Journal of Posthumanism
2025
Volume: 5, No: 6, pp. 121-135
ISSN: 2634-3576 (Print) | ISSN 2634-3584 (Online)
posthumanism.co.uk

DOI: https://doi.org/10.63332/joph.v5i6.1967

Scale and Scope Economies in the Tunisian Insurance Industry

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Abstract

The aim of this article is to estimate scale and scope economies in the Tunisian insurance sector. This is the only empirical study that we are aware of that addresses scale and scope economies in the Tunisian context. We use the stochastic Translog cost frontier to examine the economies of scope and scale. The study uses a panel of ten insurance companies observed over the period 2014-2023. These companies represent the Tunisian insurance sector since they control over 95% of the market share for claims or premiums. Additionally, we assume that all of these companies use the same production technology. We consider in this research paper the main five lines of business, i.e., automobile, group health, various risks, fire, and life insurance. According to our research, several interesting results were raised, namely, insurance companies can benefit from considerable economies of scale. However, neither economies of scope nor systematic evidence of cost complementarities between the considered lines of business are found. Furthermore, there are no cost complementarities between the two main lines of business, automobile and property/liability. Moreover, there is some indication of scope diseconomies.

Keywords: *Scale Economies, Scope Economies, Cost Complementarities, Cost Function, Tunisian Insurance Sector.*

Introduction

The insurance industry has long been a topic of interest for academics researching economies of scope and scale. The impact of these economies on industry profitability and competitive dynamics has been the subject of much recent research. Insurance companies' strategies are heavily influenced by economies of scope, which involve cost savings from providing wider large insurers gain from lower costs per unit by increasing their market share, according to recent research like those by Cummins et al (2010), Cummins and Weiss (2020). In the meanwhile, Doherty and Zeng's (2022) study explores how companies might take advantage of economies of scope by offering a variety of products across their life, health, and property insurance portfolios. Additionally, Panas and Lam (2023) look at the data-driven models and technical developments that have made it possible for insurance companies to more successfully utilize scope and scale efficiencies in a market that is changing quickly. range of goods, and economies of scale, which refer to cost advantages as organizations grow in size. These studies highlight the value of operational growth and strategic diversification, demonstrating that firms (eg., insurance companies) can gain a substantial competitive advantage by skillfully utilizing these economies. As they attempt to negotiate the intricacies of international marketplaces and regulatory frameworks, both newcomers and established companies in the insurance industry must comprehend how these two economic models interact.

Over the last two decades, a lot of research has been done on scale and scope economies in the

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insurance sector, although most of it has concentrated on developed nations (USA, France, UK, Italy, etc.). Additional study focused on the banking sector (see Laura and Stefania (2001)), the insurance sector (see Cummins et al (2010), Cummins and Weiss (2020)), and the transportation sector (see Jara-Diaz and Basso (2001)). The banking sector has been the focus of a large portion of empirical study on efficiency in this area, but the insurance sector currently appears to be showing promise.

Regarding the insurance industry's performance, Eling and Luhne (2010) documented ten research from various nations, the majority of which concentrated on the United States. A survey on the use of the DEA technique in the insurance industry was presented by Kaffash et al. (2020). The authors listed 132 studies that were released between 1993 and 2018. Our main contribution to the empirical literature is that, we have not found any studies that address economies of scale and economies of scope in the context Tunisian insurers. Rubio-Misas (2022), recorded 29 research papers as well as a book chapter that deal with insurers' performance relaying on frontier efficiency and productivity methods. Th author stated that the majority of studies surveyed focus on developed countries (the United States, Germany, Italy, and Spain, etc.) Furthermore, the author only cited 7 research papers that address economies of scale and scope. This explains our empirical contribution to this literature.

Some understanding of whether the greater growth prospects will enable cost reduction can be obtained by examining production and cost conditions that have previously prevailed. After reviewing current research, this article comes to the conclusion that large, diverse institutions haven't typically had a significant cost benefit over smaller, more specialized ones started businesses would have a cost advantage over smaller, less diverse, and recently started businesses if scale and scope economies exist.

The cost structure of the insurance industry in Tunisia is a focus of current research because the country's financial sector regulation is now being modified. The economies of scale and economies of scope in the Tunisian insurance market is examined in this study using a multiproduct Translogarithmic cost function. To the best of our knowledge, this kind of empirical research has never before been conducted in Tunisia.

In this research paper, we examine if it is better for insurers to focus on a single significant market niche or to provide many lines of business.

The remainder of the paper is structured as follows: the second section presents a literature review of the mains research dealing with economies of scale and scope economies in the insurance sector. In the third section, the economies of production are introduced. In the fourth, the methodology related to scale and scope economies is highlighted. In the fifth, the data and the method for estimating scale and scope economies are described, and in the final section, the main results are displayed.

Literature Review

Few studies have examined total factor productivity in the global insurance business, according to a study of the literature. More precisely, there don't appear to be any studies on this topic in Tunisia. For instance, Berger, Humphrey, and Pulley (1996) find that there are negligible income economies of scope and minor cost economies of scope between bank deposits and loans. The findings of studies on bank mergers and acquisitions (e.g., James and Ryngaert (2001); Houston and Ryngaert (1994)) are not entirely consistent. These studies mostly look into whether a company should operate in different industries rather than inside different industrial lines.

For our article, five studies are most pertinent. In the case of U.S. life cross-sectional data, Yuengert (1993) finds no evidence of cost scope of economies.

According to Vivian and Lai's (2005) analysis of Japanese property-liability insurance data, Keiretsu enterprises appear to be more cost-effective than independent, non-specialized firms. Hirao and Inoue (2004), on the other hand, discover cost scope economies in the Japanese property-liability insurance market. The DEA bootstrapping approach is used by Cummins, Weiss, and Zi (2003) to examine the economies of scope in the US insurance market. The aggregation theory predominates for certain financial services, whereas the strategic emphasis hypothesis predominates for others, according to Berger, Cummins, Weiss, and Zi (2000). According to Berger et al. (2000), a specialist can be classified as either a life or property-liability insurer, and a joint producer can offer both types of insurance.

Cummins and Weiss (2010) examine if it is better for insurers to specialize in one form of insurance or to offer both property-liability (P-L) and life-health (L-H) insurance. They calculated efficiency separately for L-H and P-L insurance since the two lines of the insurance sector produce quite different outcomes.

In this study, we provide scale and scope economies for the insurance companies in Tunisia. We have a short panel comprising ten companies observed over the period 2014-2023. Note that these companies have more than 95% of the market share in terms of premiums or claims, then it is indicative for the industry.

Economies of Production

Scale and scope economies: state of the art

If a company's total production cost rises more slowly than its total output, then overall economies of scale are present at a production level, y, for a single product firm. Formally, scale economies at, y, are as follows:

S = (average cost)/(marginal cost).

= C(y)/yC'(y)

= AC(y)/C'(y)

Then, we say that return to scale is increasing, constant or decreasing depending on the value of S, i.e., S>1, S = 1 or S < 1.

The degree of scale economies defined throughout the whole product set at, y, in the multiproduct firm is provided by:

$$S_i(y) = \frac{C(y)}{\sum_{i=1}^{n} y_i\, C_i(y)}$$

where $C_i\,(y) = \frac{\partial LnC}{\partial Lnw_i}$

In the same manner like in the case of single product firm, returns to scale can be increasing, constant or deceasing, if S(y) is greater, equal or less than 1. We can also calculate specific economies of scale for an increase of a subset of outputs, T, holding all others outputs (N-T) constant.

Increasing output in a multi-output system might indicate either increasing volume or increasing the number of products. The behavior of costs as products grow proportionately is linked to scale economies (radial analysis). However, the influence of adding more outputs to the company's line of business on cost is linked to economies of scope. According to Panzar and Willig (1975), the degree of economies of scale, S, can be computed analytically as the inverse of the sum of cost-product elasticities.

The relative convenience of proportionate output expansions or reductions is indicated by returns to scale that are equal to, less than, or more than unity respectively. According to Panzar and Willig (1981), the degree of economies of scope (which gauge the economics of joint production) at, y, in relation to product set T is as follows:

$$SC_{T(y)} = \frac{[C(y_T) + C(y_{N-T}) - C(y)]}{C(y)}$$

For all $i \in T$ i., the vector with a zero component in place of yi is called y_T, and for all $i \in T$, the vector with a zero component in place of y_i is called y_{N-T}. Thus, the degree of economies of scope represents the relative increase in cost that would arise from splitting up the production of, y, into product lines T and N-T (Suret (1991)).

According to Atkinson and Primont (2002), a multiproduct cost function must have weak cost complementarities between each output-pair at all, y, up to, y^*, in order to exhibit overall economies of scope at, y^*,. In other words, $\frac{\partial^2 C(y)}{\partial y_i \partial yj} \leq 0$ for $i \neq j$. Cost complementarities suggest that when the quantities of all other products increase, the marginal cost of producing any one product falls. The relationship between cost and product-mix was examined using economies of scope.

Scale and Scope Economies: Estimation Procedures

According to the conventional method, scope economies are estimated using a single continuous cost function. Berger et al. (2000) stated that the traditional method could produce inaccurate results since professionals and non-specialists might employ different technologies. Therefore, we estimated the scale and scope economies for Tunisian insurers using the preferred method suggested in Berger et al. (2000). That is, we estimate the multi-inputs and multi-outputs Translog function using the specification below:

$$ln\, C_{it} = C\left(Y_{i_t}, w\right) + v_{it} + u_{it}$$

Where Y_{i_t} is the output vector, w is the input price vector, and $ln\, C_{it}$ is the logarithm of the insurer's cost. v_{it} is a random error term that is normally distributed.

In accordance with the Hughes (1988) model formulation and Schmidt and Lovell (1979) cost frontier estimation, we arrive at:

$$\ln C_{it} = \alpha_0 + \sum_{i=1}^{m} \alpha_{i_t} \ln w_i + \sum_{k=1}^{n} \beta_{tk} \ln Y_k \quad (1)$$

$$+ \frac{1}{2} \sum_{k=1}^{n} \sum_{h=1}^{n} \beta_{kh} \ln Y_k \ln Y_h + \frac{1}{2} \sum_{i=1}^{m} \sum_{j=1}^{m} \alpha_{ij} \ln w_i \ln w_j + \frac{1}{2} \sum_{k=1}^{n} \sum_{i=1}^{m} \gamma_{ki} \ln Y_k w_i + u_{it} + v_{it}$$

The following constraints on parameters satisfy the theoretical criterion that the Translog cost function be homogenous of degree one in factor prices (Brown et al (1979)):

$$\sum_{i=1}^{m} \alpha_i = 1 \qquad \alpha_{ij} = \alpha_{ji} \qquad \sum_{k=1}^{n} \alpha_{ij} = 0 \qquad \sum_{k=1}^{n} \gamma_{ki} = 0 \quad (2)$$

Shephard's lemma (Shephard (1953)) yields demand equations in share form, which are,

$$S_i = \frac{\partial lnC}{\partial lnW_j}$$

$$S_i = \alpha_i + \sum_{i=1}^{m} \alpha_{ij} \ln w_j + \sum_{k=1}^{n} \gamma_{ki} Y_k \quad (3)$$

where S_i is share equation representing the proportion of input, *i*, in the overall manufacturing costs.

Estimates of every coefficient are obtained by jointly estimating the share equations and the cost function. Since the share equation incorporates extra information on the acceptable values of those coefficients, joint estimation yields more accurate parameter estimates even though the parameters that appear in the share equation are really a subset of those in the cost equation.

It's critical to differentiate between economies of scale and economies of scope. According to Panzar and Willig (1977), economies of scale are the reduction in average costs that result from increasing the scale of production; that is, if $C(y) < C(y)$. The decreasing portion of the well-known U-shaped cost function from economic theory is represented by this definition.

Economies of scope are cost savings that come from producing a range of outputs in one company as opposed to having them produced in different companies. Economies of scope exist if $C(y_1, y_2) < C(y_1, 0) + C(0, y_2)$.

where $C(y_1, y_2)$ is the cost function for a company producing two outputs, y_1 and y_2. (Panzar and Willig (1981)), that is, if a diversified firm providing both outputs can produce them at a lower cost than specialized firms producing them separately. Cummins (2010) stated that highest proportional variation of products made possible by a proportionate variation of inputs is associated with the concept of scale. This technical attribute is translated into an economic one, specifically the way cost C changes as output Y grows proportionately. However, the economic analysis of adding new outputs to the production line is connected to the concept of scope. To put it simply, scale analysis is concerned with creating more of each component of the same set of outputs, whereas scope analysis is concerned with expanding the set of outputs produced (Panzar and Willig (1975, 1981)).

Even when companies are running at minimum average costs, or when scale economies have been depleted, economies of scope can still persist. Shareable inputs, or "inputs... procured for the production of one output, which [are] also available to aid in the production of other outputs," are the source of cost economies of scope (Panzar and Willig (1981)). On the other hand, economies of scale are mostly the consequence of distributing a company's fixed costs over a higher output volume.

According to Panzar and Willig (1977), scale elasticity is a local indicator of overall economies of scale (SL) for a multiproduct firm, and it’s given by:

$$SL = \frac{1}{\sum \frac{lnC}{lny_k}} = \frac{1}{\sum_k \beta_k} \tag{4}$$

Although changing all outputs in fixed ratios theoretically define economies of scale with numerous outputs, in reality, outputs hardly ever vary in fixed proportions. According to Baumol et al. (1988), the overall economies of scale with many outputs are therefore commonly quantified using the Translog cost function can be used to determine the cost elasticity of the ith output via the following formula:

$$\gamma_i = \alpha_i + \sum_j \ \sigma_{ij} lny_i + \sum_k \ \delta_{ik} lnw_k \tag{5}$$

Suret (1991) stated that at the pointe estimate, if $y_i = \ w_k = 1$, reduces overall economies of scale to:

$$SL = 1/\sum_i \ \alpha_i$$
(6)

Furthermore, it is possible to apply the idea of product-specific scale economies to a subset of products. At the Translog cost function's approximation point, the degree of scale economies unique to products y_1 and y can be found by:

$$SL_{kh} = \frac{\exp(\alpha_0) - \exp(\alpha_0 + \beta_k \ln \varepsilon + \beta_h \ln \varepsilon + \frac{1}{2}\beta_{kk}(\ln \varepsilon)^2 + \frac{1}{2}\beta_{hh}(\ln \varepsilon)^2}{\exp(\alpha_0)(\beta_k + \beta_h)}$$
(7)

The output-mix can adjust in tandem with output increase thanks to this strategy. If SCL > 1, there are scale economies; if $SCL < 1$, there are scale diseconomies.

We employ two of the many additional metrics that Baumol et al. (1988) proposed as markers of the existence of cost subadditivity in a multiple output function. First, scale economies unique to a given product can be quantified for every output as follows:

$$SCL_i = \frac{AIC_i}{MC_i} \tag{8}$$

where MC_i is the marginal cost and AIC_i is the average incremental cost of production I. $AIC_i$is computed as follows if a company provides two outputs, y_1 and y_2.

$$\mathrm{AIC}_1 = \frac{C(y_1,y_2)-C(0,y_2)}{y_1}$$
(9)

where *C(0, y2)* is the production cost in the case of no production of commodity 1 (i.e., y_1).

As we have seen, the following represents the extent of overall economies of scope (*SC*) at, *y*, in relation to product set T:

$$SC_T(\mathrm{y}) = \frac{C(y_T)+C(y_{N-T})-C(y)}{C(y)} \tag{10}$$

The cost of creating the entire set (*N*) is deducted from the sum of the costs of producing the sets of products (*N-T*) and (*T*) individually. The cost of manufacturing the entire set (*N*) of products is then split by this equation. If *SC* is positive (negative), then there are economies (diseconomies) of scope.

According to Suret (1991) and from the Translog function's coefficient (in the case of a firm producing five outputs, *SC* can be obtained as follows:

$$SC = \frac{C(y1,0,0,0,0)+C(0,y2,y3,y4,y5)}{C(y1,y2,y3,y4,y5)}\text{-}1$$
(11)

When SC is larger (smaller than) zero, scope economies (diseconomies) exist.

We also computed these cost complementarities because they are a necessary condition for a multiproduct cost function to demonstrate overall economies of scope. As previously stated, cost complementarities suggest that when the quantity of all other items increases, the marginal cost of producing any one product falls.

Suret (1991) stated that cross-marginal elasticities at the approximation point can be used to compute cost complementarities (CC) by:

$$CC = \frac{\partial \ln MC_i}{Z \ln y_i} = \frac{1}{\beta_k}(\alpha_{kh} + \beta_k(\beta_h - \Delta_{kh})) \tag{12}$$

Where Δ_{kh} =1 for $i = j$ and Δ_{kh} =0 for $i \neq j$.

Two items are said to be cost complementary if their cross-marginal elasticity is negative. It should be noted that if the marginal cost of producing one product decreases when it is produced in tandem with another, then there is cost complementarity between them. In accordance with Murray and White (1983), we employed the following approximation to test this condition:

$$\beta_k \beta_h + \beta_{kh} < 0 \tag{13}$$

Cost complementarities are advantageous for output combinations that meet (13). We can compute scope economies particular to a given product. As previously stated, these economies arise when the cost of producing an output in conjunction with the current combination of other outputs is lower than the cost of producing the output apart from the other outputs.

Data and Estimation Technique

Sample

In this study, we use a panel data for 10 insurance companies operating in Tunisia over the period 2014–2023. The data were collected from the insurance companies' annual financial statements.

According to Cummins and Weiss (2000), Eling and Luhnen (2010), among many others, there are three main inputs used in this field of research, namely labor, capital, and business services. Moreover, input measurement focuses primarily on three main approaches: the asset or intermediation approach, the user-cost approach, and the modified value-added approach (see Cummins and Weiss (2000) for more details). Cummins and Weiss (2000) stated that the modified value-added approach is the most widely used to study the efficiency of insurance companies or to estimate economies of scope and economies of scale since these indicators are estimated from the Translog cost function that is based essentially on a well definition of outputs, inputs and their prices. It assumes that insurers create added value by pooling risks, collecting premiums from policyholders, and redistributing the majority of the proceeds to policyholders who have incurred losses.

In fact, estimating economies of scale and economies of scope is sensitive to the choice of variables used (inputs and outputs). Therefore, careful selection of variables is essential in this case.

Output and Cost Measurement

In order to estimate scale and scope economies we use insurance claims as a proxy for outputs (Micajkova (2015), Tayebi et al (2024)). For this reason, we adopt five outputs for five lines of business chosen depending on the availability of data, i.e., we have Automobile, fire, health, life and various risks.

Input Quantities and Prices

The inputs utilized by Tunisian insurance companies are the same since they use the same technology of production. The two types of inputs used by insurers are essentially capital and labor. Due to technological advancements in insurance manufacturing, manpower (i.e., labor) is typically the most important input (Routledge and Tuckwell (1974); Hardwick (1997)). The amount of labor is measured by the number of employees per companies. The ratio of personnel costs to total number of employees is used to calculate the price of labor. Regarding the capital factor is measured by equity capital. At constant price, the ratio of operating costs to technical provision can be used as a measure of the price of capital.

Model and Estimation Technique

Our empirical analysis considers a two-factor cost model of the type: capital (K), labor (L). The parameters of the Translog cost function are estimated from the system of equations comprising the cost function (1) and the share equations (3) by imposing the regularity constraints described previously (2). Some studies estimate only the share equations (Field and Grebenstein (1980)). But this has the disadvantage of not estimating some parameters of the cost function (1) that are necessary for calculating, for example, the degree of returns to scale and the rate of technical progress.

The joint estimation method of the cost function and the share equations is the most widespread in the literature because it improves the quality of econometric regression: the number of degrees of freedom is increased since more data is available to estimate the same number of coefficients.

The system composed of equations (1) and (3) constrained to respect the regularity conditions is not estimable because the variance-covariance matrix is singular (non-invertible). Indeed, the sum of the shares being equal to unity, the sum of the perturbations of the share equations is zero. To avoid this problem, the most common practice in the literature consists of eliminating, arbitrarily, one of the share equations, Christensen and Greene (1976) having demonstrated that the estimation results are independent of the eliminated share equation. Here we choose to eliminate the share of capital. From then, the estimated system consists of the cost function and the equation of the share of labor, then our system of equation is composed by two equations, i.e., the cost function equation and the labor share equation.

The parameters of this system of equation is estimated using a panel of Tunisian insurance companies in order to calculate scale and scope economies. The SUR (Seemingly Unrelated Regressions) method introduced by Zellner (1962) was used because it corrects for the heteroscedasticity of the residuals characteristic of panel data estimations and for the simultaneous correlation between the residuals of the different equations in the system. Here, this correlation arises from the accounting relationship between the shares, i.e., their sum is equal to one.

We estimate the degrees of scale and scope economies by product, by product-pair, and by product group for each year and for each set of companies using equations (6), (8), (10) and (12).

Indeed, when estimating the equations (6) to (12), the sign and magnitude of the coefficients indicating scale and scope economies seem to be essentially a function of the value chosen to replace the null values in the data set. This may help to partially explain the contradictory findings of earlier research.

Results

Estimation of the Cost Function

The scope economies analyses are conducted in two different ways. First, we estimate the classic Translog cost function for the specialized and non-specialized. The estimated scope and scale economies for each insurer are then determined using the estimated coefficients. Our method greatly expands on the standard examination of scope economies in financial institutions, which is restricted to displaying scope economies computed using the date's mean or median. One noteworthy finding is that, when considering all inputs and outputs, specialized are statistically smaller than non-specialized. For the sample, the models described in equations (1) and (3) have been estimated.

According to Table 1 bellow, we conclude that the majority of the explanatory factors exhibit statistically significant effects with the anticipated signs. The price of the input factors is an exception. The negligible coefficients of capital prices imply that variations in input costs are not the primary cause of cost disparities among insurance companies. Furthermore, the cost function coefficients computed for 2014-2023 using total costs and both output measures are displayed in Table 1. We may conclude that the choice of output measure appears to be irrelevant for cost function estimation because the results are fairly comparable in terms of the signs and significance levels of the coefficients. Specifically, in contrast to other models, this model indicates that the output interaction term (LnY_1*LnY_2) has a negative and not significant impact on costs.

The square terms' coefficients are statistically significant and positive. This suggests that the cost function is convex, consistent with increasing marginal costs, which is a typical assumption in economic theory. These findings imply that scope and scale economies exist at the majority of output levels. The estimates also demonstrate a well-behaved variance in that both scale and scope economies decline (rise) when outputs increase (reduce), and the cost elasticity or factor share is positive for labor input price of a credible amount close to 0.432 (i.e., the labor share). Limiting the estimates to companies with only positive results might be an alternate approach. But given that fully integrated companies may be a selection of companies because they take advantage of economies of scale and may have lower fixed costs.

Variables	**Coefficients**	**St-error**	**T-stat**	**Significance**
Ln(p1)	0.433	0.394	1.097	0.272
Ln(Y1)	-1.667	0.809	-2.061	0.039
Ln(Y2)	-0.907	0.735	-1.234	0.217
Ln(Y3)	0.686	0.530	1.294	0.196
Ln(Y4)	1.435	0.634	2.264	0.024
Ln(Y5)	-0.030	0.656	-0.045	0.964
Ln(Y1)* Ln(Y1)	0.050	0.020	2.563	0.010
Ln(Y2)* Ln(Y2)	0.310	0.066	4.672	0.000
Ln(Y3)* Ln(Y3)	-0.060	0.032	-1.900	0.057

Ln(Y4)* Ln(Y4)	0.083	0.034	2.438	0.015
Ln(Y5)* Ln(Y5)	0.286	0.019	1.504	0.133
Ln(Y1)* Ln(Y2)	-0.056	0.070	-0.805	0.421
Ln(Y1)* Ln(Y3)	0.052	0.040	1.295	0.195
Ln(Y1)* Ln(Y4)	-0.046	0.046	-1.000	0.317
Ln(Y2)* Ln(Y3)	-0.240	0.065	-3.684	0.000
Ln(Y2)* Ln(Y4)	-0.254	0.080	-3.164	0.001
Ln(Y2)* Ln(Y5)	-0.128	0.057	-2.237	0.025
Ln(Y3)* Ln(Y4)	0.213	0.045	4.766	0.000
Ln(Y3)* Ln(Y5)	-0.075	0.038	-1.992	0.046
Ln(Y4)* Ln(Y5)	0.054	0.048	1.137	0.255
Ln(p1)* Ln(p1)	0.173	0.043	4.054	0.000
Ln(Y1)* Ln(p1)	-0.100	0.052	-1.935	0.053
Ln(Y2)* Ln(p1)	0.139	0.057	2.451	0.014
Ln(Y3)* Ln(p1)	0.165	0.049	3.340	0.001
Ln(Y4)* Ln(p1)	-0.250	0.036	-6.87	0.000
Ln(Y5)* Ln(p1)	-0.093	0.040	-2.334	0.020
Constant	12.993	5.672	2.291	0.022

Table 1: Estimation of the Cost Function and Share Equation of the Entire Sector

Cost complementarities		
Automobile vs health		-1.456
Automobile vs v.risks		-1.091
Automobile vs fire		-2.437
Automobile vs life		0.205
Health vs v.risks		-0.860
Health vs fire		-1.554
Health vs life		-0.101
v.risks vs fire		1.196
v.risks vs life		-0.100
Fire vs life		0.120
Product-specific scale economies: SL		
Automobile		1.362
Health		1.650
v.risks		1.440
Fire		2.023
Life		1.550

Table 2: Cost Complementarities and Product-Specific Scale Economies for Tunisian Insurance Companies

The model calculated for the entire sample is deemed to be fairly satisfactory, with a standard error of 13, 83% and an R^2 of 0.990. Given its value, this does not appear to be the case here. The Durbin Watson statistics give an approximate measure of specification errors resulting from the exclusion of some scale-related variables because the companies in the sample are arranged according to their premium income. Only fire was consistently non-significant among the five explanatory factors used. Hence, specialization in mandatory auto and other transportation-related insurance as well as the distribution channels used are thought to have a major impact on insurance companies' prices.

Increasing one activity can typically be lucrative for the company, according to positive coefficients on the degrees of product-specific and dual-product economies of scale. Only if the other product lines are unaffected by this action is this true. For every gear, these coefficients are comparable. The lack of scope economies is confirmed by the cost complementarity tests. The cost complementarity between items 1 and 2 is particularly noteworthy. Economies of scale in a multiproduct context are those cost savings that occur when all outputs and insurance lines are grown proportionately while keeping all input prices constant. When there are cost savings to be obtained by producing several outputs together, there are economies of scope. There are no cost complementarities between the two primary product lines—automotive and property/liability.

Compared to other industrial and service sectors, the analysis of the link between average costs and operational scale is more complex in the insurance industry for two main reasons. First of all, it is not immediately apparent if focusing solely on average prices, or even if one should look at average costs at all, is a good way to determine the economic consequences on an insurance company that may be related to size. A large insurance firm might be able to earn a larger return than a small one if capital markets are imperfect, but we would completely miss any such influence if we merely looked at the income statement's cost data. The concept of size that should be used is the second challenge we encounter when examining the impact of growth in insurance companies. The AUTO variable's negative coefficient, which suggests that mandatory auto insurance should have an average cost that is less than the total non-life business, is a startling aspect of our findings.

Conclusion

The measurement of economies of scale and scope in the Tunisian insurance sector is the primary goal of this study. We demonstrate that there are notable economies of scale for insurance companies using data from 2014 to 2023. However, there is only a year's worth of data supporting the presence of economies of scale in the Tunisian insurance industry. Moreover, neither notable economies of scope nor systematic evidence of substantial cost complementarities between insurance products are found. There are no cost complementarities between the two primary product lines—automotive and property/liability. The absence of significant tests for the existence of scale and scope economies in earlier research makes it impossible to compare our empirical findings with those of other studies.

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