The Mechanics of Commercial Banking Liberalization and Growth

Alessandra Dal Colle

PII: S0378-4266(16)30046-2
DOI: http://dx.doi.org/10.1016/j.jbankfin.2016.04.014
Reference: JBF 4943

To appear in: *Journal of Banking & Finance*

Received Date: 15 August 2014
Accepted Date: 21 April 2016

Please cite this article as: Dal Colle, A., The Mechanics of Commercial Banking Liberalization and Growth, *Journal of Banking & Finance* (2016), doi: http://dx.doi.org/10.1016/j.jbankfin.2016.04.014

The Mechanics of Commercial Banking Liberalization and-Growth

Alessandra Dal Colle

CeFiMS, SOAS, University of London, UK and Chief Lending Unit, Banca Prossima, Piazza Paolo Ferrari 10, 20121, Milan, Italy.

Email: alessandra.dalcolle@bancaprossima.com

JEL classification: E44; F43; G2

Keywords: Commercial Banking; Financial Service Liberalization; Economic growth

The Mechanics of Commercial Banking Liberalization and Growth

..

Abstract

This paper attempts to formalize the effects of liberalization across the border of deposit-taking and lending activities on the regime of competition in the banking market as well as on the rate of growth of the economy.

We extend a theoretical model by Deidda (2006) where two economies - *H*ome and *F*oreign - host at least one operating bank each. The different impacts on such setting of two GATS-defined modes of commercial banking liberalization - namely the *C*ommercial *P*resence mode and the *C*ross-*B*order mode - will then be modeled. Finally, the possibility of strategic behavior by competing banks in equilibrium will also be introduced.

The model links in a causal chain the cost structure of the banking industry, the regime of competition in the liberalized banking sector and finally the rate of growth of the economy under alternative modes of liberalization. The model specifically identifies a threshold level of economic development, above which the banking sector would operate competitively, which is sensitive to different modes of commercial banking liberalization. Finally, competitive banking is shown to support an accelerating rate of growth, generating a bidirectional, self-reinforcing link between commercial banking liberalization and growth. The pace of growth is further increased, with respect to a scenario where such behavior is not present, by the presence of strategic behavior by competing banks in equilibrium.

Policy-wise the paper suggests to look at the relationship between macroeconomic fundamentals and the cost structure of commercial banking activity rather than claiming that liberalization is growth-enhancing *per se*.

JEL classification: E44; F43; G2

Keywords:
Commercial banking, Financial Service Liberalization, Economic growth

1. Introduction

The literature on the relationship between financial liberalization and economic growth is quite wide and differentiated[1]. Economics scholars and policy makers alike have offered discontinuous support to financial liberalization as an engine of growth. The era after the Second World War started with calls for restrictive interventions in the financial sector[2]. By the early 1970s, this "financial repression" policy came under severe criticism and in the Eighties, the so-called "Washington Consensus" called for liberalization of capital flows and deregulation in the recipient financial systems, as this would stimulate a sizeable flow of investments from rich countries to poor ones and could accelerate development in the latter countries. A new bout of crises in the Nineties[3] gave support to critics of the Washington Consensus, among whom Krugman (1993), who maintained that as capital was not accountable for cross-country differences in economic growth rates and no historical evidence suggested that liberalizing policies were followed by large flows of capital from rich to poor countries, therefore financial liberalization was not to be considered as an engine of growth. By the end of the Nineties financial liberalization was recommended again as a policy to enhance the functioning of domestic financial systems through its positive effects on productivity.

Even on the more specific field of commercial banking liberalization - that is the opening to international trade of deposit taking and loan granting activities - policy literature is almost equally divided. Some conclude that cross-border banking, i.e. the supply of financial services from abroad, supports the development of an efficient and stable financial system that offers a wide access to quality financial services at low cost for the host country, as reviewed by Claessens (2006). Beck et al. (2014) in a report on banking in Africa underline the benefits of cross-border banking, however tempered by a wide-ranging array of policy recommendations in the fields of national and supranational regulation and supervision. Levine (2001) reviews liter-

[1] Tornell and Westerman (2004) and Baltagi et al. (2009), together with their contribution to the debate, offer very updated reviews of the literature both on the theoretical and on the empirical side.

[2] For a comprehensive review see Andersen and Tarp (2003).

[3] Caprio and Honohan (1999) report that the average cost of 59 banking crashes in developing countries during the period 1976–96 was 9% of GDP.

ature in favour of foreign bank establishment in the host country whereas Detragiache, Poonam and Tressel (2006) express criticism of foreign banks presence especially in low-income countries mainly because of to the possible credit shrinkage and increased operating costs. Tamirisa et al. (2000) express reservations on the liberalization of banking activities both under the cross-border banking - because of the consequences on the stability of single domestic financial systems - and under the establishment of foreign banks, because of the possibility of cherry-picking lenders by foreign intermediaries.

The original question on how commercial banking liberalization does increase economic growth is hence still unresolved and this paper will present a dynamic model whose aim is to offer an analytical framework to identify the contribution of commercial banking liberalization to competition in the banking sector and hence to economic growth.

The model in this paper takes its general setting from Deidda (2006). The model in fact keeps the overlapping generation framework where individuals share their income between consumption and savings which they deposit with banks. The latter hence borrow from savers and lend to firms - which produce according to a constant return technology only if externally funded - through a technology involving economies of scale and of specialization.

The main additions to the setting of Deidda (2006) are three-fold. First, the model is assumed to work in an economy which is at least as developed as to supply enough resources to make one bank working. It is hence a scenario involving no storage technology to make up for the lack of financial intermediation; therefore a setting suitable to study economies at a later stage of development than those targeted by Deidda (2006). Second, the model is set in an international framework involving two regions of a federal state instead of a single country. Under *D*omestic *B*anking (*DB* from now on) resident savers in each of the two regions of the federal state fund, through domestic banks, loans exclusively to resident firms,. Following banking liberalization, in the federal state investments may be financed by the whole (in the *C*ommercial *P*resence mode of financial liberalization) or segregated (in the *C*ross-*B*order mode) pool of savings of the formerly Domestic Bank-only regions. Costs of banking activity change depending on which mode of liberalization is implemented. And finally the possibility of competing agents enacting strategic behavior in equilibrium is introduced.

The core contribution of the paper is to underline how different modes of commercial banking liberalization impact on the cost structure of the industry, hence on its regime of competition and their effects on the rate of

growth of the economy.

Secondly, the paper also identifies a threshold of economic development[4], measured by capital per capita, above which the banking sector would operate in monopolistic competition sustaining an accelerating rate of growth. This is to say that below the threshold the dynamics of economic growth mainly sustain banking development, while above the threshold a bidirectional, self-reinforcing link between banking activity and economic growth is envisaged. Banking liberalization modifies the setting of the threshold in so far as it changes the cost structure in the banking industry. More specifically, the higher are the fixed costs of banking activity, the higher the level of development of the economy has to be in order to sustain monopolistic competition in the banking sector as an equilibrium outcome. The model also supplies formal conditions to the thesis of Pagano (1999) and Classens (2006), stating that opening the financial sector usually brings more competition.

Finally, the model determines that strategic behavior by competing banks permanently raises the number of banks operating in equilibrium, hence it may push up the pace of growth with respect to a scenario where such behavior is not present, as is the case in Deidda (2006).

Sections 2 and 3 will introduce the framework of *D*omestic *B*anking and describe its equilibrium. In section 4 two different modes of financial liberalization will be sketched out, namely *C*ommercial *P*resence and *C*ross-*B*order mode of liberalization and they will be subsequently embodied in formal models in sections 5 and 6 respectively.

2. The model

Suppose a federal nation state exists and it is composed by two regions $i = F, H$ each populated by a continuum of size i of households and a continuum of size i of infinitely-lived firms whose behavior is described in what follows.

[4]Threshold effects are used in the most different ways in the literature. They can be deterministic, as in this this model and in in Deidda (2006), as well as stochastic, as in the sovereign debt default literature of Malik (2014) and Muller (2015) among others. However, they all share a common nature and role. They partition the set of possible values of a key variable in subsets determining a switching in the behaviour of the model and, consequently, in equilibrium results.

2.1. Households

Individuals living in region i inelastically supply labor during the first period of life and receive a salary w_t^i which is partly saved and partly consumed according to

$$U(c_{1t,}c_{2t+1}) = \lg c_{1t} + \frac{1}{1+\rho} \lg c_{2t+1}$$

subject to

$$c_{1t} = w_t^i - d_t \text{ and } c_{2t+1} = R_t^{d,i} d_t$$

where c_{1t} is the consumption of the presently young generation, d_t is young people's saving that is entirely deposited, c_{2t+1} is the consumption of the same people when old at $t+1$, ρ is the discount rate and R_t^{di} is the gross return on deposits from t to $t+1$. This framework results in optimal savings which are a constant fraction of wage as

$$d_t = (2+\rho)^{-1} w_t^i = s w_t^i \tag{1}$$

2.2. Firms

Firms have no initial endowment. They operate if and only if they are externally funded. It is also assumed that they are price takers and demand loans at the lowest rate, being indifferent across banks for all other aspects of the lending contract. The production function for the representative firm operating in region i is

$$Y_t^i = \alpha \left(A_t^i\right) \left(K_t^i\right)^{\beta} \left(l_t^i\right)^{1-\beta} \tag{2}$$

where α is the exogenous productivity coefficient, l_t^i is labor; K_t is capital, $A_t^i = \left(k_t^i\right)^{1-\beta}$, with $k_t^i = \frac{K_t^i}{l_t^i}$, and $\frac{1}{2} < \beta < 1$ is an externality effect associated with capital accumulation.

The representative firm's demand for loans stems from the production function as

$$b_t^i\big|_{R_t^{l,i} = \frac{\partial Y_{t+1}^i}{\partial K_{t+1}^i}} = \left(\frac{R_{t+1}^{l,i}}{\alpha\beta A_{t+1}^i}\right)^{\frac{1}{\beta-1}}$$

where $R^{l,i}$ is the return on lending in region i when full capital depreciation is assumed. The equation makes explicit that for the borrowing firm the cost of finance $R^{l,i}$ is the only choice variable *vis-à-vis* banks.

In equilibrium the price of the factors of production will be

$$w_t^i = (1-\beta)\alpha \left(A_t^i\right) \left(K_t^i\right)^{\beta} \left(l_t^i\right)^{-\beta} = (1-\beta)\alpha k_t^i \tag{3}$$

and

$$R_t^{l,i} = \beta\alpha \left(A_t^i\right) \left(K_t^i\right)^{\beta-1} = \beta\alpha \tag{4}$$

in the market for labor and capital respectively. The constant rate of return on capital in equilibrium implies constant returns to scale in the cumulable factor, which is the distinguishing feature of endogenous growth.

2.3. Commercial Banking

Commercial banking is defined as the bundle of deposit-taking and lending activities. In this paper, in any region i, banks are active[5] and fund themselves by issuing deposit contracts to households and generate their revenues by lending to firms. They also consume real resources for a fixed amount E^i each period and for $\int_0^{z_t^i} q(z)dz$ per unit of lending to individual firms, where z_t^i is the mass of funded firms. This generates economies of scale and of specialization in banking activity. Formally, z_t^i financed firms generate costs equal to

$$q\left(z_t^i\right) = qz_t^i + \overline{q} \tag{5}$$

where $0 < q < 1$ and $\lim_{z \to 0} q(z) = \overline{q} > 0$. The lending technology hence involves the consumption of a fraction q per unit of allocated loan to the individual firm. q is the constant marginal effect of specialization, hence a low z_t^i decreases total costs. Also, the minimal market share involves positive costs. In fact, credit analysis must be carried out for every single potential customer at credit origination before a loan is granted, i.e. before the potential borrower becomes an actual customer, hence when $z_t^i \longrightarrow 0$.

In this setting total variable costs are

$$Q\left(z_t^i\right) = \int_0^{z_t^i} q\left(z\right) dz = \frac{q}{2}\left(z_t^i\right)^2 + \overline{q} z_t^i$$

and average variable costs are

[5]This is the reason why no alternative storage technology is assumed. For a formal definition of the conditions for banking activity see note 8.

$$\frac{Q\left(z_t^i\right)}{z_t^i} = \frac{q}{2} z_t^i + \overline{q}$$

For any given z, marginal costs are higher than the average variable cost, formally $q\left(z\right) > \frac{Q(z)}{z}$. So a marginal increase in the market size z will raise average variable costs by dampening the working of the economies of specialization.

The literature offers several examples of economies of both scale and specialization in the banking sector such as those originated by the delegation to specialized agents which need a fixed investment in each period[6,7] and economies of specialization that are triggered by customers' variety, as in Sussman (1993). As to economies of scale and of specialization specific to lending technologies, Berger (2004) shows that these technologies can be arranged in a continuum ranging from those that are primarily based on "hard" quantitative data – such as financial statement lending, asset-based lending, and credit scoring systems – to relationship-based lending, which, in contrast, is based in large part on "soft" information, such as the character and reliability of the firm's owner, his specific experience in the sector, the history of the firm's relationships with its suppliers, and the business prospects in the market in which the firm operates. Quantitative-based lending originates economies of scale as its capacity limits are quite large, in fact, it is centred on accessing, storing and elaborating quantitative data through the use of computer systems and databases, i.e. "big ticket" items. On the other hand, in relationship-based lending information is generally gathered through contact over time by the bank loan officer with the firm, its owner, its suppliers and its outlet market on a variety of dimensions. In actual lending practice, analysis at credit origination is carried out using both techniques in a complementary fashion. Only when quantitative data are not available or are

[6]Freixas and Rochet (2008) offer an updated review of the role of economies of scale both on the lending and on the deposit gathrering side, in para 2.1.2. These authors summarize their position citing Benston and Smith (1976) stating "The [illegible] for this industry is the existence of transaction costs." (page 215).

[7]Were such economies of scale not present, then any single lender would have to bear the fixed costs with inefficient duplications across the economy. Then direct lending by individuals could be sustained as an equilibrium solution. Greenwood and Jovanovich (1990), among others, justify the existence of institutions, as opposed to direct lending, because of their ability to pool resources among individuals, to take up information gathering and contract-writing efficiently and to diversify risk.

of poor quality, lending is actually carried out purely on "soft" information. The larger is the share of borrowing firms evaluated on "soft" information only, the lower will be the exploitation of economies of specialization.

Formalizing the fixed and variable costs just exemplified, the balance sheet of the representative bank originating in region i can be represented as

$$D_t^i = z_t^i b_t^i + \int_0^{z_t^i} q(z) b_t^i dz + E^i = \left(1 + \frac{Q\left(z_t^i\right)}{z_t^i}\right) z_t^i b_t^i + E^i \tag{6}$$

where D_t^i are deposits originated in region i, i.e. the bank's source of funding. The RHS represents the bank's use of funds as b_t^i is the amount of loans per firm and $\left(Q\left(z_t^i\right) b_t^i + E^i\right)$ are the resources consumed by the banking activity in their variable and fixed components respectively.

From (6) the profit of the n-th bank operating in region i can be written as

$$\pi_t^{n,i} = R_t^l b_t^i z_t^i - R_t^d D_t^i = R_t^l b_t^i z_t^i - R_t^d \left[z_t^i b_t^i \left(1 + \frac{Q\left(z_t^i\right)}{z_t^i}\right) + E^i \right] \tag{7}$$

where $R_t^{u,i}$with $u = l, d$ are returns on loans or deposits respectively. Hence profit is the difference between revenues $R_t^{l,i} b_t^i z_t^i$ and all the resources needed to cover loan supply (i.e. $b_t^i z_t^i$), variable costs $\left(\frac{Q\left(z_t^i\right)}{z_t^i} b_t^i z_t^i\right)$ and fixed ones (E^i) times the cost of funding $R_t^{d,i}$.

Competition in banking activity is characterized by lenders who choose prices and the market share they wish to serve to maximize their profits and by firms who, given the price of loans, demand a quantity of credit to maximize their profits. More precisely, it is assumed that:

1. banks act as price takers in the market for deposits. In the market for loans each bank sets the interest rate $R_t^{l,i}$ as well as its market share z_t^i in order to maximize (7), subject to $z_t^i \leq \frac{i}{n_t^i}$, given the optimal behavior by competitors. Banks do not to discriminate across borrowers and charge the same interest rate to any of them;
2. there is free entry in commercial banking. The number of banks operating in region i is n_t^i and it is taken as given by each single bank;

3. firms are price-takers in the market for loans and they demand as much credit as they need to maximize their profits at the lowest rate available from banks.

Focus will be on symmetric equilibria where all banks set the same interest rate and serve the same market share. In each MOde of liberalization ($MO = D$omestic Banking, Commercial Presence and Cross-Border trade) equilibrium is defined as a set of values $\Omega^{MO^*} = \left(R^{MO,l^*}; z^{MO^*}; n^{MO^*}\right)$ for a given rate of return on deposits R^{MO,d^*} such that:

- each bank offers a rate R^{MO,l^*} and serves a market share z^{MO^*} which is the best response to competitors' offers;
- n^{MO^*} is such that profits of each operating bank is zero;
- firms demand the profit maximizing quantity of credit.

Either a $m$onopoly or a $c$ompetitive equilibrium will result depending on initial conditions. Both equilibria will be supported both in Domestic Banking and in the liberalized regimes.

3. General equilibrium and economic growth in Domestic Banking

In Domestic Banking investments in each region are funded exclusively by savings of resident individuals. It will also be assumed that each region is initially endowed with sufficient capital to develop banking activity[8].

The interplay between the regime of competition in the banking sector, as determined by the free entry condition, and profit-maximizing choices by banks stems from the equality between the sources and uses of funds in the economy. Formally,

$$is(1-\beta)\alpha k_t^i = \left[n_t^{DBi} z_t^{DBi} + n_t^{DBi} Q(z_t^{DBi})\right] b_t^{DBi} + n_t^{DBi} E^i \quad i = F, H \tag{8}$$

determines two possible equilibria for the each of the two regions i in Domestic Banking, depending on the level of economic development k_t, that read respectively

[8] i.e. $k_{i,t=0} > \frac{E^i}{i\alpha s(1-\beta)^2}$.

$$\Omega^{DBim^*} = \left\{ \begin{array}{c} R^{l,DBm^*} = R^{d,DBm^*} \frac{1}{\beta} \frac{Q\left(z^{DBi,c^*}\right)}{z^{DBi,c^*}} = R^{d,DBm^*} \frac{(1+\overline{q})}{2\beta-1} \\ z^{DBm^*} = \frac{1}{\Gamma s(1-\beta)^2} \\ n^{DBim^*} = \frac{is(1-\beta)^2 \alpha k_t^i}{E^i} \end{array} \right\} \text{ when } k_t \leq \widehat{k}^{DBi} = \frac{\Gamma}{\alpha} E^i \tag{9}$$

with $\Gamma = \frac{q(2\beta-1)}{2(1+\overline{q})s(1-\beta)^3}$ and $\frac{1}{2} < \beta < 1$ when each bank operates as a *m*onopolist and

$$\Omega^{DBic^*} = \left\{ \begin{array}{c} R^{l,DBic^*} = R_t^{d,DBic^*} \frac{1}{\beta} \left(1 + q\left(z^{DBi,c^*}\right)\right) \\ z^{DBi,c^*} = \frac{i}{n_t^{DBi,c^*}} \\ n^{DBi,c^*} = \frac{is(1-\beta)\alpha k_t^i}{E^i} \left(1 - \beta \eta_t^{DBi}\right) \end{array} \right\} \text{ when } k_t > \widehat{k}^{DBi} = \frac{\Gamma}{\alpha} E^i \tag{10}$$

with $\eta_t^{DBi} = \frac{1+\frac{Q\left(z^{DBi,c^*}\right)}{z^{DBi,c^*}}\Big)}{\left(1+q\left(z^{DBi,c^*}\right)\right)} < 1$ when banks *c*ompete.

Each of the two equilibria shows a value for the returns on loans $R^{l,DBi}$, one for the banks' market share z^{DBi} as well as the number of operating banks n^{DBi}.

The returns on loans is a mark-up on the cost of funding R_t^d which depends on variable costs of the banking sector. As expected, the mark-up is on average costs then the banking sector is monopolistic, while it is on marginal costs when the banking sector is competitive. The number of operating banks is an increasing function of the level of economic development k_t and an inverse function of the fixed costs of banking activity E^i.

The development threshold $\widehat{k}^{DBi}$, which splits banking optimal behavior between monopolistic and competitive, is higher the higher are the fixed costs of banking activity and the lower are productivity α, propensity to save s and share of labor income in the economy $(1-\beta)$. This implies that, given a set of macroeconomic fundamentals, namely α, s and $(1-\beta)$, a higher (lower) fixed costs of banking activity E^i, requires a higher (lower) level of development of the economy in order to grant a competitive banking sector.

The number of banks operating in equilibrium in any competition regime is a direct function of the macroeconomic fundamentals of the economy and an inverse function of the fixed costs E^i. Please note that the equilibrium number of operating banks is permanently higher than would have been

without conflicting market shares, as is in Deidda (2006)[9]. Specifically, when k_t grows above $\widehat{k}^{DBi}$, the number of operating banks increases and because of conflicting market shares, strategic interaction sets off. Specifically, at R_t^{l,DBm^*} each bank would be able to reap a monopoly price from a market share that is actually smaller than the profit maximizing one z_t^{DBm}, so each bank could earn an additional market share of $\left(z_t^{DBm} - \frac{i}{n_t^{DBi,c}}\right)$ by lowering the rate it charges in equilibrium by $\varepsilon \to 0$ with a drop in revenues of $\varepsilon \frac{i}{n_t^{DBi,c}} \to 0$. This will start a process of undercutting until the possibility of extra profits drops to zero, i.e. $R_t^{l,DBi} = R_t^{l,DBic*}$ and the corresponding operating banks in equilibrium are $n^{DBi,c^*} = \frac{is(1-\beta)\alpha k_t^i}{E^i}\left(1 - \beta\eta_t^{DBi}\right)$. The banks' undercutting behavior squeezes the mark-up in the competitive regime and more banks can operate than would be the case, were the market shares not conflicting . Formally, $n_t^{DBi,c'} = \frac{is(1-\beta)^2\alpha k_t}{E^i} < n_t^{DBi,c} = \frac{is(1-\beta)\alpha k_t}{E^i}(1 - \beta\eta^{DBi})$, where $n_t^{DBi,c'}$ is the equilibrium number of operating banks when there is no strategic interaction in equilibrium and $\eta^{DBi} < 1$.

The existence of equilibria formalized in (9) and (10) can be stated[10] in the following lemmas.

Lemma 1. *A local monopoly symmetric equilibrium exists if and only if the mass of firms which are actually served by all banks is lower than the total market i, i.e. if* $n^{DBi,m} z^{DBm} \leq i$.

Lemma 2. *A monopolistic competition symmetric equilibrium exists if and only if the mass of firms which are actually served by all banks is such that* $n_t^{DBi,c} z_t^{DBi,c} > i$.

Fundamentally, when the economy is not sufficiently developed, the number of banks operating in equilibrium is too low relative to the number of borrowing firms. In fact, it is so low that the resulting market shares for operating banks will not conflict and each bank will operate like a local monopolist. In other words, each bank has a potential market share larger than

[9] In note 7 on page 237 of Deidda (2006), is assumed that "(...) (the mass of firms) H, is sufficiently high. H is assumed to be large enough so that there are no strategic interactions when such competition (among financial intermediaries) starts."

[10] All calculations for the demonstration of lemmas and the proofs of propositions in the next sections are available from the author on request.

the profit maximizing one, as a consequence each can offer a monopoly rate with no danger of competitors' undercutting them, as no one has an interest in lowering profit to gain a market share that is larger than the profit maximizing one. In this equilibrium not all demand for loans is satisfied and the market share z^{i,m^*} and R^{l,im^*} are independent of banks' costs.

On the other hand, in monopolistic competition all the potentially borrowing firms are actually served, and banking has reached its efficiency limit. Banks' market shares z^{i,c^*} are conflicting and their size is an inverse function of their number, hence a direct function of fixed costs per capita. All equilibrium values are sensitive to the level of development as measured by the level of capital per capita.

Suppose the two regions have the same level of development k_t and $E^H < E^F$, then the equilibrium (gross) growth rates read:

$$g_{t+1}^{DBi^*} = \frac{k_{t+1}}{k_t} = \begin{cases} \frac{s(1-\beta)\alpha(2\beta-1)}{(1+\overline{q})} \text{ for } k_t \leq \widehat{k}^{DBH} \quad \text{and } i = F, H \\ \frac{s(1-\beta)\alpha(2\beta-1)}{(1+\overline{q})}, \frac{s(1-\beta)\alpha\beta}{1+q(z_t^{DBH})} \text{ for } \widehat{k}^{DBH} < k_t \leq \widehat{k}^{DBF} \text{ and } i = F, H \\ \frac{s(1-\beta)\alpha\beta}{1+q(z_t^{DBi})} \text{ for } k_t > \widehat{k}^{DBF} \quad \text{and } i = F, H \end{cases} \tag{11}$$

Equilibrium growth rates are determined both by macroeconomic fundamentals and banking sector structure. In fact, the higher are the saving rate s, exogenous productivity α and capital share in the economy β, the faster is growth, independently of the competition regime in banking. On the other hand, the higher are banks' variable costs, the slower is growth.

Because of the separation of the banking market in the two regions, both on the deposit and on the lending side, the path of development runs through three different stages characterized by combinations of different regimes of competition in the banking sectors of the two regions.

When the level or development is low, i.e. $k_t \leq \widehat{k}^{DBH} \leq \widehat{k}^{DBF}$, each region i has a monopolistic banking sector as there are not enough resources to fund many operating banks. The demand for investments is not fully funded and the federal state will grow at a constant rate. In essence, a vicious cycle sets in: the less regions are developed, the fewer the operating banks in equilibrium, the larger z^{DBm}. As a consequence, lowly developed regions with a banking system only operating domestically, grow more slowly also because their inefficient banking sectors use up too many resources to cover

their costs. Causality runs from economic growth to banking development as z^{DBm} is constant.

For $\widehat{k}^{DBH} < k_t \leq \widehat{k}^{DBF}$ at least region H - the one with the lowest fixed costs of banking activity - enjoys a competitive banking sector. In this region an increasing number of operating banks will in turn decrease the available market share $z_t^{DBi,c}$[11] and support growth. This is a consequence of the economies of specialization as the smaller is z, the lower are marginal costs $q(z_t^{DBi,c})$.

When both regions are developed, i.e. $k_t > \widehat{k}^{DBF}$ the banking sector is competitive everywhere, then economic growth is self-reinforcing. In fact an accelerating rate of growth will be fed by the increasing number of operating banks that will in turn decrease the available market share $z_t^{DBi,c}$, lower the marginal costs of the banking activity and support growth which in turn increases k_t and $n_t^{DBi,c}$ further squeezing $z_t^{DBi,c}$. This is a consequence of the economies of specialization. Hence, the link between banking development and economic growth becomes bidirectional.

Finally note that strategic interaction has also a lasting impact on growth as $g_{t+1}^{DBi,c'} = \frac{s\beta(1-\beta)\alpha}{1+\frac{Q(z_t^{DBi'})}{z_t^{DBi'}}} < g_{t+1}^{DBi,c} = \frac{s\beta(1-\beta)\alpha}{1+\frac{Q(z_t^{DBi})}{z_t^{DBi}})}\eta^{DBi}$ if $\eta^{DBi} < \frac{2\beta-1}{\beta}$ where $g_{t+1}^{DBi,c'}$ is the growth rate when there is no strategic interaction in equilibrium.

4. Liberalization of Trade in Banking Services

Trade in banking services can be liberalized in different modes with reference to distinctive combinations in sourcing the funds - i.e. domestic or foreign deposit - and using them - i.e. lending to resident or non resident firms. A recent contribution by Mattoo et al. (2006) underlines that liberalization of services implies that the relevant activities must, at some length, be locally produced and liberalization of trade in these services leads to enhanced competition, both at home and abroad. In fact, if the degree of competition remains unchanged, then the authors maintain that there cannot be a positive impact on growth on account of the scale effect. Conversely, a larger scale achieved merely by eliminating domestic barriers to entry and attracting domestic resources from other sectors would suffice to generate larger endogenous growth.

[11] Formally $g_{t+1}^{FAi,c}$ will increase as $\frac{\partial g_{t+1}^{FAi,c}}{\partial z_t^{FAi,c}} = -\frac{q}{2}\frac{s(1-\beta)\alpha}{\left(1+q\left(z_t^{FAi,c}\right)\right)} < 0$

Trying to apply this concept to banking services, table 1 clusters the two main activities, i.e. deposit-taking and lending, into modes of liberalization. Specifically the "*C*ommercial *P*resence" (CP) mode of liberalization is defined as a mode of operation whereby a foreign entrant bank gains access to deposit-taking activities from foreign savers. This is because deposit-taking is characterized by the simultaneity of production and consumption which implies the proximity between the consumer and producer, i.e. the need to "set up shop" in the depositors' country. In this mode of liberalization a firm can arrange a loan with a foreign bank locally. The bank, however, has to invest in order to ensure physical presence and fully-fledged operations on site.

By contrast, the "*C*ross-*B*order" (CB) mode of liberalization is defined as a mode of operation whereby loans to local borrowers can be arranged with banks abroad via telephone or some other way of communication. This is the case when investments "to set up shop" are either forbidden - and this is usually the case when domestic banks receive protection as they were a "strategic infant industry" - or too costly for the entrant bank, so "supply by distance" is the preferred route. This implies that foreign banks do not have access to local deposits and they are actually channelling "domestic" deposits to finance "foreign" loans as the possibility of interbank lending is not allowed in this model.

Table 1: Modes of financial liberalisation

Deposit from $\longrightarrow$ Loan provided by $\downarrow$	Domestic Savers	Non Resident Savers
Domestic bank	Domestic Banking	Not Allowed
Foreign bank established in its home country	Cross-Border Mode: Banking Services trade only	Not Allowed
Foreign bank established in the host country	Commercial Presence: Banking Services trade + Foreign Direct Investments	

Adapted from Kono - Schuknecht (1998)

In what follows, commercial banking liberalization will be applied across the two regions of the federal state with a total population of $(H + F)$ and it will be reflected in modifications of (8) both on the supply and on the

demand for funds. More precisely:

- in the CP mode of liberalization the fixed costs of banking activity will change to E^{CP}, irrespective of the origin of the entrant bank. This is due to investments needed to "set up shop abroad", such as "big ticket" in terms of lending technology to operate locally as well as buying/renting premises for activity on site. As a result of these investments, the lending market and the deposit market will be fully integrated;

- in the CB mode of liberalization the fixed costs of banking activity will remain unchanged. Lending activity can in fact be organized with ways of communication - such as telephone, and/or internet - which do not require major revisions in lending practices while deposit-taking remains reserved to local banks. In each of the two regions of the liberalizing federal state only those banks will operate, that the single region's own pool of saving can support. As a consequence, only (6) will be changed to the sum of the respective functions across the two regions.

Summarizing, in commercial banking liberalization the lending market is always fully integrated while the deposit market may or may not be fully integrated. Finally, the choice of the CB or CP mode of commercial banking liberalization is assumed to be taken by the federal authorities so the possibility of asymmetries across the two regions is ruled out.

5. General equilibrium and economic growth in Commercial Presence (CP)

In the Commercial Presence (CP) mode both the loan and the deposit markets are perfectly integrated and (8) changes to

$$(H+F)\,s(1-\beta)\alpha k_t = n_t^{CP}\left[\left(1+\frac{Q(z_t^{CP})}{z_t^{CP}}\right)z_t^{CP}b_t^{CP}+E^{CP}\right] \qquad (12)$$

where b_t^{CP} is the amount of loans actually granted by a bank, $\frac{Q\left(z_t^{CP}\right)}{z_t^{CP}}b_t^{CP}z_t^{CP}$ and E^{CP} are respectively total variable and fixed costs of commercial banking.

In this setting, for any given k_t, the maximum potential market share available to a single bank is the ratio of the total number of firms in the liberalizing federal state $(H+F)$ to the number of banks n_t^{CP}.

Along the same lines of the *D*omestic *B*anking setting, the interplay between the free entry condition and the optimizing behavior of banks in the *C*ommercial *P*resence mode results in a set of equilibrium values for the return on loans, the market share and the number of operating banks that read

$$\Omega^{CPm^*} = \left\{ \begin{array}{c} R^{l,CPm^*} = R^{d,CPm^*} \frac{1}{\beta} \left(1 + \frac{Q\left(z^{CP,m^*}\right)}{z^{CP,m^*}} \right) \\ z^{CP,m^*} = \frac{1}{\Gamma s (1-\beta)^2} \\ n_t^{CP,m^*} = \frac{(H+F)\alpha(1-\beta)^2 k_t}{E^{CP}} \end{array} \right\} \tag{13}$$

when $k_t \leq \widehat{k}^{CP} = \frac{\Gamma}{\alpha} E^{CP}$[12], i.e. when each bank operates as a monopolist, and a set of values equal to

$$\Omega^{CPc^*} = \left\{ \begin{array}{c} R^{l,CPc^*} = R^{d,CPc^*} \frac{1}{\beta} \left(1 + q\left(z_t^{CPc^*}\right) \right) \\ z_t^{CP,c^*} = \frac{H+F}{n_t^{CPc^*}} \\ n_t^{CPc^*} = \frac{(H+F)s(1-\beta)\alpha k_t}{E^{CP}} \left(1 - \beta \eta_t^{CP} \right) \end{array} \right\} \tag{14}$$

when $k_t > \widehat{k}^{CP}$ with $\eta_t^{CP} = \left[1 - \frac{1 + \frac{Q\left(z_t^{CPc^*}\right)}{z\left(z_t^{CPc^*}\right)}}{\left(1 + q\left(z_t^{CPc^*}\right)\right)} \right]$ when banks compete.

Therefore, for any given k_t, n_t^{CP} banks will be operating in the liberalizing federal state with an available market share no larger than $\frac{H+F}{n_t^{CP}}$ each, as $(H+F)$ is the number of operating firms in the economy. If the representative bank serves $\frac{H+F}{n_t^{CP}}$ customers in equilibrium, its market share will conflict and strategic interaction will occur among competing banks. Should this not be the case, each bank will operate as a local monopolist.

One of the first effects of commercial banking liberalization under the CP mode vs DB is to change the level of economic development needed for a competitive banking sector, i.e. $\widehat{k}^{CP} \underset{<}{\geq} \widehat{k}^{DBi}$ if $E^i \underset{>}{\leq} E^{CP}$. Also, the

[12] As $n_t^{CP,m^*} z^{CP,m^*} \leq (H+F)$ for $k_t \leq \widehat{k}^{CP}$

number of banks increases or decreases relative to Domestic Banking in proportion to per capita fixed costs of banking activity i.e. $n_t^{CP} \lessgtr \sum_i n_t^{DBi}$ if $\frac{E^{CP}}{(H+F)\left(1-\beta\eta_t^{CP}\right)} \gtrless \left(\sum_i \frac{i\left(1-\beta\eta_t^{DBi}\right)}{E^i}\right)^{-1}$. This is to say that liberalization stimulates banking activity, by increasing the number of operating banks, if the fixed costs in per capita terms in the liberalizing federal state are lower than the sum of the corresponding ratios in the two formerly autarkic regions.

Finally, substituting n_t^{CP} from (13) or (14) in (12) one obtains the growth rate as:

$$g_{t+1}^{CP} = \frac{k_{t+1}}{k_t} - 1 = \begin{cases} \frac{s\beta(1-\beta)\alpha}{1+\frac{Q(z^{CPm})}{z^{CPm}}} - 1 \text{ for } k_t \leq \widehat{k}^{CP} \\ \frac{s\beta(1-\beta)\alpha}{1+q(z_t^{CPc})} - 1 \text{ for } k_t > \widehat{k}^{CP} \end{cases} \tag{15}$$

The question whether the CP mode of commercial banking liberalization is growth-enhancing vs Domestic Banking mode is examined in the next proposition.

Proposition 3. *A liberalizing economy whose banking sector operates under the CP mode will grow faster than under the DB mode if liberalization brings about more competition in the banking sector in equilibrium in the form of:*

- *lower level of development needed to sustain a competitive banking sector, i.e. $\widehat{k}^{CP} < \widehat{k}^{DBH} < \widehat{k}^{DBF}$ as $E^{CP} < E^{DBH} < E^{DBF}$*
- *smaller market share for operating banks, i.e. $z_t^{CPc} < z_t^{DBic}$ when $k_t > \widehat{k}^{DBF}$.*

The intuition behind Proposition 3 lies again in the effects of the change in the fixed costs of banking activity in the CP mode, due to the need to "set up shop abroad". For any given level of economic development, if $E^{CP} < E^{DBi}$, then the banks originating in region i are operating as monopolist in DB and, because with liberalization fixed costs have decreased, they now start to compete and set off an accelerating rate of growth. Should the European Union be thought of as a federal state, this case might be exemplified by countries whose commercial banking sector was over-regulated and protected against foreign competition by national legislation, causing high E^i per capita. The access to the European Union has called for simplification

in regulations, which has decreased fixed costs. Banks can thus compete on a level with the other European partners[13].

6. General equilibrium and economic growth in Cross-Border trade in Banking Services (CB)

In the Cross-Border (CB) mode of liberalization, banks face a demand for loans from all the firms located in the whole liberalizing federal state, but they cannot access the deposit-taking activity in the other region of the liberalizing federal state. The partition of the deposit market requires two equilibrium conditions and specifically

$$is(1-\beta)\alpha k_t^i = n_t^{CB,i}\left[z_t^{CB}\left(1+\frac{Q(z_t^{CB})}{z_t^{CB}}\right)b_t^{CB,i}+E^i\right] \quad \forall i=F,H \tag{16}$$

where $b_t^{CB,i}=\frac{(H+F)k_{t+1}}{z_t^{CB}n_t^{CB,i}}$, as well as two free entry conditions, one for each region i, i.e. $\left[R_t^{l,CB}-R_t^{d,CB}\left(1+\frac{Q(z_t^{CB})}{z_t^{CB}}\right)\right]b_t^{CB,i}k_{t+1}^i = R_t^{d,CB}E^i \;\; i=F,H.$ In addition to that, as the market for loans is unique in the CB mode, equilibrium must also hold for the whole federal state, hence

$$(H+F)s(1-\beta)\alpha k_t = \left(1+\frac{Q(z_t^{CB})}{z_t^{CB}}\right)(H+F)\,k_{t+1}+\sum_{i=F,H} n_t^{CBi}E^i \tag{17}$$

Similarly to the previously analyzed mode of liberalization, the interplay between the free entry condition and the profit maximizing behavior of banks in the Cross-Border mode results in

$$\Omega^{CBm^*} = \left\{ \begin{array}{c} R^{l,CBm^*} = R^{d,CBm^*}\frac{1}{\beta}\left(1+\frac{Q\left(z^{CB,m^*}\right)}{z^{CB,m^*}}\right) \\ z^{CB,m^*} = \frac{1}{\Gamma s(1-\beta)^2} \\ n_t^{CBi,m^*} = \frac{is(1-\beta)^2\alpha k_t}{E^i} \end{array} \right\} \tag{18}$$

[13]The opposite case, i.e., $E^{CP} > E^{FAi}$ for the European Union might be exemplified by countries which were actually "financial centres" taking the benefit of a very low level of regulation, hence a low E^i. Access to the Union in this case has called for more regulation which has resulted in an increase in fixed costs of financial intermediation to E^{CP}.

when $k_t \leq \widehat{k}^{CB} = \frac{\Gamma}{\alpha\, i} E^i$ and ${}_i n_t^{CBim^*} = s(1-\beta)^2 \alpha k_{ti} \frac{i}{E^i}$ if banks act as local monopolists. If the banking market is competitive the equilibrium is

$$\Omega^{CBc^*} = \left\{ \begin{array}{c} R_t^{l,CBc^*} = R_t^{d,CBc^*} \frac{1}{\beta} \left(1 + q\left(z_t^{CBc^*}\right)\right) \\ z_t^{CBc^*} = \frac{H+F}{{}_i n_t^{CBic^*}} \\ n_t^{CBi,c^*} = \frac{is(1-\beta)\alpha k_t}{E^i} \left(1 - \beta \eta_t^{CB}\right) \end{array} \right\} \tag{19}$$

when $k_t > \widehat{k}^{CB}$ with $\eta_t^{CB} = \left[1 - \frac{1 + \frac{Q\left(z_t^{CBc}\right)}{z\left(z_t^{CBc}\right)}}{\left(1+q\left(z_t^{CBc}\right)\right)} \right]$ and ${}_i n_t^{CBic^*} = s(1-\beta)\alpha k_t \left(1 - \beta \eta_t^{CB}\right)_i \frac{i}{E^i}$.

Similarly to the CP mode, for any given k_t, each bank will be facing a demand for loans from all of the firms located in the liberalizing federal state. Each bank will be targeting a potential market share of $\frac{H+F}{\sum_i n_t^{CBi}}$. If the representative bank serves these customers in equilibrium, its market share will conflict and strategic interaction will occur among competing banks. Should this not be the case, each lender will operate as a local monopolist.

With CB commercial banking liberalization the development threshold for the banking sector to behave competitively lowers the higher is the sum of fixed costs of banking activity, i.e. $\widehat{k}^{CB} > \widehat{k}^{DBi}$ as ${}_i E^i > E^i$.

Substituting ${}_i n_t^{CBi}$ from (18) or (19) in (17) one obtains a growth rate of

$$g_{t+1}^{CB} = \frac{k_{t+1}}{k_t} - 1 = \left\{ \begin{array}{l} \frac{s\beta(1-\beta)\alpha}{1+\frac{Q(z_t^{CBm})}{z_t^{CBm}}} - 1 \text{ for } k_t \leq \widehat{k}^{CB} \\ \frac{s\beta(1-\beta)\alpha}{1+q\left(z_t^{CBc}\right)} - 1 \text{ for } k_t > \widehat{k}^{CB} \end{array} \right. \tag{20}$$

The next proposition examines whether the CB mode is growth-enhancing for the new liberalizing federal state vs Domestic Banking.

Proposition 4. *A liberalizing economy whose banking sector operates under the CB mode will grow faster than under the DB mode if liberalization brings about more competition in the banking sector in equilibrium in the form a smaller market share for operating banks, i.e. $z_t^{CBc} < z_t^{DBic}$ when $k_t > \widehat{k}^{DBi}$.*

The comparisons in Proposition 4 rely on the same mechanics as Proposition 3. In terms of the definition of the regime of competition in the banking sector the CB mode of liberalization fares midway between the DB and the CP mode of liberalization. Similarly to Domestic Banking,

$\sum_i n_t^{CBi}$ banks will be active in the whole liberalizing federal state, with $\sum_i n_t^{CBi} > \sum_i n_t^{DBi}$ if $\frac{i}{E^i}\left(\eta_t^{CB} - \eta_t^{DBi}\right) < \frac{\bar{i}}{E^{\bar{i}}}\left(\eta_t^{DB\bar{i}} - \eta_t^{CB}\right)$ where $i = F, H$ and $\bar{i} = H, F$.

Please note that as the liberalizing federal state has to support all the banks operating in the two regions, the level of development needed for a competitive banking sector is necessarily higher than that in DB. As a consequence, liberalization under CB mode can generate the highest impact on growth, once the regions and the federal state are developed enough to sustain a competitive banking sector.

7. Conclusion

Following Cetorelli (1997), Claessens (2006) and Tornell and Westermann (2004) - who identify the change in the costs of financial intermediation, and eventually of the regime of competition in the financial sector as one of the main channels of transmission of the effects of financial liberalization on economic growth - the model in this paper also establishes a direct link between commercial banking liberalization and economic growth which is essentially shaped by the costs of banking activity and the regime of competition in the banking sector[14].

The original contribution of this paper may be found in the specification of the "mechanics of commercial banking liberalization" linking the variation in cost structure of the banking industry undergoing alternative modes of liberalization, the regime of competition in the liberalized banking sector and the rate of growth of the economy. Summarizing, the link between competition and commercial banking liberalization fundamentally rests on the basic idea that the more players in the market – in this case on the supply side of loans – the higher the level of competition. The equilibrium number of operating banks depends on fixed costs of banking activity and resources available, as measured by capital per capita. Commercial banking liberalization, in the different modes of Commercial Presence and Cross-Border banking, changes the fixed costs of banking activity and therefore

[14]Blackburn and Hung (1998) describe a bidirectional link between financial and economic development based on the reduction of costs of project appraisal and ultimately of lending and on an increase in the number of such projects, which reduces the costs of establishing financial intermediaries.

the equilibrium number of operating banks, given the available resources, and consequently the regime of competition.

Also, the model identifies a path-dependency between commercial banking liberalization and economic growth as it specifies a threshold level of development above which the banking sector becomes competitive, sustaining an accelerating rate of growth. Such threshold level of economic development increases with the level of fixed costs of banking activity. As long as commercial banking liberalization lowers the fixed costs of banking activity, the banking sector may see an increase in competition. This gives formal support to the view that opening the financial sector usually brings more competition, as underlined in Pagano (1993) and Claessens (2006) among others, and hence supports faster growth.

Another contribution by the paper is to point out the effects of strategic behavior by banks on the degree of competition in the banking sector and hence on economic growth. More specifically, differently from Deidda (2006), the model underlines that undercutting behavior by active banks increases their number with respect to those that would have operated were the market shares not conflicting and this may have a positive impact on growth.

The models hence offer multifaceted and qualified answers to the question whether commercial banking liberalization is actually growth-enhancing. More specifically, commercial banking liberalization does increase economic growth only if the level of fixed costs of banking activity in the liberalized economy is more favorable than that under Domestic Banking. Should this not be the case, then commercial banking liberalization could still prove growth-enhancing for the economy but only for high levels of economic development. Dal Colle (2010) offers some support to these results as causality is found to run from economic to financial development in low income regions, as is the case modelled in this paper when the threshold level of development leading to competition in the banking sector is yet to be reached.

The main policy recommendation that seems to emerge from the model is that in order to stimulate economic growth via commercial banking liberalization it is not particularly useful to lower barriers to entry in the form of fixed costs *per se*, but proper account has to be taken of their relationship to macroeconomic fundamentals of the liberalized economy. In fact the thresholds delimiting a competitive banking sector - giving way to self-reinforcing growth - are a function not only of the fixed and variable costs of banking activity, but also of exogenous productivity α, propensity to save s share of labor income in the economy $(1-\beta)$. Non negligible caveats should be

added to such policy recommendation[15], in so far as the model presented here does allow neither for the workings of the interbank deposit market nor for macroeconomic or idiosyncratic risk. Furthermore, the costs of banking activity are modeled as "flow only" and therefore they are unrelated to the performance of the stock of old loans.

[15]Such policy recommendation would also greatly benefit from the empirical support from the estimation of equilibrium relationships (11), (15) and (20). This calls for the development of an original composite indicator related to loans from non-resident banks (amount outstanding) to GDP and bank concentration ratio from Beck et al. (2000) as well as an index of the quality of regulation. Also, according to I-TIP Service database these data should be reflecting trade in banking services from 2008, a period where quality of data may be impaired by the effects of the 2007-2009 global financial crisis. Further details are available from the author on request.

[1] Andersen, T. P. and Tarp, F., "Financial Liberalisation, Financial Development and Economic Growth in LDCs", *Journal of International Development*, 2003, **15**, 189–209

[2] Baltagi, B.H., Demetriades, P.O. and Hook Law, S.,"Financial Development and openness: Evidence from panel data", *Journal of Development Economics*, 2009, **89**, 285-296

[3] Beck, T., Fuchs, M., Singer, D. and Witte, M., Making cross-border banking work for Africa. Washington, DC ; World Bank Group, 2014

[4] Beck, T., Demirgüç-Kunt, A., Levine, R., "A New Database on Financial Development and Structure", *World Bank Economic Review,* 2000, **14**, 597-605. http://siteresources.worldbank.org/INTRES/Resources/469232-1107449512766/FinStructure_November_2013.xlsx

[5] Benston, G. and Smith, C.W., "A transaction cost approach to the theory of financial intermediation", *Journal of Finance*, 1976, **31**, 215-231

[6] Berger, A.N., "Potential Competitive Effects of Basel II on Banks in SME Credit Markets in the United States", Board of Governors of the Federal Reserve System, *mimeo,* 2004

[7] Borchert, I., Gootiiz, B., Mattoo, A.,"Policy Barriers to International Trade in Services: Evidence from a New Database", *World Bank Economic Review*, 2014, **28**, 1, 162-188

[8] Blackburn, K. and Hung V. T. Y., "A Theory of Growth, Financial Development and Trade", *Economica*, 1998, **65**, 257, 107-124

[9] Caprio G. and Hohohan P., "Restoring banking stability: beyond supervised capital requirements", *Journal of Economic Perspectives,* 1999, **13**, 4, 43–64

[10] Cetorelli N., "The Role of Credit Market Competition on Lending Strategies and on Capital Accumulation", Federal Reserve Bank of Chicago, Working Papers Series, Research Department WP 14, 1997

[11] Claessens, S., "Competitive implications of Cross Border Banking", World Bank, Policy Research Working Paper, 3854, 2006

[12] Dal Colle, A., "Finance–growth nexus: does causality withstand financial liberalization? Evidence from cointegrated VAR", *Empirical Economics*, **41**, 1, 127-154

[13] Deidda, L., "Interaction between Economic and Financial Development", *Journal of Monetary Economics*, 2006, **53**, 233–248

[14] Detragiache, E., Tressel, T. and Gupta P., "Foreign Banks in Poor Countries: Theory and Evidence", IMF, Working paper WP/06/18, 2006

[15] Freixas, X.J. and Rochet, F., Microeconomics of Banking, Cambridge, Massachussets, MIT Press, 2008

[16] Greenwood, J. and Jovanovich, B., "Financial Development, Growth, and the Distribution of Income", *Journal of Political Economy*, 1990, **98**, 1076-1107

[17] I-TIP Services database, http://i-tip.wto.org/services/default.aspx,

[18] Kono, M. and Shuknecht, L., "Financial Services Trade, Capital Flows and Financial Stability", WTO Staff Working Papers, ERAD, 1998, 12

[19] Krugman, P., "International Finance and Economic Development" in Giovannini, A. (Eds), Finance and development: issues and experience, Cambridge University Press, Cambridge, (UK), 1993

[20] Levine, R., "International Financial Liberalisation and Economic Growth", *Review of International Economics,* 2001, **9**, 688-702

[21] Liu H., Molyneux P, Nguyen L. H., "Competition and risk in South East Asian commercial banking", *Applied Economics*, 2012, **44**, 28, 3627-3644

[22] Malik, S., "Ex-ante implications of sovereign default ", Journal of Banking and Finance, 2014, **49**, 386-397

[23] Mattoo, A., Rathindran, R. and Subramanian, A., "Measuring Services Trade Liberalization and Its Impact on Economic Growth: An Illustration", *Journal of Economic Integration*, 2006, **21**, 64-98

[24] Mueller, A., Storesletten, K., Zilibotti, F., "Sovereign Debt and Structural Reforms ", CEPR Discussion paper no. 10588, 2015

[25] Pagano, M., "Financial Market and Growth. An Overview", *European Economic Review*, 1993, **37**, 613-622

[26] Sussman, O., 1993. A theory of financial development, in Giovannini, A. (Eds), Finance and development: issues and experience, Cambridge University Press, Cambridge, (UK), 1993

[27] Tamirisa, N. T., Sorsa, P., Bannister, G. J., McDonald, B. J. and Wieczorek, J., "Trade Policy in Financial Services", IMF, Working paper WP/00/31, 2000

[28] Tornell, A. and Westermann, F., "The Positive Link between Financial Liberalization, Growth and Crises", CESifo, Working Paper no. 1165, 2004

Appendix to The Mechanics of Commercial Banking Liberalization and Growth

...

...

Appendix A. Appendix

Please note that number between parentheses refer to equations in the paper whereas (A.#) refer to equations in this Appendix.

Appendix A.1. Static Optimization

Omitting DB for simplicity, first order conditions from (7) are

$$\frac{\partial \pi_t^{n,i}}{\partial R_t^{l,i}} = \frac{1}{\beta - 1}\frac{b_t^i}{R_t^l}\left\{R_t^{l,i} - R_t^{d,i}\right\} z_t^i + b_t^i z_t^i - \frac{1}{\beta - 1}\frac{b_t}{R_t^l} R_t^{d,i} z_t^i \frac{Q\left(z_t^i\right)}{z_t^i} = 0 \quad \text{(A.1)}$$

$$\frac{\partial \pi_t^{n,i}}{\partial z_t^i} = \left(R_t^{l,i} - R_t^{d,i}\left(1 + \frac{Q\left(z_t^i\right)}{z_t^i}\right)\right) b_t^i - R_t^{d,i} b_t^i z_t^i \frac{q}{2} = 0 \quad \text{(A.2)}$$

and from (A.1) the optimal rate of returns on loans is

$$R^{l,i} = R_t^{d,i}\frac{1}{\beta}\left(1 + \frac{Q\left(z_t^i\right)}{z_t^i}\right)$$

Appendix A.2. Number of banks operating in equilibrium in Domestic Banking

The aggregate supply of funds, defined from (1) and (3) multiplied by the size of the economy, equals the resources from (6) used up by all the n_t^{DBi} operating banks, hence

$$is(1-\beta)\alpha k_t^i = \left[n_t^{DBi} z_t^{DBi} + n_t^{DBi} Q(z_t^{DBi})\right] b_t^{DBi} + n_t^{DBi} E^i \quad i = F, H \quad \text{(A.3)}$$

The separation in the deposit markets requires two accumulation functions and two free entry conditions, one for each region i, implying that for any given k_t, $n_t^{DB,i}$ intermediaries are operating. In equilibrium each intermediary will set the interest rate on loans and choose the market share so as to maximize (7) subject to $z_t^{DBi} = \frac{i}{n_t^{DBi}}$ as each of them cannot have more than $\frac{i}{n_t^{DBi}}$ market share as a potential customer base, as i is the number of operating firms in the region which result in $\left[R_t^{l,DBi} - R_t^{d,DBi}\left(1 + \frac{Q(z_t^{DBi})}{z_t^{DBi}}\right)\right] b_t^{DBi} k_{t+1}^i = R_t^{d,DBi} E^i \;\; i = F, H$ hence

$$n_t^{DBi} = \frac{is(1-\beta)\alpha k_t^i}{E^i}\left(1 - \frac{R_t^{d,DB,i}\left(1 + \frac{Q(z_t^{DBi})}{z_t^{DBi}}\right)}{R_t^{l,DBi}}\right) \quad i = F, H \tag{A.4}$$

where substituting $b_t^{DBi} = \frac{ik_{t+1}^i}{n_t^{DBi} z_t^{DBi}}$ in (A.3) results in

$$k_{t+1}^i = \frac{s(1-\beta)\alpha k_t^i - n_t^{DBi}\frac{E^i}{i}}{\left[1 + \frac{Q(z_t^{DBi})}{z_t^{DBi}}\right]} \quad i = F, H \tag{A.5}$$

The accumulation equation is the ratio of individual savings $s(1-\beta)\alpha k_t^i$ (net of per capita fixed cost for financial intermediation $n_t^{DBi}\frac{E^i}{i}$) to variable resources for financial intermediation, which are the sum of actual loans and average variable costs $\left(1 + \frac{Q(z_t^{DBi})}{z_t^{DBi}}\right)$.

Hence

$$\frac{k_{t+1}^i}{k_t^i} = \frac{\frac{s\beta(1-\beta)\alpha}{1+\frac{Q(z_t^{DBi})}{z_t^{DBi}}}}{\frac{s\beta(1-\beta)\alpha\eta_t^{DBi}}{1+\frac{Q(z_t^{DBi})}{z_t^{DBi}}}} \quad i = F, H \tag{A.6}$$

Appendix A.2.1. Local Monopoly Symmetric Equilibrium

Supposing the constraint is not binding first order conditions from the maximization of (7) subject to $z_t^i = \frac{i}{n_t^{DBi}}$ result in

$$R^{l,FAm} = R_t^{d,FAm}\frac{1}{\beta}\left(1 + \frac{Q\left(z^{FAm}\right)}{z^{FAm}}\right) \tag{A.7}$$

and

$$z^{FAm} = \frac{1}{\Gamma s\left(1-\beta\right)^2} \tag{A.8}$$

with $\frac{1}{2} < \beta < 1$ and $\Gamma = \frac{q(2\beta-1)}{2(1+\overline{q})s(1-\beta)^3}$.
Finally, substituting (A.7) and (A.8) in (7) valued at zero one obtains

$$n^{DBi,m} = \frac{is(1-\beta)^2\alpha k_t}{E^i} \tag{A.9}$$

Proof of Lemma 1. Given z^{DBm} and $n^{DBi,m}$ from (9) and the fact that $n^{DBi,m}$ is increasing in k_t, then there must exist a threshold level of capital $\widehat{k}^{DBi}$ below which $n^{DBi,m}z^{DBm} \leq i$ is verified. In fact $n^{DBi,m}z^{DBm} \leq i$ can be rewritten as $\frac{is(1-\beta)^2\alpha k_t^i}{E^i}\frac{1}{\Gamma s(1-\beta)^2} \leq i$ that is $k_t \leq \widehat{k}^{DBi} = \frac{\Gamma}{\alpha}E^i$. Having established $\widehat{k}^{DBi}$, then the margin on the z^{DBm}-th customer, that is $\left(R^{l,DBm} - R^{d,DBm}\left(1+q\left(z^{DBm}\right)\right)\right)b_t^{DBim}$ is zero at $R_t^{l,i} = R^{l,DBim^*}$ and $z^{DBi} = z^{DBm^*}$from (9). Banks are not keen to compete by undercutting on the price of loans and $n^{DBi,m}z^{DBm} \leq i$ ensures their market shares are not conflicting, so (9) can be considered an equilibrium for $k_t \leq \widehat{k}^{DBi}$.
On the other hand, when $k_t^i > \widehat{k}^{DBi}$, $n^{DBi,m}z^{DBm}$ is no longer lower than i and the margin on the z^{DBm}-th customer calculated at $R^{l,DBm}$ from (9) is positive for any $z_t^i < \frac{1}{\Gamma s(1-\beta)^2}$, then the profit-maximizing behavior of banks would drive them to undercut the price. Consequently, $R^{l,DBm}$, z_t^i and n_t^i from (9) cannot be considered an equilibrium for $k_t^i > \widehat{k}^{DBi}$.

Appendix A.2.2. Monopolistic Competition Symmetric Equilibrium

Eventually, economic growth will make the actual level of capital per capita grow above $\widehat{k}^{DBi}$. As a consequence the number of operating intermediaries will increase above $\widehat{n}^{DBi}$. Should banks behave like under local monopoly, market share would be conflicting in equilibrium, making equilibrium untenable.

In such an environment, equilibrium has to sustain a market share potentially available to a single intermediary of $\frac{i}{n_t^{DBi,c}}$ as i is the number of operating firms in the region. With such a market share and a monopoly rate of return each intermediary would earn an extra-profit, as he would be able to reap a monopoly price from a market share that is actually smaller

than the profit maximizing one in monopoly. As a consequence, each intermediary, by lowering the rate he charges in equilibrium by $\varepsilon \to 0$, could earn an additional market share of $\left(z_t^{FAm} - \frac{i}{n_t^{DBi,c}}\right)$ with a drop in revenues of $\varepsilon \frac{i}{n_t^{DBi,c}} \to 0$. This will start a process of undercutting by intermediaries until the possibility of extra profits drops to zero, i.e.

$$R_t^{l,DBic} = R_t^{d,DBic} \frac{1}{\beta} \left(1 + q\left(z_t^{DBi,c}\right)\right) \tag{A.10}$$

Finally, substituting (A.10) and $z_t^{DBi,c} = \frac{i}{n_t^{DBi,c}}$ in (7) valued at zero one obtains

$$n_t^{DBi,c} = \frac{is(1-\beta)\alpha k_t}{E^i}\left(1 - \beta\eta_t^i\right) \text{ with } \eta_t^{DBi} = \frac{\left(1 + \frac{Q\left(z_t^{DBic}\right)}{z_t^{DBic}}\right)}{\left(1 + q\left(z_t^{DBic}\right)\right)} < 1 \tag{A.11}$$

Proof of Lemma 2. Should $k_t \leq \widehat{k}^{DBi}$, there would be no competitive equilibrium as Lemma 1 would apply. Should $k_t > \widehat{k}^{DBi}$, Lemma 1 would not apply, and the competitive equilibrium would have to be such as there were no incentive for banks to deviate from it. No alternative equilibrium with $z_t = \frac{i}{n_t^{DBi,c}}$ and R_t^l different from (10) can however be calculated.

Appendix A.2.3. Monopolistic equilibrium without strategic behavior in equilibrium

Were strategic behavior absent in equilibrium - as in Deidda (2006) - the number of banks in the competitive equilibrium would have been $n_t^{DBi,c'} = \frac{is(1-\beta)^2\alpha k_t}{E^i}$ and growth $g_{t+1}^{DBi,c'} = \frac{s\beta(1-\beta)\alpha}{1+\frac{Q(z_t^{DBi'})}{z_t^{DBi'}}}$ with $z_t^{DBi'} = \frac{i}{n_t^{DBi,c'}}$ and $n_t^{DBi,c'} = n_t^{DBi,c}\frac{(1-\beta)}{(1-\beta\eta^{DBi})}$.

Hence $n_t^{DBi,c'} = \frac{is(1-\beta)^2\alpha k_t}{E^i} < n_t^{DBi,c} = \frac{is(1-\beta)\alpha k_t}{E^i}(1 - \beta\eta^{DBi})$
as $1 - \beta < 1 - \beta\eta^{DBi}$
and $1 > \eta^{DBi}$

Also $g_{t+1}^{DBi,c'} = \frac{s\beta(1-\beta)\alpha}{1+\frac{Q(z_t^{DBi'})}{z_t^{DBi'}}} < g_{t+1}^{DBi,c} = \frac{s\beta(1-\beta)\alpha}{1+\frac{Q(z_t^{DBi})}{z_t^{DBi}}}\eta^{DBi}$

as $1 + qz_t^{DBi} + \overline{q} < 1 + \frac{q}{2} z_t^{DBi'} + \overline{q}$
and $\frac{i}{n_t^{DBi,c}} < \frac{1}{2} \frac{i}{n_t^{DBi,c'}}$
$2n_t^{DBi,c'} < n_t^{DBi,c}$
$2 - 2\beta < 1 - \beta\eta^{DBi}$
$1 - 2\beta < -\beta\eta^{DBi}$
if $\eta^{DBi} < \frac{2\beta - 1}{\beta}$

Appendix A.3. Number of banks operating in equilibrium under Commercial Presence

In the federal state setting the pool of deposits equals the sum of savings in previously domestic bank-only regions. Also, the demand for loans is increased by the larger size of the economy and the higher fixed costs of financial intermediation. So the equilibrium is described by (12)

which, substituting $b_t^{CP} = \frac{(H+F)k_{t+1}}{n_t^{CP} z_t^{CP}}$, generates the accumulation equation of the form

$$k_{t+1} = \frac{s(1-\beta)\alpha k_t - \frac{n_t^{CP} E^{CP}}{(H+F)}}{\left(1 + \frac{Q(z_t^{CP})}{z_t^{CP}}\right)} \tag{A.12}$$

The optimal number of banks is found by imposing a free entry condition of the type $\left[R_t^l - R_t^d \left(1 + \frac{Q(z_t^{CP})}{z_t^{CP}}\right)\right] \frac{(H+F)}{n_t^{CP}} k_{t+1} = R_t^d E^{CP}$. Substituting (A.12) one obtains

$$n_t^{CP} = \frac{(H+F)\, s(1-\beta)\alpha k_t}{E^{CP}} \left(1 - \frac{R_t^d \left(1 + \frac{Q(z_t^{CP})}{z_t^{CP}}\right)}{R_t^l}\right) \tag{A.13}$$

Appendix A.4. Number of banks operating in equilibrium under Cross-Border trade in Financial Services

Equilibrium in the market for funds in each region of the economy yields a demand for loans of $b_t^{CB,i} = \frac{(H+F)k_{t+1}}{z_t^{CB} n_t^{CB,i}}$ and requires the two equilibrium conditions in (16) and two accumulation functions and two free entry conditions, one for each region i,

i.e. $\left[R_t^{l,CB} - R_t^{d,CB} \left(1 + \frac{Q(z_t^{CB})}{z_t^{CB}}\right)\right] b_t^{CB,i} k_{t+1}^i = R_t^{d,CB} E^i \;\; i = F, H$ which result in

$$n_t^{CB,i} = \frac{is(1-\beta)\alpha k_t^i}{E^i}\left(1 - \frac{R_t^{d,CB}\left(1+\frac{Q(z_t^{CB})}{z_t^{CB}}\right)}{R_t^{l,CB}}\right) \qquad i = F, H \tag{A.16}$$

In addition to that, as the market for loans is unique in the CB mode, equilibrium must also hold for the whole federal state, hence

$$(H+F)s(1-\beta)\alpha k_t = \left(1+\frac{Q(z_t^{CB})}{z_t^{CB}}\right)(H+F)\,k_{t+1} + \sum_{i=F,H} n_t^{CBi}E^i \tag{A.17}$$

By summing up equations (16) across regions on the left-hand side one obtains the same supply of saving as in the CP mode[1], i.e. the left-hand side of (A.17). This is further evidence that the size of the financial market in the CB mode is the same as in the CP and that the modes of liberalization differ only by the internal distribution of market shares. The aggregate accumulation function is hence

$$k_{t+1} = \frac{s(1-\beta)\alpha k_t - \frac{\sum_i n_t^{CBi}E^i}{(H+F)}}{\left(1+\frac{Q(z_t^{CB})}{z_t^{CB}}\right)} \tag{A.18}$$

which, substituting in (16) or (A.16), identifies the equilibrium number of operating banks.

[1]It is easy to verify that $b_t^{CP} = \sum_{i=F,H} b_t^{CB,i} = \frac{(H+F)k_{t+1}}{z_t^{CB}\sum_{i=F,H} n_t^i}$