Performance measures of retail banking networks: a decision support tool

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Abstract

In this paper, we apply a standard model of performance evaluation to the retail banking industry. In this framework, the global economic performance is broken down into technical efficiency related to the optimal use of resources and price efficiency related to the optimal choice of a product-mix. Our main contribution is twofold. First we adapt this traditional framework to the retail banking network by giving a relevant interpretation of the efficiency measures at the branch manager and at the regional top management levels. Second, we relate explicitly the product-mix efficiency to the market environment and to the size of branches. We postulate that branches in different environments could face different production technologies and that optimal product-mixes could vary with the size of the branches. We take a sample size of 1585 branches from a single bank brand breaking down in 17 French regions. We use a nonparametric approach to model the production technologies and to identify optimal benchmarks. Our main objective is to end up with a decision support tool for the top bank management in order to plan product-mix strategies and to give the right incentives to branches' managers. This tool should prove useful since, in retail banking networks, such tools have to be simple, robust, easy to control, and adapted to the vertical organization of the banking network.

1. Introduction

Inside a banking group, two decision levels interact with their own economic objectives, one at the top bank level and another at the branches level (retail banking network). It is therefore vital for any successful organization to clearly identify each responsibility and decision power before developing tools to improve the decision making processes of the top managers. By one hand we follow Ittner et al. (2003) who highlight that many firms are adopting strategic performance measurement systems (SPM). Our work is in keeping with the contingency theory approach of the SPM, its main objective being to link the performance measures with the strategic priorities. And by another hand we follow Demski (1994) who argues that the responsibility of the evaluated entity has to be determined and identified before the definition of the measure evaluation. Brickley et al. (1997) use stronger arguments to emphasise the importance of the responsibility notion. For them, the distribution of the decision rights in an organisation impacts and is impacted in return by the ability to propose fair and right performance measures. Here, we address managerial control and the ability to maintain coherent decision-making between policies made at the top banking group level and the performance measures of the branches.

In this paper, a coherent framework is developed to evaluate banking network performance which separates branches management inefficiency from bank top management inefficiency. This approach assumes that each manager (at the top bank and branch level) acts to maximize his own utility: first the central bank managers aim at maximizing the Net Banking Product (NBP) by making decisions about the localization, the level of resources and the "product-mix" strategy of the branches; and second the branch managers make decisions to optimize their commissions which are directly related to the branch performance. Conventionally, partial productivity indices are used to evaluate branch performance such as the amount of deposits divided by the number of employees, or the amount of financial savings divided by employees. These indices evaluate performance of the branch, and the top bank management gives incentives (concretized by commissions) which depend on their performance level. Moreover, the top bank management uses these incentives to communicate their product strategy. However, integrating both objectives in a common decision support tool is not an easy task because the top bank managers' performance language is financial (profitability objectives) and the branches managers' performance language is productive (productivity objectives to maximize the commissions). Moreover, one has to clearly identify the specific responsibilities in order to define fair measures of performance. Our model allows us to link the two objectives, although they are different in nature. It aims at evaluating the performance of a branching network with two levels of decision (branches and top bank management) to answer to the following three questions:

(Qa) Who is responsible for the network inefficiency: branches management, top management, or both?

And after that, we analyse the implications of the empirical results on strategic control practices:

(Qb) Are the inefficiencies of top bank management and the branches correlated?

(Qc) How does top management need to adapt the incentives plan to reach maximal Net Banking Profit?

The starting point of the analysis is a production model. In its simplest form it is constructed from a set of relevant inputs and desirable outputs of the bank branch retailing process, together with some basic assumption on the nature of the production possibilities. Within this framework, we estimate the branches management inefficiency as the inability to maximize the level of activity given a fixed level of resources and localization is a specific market environment. At the bank top management, inefficiency is defined as the inability of the banking group to maximize the Net Banking Profit given their rate of margin on activities. We explicitly relate the latter inefficiency to the market environment and to the size of branches. We postulate that branches in different environments could face different production technologies and that optimal product-mixes could vary with the size of the branches. We conduct our analysis on a population of 1585 French bank branches. These branches are under the same brand, but are distributed among seventeen independent regional banks.

Our paper is in keeping with the literature on the relative performance evaluation measures (Dopuch and Gupta, 1997). We follow as closely as possible with our data the benchmarking precepts stated by Brickley et al. (1997, p187). From a methodological point of view, it is related to the literature on performance evaluation of retail banking for which there is a modest number of studies as emphasized by McEachern and Paradi (2007). One main reason for this fact is the difficulty to obtain specific data. The first paper was published by Sherman and Gold (1985), comparing 14 branches of a US bank, followed by Parkan (1987), Oral and Yolalan (1990), Vassiloglou and Giokas (1990), Giokas (1991), Tulkens (1993), Al-Faraj et al. (1993) and Sherman and Ladino (1995). These studies are focused on the operational efficiency of the branches. More recently, the global performance of the branches was the main interest in evaluating its productivity, its profitability or its service quality (Schaffnit et al.1997, Athanassopoulos 1997, Soteriou and Zenios 1999, Hartman et al. 2001, Camanho and Dyson 2008, Conceiçao et al. 2007). However, all of these papers are only interested in evaluating the branches level efficiency and none of them analyze the inefficiency of the top bank management. Our approach attempts to close this gap.

Two papers are more closely related to our work. First, Athanassopoulos (1998) was interested to neutralize the impact of the trade environment on the measure of the performance of the branches. We adopt his approach to include markets environment in our study and we explicitly specify a different production technology for each environment. Second, McEachern and Paradi (2007) propose a comparative analysis of the branches network. Here we adopt their managerial objective of intra- and inter performance analysis by analyzing the relative performance of seventeen networks. Finally our approach aims at answering the claim of Berger, Leusner and Mingo (1997) "*An understanding of bank branch efficiency may help resolve a number of conceptual, measurement, and policy questions about efficiency at the bank level*".

The remainder of the paper is structured as follows. Section 2 presents the model and the hypothesis of the analysis. Section 3 discusses describes the context of the study and the data collection. Section 4 presents the empirical results. We conclude in Section 5.

2. The model

The model we use is based on a standard approach for measuring economic, technical and allocative efficiencies under a non parametric frontier estimation framework. Our main contributions are 1) a relevant interpretation of the economic efficiency in the banking context and 2) the introduction of environment and size heterogeneities in the technology modelling. We first present the economic background that we adapt to the specific banking context in a second stage.

2.1. General framework for efficiency measurement

Let $x \in R_+^N$ denote the vector of inputs and $y \in R_+^M$ the vector of outputs for branches. We model a production technology by a production possibility set *T(x,y)* defined as:

$$T(x,y) = \{(x,y) : x \text{ can produce } y\} \qquad (1)$$

We add structure to (1) by imposing the core Shephard axioms (see Färe and Primont (1995) for details): possibility to produce no output and impossibility to produce outputs without inputs, free disposability of inputs and outputs, convexity and variable returns to scale.

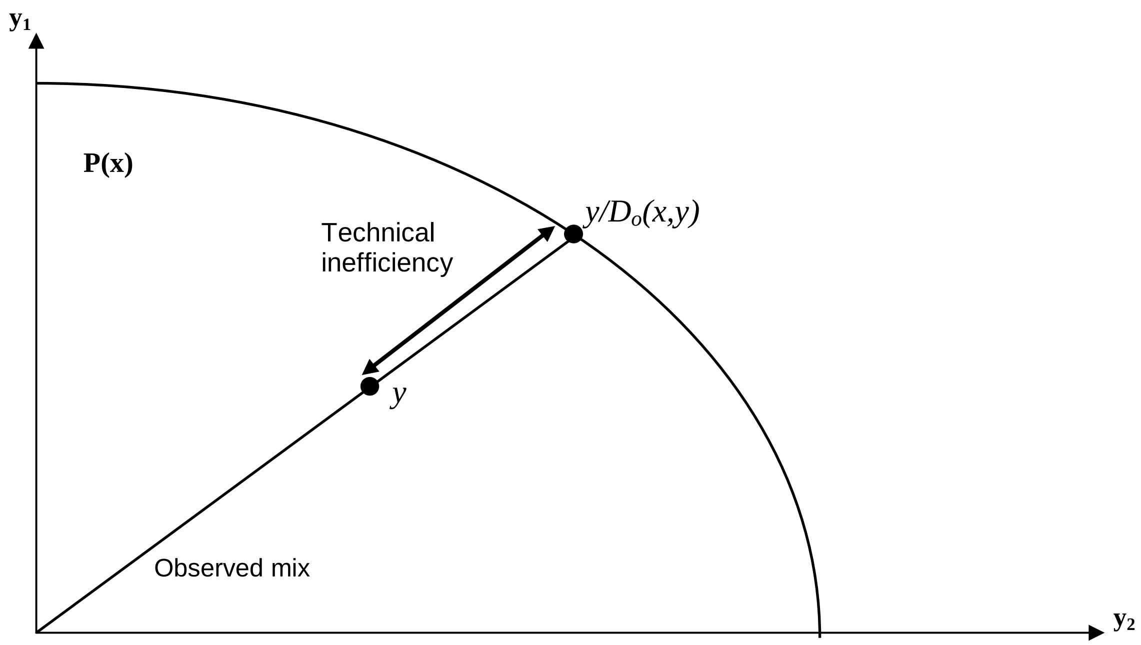
We now turn to the technical efficiency measure based on the Shephard's output distance function:

The function $D_o : R_+^M \longrightarrow R_+$ defined by:

$$D_o(x,y) = \inf_{\lambda} \left\{ \lambda \in \Re_+ : (x, \frac{y}{\lambda}) \in T(x,y) \right\}, \qquad (2)$$

is called the Shephard's output distance function from which we compute the technical efficiency. An analysis of the properties of the output distance function can be found in (Färe and Primont, 1995). Note that $(x,y) \in T \Longleftrightarrow D_o(x,y) \leq 1$. Thus, it is possible to characterize the production set from the output distance function. A standard figure helps to interpret it.

Figure 1. The output distance function and the measure of technical inefficiency

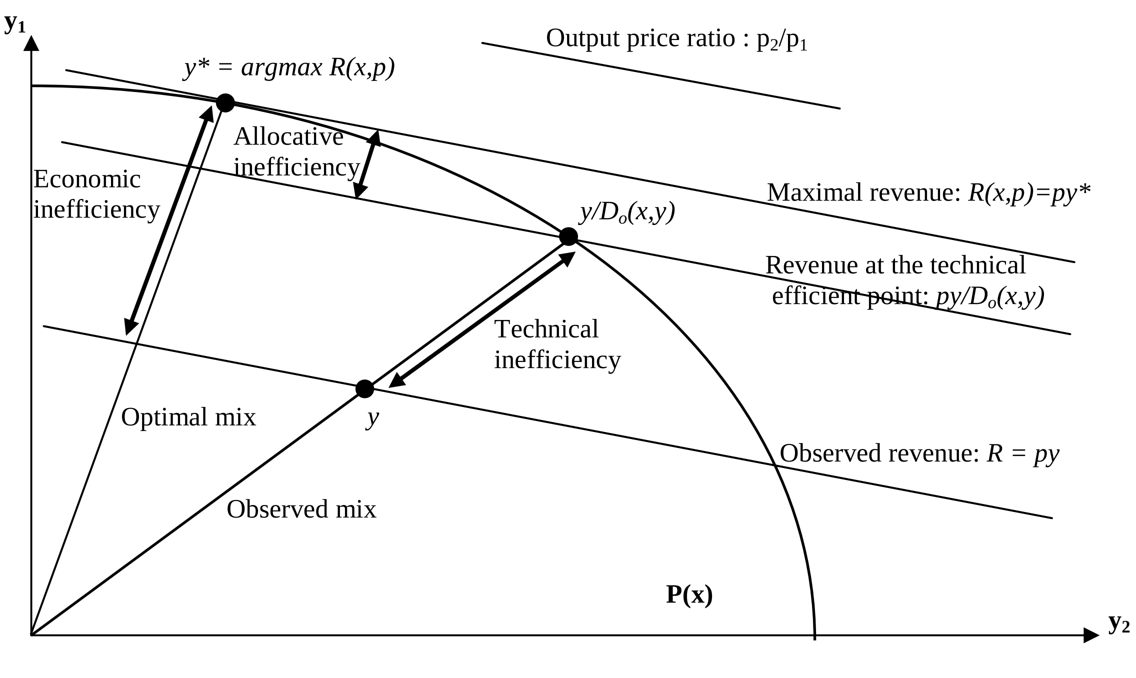


In figure 1 we consider a fixed input vector and we model the output production possibility set $P(x)$. Formally, we have: $P(x)=\{y:(x,y)\in T(x,y)\}$. We also consider an output vector y that belongs to the output set $P(x)$. The output distance function projects the output vector y in a radial direction onto the boundary of $P(x)$ at the point $y/D_o(x,y)$. Thus it follows that the value of the distance function $D_o(x,y)$ is one if, and only if, the output vector in question is on the boundary of $P(x)$; otherwise it is strictly less than one. Following Farrell (1957) a natural efficiency measure is defined as the reciprocal of the Shephard's output distance function and it is interpreted as the maximal feasible radial expansion of a production vector. As an example, if $D_o(x,y)=0.8$, it means that all the outputs could be expanded by 25% ($(1/D_o(x,y))-1$) by keeping the level of inputs unchanged. Note that the efficiency is measured along the observed product-mix and thus considers a proportionate change in the outputs. By introducing prices in the analysis, we can now define the economic and the allocative efficiencies. We first define the revenue function as:

$$R(x,p) = \sup_y \{ py : (x,y)\in T(x,y) \} . \tag{3}$$

The revenue function is interpreted as the maximal feasible revenue given an input vector (x) and an output price vector (p). Again, the following figure helps to interpret these efficiencies.

Figure 2. The revenue function and the measure of economic and allocative inefficiency



In figure 2 the tangency locus between the line figuring the output price ratio (p_2/p_1) and the boundary of $P(x)$ helps to determine the production plan which is the solution of the optimization problem of the revenue function ($y^* = \arg\max\{ py : (x, y) \in T(x,y) \}$). This intersection point defines the maximal revenue $R(x, p) = py^*$. We also define the observed revenue $R = py$ at the observed output vector y and the revenue at the technical efficient production plan $py/D_o(x, y)$. Following Farrell (1957) the economic efficiency is calculated by $R(x, p)/R$ and the allocative inefficiency is computed as the residual between the economic and the technical inefficiencies. We therefore have the following multiplicative decomposition:

Economic efficiency = Technical efficiency * Allocative efficiency. (4)

Note that in the revenue maximizer production plan the product-mix is different from the mix of the evaluated production plan. The former takes into account the output prices to choose the relevant product-mix that maximizes revenue. This inefficiency in the product-mix is captured by the allocative inefficiency.

So far, we have formally defined the production possibility set, the output distance function and the revenue function. We now turn to the estimation of the related efficiency measures. We start from a sample of K branches for which the input/output vectors ($(x^k, y^k), k = 1,..., K$) are observed. Therefore, these production plans are feasible and belong to the production set. Now by adding some structure through the basic axioms we have stated (free disposability, convexity and variable returns to scale), an operational definition of the production possibility set is given by:

$$T(x, y) = \Big\{ (x, y) : x \in R_+^N, y \in R_+^M, \sum_{k=1}^{K} y_m^k z_k \geq y^m, m = 1,..., M, \\ \sum_{k=1}^{K} x_n^k z_k \geq x^n, n = 1,..., N, \sum_{k=1}^{K} z_k = 1, z_k \geq 0, k = 1,..., K \Big\} \quad (5)$$

From this operational definition of the production set and from the definition of the output distance function (2) and the revenue function (3), the technical efficiency measure and the maximal revenue are computed by the following two linear programs:

Computation of the technical efficiency

$$D_o(x,y)^{-1} = \max_{z,\lambda} \ \lambda$$

$$\begin{aligned} s.t. \ & \sum_{k=1}^{K} z_k y_m^k \geq \lambda y_m \quad \forall m = 1,\cdots,M \\ & \sum_{k=1}^{K} z_k x_n^k \leq x_n \quad \forall n = 1,\cdots,N \\ & \sum_{k=1}^{K} z_k = 1 \\ & z_k \geq 0 \quad \forall k = 1,...,K \end{aligned} \tag{P1}$$

Computation of the revenue function

$$R(x,p) = \max_{z,\tilde{y}} \ \sum_{m=1}^{M} p_m \tilde{y}_m$$

$$\begin{aligned} s.t. \ & \sum_{k=1}^{K} z_k y_m^k \geq \tilde{y}_m \quad \forall m = 1,\cdots,M \\ & \sum_{k=1}^{K} z_k x_n^k \leq x_n \quad \forall n = 1,\cdots,N \\ & \sum_{k=1}^{K} z_k = 1 \\ & z_k \geq 0 \quad \forall k = 1,...,K \end{aligned} \tag{P2}$$

We can now compute the:

1) Economic inefficiency : $\dfrac{R(x,p)}{py}$
2) Technical inefficiency: $D_o(x,y)^{-1}$
3) Allocative inefficiency: $\dfrac{R(x,p)D_o(x,y)}{py}$

2.2. Application to the specific banking context

When applied to the banking industry, the general framework presented above needs to take into account some specific features. First, we have to slightly modify the framework of the revenue function to include the main output specificity of the banking industry. Indeed, while outputs are traditionally measured in quantity and measures in physical units, banking outputs are often measured in value. This evidence leads to two deviations from the standard model. First it would make no sense to include prices in the revenue function where outputs are yet measured in values. Instead, we use margin rates to reveal the economic objectives of the regional banking groups. The revenue is thus interpreted as the net banking product (the sum of margin rates multiplied by the outputs in value). This implies that the efficiency will be measured in value (in euros) and as a direct benefit we could directly compare and aggregate different efficiency measures for different branches. Second while Shephard's distance function and Farrell's inefficiencies are relative measures (expressed in percentage of the evaluated branch input/output vector), we will use absolute measures in value. This means that we now face an additive decomposition instead the traditional multiplicative one. We therefore have the following decomposition:

Economic inefficiency (maximal NBP – observed NBP) =
Technical inefficiency (technical efficient NBP – observed NBP) + (6)
Allocative inefficiency (maximal NBP – technical efficient NBP).

Since technical efficiency is clearly related to the branch manager effort, we call it the branch inefficiency. As we have seen, the allocative inefficiency can be easily interpreted as a product-mix inefficiency that is attributed to the top bank manager. The adapted model is illustrated in the following figure (figure 3).

Figure 3. Optimal Net Banking Product and measure of branch and product-mix inefficiencies

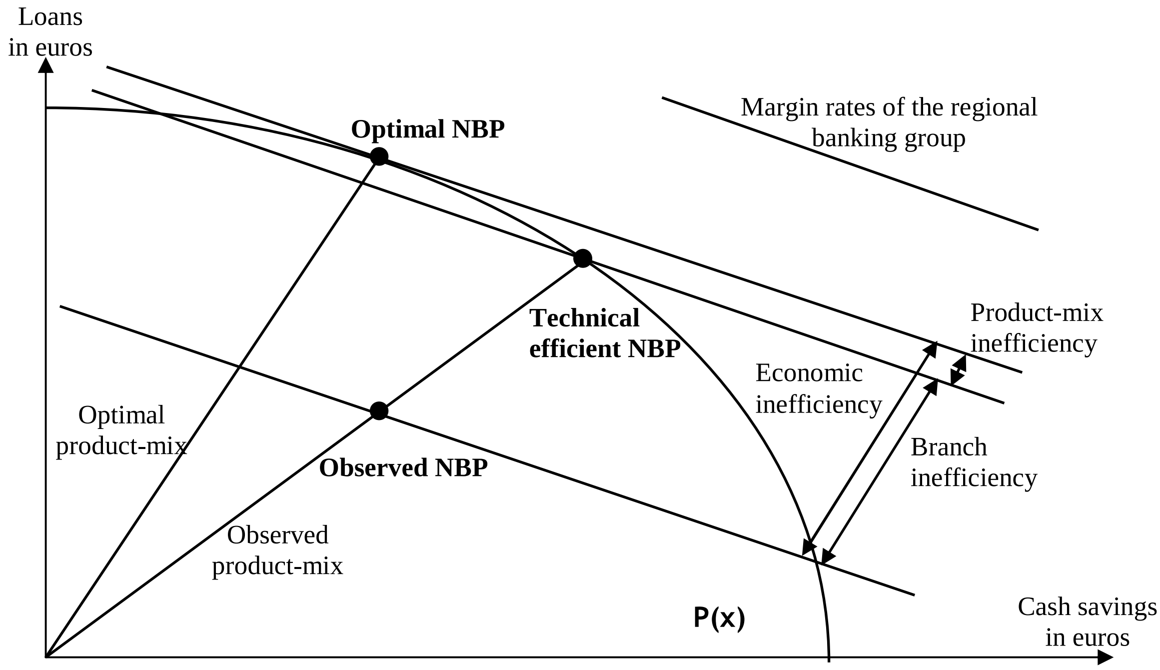
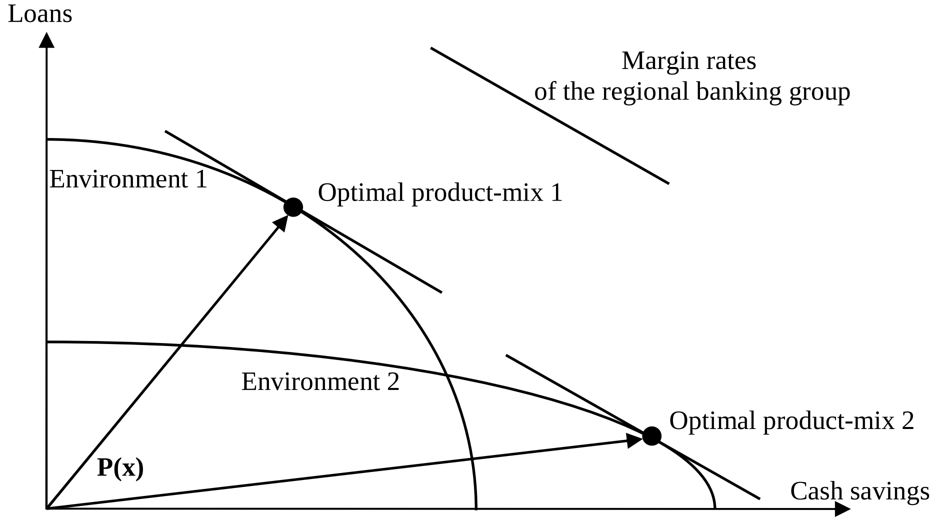


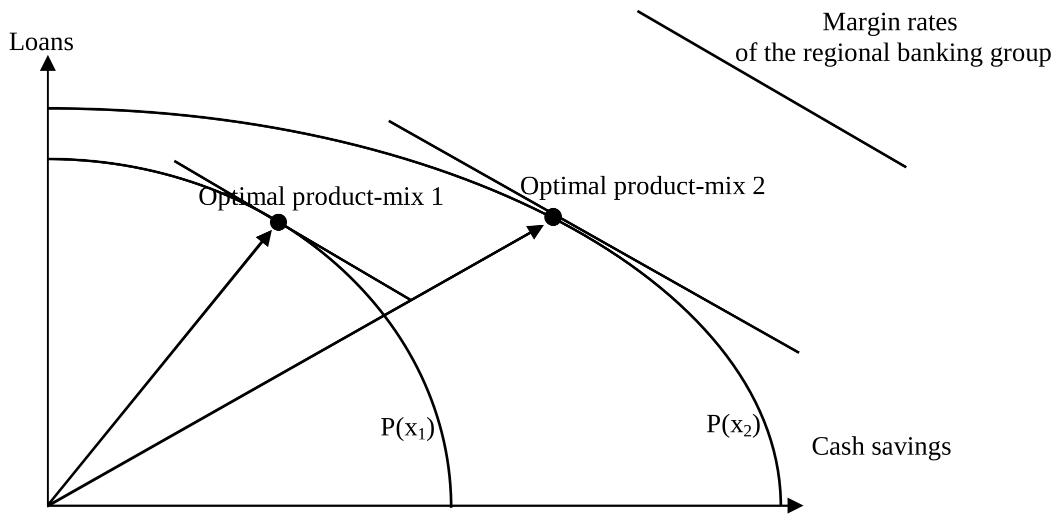
Figure 4. Optimal product-mix and the effect of environment



In figure 4, two technologies are modelled for two different environments and for the same input bundle. As the technologies can be different for different environments, it is clear that, under the same margin rates, the optimal product-mix will be different. As a conclusion, a different environment leads to a different optimal product-mix and as a direct consequence, top bank managers have to apply different product strategies and different incentives to branches in different environments.

Finally we also consider that the size of the branches impacts their production possibility sets. Hence, we definitely exclude the constant returns to scale assumption that considers homothetic boundaries for $P(x)$ and thus a uniform optimal product-mix at any scale of operations. We therefore assume variable returns to scale in all models to allow for different optimal product-mix at different production scales as illustrated in the following figure. In figure 5, we model the same technology but at two different levels of input utilization. The boundaries of the production sets $P(x_1)$ and $P(x_2)$ possibly have different shapes under a variable returns to scale assumption. As for environment, different sizes lead to different optimal product-mix and as a direct consequence, top bank managers have to apply different product strategies and different incentives to branches of different size.

Figure 5. Optimal product-mix and the effect of size



3. Research site and data collection

The context of this study is a French banking group. In this group, seventeen independent regional banks co-exist. Each of them has a central management and a branch network. There are two levels of decision making: the central management of the regional bank and the management of the branch. The central management of the regional bank seeks to maximize the NBP. This one is the turnover realized by the branches and an aggregate at the regional bank level. The central management looks for improving the profitability of the regional bank and uses a measure such as NBP divided by investment.

3.1. Performance measures and incentives plans

Figure 6 shows the distribution of the decision making among the central management and the branches managers. The central bank management is solely responsible for making the decisions for the branch network (branch localization, branch equipment and output mix) as well as for its policies and its future. Bank branches are the points of sale of the bank. They are part of the bank, wholly owned entities. However, the tasks of the branches are sales and advisory, but not only, they play a crucial role in the support of the information bank system by maintaining a direct relationship with local customers. The branches sell different types of products: deposits, personal loans and mortgages, commercial loans and mortgages, special services (issuing of credit cards and ATM cards), insurance and securities, life insurance and financial capital (equity); and they use three types of resources: human resources, operating capital, customer sales base. The customer base is a specific banking resource considered as the necessary funds to allow the bank branch to be a retailer for credit and liquidity services.

Here, we suppose that the central bank management knows the rate of margin of the products and the product-mix strategy which maximizes its financial situation. These preferences depend on financial markets, interest rates, legislation, national and the international competition. According to these elements, central bank managers have to elaborate an incentives plan. Conventionally, bank branches are evaluated thanks to productivity indices (and partial productivity indices in particular) and the objectives to be reached are declined in sale volume by product. If the objectives are achieved, the branches management and the front office sellers get commissions. This is the way used by the central management to communicate the product-mix strategy. Nevertheless, branches profitability is evaluated too, but it is not a way to communicate product-mix strategy, profitability is evaluated to check the selling prices. To increase the selling volume the branches could not sell under any price.

Figure 7 shows the relationships between the decisions made by the central management (materialized by the incentives plan) and the actions made by the branches (materialized by the sale volume). Then, we need at least two performance measures to evaluate the branches actions. One, to evaluate the capacity of the branches to avoid waste of the allocated resources (by the central management); and another one to evaluate the capacity of the branches to apply the incentives plan (communicated by the central management).

In this research; we compute three efficiency scores:

1. The technical efficiency score which evaluates possible increases in the profit margin of branches without changing its product mix but in improving its global productivity;
2. The allocative efficiency score which evaluate if a branch can increase its profit margin just by changing its product mix and following correctly the incentive plan of the central bank;
3. The global efficiency score which evaluates possible increases in the profit margin of branches by changing its product mix and improving its global productivity.

Figure 6. Decision making process inside the banking group

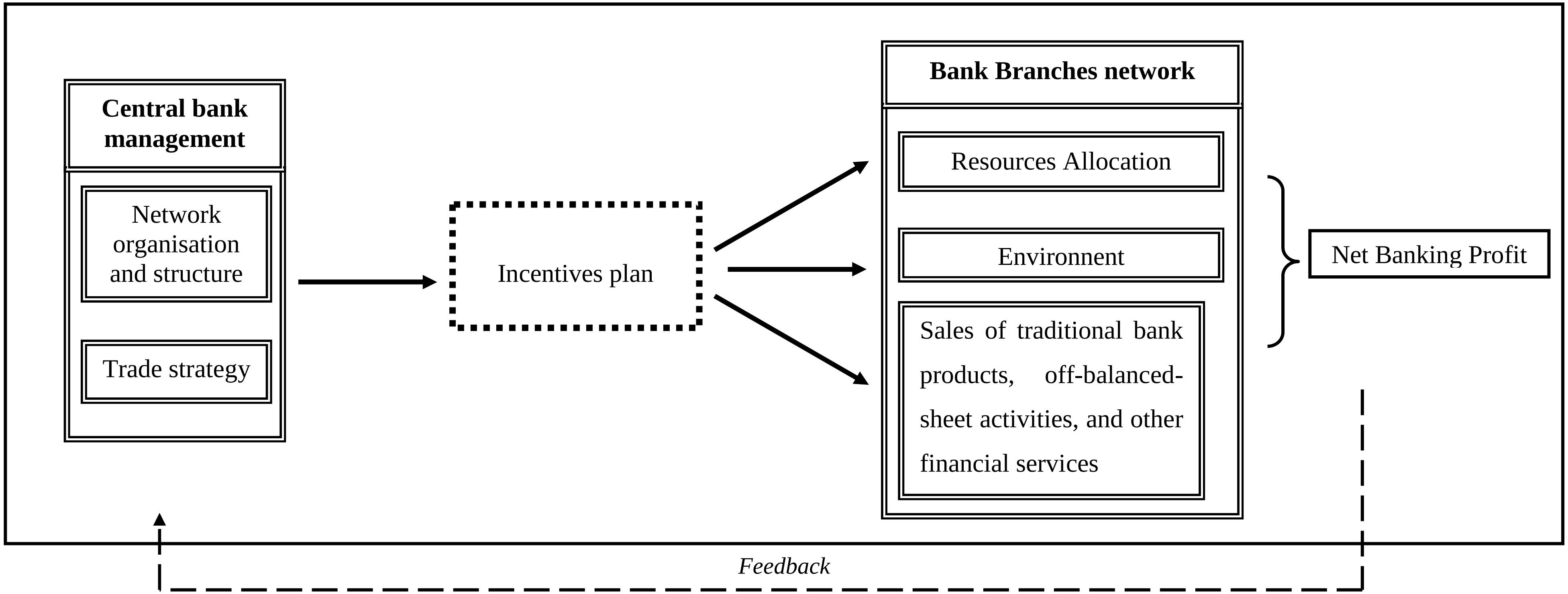
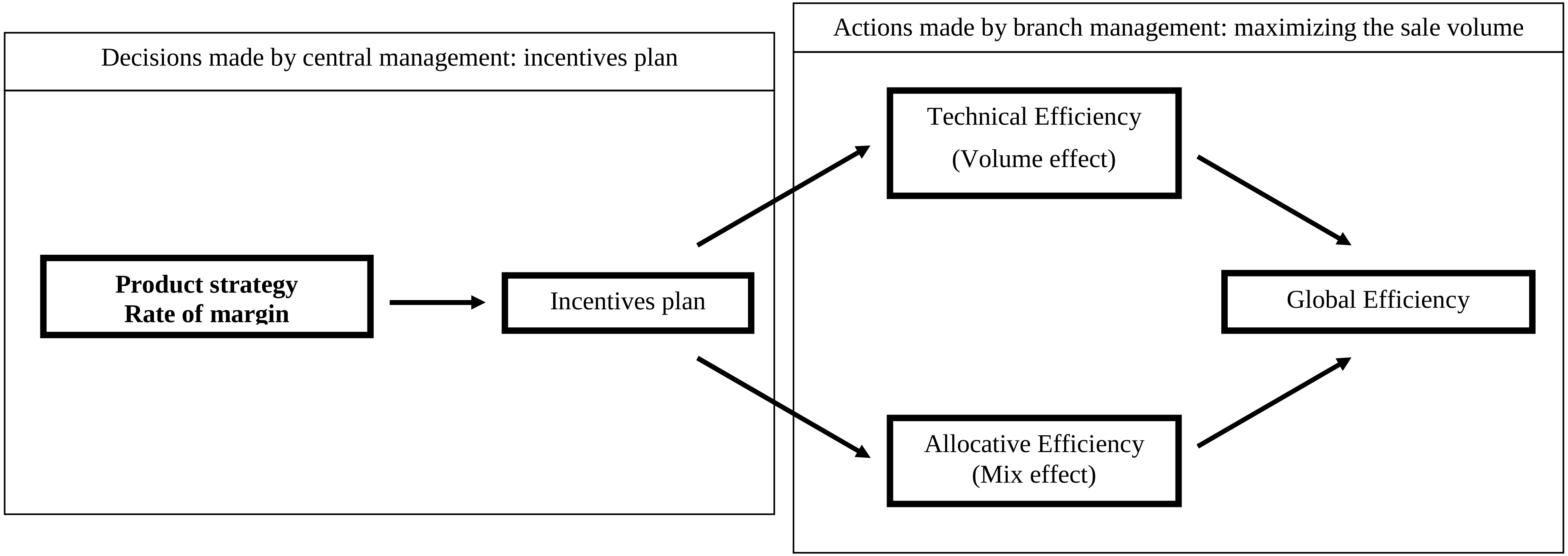


Figure 7. Relationships between incentives plan and performance measures



3.2. Data collection

The branches are retailers of banking products (deposits and loans) and non banking products (damage insurance, payment method services and financial savings). To accomplish the sale of theses products, they ensure services to the customers. Usually, the monetary measurements are preferred over the physical quantities sold, because the prices of the goods are supposed to reflect the level of services rendered.

3.2.1. The variables selected

The action process of the bank branches is presented in figure 8 and can be summarized as follows.

- Bank branches offer several products to their customers; these can be grouped by four types: cash savings products also known as interest-bearing deposits and simple deposits with services related to the management of demand accounts, personal and business loans, damage insurance products and financial savings products. Some result from intermediation, others do not, although the production of each is the responsibility of the bank's general manager.
- To sell the products to local customers, the bank branches use three types of essential resources: human resources, operating resources and customer capital. Customer capital is a specific characteristic of the banking activity. The bank branch contributes directly to the role of financial intermediary of the bank: it collects the deposits that comprise the liabilities on the bank's income statement and it grants loans that comprise the assets on the bank's income statement. The branch's customer capital can be considered as business funds.

Figure 8. The set of relevant inputs and desirable outputs of the branches retailing process

Inputs	Outputs
• Number of personnel	• Cash savings
• Amount of operating expenses	• Loans (personal loans, mortgages, and commercial loans)
• Number of current accounts	• Damage insurance
	• Financial savings (Mutual funds and life insurance)

Figure 9 presents the proxies chosen to estimate the selected inputs and outputs. In that way, for the outputs side, proxies are value of loans portfolio, value of interest-bearing deposits portfolio, amount of damage insurance premiums, and amount of financial savings portfolio; and for the inputs side, proxies are number of full-time equivalent employees, operating expenses, and number of active current accounts.

Figure 9. Proxies selected to estimate the inputs and the outputs of the bank branches

	Inputs and outputs	Proxies
Output 1	Cash savings	Value of interest-bearing deposits portfolio
Output 2	Loans	Value of loans portfolio
Output 3	Damage insurance products	Amount of damage insurance premiums
Output 4	Financial savings products	Amount of financial savings portfolio
Input 1	Human resources	Number of full-time equivalent employees
Input 2	Operating resources	Operating expenses
Input 3	Customer capital	Number of active current accounts

3.2.2. Overview of the data

Table 1 presents summary statistics for the variables used in the definition of the retailing process of the 1585 branches on evaluation. For most of the variables, the median value is lower than the mean value meaning that some large values are present in the data. By looking at the range, we also see a large variation in size between the small and the large branches. This observed variation will be taken into account by our model since we explicitly compute the optimal product-mix at each scale of operations.

Table 1. Descriptive statistics for the 1585 branches

Variable	**Minimum**	**Median**	**Maximum**	**Mean**	**St. dev.**
Number of employees	1	10	47	11	6
Operating expenses	74	645	3 894	772	460
Number of accounts	595	5 591	23 767	6 409	3 619
Cash savings	4 060	42 759	279 083	51 284	35 151
Loans	2 302	39 469	310 050	48 935	35 369
Damage insurance products	8	695	5 638	896	664
Financial savings products	606	24 366	224 983	31 589	25 798

The 1585 branches are also characterized by different local commercial environment. As discussed above, we will model a production technology specific to each environment. Branches are classified into eight distinct environments (cf. figure 10). The classification has been established both from experts' opinion and on data analysis on a set of twelve criteria: rate of employee assets working in the agricultural field, rate of employees, rate of operative manufacturer, rate of businesses, rate of executives, rate of retirees, portion of more than fifteen years-old studying, rate of unemployment, income per family, portion of secondary residences, portion of homeowners, rate of population growth. The variability in market environment probably leads to a specialization in the products sold by the branches. In terms of management control an important question that arises is the determination of the right incentives plan by type of environment.

Figure 10. Description of the eight environments

ENV1	Rural areas with a high rate of employee assets working in the agricultural field and a high rate of retirees
ENV2	Rural areas with a high rate of operative worker and of employee assets working in the agricultural field and a high rate of retirees
ENV3	Residential areas with a high rate of businesses, retirees and secondary residences
ENV4	Peripheral areas with a high rate of population growth, a significant portion of large dwellings and homeowners
ENV5	Urban areas with a high rate of students and of population growth
ENV6	Urban areas with a high rate of unemployment and low incomes
ENV7	Urban areas with quite high unemployment and income
ENV8	Urban areas with a high rate of executives and high incomes

In Table 2, we present the distribution of the branches among the seventeen Regional Banking Groups (denoted RBG) and among the eight environments. We note that the banking groups are different, especially with regards to their size, the smallest comprised a network of 28 branches and the largest of 376. The number of branches per environment is also quite variable. Each banking group is present in at least three different environments. To face the competitive pressure, the trade strategy of all the regional banking groups is to be present in all the types of environment of their territory. Inside each regional banking group, we use a Herfindhal score to evaluate the concentration of the branches among the different environment. The least concentrated regional banking group is RBG5 (Herfindhal score 0.146) and the most concentrated one is RBG14 (Herfindhal score 0.465). We can notice that none of the regional banking groups are highly concentrated in solely one environment.

Table 2. Distribution of the 1585 branches among the seventeen regional banking groups and the eight different environments

	ENV1	ENV2	ENV3	ENV4	ENV5	ENV6	ENV7	ENV8	TOTAL	Herfindhal
RBG1	15	9		5	6		2		37	*0.251*
RBG2		1	11	12		2	2		28	*0.325*
RBG3	11	5	2	5	7	11	17	3	61	*0.159*
RBG4	66	52	16	38	13	7	30	2	224	*0.193*
RBG5	**5**	**10**	**2**	**5**	**8**	**11**	**10**	**1**	**52**	***0.146***
RBG6					3	4	9	1	17	*0.331*
RBG7	15	14	11	6	1	1	5		53	*0.200*
RBG8	24	14	2	8		5	9	2	64	*0.220*
RBG9	11	7	4	20	11	68	34	5	160	*0.250*
RBG10	5	5	1	17	6	9	24	20	87	*0.180*
RBG11	2		4	2	4	14	24	1	51	*0.299*
RBG12	31	11	9	45	20	10	19		145	*0.187*
RBG13	7	32		18	6	3	11	5	82	*0.227*
RBG14				**2**	**4**		**15**	**36**	**57**	***0.465***
RBG15	17	39	1	149	29	77	58	6	376	*0.240*
RBG16		4	3	6	8	8	24	1	54	*0.249*
RBG17	3	6		3	4	6	13	2	37	*0.182*
TOTAL	212	209	66	341	130	236	306	85	1585	*0.241*

In the model, the objective of the regional banking group is to maximize the NBP. Table 3 presents the rate of margins for the four selected products in this analysis. Margin rates are group specific since they depend on financial markets conditions, interest rates, legislation and local competition. We can report at least 20 % of variability among the rate of margins even for products such as cash savings (minimum is 2.93% and the maximum 3.38%) or loans (the minimum is 4.86% and the maximum 6.00%) which are highly regulated products.

Table 3. Margin rates for regional banking groups

	Rate of cash savings margin	**Rate of loans margin**	**Rate of damage insurance products**	**Rate of financial savings products**
RBG1	3.19%	5.70%	9.93%	0.59%
RBG2	2.95%	5.15%	11.36%	0.53%
RBG3	**2.93%**	5.74%	12.93%	**0.37%**
RBG4	3.12%	5.69%	11.39%	0.45%
RBG5	3.21%	**6.00%**	11.64%	0.60%
RBG6	3.03%	5.55%	16.73%	0.41%
RBG7	3.34%	5.40%	12.06%	0.66%
RBG8	3.23%	5.61%	10.81%	0.57%
RBG9	3.09%	5.94%	**8.41%**	0.70%
RBG10	3.13%	5.07%	10.03%	**0.93%**
RBG11	2.97%	5.73%	10.25%	0.56%
RBG12	3.03%	5.42%	**12.82%**	0.57%
RBG13	**3.38%**	5.61%	10.77%	0.58%
RBG14	3.11%	**4.86%**	10.60%	0.69%
RBG15	3.13%	5.27%	10.34%	0.80%
RBG16	2.98%	5.75%	11.64%	0.55%
RBG17	3.14%	5.83%	10.02%	0.61%

4. Empirical results

In this section we present the material necessary to answer to the three initial questions defined in the introduction (Qa, Qb, and Qc). First; we describe the results from our linear mathematical programs (P1 and P2), and second we discuss the implications of the results on strategic control practices and on incentives plans.

4.1. Main results

A synthesis of the main results is presented in Table 4. While we compute the three inefficiency measures at the branch level, we present here aggregate results at the regional bank level. To obtain aggregate measures, we have added the branches' inefficiencies. In contrast to the traditional framework for which multiplicative and relative efficiency measures are used, the addition of scores is meaningful in our context because we have an additive decomposition of the economic inefficiency and we use Euros as the single and common unit of measurement for all the types of inefficiencies. Nevertheless for the sake of comparisons among the different regional networks, we have finally reported the inefficiencies in percentage of the regional bank PNB. As an example of interpretation of figures in Table 4, the regional bank RGB1 shows an inefficiency score of 27% on the branch inefficiency. It means that if all the branches among this group were technically efficient, RGB1 could improve its PNB by 27%. Moreover, the choice of the optimal product-mix would raise the PNB by 5% and as a result, improving both technical and allocative efficiency could raise the PNB by approximately one third. It is clear that for RGB1, the main source of improvement is at the branches level and that the top management seems quite efficient in the incentives it gives to define the branches' product-mix depending on their size and their environment. However, it is not the case for all the banking groups and RGB6 shows an inverse picture. Here, the main source of improvement is at the regional level (40% of inefficiency) while the branches inefficiency is around the sample average. By looking at RGB15 we finally have results where the total inefficiency is equally split among the branches and the top management. These results are very relevant from a management control point of view in the sense that they analyze the causes of the economic inefficiency.

On average, the technical and allocative inefficiencies are quite the same (respectively 15% and 13%) but much more variability is present at the individual level as shown by the results. A simple OLS regression of technical inefficiency on product-mix inefficiency shows that there is no correlation among the two types of inefficiencies and we can therefore conclude that there is no association between branch management performance and top bank management performance. (In)efficiency of branches does not induce or preclude (in)efficiency of the top bank manager. We also note a large variation in the level of inefficiency between the seventeen bank networks. Economic inefficiency is going from 16% to 55%. The same variability is observed for the allocative inefficiency (5% / 40%) while the range for branch inefficiency is smaller (8% / 28%).

Table 4. Managerial objectives expressed by technical efforts and product-mix efforts (Qa)

	Branch inefficiency	Product-mix inefficiency	Economic inefficiency
RBG1	**27%**	**5%**	**32%**
RBG2	16%	12%	28%
RBG3	28%	22%	51%
RBG4	13%	30%	42%
RBG5	12%	13%	24%
RBG6	**15%**	**40%**	**55%**
RBG7	12%	4%	16%
RBG8	18%	11%	29%
RBG9	24%	13%	37%
RBG10	9%	8%	18%
RBG11	17%	11%	29%
RBG12	22%	9%	32%
RBG13	15%	8%	23%
RBG14	13%	9%	22%
RBG15	**8%**	**7%**	**16%**
RBG16	19%	11%	30%
RBG17	21%	15%	36%
TOTAL	15%	13%	28%

The results presented in Table 4 are derived from a model which takes explicitly into account the size and the environment effects at the branches level. We now want to test if these effects could remain at the regional level. Indeed, if a regional group has a great concentration of its branches in some specific environments, it may be easier to give the right incentives in terms of product-mix and thus the allocative inefficiency could be related to the concentration of the branches. Second, following the same argument, if the size of the branches is relatively homogenous among a regional group, it could be easier to manage the incentives plan on product-mix and thus the allocative inefficiency could be positively related to the heterogeneity in size. We therefore test for these two hypotheses with OLS regressions where the dependant variables are a Herfindahl index of concentration and a heterogeneity index of size computed as the variance of branches' size. The result is that there is no relationship between neither the concentration of the branches among the different environments nor the heterogeneity in size and the regional group allocative inefficiency.

4.2. Results on strategic control practices

Beside the diagnostic results given above, our model can be used as a tool to analyze more deeply the nature of inefficiencies and to infer corrective actions. We illustrate here how a top bank manager could measure the necessary changes in product-mix which lead to the maximal Net Banking Profit. From the four outputs we consider, we chose the cash savings as a standard and we compute the ratios of other outputs over cash savings. All the results presented are therefore relative to cash savings. The first ratio is loans / cash savings for which the results are presented in Table 5. Results for the other ratios (damage Insurance/cash savings and financial savings/ cash savings) are presented in the Appendix. Table 5 gives the increase or decrease of the ratio loans/cash savings by environment and on total. We interpret here the first line. For the group RBG1 the ratio loans/cash savings has to be increased globally by 4% to get the product-mix efficiency. Therefore little inefficiency arises at the aggregate level. Nevertheless, if we analyse the results environment by environment we find much more disparities. For example the branches located in ENV1 have to make a reduction of 17% of the ratio (by decreasing the volume of loans or increasing the volume of cash savings) while the branches located in ENV4 have to increase the ratio by 41%. For other banking groups, we see that some groups have to change drastically this ratio. For example the group RGB5 has to increase this ratio by 34% while the group RGB10 has to reduce it by 11%. We also notice that the ratio has to decrease in rural environments (ENV1-ENV3) while it has to increase in the urban environments (ENV4-ENV8). Without going in further interpretations, we are convinced that these results constitute a relevant tool for the regional managers in defining the incentives for each branch according to their environment.

Table 6. Changes in product-mix to reach allocative efficiency (loans / cash savings)

ratio loans / cash savings	**ENV1**	**ENV2**	**ENV3**	**ENV4**	**ENV5**	**ENV6**	**ENV7**	**ENV8**	**TOTAL**
RGB1	**-17%**	**2%**		**41%**	**30%**		**-1%**		**4%**
RGB2		-7%	-6%	28%		42%	144%		23%
RGB3	-20%	-40%	-45%	13%	45%	50%	41%	17%	19%
RGB4	-42%	-29%	-29%	-4%	8%	-24%	-23%	-26%	-25%
RGB5	**-42%**	**-18%**	**-4%**	**72%**	**68%**	**30%**	**91%**	**0%**	**34%**
RGB6					29%	-2%	0%	52%	8%
RGB7	-6%	-9%	2%	36%	7%	-2%	-3%		0%
RGB8	0%	-7%	4%	33%		3%	27%	60%	9%
RGB9	-10%	-12%	18%	87%	120%	44%	93%	46%	58%
RGB10	**-54%**	**-50%**	**-41%**	**-24%**	**-16%**	**-21%**	**17%**	**-4%**	**-11%**
RGB11	-43%		-3%	141%	49%	32%	45%	55%	39%
RGB12	-31%	-8%	9%	31%	20%	19%	8%		8%
RGB13	-4%	-23%		38%	16%	23%	53%	35%	11%
RGB14				-12%	-33%		21%	40%	28%
RGB15	-21%	-17%	0%	24%	4%	-6%	31%	0%	11%
RGB16		-23%	-4%	12%	31%	18%	93%	21%	49%
RGB17	-4%	44%		98%	117%	71%	77%	86%	70%
TOTAL	**-25%**	**-18%**	**-8%**	**26%**	**30%**	**18%**	**40%**	**26%**	**14%**

5. Concluding remarks

5.1. Links with a selected literature

Benchmarking is a promising managerial tool for an organizational structure such as a banking network. Central management frequently benchmarks branches. In the construction of our model, we follow the three guidelines proposed by Brickley et al. (1997, page 187). The efficiency score is calculated with respect to the differences in the environments and in the decision empowerment, and with consideration of the architecture as a system of complements.

Our paper also encompasses to the financial literature on positive agency theory and more precisely on organizational architecture theory. Our model is constructed within a normative approach of agency theory, but our empirical results show that the choice of performance measures is essential since it determines the performance of the entire banking group. In this aspect, we can recognize the three components of the organizational architecture: decision rights, incentives plan, and performance measures. In the construction of our model, we consider these three components as the "*three legs of a stool*" (following Brickley,et al. 1997, page 181). As a second empirical result, we show that the choice of performance measures is crucial: these are the wheels to ensure the good working of the organizational architecture. In other words, if the chosen performance measures are not incorporated in a banking group perspective, all the individual profitability gains which are obtained at a branch managerial level are lost at central managerial bank level in an increase of the allocative inefficiency. Moreover, in developing a normative agency model and in proposing a positive agency interpretation of the empirical results, we follow Jensen's recommendations (1983) which suggested bringing the two agency literatures become closer. Finally, we show that to optimize the financial results of an organization such as a banking group it is not enough to optimize the individual situation of its entities (bank branches).

5.2. Discussion of the empirical results

The efficiency scores calculated have the objective of assisting managerial decision making and in particular the central regional bank managerial decision making. They are performance measures and present quite a few interesting managerial requirements: simple, robust, easy to control, adaptive, as complete as possible, and easy to communicate with (Little, 1970). The efficiency scores are simple because they are easy to understand and robust because there are no absurd answers. They are easy to control because we have explicitly included the decisional power of the branches managers and of the central regional bank managers in the model. Moreover, they are adaptive because in the future we could integrate new information such as market share for example and as complete as possible because the model used is constructed according to a global vision of the banking group. Finally, they are easy to communicate because they are performance measures which are easy to interpret and they are quite familiar ground for banking managers.

We develop two managerial aspects of our empirical results: (i) implications of the results on benchmarking practices and (ii) implications of the results on managerial practices.

(i) The efficiency scores are useful to practice internal benchmarking, they are particularly congruent because they respect the controllability principle at the branch level (branches are only compared to other branches constrained within same trade area). But there is another interesting managerial aspect, it is to benchmark the regional banking group –in other words at the upper aggregate managerial level.

(ii) Our findings confirm that the product mix strategy (through the rate of margins) has to take into account the size and the localization of the branches. The results of our analysis could help the top bank management to adapt the incentives to each branch. The model developed here could also be used as a prospective management tool. It is based on four key variables (margins, size, localization and inputs). By fixing any three of them, this allows us to simulate the last one. For example, bank top management could anticipate the effect of changes in the rate of margins on optimal output mixes to adapt their incentives plan.

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Appendix

Table A1. Changes in product-mix to reach allocative efficiency (damage insurance/cash savings)

Damage insurance/cash savings	ENV1	ENV2	ENV3	ENV4	ENV5	ENV6	ENV7	ENV8	TOTAL
RGB1	-5%	-25%		92%	-9%		-1%		3%
RGB2		-34%	-30%	-11%		-23%	-17%		-21%
RGB3	3%	-23%	-17%	87%	32%	47%	54%	-13%	32%
RGB4	23%	-23%	-26%	35%	7%	-9%	11%	-33%	7%
RGB5	-46%	-44%	-7%	6%	-21%	-12%	3%	0%	-18%
RGB6					-7%	-22%	-23%	-30%	-21%
RGB7	7%	-3%	-9%	173%	-17%	43%	54%		25%
RGB8	-27%	-41%	-14%	22%		-22%	-13%	-55%	-22%
RGB9	-16%	-9%	23%	76%	22%	9%	45%	-44%	22%
RGB10	-48%	-47%	-17%	-14%	-8%	-19%	8%	-26%	-14%
RGB11	-19%		-19%	57%	22%	12%	20%	-30%	14%
RGB12	-10%	-8%	-20%	10%	-15%	-5%	-3%		-4%
RGB13	-29%	-24%		66%	-25%	7%	22%	-26%	3%
RGB14				24%	-11%		20%	-18%	-6%
RGB15	-38%	-28%	0%	-8%	-13%	-14%	-11%	-48%	-14%
RGB16		-31%	-10%	-19%	-16%	-6%	14%	-62%	-3%
RGB17	-3%	78%		178%	134%	117%	161%	62%	120%
TOTAL	**-4%**	**-21%**	**-17%**	**17%**	**-1%**	**1%**	**19%**	**-24%**	**2%**

Table A2. Changes in product-mix to reach allocative efficiency (financial savings/cash savings)

Financial savings/cash savings	ENV1	ENV2	ENV3	ENV4	ENV5	ENV6	ENV7	ENV8	TOTAL
RGB1	19%	34%		34%	-4%		23%		21%
RGB2		-39%	20%	49%		28%	17%		31%
RGB3	-53%	-45%	-47%	-31%	-54%	-41%	-42%	-29%	-44%
RGB4	-65%	-59%	-57%	-56%	-48%	-54%	-53%	-61%	-59%
RGB5	81%	109%	14%	53%	33%	40%	92%	0%	66%
RGB6					-44%	-53%	-55%	-72%	-54%
RGB7	30%	17%	7%	38%	38%	9%	12%		21%
RGB8	6%	-15%	9%	4%		5%	5%	-14%	0%
RGB9	-12%	-28%	-3%	-15%	-35%	-4%	-7%	-13%	-10%
RGB10	33%	78%	-14%	57%	38%	37%	25%	16%	34%
RGB11	-19%		20%	124%	12%	27%	57%	18%	41%
RGB12	-19%	-8%	-6%	-1%	11%	0%	28%		0%
RGB13	-2%	12%		12%	3%	45%	63%	6%	18%
RGB14				16%	103%		44%	-5%	16%
RGB15	7%	1%	0%	11%	18%	22%	14%	-9%	13%
RGB16		31%	38%	34%	9%	19%	14%	44%	19%
RGB17	-28%	22%		-13%	17%	-12%	18%	-7%	6%
TOTAL	**-20%**	**-5%**	**-9%**	**6%**	**3%**	**8%**	**11%**	**-3%**	**1%**