{i_1}{1+i_1} + \lambda_t N\pi_{1,t} = \frac{L}{2} + \lambda_t N\pi_{1,t}\left(\frac{1+\sigma i_1}{1+i_1}\right) \tag{13}$$

$$Y_{2,t} = \frac{L}{2}+(1-\lambda_t)N\pi_{2,t}(\sigma-1)\frac{i_2}{1+i_2}+(1-\lambda_t)N\pi_{2,t} = \frac{L}{2}+(1-\lambda_t)N\pi_{2,t}\left(\frac{1+\sigma i_1}{1+i_1}\right) \tag{14}$$

Using (2) to (8) and taking into account that from (12) the rate of interest only depends on the given regional stock of bank capital, the regional short-run equilibrium profits can be expressed as:

$$\begin{aligned}
\frac{\partial\pi_{k,t}}{\partial m^s_{r,t}} &= \frac{\partial i_{r,t}\left(M^S_{r,t}\right)}{\partial M^S_{r,t}}\frac{\partial M^S_{r,t}}{\partial m^s_{r,t}}m^s_{r,t} + i_{r,t}\left(M^S_{r,t}\right) = 0 \\
i_{r,t}\left(M^S_{r,t}\right) &= \frac{\partial i_{r,t}\left(M^S_{r,t}\right)}{\partial M^S_{r,t}}m^s_{r,t} \\
i_{r,t}\left(M^S_{r,t}\right)M^S_{r,t} &= M^S_{r,t}\frac{\partial i_{r,t}\left(M^S_{r,t}\right)}{\partial M^S_{r,t}}m^s_{r,t} \\
\frac{M^S_{r,t}}{m^s_{r,t}} &= \frac{\partial i_{r,t}\left(M^S_{r,t}\right)}{\partial M^S_{r,t}}\frac{M^S_{r,t}}{i_{r,t}\left(M^S_{r,t}\right)}
\end{aligned}$$

Note that $\frac{\partial M^S_{r,t}}{\partial m^s_{r,t}} = 1$ and $\frac{\partial i_{r,t}\left(M^S_{r,t}\right)}{\partial M^S_{r,t}} < 0$.

In correspondence of the optimal amount of loans the elasticity of the interest rate with respect to the demand for loans is equal to the number of banks ($\varepsilon_{i,m} = k_r$) and the elasticity of the demand for loans with respect to the interest rate is equal to the bank's market share $\left(\varepsilon_{m,i} = \frac{m^s_{r,t}}{M^S_{r,t}}\right)$.

$$\pi_{1,t} = \frac{\mu}{\sigma N}\left[\frac{Y_{1,t}}{\lambda_t + \phi(1-\lambda_t)} + \frac{Y_{2,t}}{\phi\lambda_t + 1 - \lambda_t}\phi\right] = \frac{\mu}{\sigma N}\Lambda_{1,t}$$

$$\pi_{2,t} = \frac{\mu}{\sigma N}\left[\frac{Y_{1,t}}{\lambda_t + \phi(1-\lambda_t)}\phi + \frac{Y_{2,t}}{\phi\lambda_t + 1 - \lambda_t}\right] = \frac{\mu}{\sigma N}\Lambda_{2,t}$$

Finally, using (13) and (14), we obtain:

$$\pi_{1,t} = \frac{L\mu\left[\sigma\left(\phi\Delta_1 + \Delta_2\right) - Z_2(1-\lambda_t)(1-\phi^2)\mu\right]}{2N\left\{\sigma^2\Delta_1\Delta_2 + \lambda_t(1-\lambda_t)(1-\phi^2)Z_1Z_2\mu^2 - \mu\sigma\left[\lambda_t Z_1\Delta_2 + (1-\lambda_t)Z_2\Delta_1\right]\right\}}$$

$$\pi_{2,t} = \frac{L\mu\left[\sigma\left(\Delta_1 + \phi\Delta_2\right) - Z_1\lambda_t(1-\phi^2)\mu\right]}{2N\left\{\sigma^2\Delta_1\Delta_2 + \lambda_t(1-\lambda_t)(1-\phi^2)Z_1Z_2\mu^2 - \mu\sigma\left[\lambda_t Z_1\Delta_2 + (1-\lambda_t)Z_2\Delta_1\right]\right\}}$$

where $Z_r = \frac{1+\sigma i_r}{1+i_r}$.

Given that the agricultural price is 1, the real income of an entrepreneur in region r is:

$$\omega_{r,t} = \pi_{r,t}P_{r,t}^{-\mu}$$

The share λ_t changes through time according to entrepreneurial migration decisions, which are based on the comparison between regional incomes. We now turn to the description of the migration law presenting the full dynamical model.

4 Entrepreneurial migration and the full dynamical system

Under the simplifying assumption of myopic behaviour (see Fujita et al. 1999, Forslid and Ottaviano, 2003; and Baldwin et al., 2003) and more specifically of naïve expectations, the economic incentive of entrepreneurial migration is summarised by the ratio of regional real incomes realised during period t:

$$\begin{aligned}\Omega(\lambda_t) &= \frac{\omega_{1,t}(\lambda_t)}{\omega_{r,t}(\lambda_t)} \qquad (15)\\ &= \frac{\sigma\left(\phi\Delta_1 + \Delta_2\right) - Z_2(1-\lambda_t)(1-\phi^2)\mu}{\sigma\left(\Delta_1 + \phi\Delta_2\right) - Z_1\lambda_t(1-\phi^2)\mu}\left(\frac{\Delta_2}{\Delta_1}\right)^{\frac{\mu}{1-\sigma}}\left(\frac{1+i_2}{1+i_1}\right)^{\mu}\end{aligned}$$

The ratio $\Omega(\lambda_t)$ is at the center of the dynamic law governing the shifts between regions of the manufacturing activity:

$$M(\lambda_t) = \lambda_t + \lambda_t(1-\lambda_t)\gamma\frac{\Omega(\lambda_t) - 1}{1 + \lambda_t(\Omega(\lambda_t) - 1)} \qquad (16)$$

where γ denotes the migration speed.

Taking into account the obvious constraints on the entrepreneurial share $0 \leq \lambda_t \leq 1$, the full dynamical system is given by

$$\lambda_{t+1} = Z(\lambda_t) = \begin{cases} 0 & if \quad M(\lambda_t) < 0 \\ M(\lambda_t) & if \quad 0 \leq M(\lambda_t) \leq 1 \\ 1 & if \quad M(\lambda_t) > 1 \end{cases} \tag{17}$$

A long-run equilibrium λ satisfies the condition $\lambda = Z(\lambda)$. There are two types of equilibria: a Core-Periphery equilibrium corresponds to all the manufacturing activity agglomerating in one region: $\lambda^{CP(0)} = 0$ or $\lambda^{CP(1)} = 1$; whereas for an interior equilibrium it must be $\Omega(\lambda^*) = 1$. However, in general, given the shape of the function $\Omega(\lambda)$, it is not possible to derive a closed form solution for λ^*. Moreover, more than an interior equilibrium may exist. Therefore, in what follows, except for the case of fully symmetric regions, we must rely on simulations.

Stability requires that $-1 < Z'(\lambda) < 1$. Typically, the stability analysis in discrete time is much more complicated that in continuous time (see Commendatore et al., 2008), the former involving the possibility of a much larger set of bifurcation scenarios. Thus, in order to keep the analogy with its continuous time counterpart, we assume that $Z'(\lambda) > -1$ and we explore the case $Z'(\lambda) < -1$ in future work. Depending on the type of equilibrium considered, the condition $Z\prime(\lambda) < 1$ translates into $\Omega(0) < 1$ or $\Omega(1) > 1$ for the Core-Periperiphery equilibria $\lambda^{CP(0)} = 0$ or $\lambda^{CP(1)} = 1$, if the constraints are not binding. Otherwise $Z'(0) = Z'(1) = 0$ when the constraints are binding. Instead, an interior equilibrium is stable for $\Omega'(\lambda^*) < 0$.

5 The case of fully symmetric regions

In the fully symmetric case the regions enjoy the same level of financial development and the banking capital is equally spread across space (i.e., $k_1 = k_2 = \frac{K}{2}$, which implies $i_1 = i_2 = i$). Eq. (15) becomes:

$$\Omega(\lambda_t) = \frac{\sigma\left(\phi\Delta_1 + \Delta_2\right) - Z(1-\lambda_t)(1-\phi^2)\mu}{\sigma\left(\Delta_1 + \phi\Delta_2\right) - Z\lambda_t(1-\phi^2)\mu}\left(\frac{\Delta_2}{\Delta_1}\right)^{\frac{\mu}{1-\sigma}}$$

with $Z = \frac{1+\sigma i}{1+i}$.

In this context, Figure 1 allows to describe the local stability properties of interior and the Core-Periphery equilibria. As in the standard symmetric FE model a symmetric interior equilibrium – corresponding to an equal distribution of manufacturing activities between the regions – exists, $\lambda^* = \frac{1}{2}$. This equilibrium is stable for $\Omega\left(\frac{1}{2}\right) < 0$, that is for:

$$\phi < \phi_B \equiv \frac{\left(\sigma - Z\mu\right)\left(\sigma - 1 - \mu\right)}{\left(\sigma + Z\mu\right)\left(\sigma - 1 + \mu\right)}$$

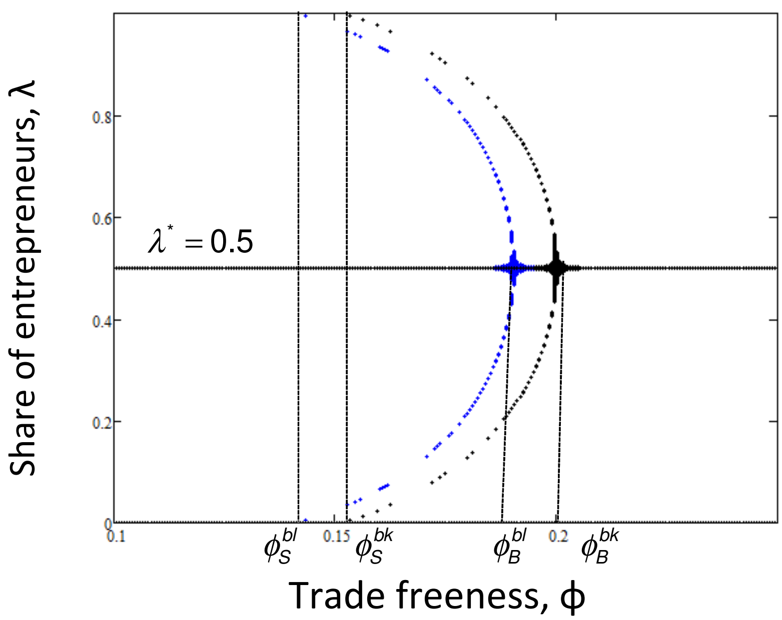

Figure 1: Symmetric case, $i_1 = i_2$

where ϕ_B represents the so-called 'break' point, above which trade is sufficiently free so that agglomeration forces exceed dispersion forces; a small shock sets in motion a cumulative process bringing about the progressive shift of all industrial sector in only one region, with $(\sigma - Z\mu)(\sigma - 1 - \mu) > 0$ representing the so-called 'no black hole' condition. In the terminology of the mathematical theory of dynamical systems, ϕ_B represents a '(subcritical) pitchfork bifurcation point'.

Instead, the Core-Periphery equilibria $\lambda^{CP(0)} = 0$ and $\lambda^{CP(1)} = 1$ are stable as long as the following condition holds

$$\Phi(\phi) = \phi^{1-\frac{\mu}{\sigma-1}} - \frac{\sigma(1+\phi^2) - Z\mu(1-\phi^2)}{2\sigma} > 0 \tag{18}$$

Notice that the above condition applies simultaneously to both Core-Periphery equilibria due to the symmetric properties of the map $\Omega(\lambda_t)$. It is possible to show that there is a value of the trade freeness parameter, the so-called 'sustain' point, ϕ_S, for which $\Phi(\phi_S) = 0$. ϕ_S is the lowest value of trade freeness that allows for a Core-periphery outcome. In the terminology of the mathematical theory of dynamical systems, ϕ_S represents a 'transcritical bifurcation point' or, considering the hitting of the constraint a 'border collision bifurcation point'.

Finally, for $\phi_S < \phi < \phi_S$, two other interior equilibria emerge which are symmetric to each other, $\widetilde{\lambda}$ and $1-\widetilde{\lambda}$, in correspondence of which $\Omega(\widetilde{\lambda}) = \Omega(1-\widetilde{\lambda}) = 1$. These equilibria are both unstable and separate the basins of attraction of the symmetric and Core-Periphery equilibria; where a basin of attraction of an equilibrium represents the set of initial values of the entrepreneurial share, λ_0, that converges to that equilibrium. The larger is the set the more likely is that the corresponding equilibrium becomes the final state of the system.

With the help of Figure 1, we also explore the consequences of a reduction in the degree of competition within the banking sector increasing by same amount the rate of interest of the regions ($\Delta i_1 = \Delta i_2 = \Delta i > 0$). As shown in figure 1 by the shift from the black to the blue line this implies that the symmetric equilibrium becomes unstable for a lower level of trade freeness, while the Core-Periphery equilibria become stable at a lower level of ϕ, so both the break point and the sustain point move to the left with respect to their previous values (from ϕ_B^{bk} to ϕ_B^{bl} and from ϕ_S^{bk} to ϕ_S^{bl}).

Thus, the introduction of a banking sector within a FE model favours agglomeration over dispersion forces. This can be explained considering that a positive interest has two effects: i) on production costs since it increases the wedge between the marginal cost of unskilled labour and the price of the manufactured varieties; however, due to symmetry this has no bearings on the distribution of economic activities between the regions; ii) on the overall income, since it increases bank revenues, without affecting the other income components; and therefore making more relevant the so-called 'home market effect' given that bankers are not mobile. Indeed, for the symmetric case, it can be shown that

$$Y_{1,t} + Y_{2,t} = Y_W = \frac{\sigma L(1+i)}{\sigma - \mu + \sigma(1-\mu)i}$$

and then $\frac{\partial Y_W}{\partial i} = \frac{\sigma(\sigma-1)\mu L}{[\sigma-\mu+\sigma(1-\mu)i]^2} > 0$.

A change in the degree of competition in the manufacturing sector has a similar effect. A decrease in the elasticity of substitution ($\Delta\sigma < 0$) / an increase in the love of variety determines an increase in the mark-up over the marginal cost of labour. Also in this case, the impact of the home market effect (and therefore the weight of agglomeration with respect to dispersion forces) is stronger. Overall, a lower degree of competition, both in the manufacturing sector and in the banking sector, enhances agglomeration forces, making more likely Core-periphery outcomes.

6 Unequal financial development

In the context of our model, the idea of uneven financial development is captured by the assumption of a different distribution of capital stocks between the regions. From (12), this implies different regional interest rates, $i_1 \neq i_2$. Notwithstanding this is a simple modification, the assumption of asymmetric regions does not allow for closed form solutions. Therefore, as mentioned above, we have to resort to simulations.

Figures 2 and 3 show how the structure of the long-term equilibria is notably modified when we consider regions characterised by different levels of financial development.

Figures 2 presents the case when the interest rate of the region 1 is smaller than the interest rate of region 2, $i_1 < i_2$. The equilibrium locus is now split into two pieces: the first lying above and the second below the 0.5 horizontal line. Considering the piece above, for $0 < \phi < \phi_{S(1)}$, only three equilibria exist, the interior asymmetric equibrium just above the 0.5 horizontal line is stable, whereas the two Core-Periphery equilibria are unstable. As ϕ crosses $\phi_{S(1)}$, the Core-Periphery equilibrium $\lambda^{CP(1)} = 1$ gains stability. Within the interval $\phi_{S(1)} < \phi < \phi_B$, another interior equilibium is present, which is unstable, with $\phi_{S(1)}$ representing a sustain point for $\lambda^{CP(1)}$ – and in terms of the language of dynamical systems theory, a 'transcritical' bifurcation point. The latter has emerged togheter with the stable equilibrium, after a so-called fold bifurcation, as ϕ crossed from right to left ϕ_B. As before, the unstable equilibrium separates the basins of attraction of the stable asymmetric interior equilibrium and of the Core-Periphery equilibrium $\lambda^{CP(1)} = 1$. At $\phi = \phi_{S(0)}$, representing a sustain point for the Core-Periphery equilibrium $\lambda^{CP(0)}$ – and a 'transcritical' bifurcation point as well – the second piece of the equilibrium locus enters in the relevant interval $[0, 1]$ on which it is lying another unstable interior asymmetric equilibrium. For $\phi_{S(0)} < \phi < \phi_B$, five equilibria exist with again the two unstable asymmetric equilibria separating the basins of attraction of the stable asymmetric equilibrium and of the two Core-Periphery equilibria. Finally, for $\phi > \phi_B$ only the piece of the equilibrium locus below 0.5 exists. The unstable

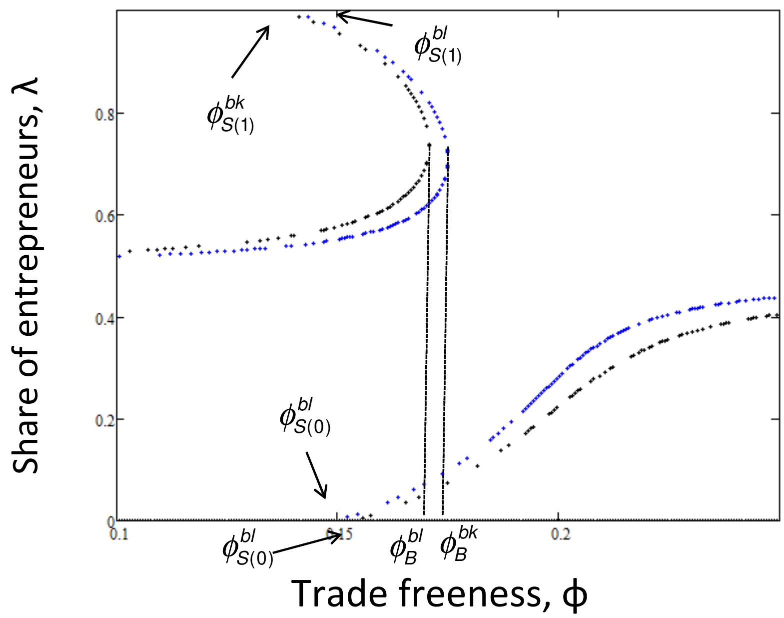

Figure 2: Asymmetric case, $i_1 < i_2$

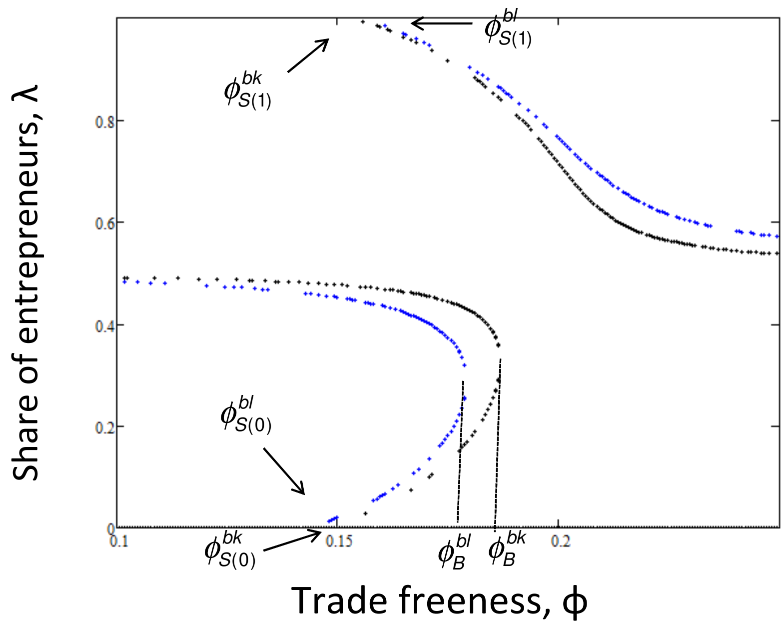

Figure 3: Asymmetric case, $i_1 > i_2$

asymmetric equilibria separates now the basins of attraction of the two Core-Periphery equilibria, with the basin of $\lambda^{CP(1)}$ notably larger that the one of $\lambda^{CP(0)}$.

In summary, when $i_1 < i_2$, the interior stable equilibrium becomes asymmetric with a larger share of firms located in region 1 ($\lambda^* > \frac{1}{2}$), but also unstable for a lower level of the trade freness; at the same time, the Core-Periphery equilibrium where all firms are located in region 1 ($\lambda^{CP(1)}$) becomes stable for a lower level of trade freness with respect to both the symmetric case and the Core-Periphery equilibrium where all firms are located in region 2 ($\lambda^* = 0$). Thus, firms tend to move in the region where the degree of concentration in the banking industry and the interest rate are lower; and obviously, this effect is the greater the larger is the difference between interest rates (as shown in figure 2 after shifting the black line into the blue line). The same reasoning applies for the opposite situation according to which region 2 has the most advanced financial sector ($i_1 > i_2$, see Figure 3) .

Comparing Figures 1 and 2 it is also possible to describe a process of locational hysteresis. In the symmetric case, if the trade freness parameter ranges between the sustain point and the break point and the symmetric equilibrium is stable, a temporary shock determining a reduction of the interest rate in region 1 could induce firms to move from region 2 to region 1, and could drive the economy away from that equilibrium, now disappeared, towards the Core-Periphery equilibrium, again stable, where all firms are located in region 1; in this context, the removal of the shock would not bring back the economy to the previous equilibrium. The process of locational hysteresis has relevant implications for the policy analysis because regions implementing earlier reforms, which increases the degree of competition in the banking industry and lowers the interest rate, get a first mover advantage; in fact, regions adopting later the same reform could not arrest or reverse the migration of firms towards the other region.

7 Conclusions

In this paper we provided a first contribution filling a gap in the NEG literature by exploring the relationship between the spatial distribution of industrial economic and the level of financial development.

To accomplish thisobjective, we introduced in a standard fooloose entrepreneur (FE) model an oligopolistic banking sector.

Our results can be summarized as follows.

When regions are characterised by the same degree of financial development, a reduction in the degree of competition in the banking sector, determining an equal increase in the rate of interest in the regions, implies that the symmetric equilibrium becomes unstable for a lower level of trade freeness, while, at the same time, the Core-Periphery equilibria become stable, so that the introduction of a banking sector within a FE model favours agglomeration forces through an income effect.

When the degree of financial development is different for the two regions, these results are reinforced: the stable interior equilibrium becomes asymmetric with a larger share of entrepreneur located in the region where the competition degree of the banking sector is higher; at the same time, the Core-Periphery equilibrium where all firms are located in the region with the lower interest rate becomes stable at a lower level of trade freeness and, compared with the Core-Periphery equilibrium where all firms are located in the region with the higher interest rate, becomes the most likely outcome. Basically, a divergence in the level of financial development between the regions could promote a migration process where manufacturing firms would tend to move towards the region with a more competitive banking sector and with a lower interest rate; and, obviously, this effect is the higher the larger is the difference between the interest rates.

Finally, as in the standard FE model, the analysis also allows to display a process of locational hysteresis. If the economy is characterized by an interior stable and symmetric equilibrium, a temporary shock determining a reduction of the interest rate in one region could induce firms to move towards the other region favouring agglomeration, the removal of the shock could not reverse this result. Locational hysteresis has relevant implications for policy analysis because regions implementing earlier reforms, which reduce the concentretion degree in the banking industry and the interest rate, get a first mover advantage; in fact, regions adopting later the same reform could not arrest or reverse the migration of firms towards the other region.

Within the logical framework of the NEG, this paper represents a first step of a research project aiming to explore the impact of the degree of regional financial development on the spatial distribution of economic activity. Next steps would have to be targeted to remove some of our simplifying assumption: on the one hand, we could allow for inter-regional/international bank mobility and/or for inter-regional/international financial capital flows; on the other hand, we could allow for a propensity to save greater than zero and so we could introduce a market for deposits. Morerover, within an analitical framework different from the FE model, we could allow banks to provide loans also to finance investment in fixed capital.

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