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Branch banking dynamics, collective behaviour and overclustering

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Abstract

We provide an empirical and theoretical analysis of branch banking dynamics in Italy, focussing on banks' location choices in the decentralised system emerged after the deregulation of late 1980s and early 1990s. Until the regime change the Italian banking sector was characterised by a centralised system in which the opening of new branches was subject to a Bank of Italy''s authorisation. As a consequence of the 1990 "branch liberalisation" there was a collective phenomenon of new openings that, in some circumstances, has produced overclustering episodes, due to the lack of coordination in an uncertain decisional context. Different performances at the system level can be linked to different aggregation of errors in alternative organisational settings. We suggest that policy intervention may improve information gathering and diffusion at the system level, reducing the incidence of locational errors.

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1 Introduction

In this paper we investigate the effects of the deregulation of late 1980s and early 1990s on branch banking dynamics in Italy. In particular, we focus on banks' location choices and potential overclustering patterns consequent to banks' co-movements in an uncertain decisional context. Our aim is to show that uncoordinated actions in a decentralised system may produce costly *locational* errors, due to "excessive entry" in local markets, which may be reduced through a policy intervention aimed at improving information gathering and diffusion at the system level.

Until the end of the 1980s the Italian banking sector was characterised by a centralised system according to which the openings of new branches was subject to an administrative authorisation of the Bank of Italy. As a consequence of the 1990 "branch liberalisation" banks were free to open new branches in desired locations. This regime change provoked the opening of a large number of new branches, from about 15000 in 1989 to more than 30000 in 2005. The lack of coordination consequent to the transition from a planned to a market-oriented system has increased the likelihood of overclustering due to excessive entry in local markets, a problem that in the past was avoided through a centralised management of banks' geographical expansion strategies.

We suggest a *biological* interpretation of banks' collective behaviour based on an analogy between the potential level of deposits banks can collect in a location and the environment's carrying capacity for a certain "population". We analyse behavioural patterns at a different level of spatial aggregation to see whether banks' co-movements resulted in overclustering phenomena, that is a growth of the bank branch "population" above the location's carrying capacity.

Our analysis of banks' collective behaviour shows that "distribution matters": decentralised location choices produce a branch-to-deposit distribution with a right fat tail; being the level of deposits banks can collect an important variables influencing branch profitability, an excessive "aggregation" in certain locations may lead to the "saturation" of local resources. This phenomenon has serious implications for banks' behaviour and can lead to costly process of restructuring through branch closures. Then, banks may incur in locational "errors" due to uncoordinated decisions in a deregulated environment. This problem was avoided through a high rate of refusal in authorising new openings in the period governed by the Bank of Italy, at the cost of producing an under-dimensioned bank branch network. We provide an interpretation of branch banking dynamics in alternative organisational settings (that is, hierarchies vs. polyarchies), along the lines proposed by Sah and Stiglitz (1986), showing that different aggregation of errors produce different performances at the system level.

The paper is organised as follows: after this introduction, the empirical analysis of banks' location choices and branch-to-deposit ratio dynamics is presented in section 2. In section 3 we discuss the effects of different institutional regimes on branch banking dynamics, highliting the major advantages and disadvantages of hierarchical and polyarchical organisational structures and the potential role for policy intervention. Section 4 includes some concluding remarks.

2 Banks' co-movements and overclustering

The planned system operational until the late 1980s was based on the administrative control of the Bank of Italy on the openings of new branches in certain locations. One of the goals of this system was directed to avoid *overbranching* situations through a centralised management of banks' geographical expansion (Comana, 1990). An important factor at the basis of the Bank of Italy's decisions was the relationship between the number of banks operating in a certain location and the level of deposits. According to this indicator the centralised model was oriented to rationalise the presence of banks on the Italian territory (Banca d'Italia, 1978, 1982). On the other hand, it resulted in an under-dimensioned branch network with respect to other European countries (Corbellini, 1990).

After the liberalisation the number of bank branches has doubled in approximately 15 years and the Italian branch network has reached (and overcome) the European standard. On the other hand, in a decentralised setting it is likely that, while a bank is studying the attractiveness of a local market, other banks are doing the same thing; furthermore competitors would be in a more advanced stage of the decisional process leading to a location choice (Comana, 1990). In this context, co-movements of banks towards the same locations may lead to overclustering phenomena. In other words, deregulation has provoked a lack of coordination increasing the likelihood of excessive entry in local markets. The increase of the number of branch closures after deregulation could be at least partially due to the need of restructuring banks' branch networks, decreasing the number of branches in "congested" locations. To empirically assess the relevance of this phenomenon, we provide an analysis of the spatial distribution of the branch-to-deposit ratio. We investigate behavioural patterns emerging from banks' location choices, suggesting a biological analogy between the "carrying capacity" of an environment and the number of branches a location can support given the level of banks deposits.[1]

The decision of opening new branches in certain locations depends on the profitability of the action. There are many variables affecting profits that banks consider when facing this decision. A relevant one is the level of deposits that a bank can collect in a given location. Given that we do not have data on the amount of deposits for each bank branch, in what follows we consider the Branch-to-Deposit Ratio (henceforth, BDR) as a proxy for branch profitability in a given municipality.

The median of the 2005 BDR spatial distribution is equal to 0.0668 while the minimum and maximum values are 0.0011 and 0.3221, respectively. A relevant aspect is that its skewness is equal to 1.8017, due to the right "fat tail" of the distribution (see Figure 1). The shape of the distribution is similar for previous years as shown in table I. Then, we observe a right-skew BDR distribution in all years from 1998 to 2005: we can consider this statistical regularities as a stylised fact emerging from banks' location choices. Our hypothesis is that

[1]Data on bank deposits, loans and bank branches in Italian municipalities (starting from 1998) are available at the website of the Bank of Italy (www.bancaditalia.it). In general, our dataset contains information on bank branches in more than 8000 locations, from 1936 to 2005; the number of banks involved is around 2000. We have added to this dataset information on bank deposits in Italian municipalities (for the period 1998-2005).

the existence of high values of BDR in the right tail of the distribution can be related to overclustering phenomena due to excessive entry in local markets, given the level of bank deposits.

Selecting locations in the right tail of the distribution, for instance with BDR> 0.15, we observe that these locations have a lower number of branches (the median is 3) with respect to the general case (the median is 5). The median of bank branches is equal to 4 in the intermediate case with BDR> 0.1. If we set a threshold as the minimum number of branches per location and look at the BDR spatial distribution we observe that the skewness of the distribution decreases as the threshold increases (see Figure 2). Then, large values of BDR are generally associated with medium-small locations (in terms of the number of branches). Interestingly enough, we do not observe a similar regularity looking at locations with "low" level of BDR. Therefore, it results that potential overclustering phenomena are more likely to happen in small locations: if different banks collectively decide to open branches in these locations, it is more likely that the number of branches becomes "excessive" because of the limited amount of deposits.

From a biological/ecological point of view, we can interpret the potential level of bank deposits in a certain location as the "carrying capacity" of that geographical site.[2] The carrying capacity of an ecosystem is the supportable population of an organism in terms of food, water and other characteristics of the habitat, that is the number of individuals an ecosystem can support without a negative impact on the environment. Typically, when population density increases, there is a decrease of the birth rate and an increase of the death rate. Then, population increases below the carrying capacity and decreases above. According to this biological interpretation, we consider the level of deposits as an indicator of locations' carrying capacity. Then, if BDR is "low", the location can support the number of existing branches and the stock of bank branches can raise until the "population" is below the carrying capacity. In the opposite case, the bank branch stock should decrease because the "population" is above the carrying capacity (that is, BDR is "high") and the level of deposits is not sufficient to assure positive profits to banks. In our case the "population" is the stock of bank branches in a location and, according to our view, its growth rate should display a relationship with BDR, leading to an increase (decrease) of the "population" below (above) carrying capacity.

We start analysing a quite large fraction of locations in the right tail of the BDR spatial distribution, selecting those with a value higher than 0.1 in the year 1998 (301 observations). We refer to this set of locations as high BDR locations. If we consider the evolution of all locations vs. high BDR locations, what we observe is that growth rates of bank branches as well as the stock of branches exhibit similar patterns from 1936 to some years before 1998. It is worth noticing that some years before 1998 the number of openings in "selected" locations shows a remarkable increase with respect to the general case: it seems that banks *collectively* decide to open branches in these locations, resembling a "following the herd behaviour". After 1998, given an increased BDR ratio, banks decide to decrease the flow of branch openings and to close some branches (see Figure 3). The analysis of stocks gives

[2]Thanks to Massimiliano Riggi (UnicreditGroup) for his suggestions on this point.

support to the divergence of dynamic patterns around 1998 (see Figure 4).[3]

The next step of the analysis is aimed at understating whether the choice of higher thresholds for selecting high BDR locations may provide a more comprehensible interpretation of the phenomenon. Following the same procedure, we select locations with BDR> 0.15 in 1998 (78 observations). Even in this case we observe that the global pattern (all locations) and the pattern of high BDR locations are similar until some years before 1998. The high values of BDR observed in 1998 in "selected" locations was the result of the co-movements of banks following similar location choices. As a consequence, banks decided to stop the opening process and close some branches. Accordingly, growth rates of bank branches become negative in last years (see Figure 5) and the decision of closing branches in these locations resulted in a decrease of the stock of bank branches (see Figure 6).

Furthermore, if we repeat the same exercise, choosing successive years to select high BDR locations, we observe the same behavioural pattern (see Figure 7). For last years (for example, 2005) we observe only the first part of the phenomenon (that is, an aggregation pattern).

Banks' collective behaviour reveals an "overshooting" pattern in branch location choices. The first part of the dynamics is characterised by co-movements of banks opening new branches in certain locations. As a consequence of this aggregation phenomenon, BDR increases, potentially leading to a decrease of branch profitability. This period is associated to growth rates of branch openings in high BDR locations higher than in the global case. Banks' decisions can be the result of independent choices (each of which evaluating the profitability of different locations) as well as the consequence of herding dynamics due to the decision of imitating others' location choices (given the uncertainty about alternatives). The decreased attractiveness of locations with high BDR leads to the end of branch openings and also to some closures, with an inversion of branch banking dynamics and a decrease of the stock of branches in these locations.

Following the biological analogy, when the "population" of bank branches increases above locations' carrying capacity there is a negative impact on the environment because of a scarcity of resources to sustain individuals. In other words, co-movements of banks towards the same locations produce a "saturation" of resources (with an expected decrease of branch profitability that we relate to the increase of BDR). This aggregation pattern typically resembles a "following the herd behaviour", as noted above. Then, the environment needs a negative "natural increase" to re-establish a viable ratio between population and resources. Consequently, we observe negative growth rates of the bank branch stock in high BDR locations, that is an overshooting pattern resulting in a costly process of reorganisation of the banks' network due to branch closures in saturated locations.

[3]It is just the case to note that locations with medium-small values of BDR do not follow a similar patter. In these cases the evolution of bank branches replicates the global dynamic or shows a higher growth rate.

3 Branch banking dynamics in Italy: organisational settings and locational errors

According to Sah and Stiglitz (1986), the architecture of different systems has an important role related to information spreading and, in particular, to the aggregation of errors. The different organisation of economic systems can explain differences in overall performances. Two alternative types of architecture are "polyarchies" (systems in which there are independent and possibly competing sources of decision making) and "hierarchies" (systems in which the decision making authority is more concentrated). Using the analogy from classical theory of statistical inference, Sah and Stiglitz (1986) show that "hierarchies" tend to display a greater incidence of Type-I errors (projects which are rejected should have been accepted) while "polyarchies" tend to display a greater incidence of Type-II errors (projects which get accepted should have been rejected).[4]

As said above, the centralised system was successful in avoiding excessive entry but it produced an under-dimensioned branch network with respect to other European countries. Corbellini (1990) maintains that in 1990 the "distance" between the Italian branch network and that typical of European countries, produced by the strict application of controls on banking retail, was quite elevated: according to the author a rough estimate of the growth potential of the branch network indicated that Italy needed about 15000 units to reach the European standard. In fact, the stock of bank branches in Italy, that was equal to about 15000 branches in 1989, has overcome 30000 units in recent years. In a long-run perspective, consider that between 1936 and 1985 the number of bank offices grew 87% in Italy; during the same period the number of bank offices in United States increased by 1228% (Guiso et al., 2007).

In other words, the centralised system rejected some (locational) projects that should have been accepted. After the liberalisation the Italian branch network has reached (and overcome) the European standard. On the other hand, some episodes of excessive entry has happened as a consequence of the decentralised decision making. Hence, a problem of decentralised systems due to the lack of coordination is that of accepting (locational) projects that would have been rejected.

Given that, it emerges a potential role for policy intervention aimed at rationalising the expansion of the bank branch network, mitigating the tendency of decentralised systems to incur in Type-II errors. According to Ciocca et al. (1974), as a consequence of limitations to agents' information, even in a decentralised banking system it emerges the problem of gathering additional information on banks' decisions about the number and the location of branches. Independently of the control on openings, the monopolistic competition nature of banking markets may result in a costly process of competition through new openings instead

[4]According to Sah and Stiglitz (1986), if agents decisions are completely faultless then the architecture of the economic ceases to be a relevant issue. In this case there are no differences between the performances of a polyarchy and a hierarchy. This is true when, in absence of uncertainty on the outcomes of projects, one assumes that there are no differences between projects which are "worth selecting" and those which are "actually selected".

that prices, increasing the overall cost of banking services to the collectivity.

A "third party" agent (for instance, the Central Bank) could collect information on banks' "desired" locations to open new branches in order to evaluate the likelihood of excessive entry in local markets and avoid potential overclustering phenomena. According to the biological analogy, the "third party" agent would have the role of evaluating the evolution of locations' carrying capacity as a consequence of *actual* and *expected* banks' location choices. Broadly speaking, this policy intervention should be addressed to provide disincentives to multi-locations in saturated sites and incentives to bank branch openings in under-served locations.[5]

4 Concluding remarks

We have proposed an empirical and theoretical analysis of banks' collective behaviour, focussing on bank branch location choices in the Italian territory in the post-liberalisation period. In a decentralised setting, banks' collective behaviour, involving autonomous decisions (e.g., independent evaluations of the profitability of locations) and/or herding dynamics (e.g., the simple imitation of others' strategies), may result in the saturation of local resources when the number of branches becomes excessive with respect to bank deposits. Our empirical analysis on location choices shows that, in some circumstances, banks' co-movements may produce higher values of the branch-to-deposit ratio, increasing the likelihood of overclustering phenomena. In a biological/ecological perspective, the population of bank branches may grow above the environment's carrying capacity, generating a situation that requires some periods of negative growth to re-establish an appropriate ratio between the population (e.g., bank branches) and local resources (e.g., bank deposits).

The right-skew shape of the BDR spatial distribution (a banking sector stylised fact emerging from data analysis in successive years) suggests that these events are possible. To test the hypothesis according to which high BDR locations can be involved in overclusetring phenomena, we investigate the consequences of high BDR values on branch banking dynamics. The typical pattern we find in high BDR locations, selected according to a certain threshold of BDR in a given year, is the following: (i) banks *collectively* move towards certain locations, producing an increase of BDR; during this phase, the growth rate of bank branches in these locations is higher than the aggregate growth rate; (ii) the opening of new branches may become excessive with respect to the level of deposits banks can collect; this situation produces a decrease of bank branches' growth rate that, in some cases (e.g., the observations in the right tail of the BDR distribution), may produce a decrease of the bank branch stock. Accordingly, it emerges an *overshooting* pattern, due to banks' co-movements resulting in an excessive entry in local market and a saturation of resources, which implies

[5]Chang et al. (1997) suggested a similar policy advice. Analysing bank branch location choices in New York City (1990-1995), the authors show that "banks are more likely to open branches in tracts where there are already other branches, ceteris paribus" (Chang et al., 1997, p. 4). This tendency "could produce a distribution of bank branches that is more skewed than the demographic and economic factors that affect branch profitability, and may justify policy intervention" (Chang et al. 1997, p. 4).

a consequent decrease of the bank branch stock in high BDR locations. It is worth noticing that an overshooting phenomenon represents a costly process of reorganisation of the bank branch network, operating through the closures of branches in excess with respect to local resources.

The theoretical framework proposed by Sah and Stiglitz (1986), on the aggregation of errors in different organisational settings, allows us to discuss the role of alternative structures of the banking system in shaping branch banking dynamics and locational errors: the centralised system operating until the late 1980s succeeded in avoiding overbranching (low rate of Type-II errors) at the cost of producing an under-dimensioned bank branch network (high incidence of Type-I errors); on the other hand, the decentralised system emerged after the 1990 "branch liberalisation" has resulted in a remarkable growth of the bank branch network, reaching the typical size of other European countries (low rate of Type-I errors), at the cost of producing some overclustering phenomena (high incidence of Type-II errors).

We maintain that the performances of decentralised systems may be improved through a policy intervention aimed at mitigating their tendency to incur in Type-II errors, that is to accept (locational) project which should have been rejected, minimising the likelihood of overclustering phenomena due to uncoordinated location choices in an uncertain decisional context. In other words, a "third party" agent could improve information gathering and diffusion at the system level, providing an appropriate incentive structure to rationalise the evolution of the bank branch network.

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Table I. BDR distribution.

year	*median*	*skewness*
1998	0.0607	1.3104
1999	0.0663	1.1059
2000	0.0717	1.2132
2001	0.0714	1.8151
2002	0.0700	1.3814
2003	0.0690	1.8159
2004	0.0676	1.7221
2005	0.0668	1.8017

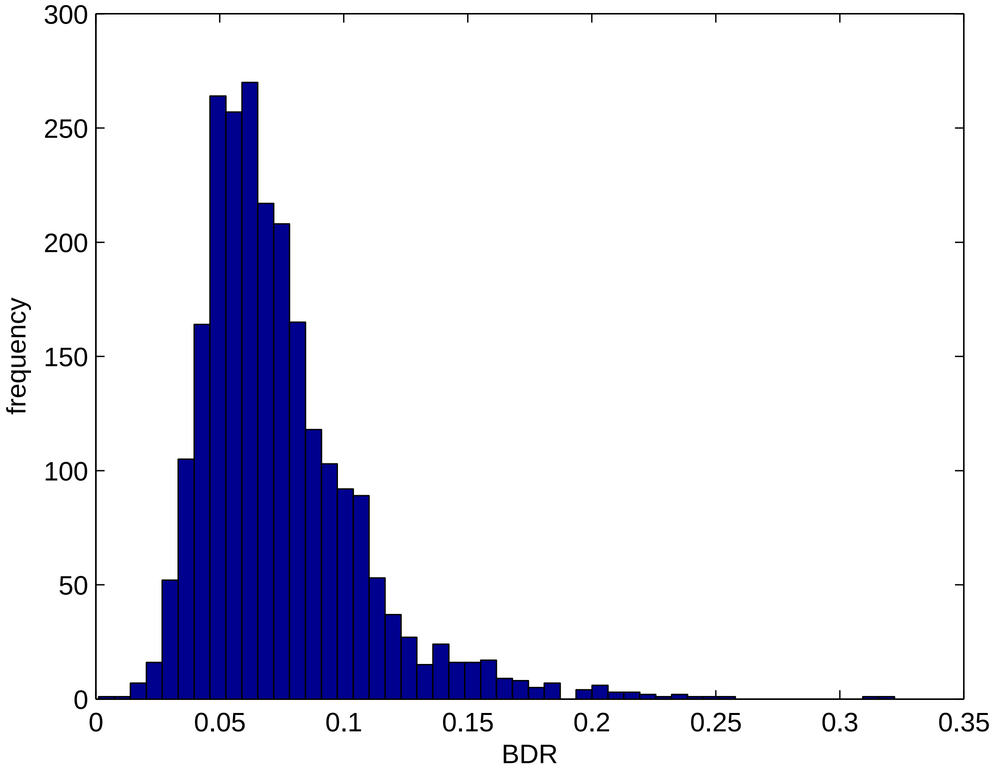

Figure 1: BDR distribution: year 2005

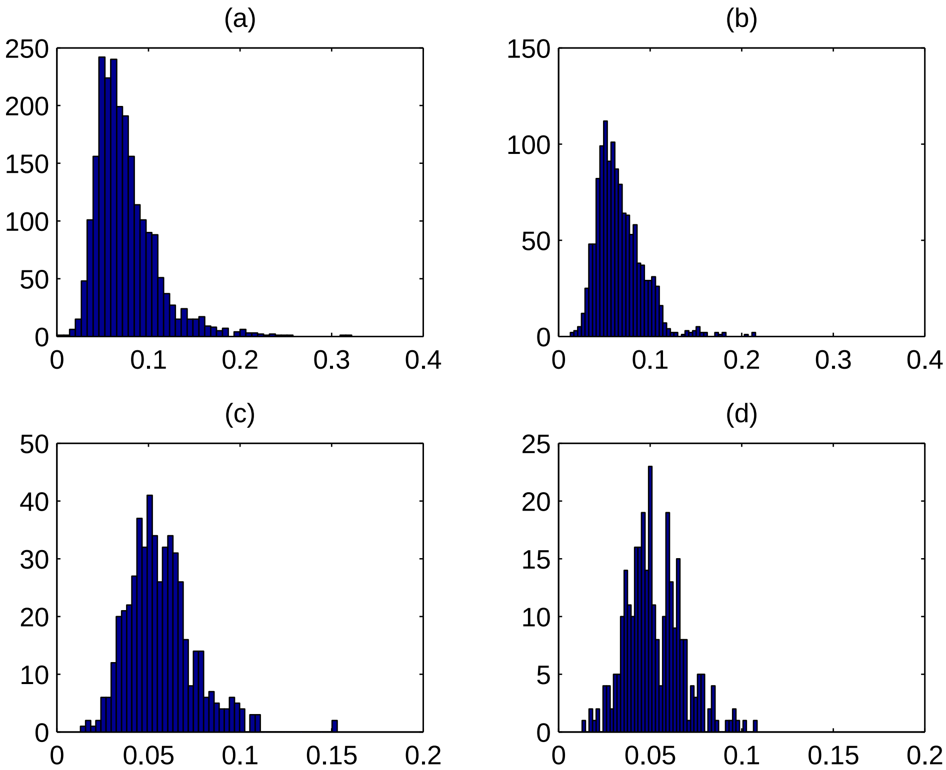

Figure 2: 2005 BDR distribution for different threshold: (a) 3 branches (skewness=1.7541); (b) 5 branches (skewness=1.3685); (c) 10 branches (skewness=1.0024); (d) 15 branches (0.5337)

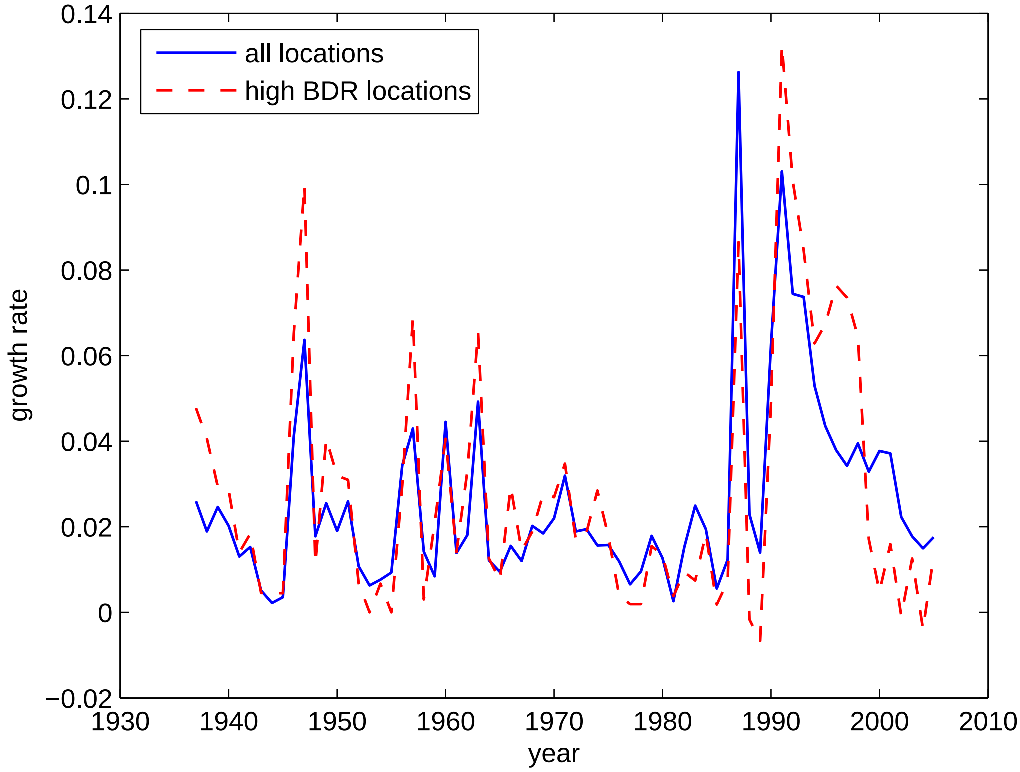

Figure 3: Growth rates of bank branches from 1936 to 2005: all locations (*solid line*) vs. high BDR locations (*dashed line*). High BDR locations are selected according to the following threshold: BDR> **0.10**.

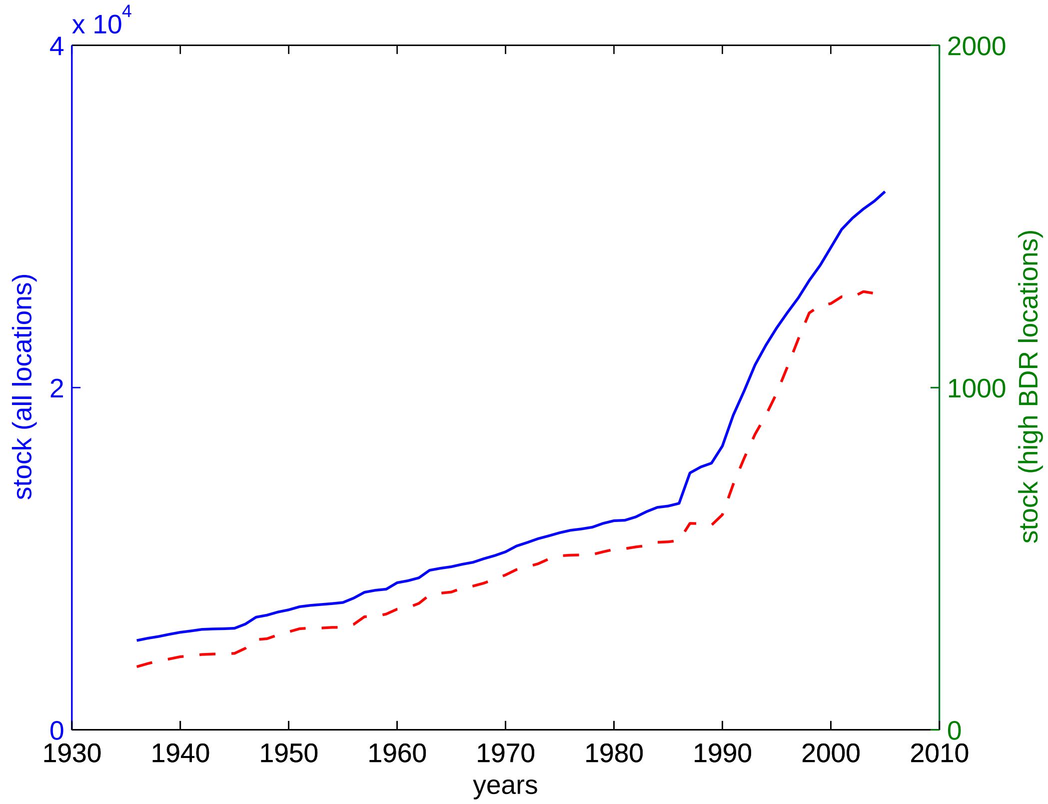

Figure 4: Total number of bank branches from 1936 to 2005: all locations (*solid line*) vs. high BDR locations (*dashed line*). High BDR locations are selected according to the following threshold: BDR> **0.10**

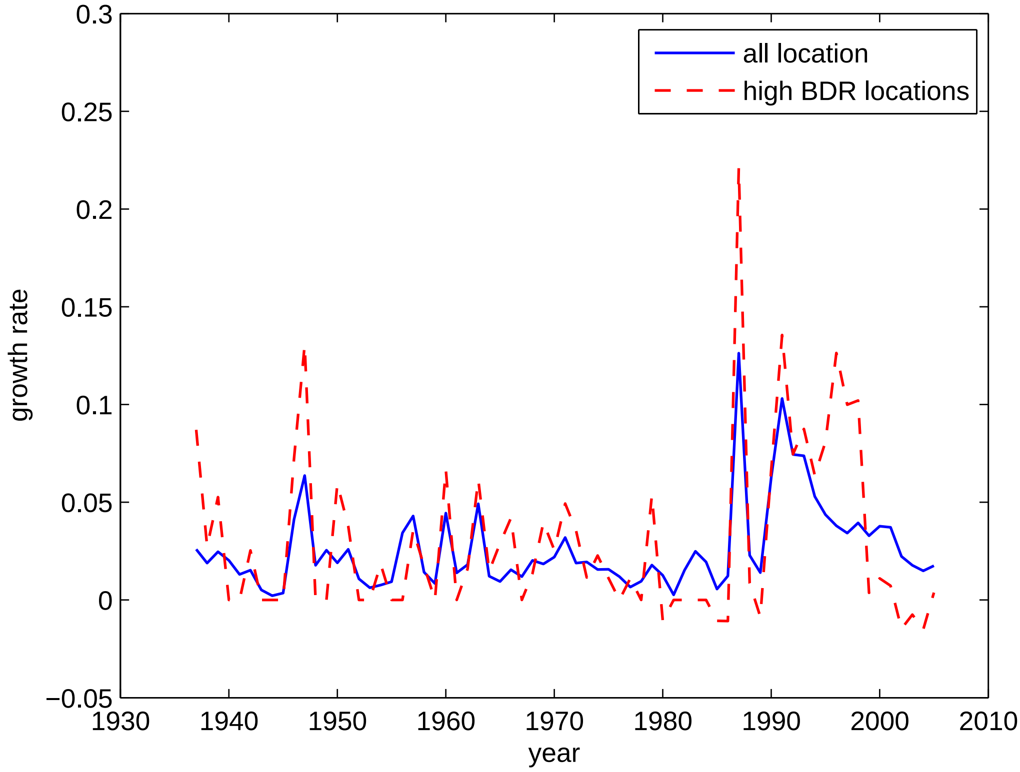

Figure 5: Growth rates of bank branches from 1936 to 2005: all locations (*solid line*) vs. high BDR locations (*dashed line*). High BDR locations are selected according to the following threshold: BDR> **0.15**

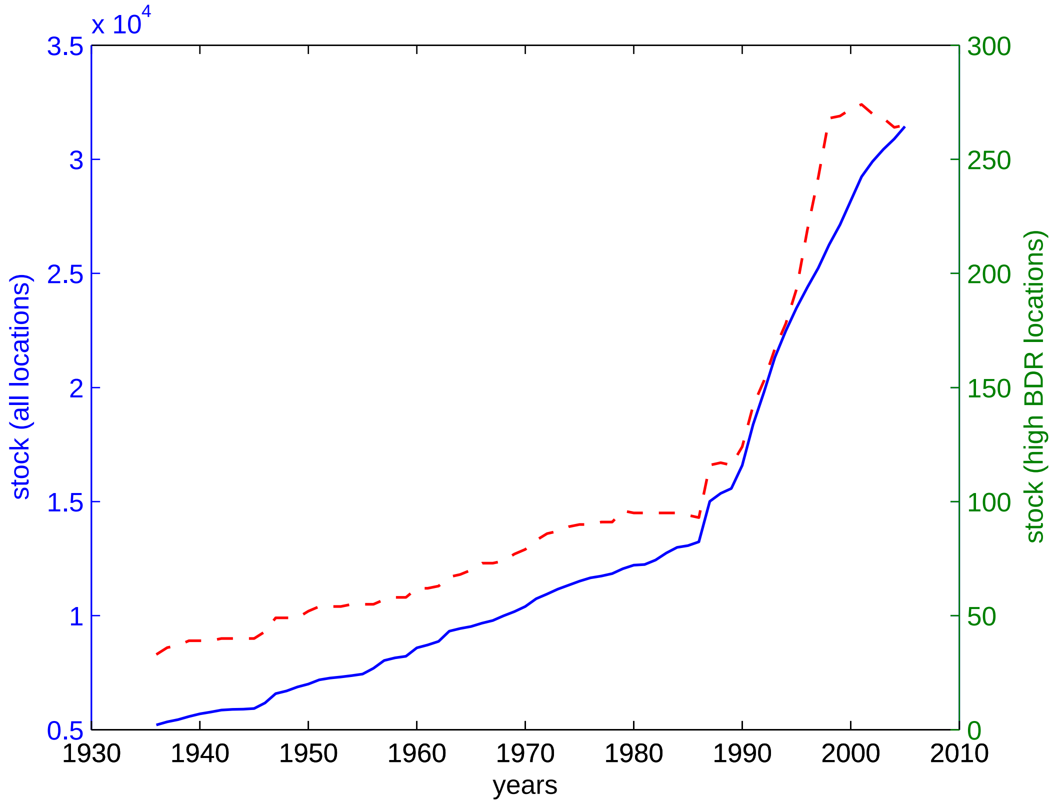

Figure 6: Total number of bank branches from 1936 to 2005: all locations (*solid line*) vs. high BDR locations (*dashed line*). High BDR locations are selected according to the following threshold: BDR> **0.15**

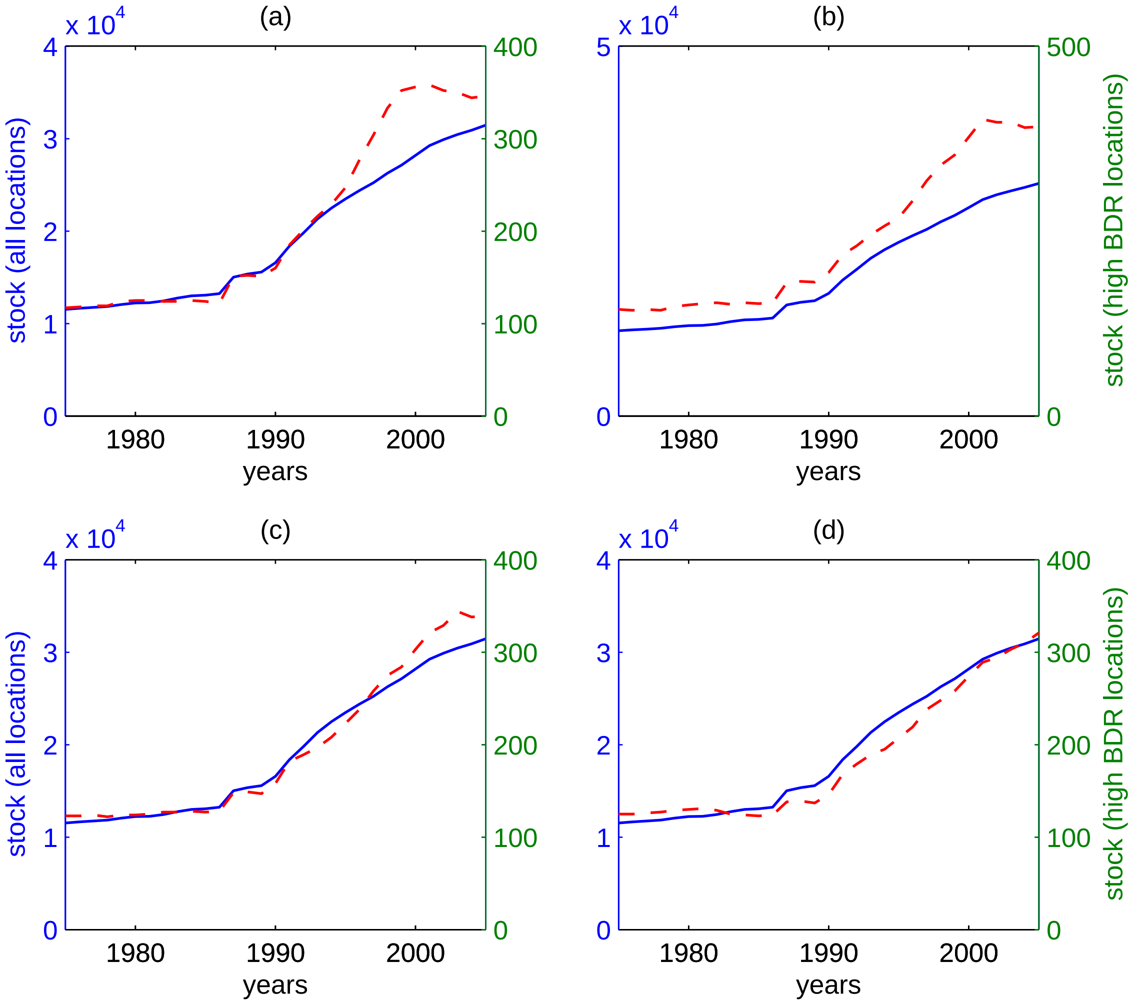

Figure 7: Total number of bank branches from 1975 to 2005: all locations (*solid line*) vs. high BDR locations (*dashed line*). High BDR locations are selected according to the threshold BDR$>$ **0.15** in the following years: (a) 1999; (b) 2001; (c) 2003; (d) 2005.