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Determinants of profitability of life and non-life insurance companies: evidence from Ecuador

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Abstract

Purpose – The purpose of this paper is is to identify the main determinants of insurance profitability on life and non-life segments to obtain which variables affect in each market of the Ecuadorian insurance sector.
Design/methodology/approach – The authors use a large panel data set with financial information from 2001 to 2017 and estimate the determinants through a panel corrected standard errors regression.
Findings – The authors found that net premiums, technical reserves, capital ratio and score efficiency are micro-determinants in the life insurance sector, whereas in the non-life sector, the micro-determinants include also claim level and liquidity ratio; moreover, the authors found that HHI is a determinant of profitability only in the life insurance. Among the macro determinants set, the authors found that the interest rate has also a significant impact both in the life and non-life insurance.
Originality/value – The authors analyze a dollarized emerging country, which is the first time in this kind of studies. The authors also include the structure-conduct-performance and relative market power paradigm as well as the ES hypothesis, calculated through the data envelopment analysis, as determinants of insurance profitability. Finally, this is the first research to examine the determinants of profitability in Latin American and Caribbean insurers.

Keywords DEA, Emerging country, Concentration analysis, Insurance profitability
Paper type Research paper

1. Introduction

Insurance is one of the sectors that provide financial services such as banking industry; these two sectors are involved in the risk market and play a fundamental role in the economic growth. On the one hand, the banking sector promotes the sale of risk from the granting of loans to economic agents and where it obtains profits from an interest rate, while the insurance industry absorbs that risk contracted by the bank with its lenders and also makes investments to maintain the financial stability in the long run. In addition, this industry incurs in other risks that are not necessarily related to the banking system but directly to firms and individuals that wish to minimize their own risk of loss of any type asset or health. In this line, the risk absorption role of insurers promotes stability in the financial markets and provides a "sense of peace" to economic entities (Akotey, Sackey, Amoah and Manso, 2013).

The current business world without insurance companies is unsuitable because risky businesses have not a capacity to retain all types of risk that they are faced during operations (Ahmed *et al.*, 2010). This undoubtedly helped insurance firms to continue operating and making profits through their insured, although as mentioned Hardwick and

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Adams (2002) the insurance industry has been operating in an increasingly competitive environment spurred on by the World Trade Organization. Also Gardner and Grace (1993) called that the insurance industry responses include innovations in product design, a movement from protection to vestment-oriented product writings, heightened level of merger and acquisition activity, the demutualization of a few large insurers and the serious financial problems and insolvencies of others.

In this sense, Charumathi (2012) argues that a well-developed and evolved insurance industry is a boon for economic development as it provides long-run funds for infrastructure development of every economy; this is because it helps firms to continue their operations without worrying about an extraordinary event that limits their production capacity. Indeed, without growth, an insurer may not garner the business volume necessary to ensure the collective pooling of insurance risks under the law or large numbers upon which the insurance operation relies for this reason the profitability of the insurer determines to large extent its ability to invest and growth (Greene and Segal, 2004).

Insurance profitability is related to the firm internal conditions or microeconomic factors and to macroeconomic factors, and also to industry-related factors which refer to the influence of variables that are not only the product of managerial decisions such as the concentration index and firm market share (Athanasoglou *et al.*, 2008; Bourke, 1989; Tipurić *et al.*, 2008). Therefore, knowing clearly most of the variables that influence the insurance industry is not only important for the institution *per se*, but also for public policy makers involved in the financial system such as central banks, supervisory institutions of financial sector and also the government as the main stakeholder in economic growth.

In this context, the global volume of gross premiums is expected to continue growing after 2016, driven by strong growth in emerging markets; particularly the participation of Latin American and Caribbean (LAC) in the global insurance industry has been increasing steadily given that in 1980 the market share of this region was 2 percent but in 2016 this participation increased to 3.1 percent; nevertheless, this trend has been slowed only in the periods of economic and financial crises that have affected this region (MAPFRE Economic Research, 2017).

Ecuador since 2006 had presented positive growth rates in the insurance industry, driven by the growth of life and non-life insurance segment. However, in 2015 this industry showed a decrease of −2.2 percent that was worsened (−2.8 percent) in 2016 (MAPFRE Economic Research, 2017), due to the difficult economic situation faced by the country after to the fall in the oil price and the appreciation of the dollar. Despite this situation, the life insurance segment had a growth of 7.4 and 14.3 percent, respectively, while the non-life insurance segment was the most affected by the situation in the country. In 2017, this industry recovered and had a grow of 0.8 percent over the previous year (SCVS, 2018), due in turn to the improvement of the country's economic performance, and again influenced by life insurance that grew by 7.8 percent over the previous year.

The insurance industry is divided into two main segments: life insurance firms and general or non-life insurance firms. In Ecuador, in recent years, the gross written premiums of these two groups have been behaving differently. While the life insurance segment has been growing, the non-life segment has come in a nosedive. These two markets, although belonging to the same industry, operate with different and specialized products that could be affected in different ways by microeconomic, industrial and/or macroeconomic variables (MAPFRE Economic Research, 2017; OECD, 2018).

There is a large amount of empirical literature that addresses the microeconomic and macroeconomic determinants on profitability of the banking industry. However, there is very little literature that addresses the factors that determine profitability in the insurance industry. Moreover, most of the insurance research has focused on the life insurance segment, leaving the non-life segment aside. Additionally, these investigations have been carried out mostly for developed economies and very few for emerging economies, and even less so for LAC.

The Ecuadorian insurance industry is not concentrated and it is one of the countries in LAC with this lowest indicator, so this sector is considered highly competitive; nevertheless, by separating the segments in life and non-life, the life segment is more concentrated than the non-life segment. Despite this, the penetration level of the insurance industry is below the average of LAC with a rate of 1.7 percent in 2016, showing that the participation of this sector in the economy is not as strong as in other countries with similar characteristics. In addition, the maturity of this sector grew until 2012, and after that it stagnated until 2014 where it began to return to its trend, although this maturity of the industry has been driven by deepening and not by the penetration rate. Finally, in Ecuador, there is no solid culture regarding insurance contracting, which is reflected in the low level of risk prevention although it is a country with high delinquency rates, homicide and geographically located in the so-called "fire belt" that is an earthquake-prone location, where the earthquake of April 16, 2016 had already taken effect and leaving great losses (MAPFRE Economic Research, 2017).

On this background, this study examines the microeconomics, industry-related and macroeconomics determinants of operational profitability in the Ecuadorian insurance industry over the period 2001–2017. We use the net premium, technical reserves, liquidity, leverage, equity-to-assets (ETA) ratio, capital intensity, labor intensity, total claims payed, technical efficiency (DEA methodology) and size as independent variables in the group of microeconomic determinants. In the industry-related determinants, we use some concentration index such as Herfindahl–Hirschman index (HHI) according to the structure-conduct-performance (SCP) hypothesis and market share to test the relative market power (RMP) paradigm. Finally, for the macroeconomic determinants we use the inflation, active interest rate, financial system total loans and the cyclical output in order to identify the relationship between business cycle and insurance profitability. Our main objective is to identify the principal determinants of insurance profitability on life and non-life segments to obtain differences on those variables affecting each market using a panel corrected standard errors (PCSE) method.

Our paper contributes to the existing empirical literature in three ways. First, we analyze a dollarized emerging country, which is the first time in this kind of studies. Second, we include the SCP paradigm, RMP paradigm and the efficient structure (ES) hypothesis as determinants of insurance profitability in line with Alhassan *et al.* (2015) but we also implement the data envelopment analysis (DEA) to contrast the results. Finally, to the best of the author´s knowledge, this is the first research to examine the determinants of profitability in LAC insurers.

The rest of the document is as follows: Section 2 provides a review of the relevant literature, Section 3 reviews the methodology and materials; Section 4 shows the empirical results and, finally, Section 5 shows the conclusion and discussions section.

2. Literature review

The theoretical basis for analyzing the profitability determinants on businesses from different economic sectors has been formulated around the industrial organization literature that comprises two main hypotheses which study the relationship between performance and competition through structural models. On the one side, the SCP paradigm proposed by Bain (1951) suggests that higher market shares, which create a collusive environment, can result in higher monopolistic profits. In this sense, the SCP paradigm implies a positive relationship between market shares and profitability. On the other hand, the ES hypothesis, which was initially developed by Demsetz (1973) and Peltzman (1977), suggests that efficient firms generate higher sales through lower pricing, resulting in higher market shares.

Therefore, higher profits were reached by firms for being efficient and not because of a collusive anticompetitive behavior. Several studies addressed these two hypotheses in the search of finding businesses profitability determinants in different economic sectors.

The theory around profitability determinants in the financial sector has been mostly developed for the banking industry. This topic was initially studied in developed countries, such as the USA (Edwards and Haggestad, 1973; Heggestad and Mingo, 1976), Canada, Western Europe and Japan (Short, 1979), evaluating the impact of concentration level in the industry over the banks' performance. The structure–performance relation in the banking sector was the main objective of these previous studies. The ES hypothesis was also studied by some authors as part of the market structure impact on banking profitability (Berger, 1995a; Smirlock, 1985).

Likewise, several studies included the analysis of internal and external factors, other than market structure variables, affecting profitability in the banking sector (Short, 1979; Bourke, 1989; Molyneux and Thornton, 1992; Goddard *et al.*, 2004; Pestana *et al.*, 2007; Albertazzi and Gambacorta, 2009; Shehzad *et al.*, 2013), which have also been used in the insurance industry as profitability determinants specially in developed countries (Gardner and Grace, 1993; Bajtelsmit and Bouzouita, 1998b; Browne *et al.*, 2001). Though this analysis has also been broadened for developing economies, there is little evidence for the banking sector in LAC countries (Brock and Rojas-Suarez, 2000; Chortareas *et al.*, 2011; Guillén *et al.*, 2014; Jara-Bertin *et al.*, 2014), and non-existence evidence for the insurance industry in the same region. The results obtained are diverse without reaching a consensus about which specific variables determine profitability. Also, researches within the insurance industry have focused on life insurance, leaving aside the non-life segment.

The most widely used dependent variable to measure profitability both in the banking and the insurance sectors is the return on assets (ROA) ratio (Greene and Segal, 2004; Alhassan *et al.*, 2015). However, some authors prefer to test different measures, for example, Petroni (1992) suggests that profitability financial indicators, such as ROA, are subjected to inter-period actuarial smoothing via manipulation particularly in terms of claims loss reserves because of managerial incentives (Grace, 1990) such as the minimization of tax payments and smoothing fluctuations in reported income.

In the same line, Bourke (1989) compares different measures of profitability such as return on capital, ROA and value-added return on total assets. Also, Akotey *et al.* (2013) compares three profitability measures: ROA, investment income and the underwriting profits. On the other hand, Choi and Weiss (2005) employ as a measure of profitability the underwriting profit margin considering the discount of incurred losses. Adams and Buckle (2003) use as dependent variable the ratio of net investment income to net premiums arguing that it summarizes performance in the two major economic activities of insurance firms such as investment management and the underwriting of business risks.

One of the earliest researchers in the insurance industry that studied the SCP paradigm was Joskow (1973) who finds that the combination of state regulation, cartel pricing and other legal peculiarities has resulted in the use of an inefficient sales technique. In this line, Joskow and McLaughlin (1991) found that the major barrier to effective competition is state rate regulation rather than anticompetitive behavior. Chidambaran *et al.* (1997) also studied this hypothesis and found evidence in favor concluding that the claims-and-expense-adjusted price of insurance tends to be higher when the market of a specific line of insurance is more concentrated. Likewise, Bajtelsmit and Bouzouita (1998a) found a positive and significant impact of concentration on profitability for combined liability and physical damage lines in private passenger automobile insurance. Also, Pope and Ma (2008) examined the SCP paradigm and found evidence in the support of this hypothesis when the levels of liberalization in the economy were low. Moreover, Bajtelsmit and Bouzouita (1998b) found that US states with higher levels of concentration have higher average profit margins in the commercial automobile insurance lines; this conclusion is in line with the idea that large insurers have significant cost advantages over small insurers, because of economies of scale or scope, capacity, service provision or other factors.

On the other hand, many studies have been done analyzing the relation between efficiency and profitability in the insurance industry. Choi and Weiss (2005) examine the relationships among market structure, efficiency and performance in US property-liability insurers over the period 1992–1998 using data at company and group levels, and found that cost-efficient firms charge lower prices and earn higher profits, in conformance with the ES hypothesis; in addition, Berry-Stölzle *et al.* (2011) analyze the property and liability insurance industry in 12 European countries from 2003 to 2007 and found that more cost and revenue efficient insurers charge lower prices than their less efficient counterparts, whereas other authors have not found evidence in the favor of ES hypothesis (Bajtelsmit and Bouzouita, 1998a; Weiss and Choi, 2008). Overall, the results obtained to determine if the most efficient insurers and the level of concentration affect the firm profitability have not had a consensus.

2.1 Profitability determinants

Microeconomic, industry-related and macroeconomic factors have been analyzed in previous studies as determinants of banks' and insurers' profitability. The evidence is limited to developed countries and scarce in emerging countries. Table I shows a non-exhaustive list of empirical research works in many countries that have studied the microeconomic and macroeconomic factors that affect the profitability of the insurance industry.

In line with Table I, Akotey *et al.* (2013) frame three-level factors of profitability determinants (micro, macro and meso factors) defining the micro factors as firm-specific factors such as size, capital, efficiency, age and ownership structure; the macro factors as the variables that do not depend on the insurance business, such as inflation, gross domestic product (GDP) growth, population growth, interest rate and market growth; and the meso factors as the variables related to the influence of support-institutions such as regulators. In Table I, we show the different effects of micro and macroeconomic determinants on insurance profitability that the empirical literature provides. The previous studies do not show a consensus of how and what variables affect the insurance profitability in many countries.

The results show that the firm size is one of the most variables used as an internal factor that affects profitability in this sector, although this variable is used to test the SCP hypothesis, research works also introduce this variable to test economies or diseconomies of scale in the market such as Alhassan *et al.* (2015). Efficiency is often used to test the ES hypothesis; many authors suggest that if an insurance firm is more efficiency, this would increase the profitability and also the market share. Risk is other important variable as insurers with high-underwriting risk would be less profitable, because the firm not be enough to cover for losses incurred under the policies underwritten; nevertheless, Ahmed *et al.* (2010) found a positive relationship of risk and profitability, different from what was found by Alhassan *et al.* (2015).

As shown in Table I, most of the studies use leverage as microeconomic determinant of profitability, the reason is because this variable reflects insurance firms ability to manage theirs economic exposure to unexpected losses (Charumathi, 2012). The results also suggest that there are no consensuses about the impact of leverage on profitability. Adams (1996) found that leverage was positive related to insurance profitability in New Zealand, Adams and Buckle (2003) and Akotey *et al.* (2013) also found a positive relationship between leverage and profitability in the Bermuda and Ghana insurance market, respectively; however, Charumathi (2012) and Ahmed *et al.* (2010) found an inverse impact of leverage and profitability.

Liquidity is other ratio that is used as microdeterminant of insurance profitability because it is the ability of the insurers to fulfill their immediate commitments to

Author	Country	Period	Submarket	Micro-determinants	Macro determinants
Alhassan *et al.* (2015)	Ghana	2007–2011	Non-life	Efficiency (+), leverage (+), risk (–), HHI (+)	Inflation (–)
Alhassan *et al.* (2015)	Ghana	2007–2011	Life	Efficiency (+), leverage (+), risk (–), HHI (–), CR4 (–), size (+)	Inflation (–)
Akotey *et al.* (2013)	Ghana	2000–2010	Life	Gross written premiums (+), leverage (+), claims (–), expenses on management (–), reinsurance (+), size (+)	Interest rate (+)
Olaosebikan (2013)	Nigeria	2004–2009	Micro-life	Reinsurance (–), product mix (–)	Interest rate (+)
Ahmed *et al.* (2011)	Pakistan	2001–2007	Life	Leverage (–), size (+), risk (+)	
Charumathi (2012)	India	2008–2011	Life	Size (+), liquidity (+), leverage (–), premium growth (–), equity capital (–)	
Choi and Weiss (2005)	USA	1992–1998	Non-life	Concentration (+), cost scale-efficiency (+), revenue scale-efficiency (+), revenue X-efficiency (+), advertising intensity (+), reinsurance ceded (+), reinsurance assumed (–), mix of business (–)	Market growth (+), regulation (–)
Shiu (2004)	UK	1986–1999	Non-life	Underwriting cycle (–), reinsurance dependence (–), liquidity (–)	Unexpected inflation (–), Interest rate change (–), interest rate level (+)
Chen and Wong (2004)	Asian countries		Life	Size (+), investment performance (+), change in asset mix (–), change in product mix (–)	
Chen and Wong (2004)	Asian countries		Non-life	Size (+), investment performance (+), liquidity (+), surplus growth (–), combined ratio (–), operating margin (+)	
Bajtelsmit and Bouzouita (1998a)	USA	1984–1992	Non-life	Delay (+), HHI (+), wages (+)	Population growth (+), interest rate (+)

Source: Authors

Table I. Empirical evidence: micro–macro determinants of insurance profitability

policyholders without having increase profits, in this sense a positive relationship with profitability is expected; nevertheless, the results are mixed in the literature. Gross written premium, reinsurance, premium growth and equity capital are other important internal factors that can affect the profitability of insurance; these variables are not the only ones that have been studied to relate them to profitability, in fact there are other variables that have to do with the cost structure of the company such as spending on salaries, administrative expenses, payment of claims, among others.

In terms of the industry level, the empirical evidence has focused in the relationship between market concentration such as HHI, CR4, market share and insurance profitability, in concordance to the SCP hypothesis. Nevertheless, some negative relationships between these two variables were found, contrary to what the SCP hypothesis suggests, such as Ippolito (1979) and Cummins and Harrington (1987).

Turning to the macroeconomic determinants of insurance profitability, the most common variables used as determinants are inflation, economic growth as the GDP, interest rate and population growth. The evidence suggests a negative relationship between inflation and insurance profitability and there is a clear consensus in this conclusion. However, the results between interest rate and profitability are varied and some authors found a positive relationship, others have found a non-existent impact and some suggest a negative relationship with profitability. Finally, the previous studies on insurance profitability determinants have not found a relationship between GDP and profitability, although Haiss and Sümegi (2008) suggest that there is a correlation between insurance investments and GDP growth for EU-15 countries with mature financial markets and a short-run connection between non-life expenditure and GDP for the emerging-market-type central and eastern Europe countries.

3. Data and empirical methods

In this section, we discuss the empirical strategy used to evaluate the relationship of microeconomic, industry-related and macroeconomic factors on the profitability of life and non-life insurers. First, we describe the data used on the present study followed by a description of the DEA technique used to estimate the technical efficiency of an insurance firm. Then, we provide a description of the empirical model as well as the variables chosen for each type of factors.

3.1 Data structure

Our study uses official financial information provided by the Superintendency of Companies, Securities and Insurance (SCVS)[1] which is the institution in charge of controlling the insurance market in Ecuador. The insurers are required to provide monthly cumulative financial reports to this institution. We have considered the information provided to December of every year over a period of 17 years. We employ an unbalanced panel data set that includes information obtained from financial statements of 29 life and 38 non-life insurance firms over the period 2001–2017. Table II summarizes the number of insurance firms included in the data set by year for life and non-life insurance sectors.

	Life insurance			Non-life insurance		
Year	*n*	%	Cum	*n*	%	Cum
2001	27	6.25	6.25	28	5.36	5.36
2002	27	6.25	12.50	28	5.36	10.73
2003	27	6.25	18.75	29	5.56	16.28
2004	27	6.25	25.00	29	5.56	21.84
2005	27	6.25	31.25	29	5.56	27.39
2006	26	6.02	37.27	32	6.13	33.52
2007	26	6.02	43.29	33	6.32	39.85
2008	26	6.02	49.31	33	6.32	46.17
2009	27	6.25	55.56	33	6.32	52.49
2010	26	6.02	61.57	35	6.70	59.20
2011	26	6.02	67.59	35	6.70	65.90
2012	27	6.25	73.84	34	6.51	72.41
2013	25	5.79	79.63	30	5.75	78.16
2014	23	5.32	84.95	28	5.36	83.52
2015	23	5.32	90.28	29	5.56	89.08
2016	22	5.09	95.37	29	5.56	94.64
2017	20	4.63	100.00	28	5.36	100.00

Source: Superintendency of Companies, Securities and Insurance (SCVS)

Table II. Number of insurance firms included in the panel data set by year.

The data of the macroeconomic conditions in the Ecuadorian economy were obtained from the Central Bank of Ecuador[2].

According to the variables included in our data set, we have the factors define in Table III divided into three types of aspects: microeconomic, industry-related and macroeconomic determinants. We also include the expected sign of the relationship we hope to find as a result of our estimation. The choice of the independent variables is based according to the theoretical relationship exposed in the insurance and bank literature in concordance with the results of the correlation analysis presented in Appendix 1.

The ROA ratio has been the most widely used profitability measure in this kind of studies (Greene and Segal, 2004; Alhassan *et al.*, 2015). The starting point of our analysis focuses on the usage of ROA as a dependent variable to estimate the determinants of profitability in insurers firms. However, we consider important to test different measures of profitability because ROA is not a sufficient one. Petroni (1992) suggests that profitability financial indicators, such as ROA, are subjected to inter-period actuarial smoothing via manipulation particularly in terms of claims loss reserves because of managerial incentives (Grace, 1990) such as the minimization of tax payments and smoothing fluctuations in reported income.

According to this, Adams and Buckle (2003) use as a dependent variable the ratio of net investment income to net premiums arguing that it summarizes performance in the two major economic activities of insurance firms such as investment management and the underwriting of business risks. Choi and Weiss (2005) employ as a measure of profitability

Variable	Definition	Expected relation	Type of factor
Dependent variable			
ROA	Return on assets = net income/assets		Profitability measure
ln(INV)	ln(investment income)		Profitability measure
ln(PROF)	ln(profit-after-taxes)		Profitability measure
Independent variables			
ln(NP)	Natural logarithm of net premium	+	Micro determinant
ln(TR)	Natural logarithm of technical reserves	+	Micro determinant
LIQ	Liquidity = current assets/current liabilities	+	Micro determinant
LEV	Liabilities/Equity	−	Micro determinant
ETA	Equity/Assets	−	Micro determinant
CI	Capital intensity = fixed assets/net premium	+	Microdeterminant
LI	Labor intensity = salary expenses/net premium	+	Micro determinant
ln(CL)	Natural logarithm of Claims	−	Micro determinant
EFF	Technical efficiency (DEA)	+	Micro determinant
Size	1: firms with market share above the mean of the year. 0: firms with market share below the mean of the year	+	Micro determinant
HHI	Herfindahl–Hirschman index	+	Industry-related
MS	Market share	+	Industry-related
ln(CV)	Natural logarithm of credit volume		Macro determinant
CYCL	Cyclical output	+	Macro determinant
INF	Annual inflation	−	Macro determinant
IR	Annual placement interest rate	−	Macro determinant
Multinational	1: if the firm has 45% or more of foreign investment 0: if the firm has less than 45% of foreign investment	+	Control
Bank related	1: if the insurance relates its business with any bank of the Ecuadorian financial system 0: if the insurer is not business-related with any bank in the Ecuadorian system	+	Control

Source: Authors

Table III.
Definition of the dependent and explanatory variables used in the empirical model

the underwriting profit margin considering the discount of incurred losses. Akotey *et al.* (2013) also compare three profitability measures: ROA, which is included to measure the profitability of an insurer in relation to gross premiums written by a company; investment income, to evaluate the effectiveness of the investment portfolio of insurers; and the underwriting profits to measure the efficiency of the core activities of the insurer. For this reason, we have tested our estimation through the usage of two additional dependent variables: income from investments and profit after tax payments:

- ROA: this financial ratio captures the ability of the company in terms of profit generation related to the total amount of assets, so it measures the operational efficiency of the company in terms of managing its assets. In other words, it explains how effective the firm is generating earnings using its available assets.
- Income from investments: it represents the earnings from investment activities of the insurance firm. It is considered an output of the insurance firms like earnings by premiums. The investment performance is a critical factor for the financial stability of an insurer.
- Profit-after-taxes: it captures the underwriting results of the firm. This is a key component of profitability because it represents the earnings from the total operating activity.

Among the micro-determinants, we include the following variables:

- Net premiums: this variable captures the income from the core operation of the insurance companies. The net premium is the premium after deducting the reinsurance ceded or reinsurance costs. We expect to obtain a positive relationship with profitability explained by the fact that an increase of this variable will led to an increase in ROA because the firm will increase its profit if it generates more income from the core operation of the business.
- Technical reserves: we include technical reserves or provisions as a financial guarantee of good performance. This variable accounts for the expected future loss, meaning the estimated liability for incurred claims.
- Liquidity ratio: because of the uncertainty the insurance firms perceive, related to the timing, frequency and severity of insurance claims or benefits, it is very important for them to plan their liquidity carefully to achieve higher profitability. This ratio captures the capacity of the insurance firm to face short-term liabilities as they fall due. The literature is ambiguous about the relationship expected of liquidity and profitability. Some suggest that there is a positive relationship with profitability and solvency of an insurer (Lee and Urrutia, 1996; Chen and Wong, 2004; Charumathi, 2012); others mention that there is negative relationship (Ahmed, *et al.*, 2010; Carson and Scott, 1997) between profitability and liquidity because higher levels of liquid assets, translated into a higher liquidity ratio, usually generate costs of maintenance not adding value to the company and instead discouraging to raise external funds.
- Leverage ratio: this variable is included in our analysis to consider the ability of an insurer to deal with unexpected losses. Some authors have found a positive relationship between profitability and financial leverage, meaning that increasing their liabilities or decreasing their equity increase their profitability because high-leveraged institutions can pass higher returns to its shareholders, also it obliges managers to generate more cash flow to meet their obligations (Alhassan *et al.*, 2015; Akotey *et al.*, 2013; Adams and Buckle, 2003), whereas other has found a negative relationship associated with the hypothesis that higher levels of profitability are achieved when the insurers or banks deal with lower levels of leverage explained by

the idea that having higher amount of capital allows the company to develop more projects and manages less costs of agencies – in terms of maintaining high liabilities – such as the cost of monitoring and control that usually leads to underinvestment incentives (Al-Kayed *et al.*, 2014; Hutchison and Cox, 2007; Charumathi, 2012).

- ETA ratio: this ratio is also known as the capital ratio which examines the risk behavior of financial institutions. Through this variable, we control the capital structure of the insurance firm. In this line, the degree of capitalization tends to have an inverse relationship with profitability since greater capital induces financial institutions to take less risk and consequently earn less profit Chortareas *et al.* (2011); also, Goddard *et al.* (2010) mention that the opportunity cost of having high levels of capital tends to discourage shareholders return. However, on the other hand, some authors state that this relationship might be positive (Athanasoglou, *et al.* 2008; Lee and Hsieh, 2013) particularly once the assumption of one-period model of perfect capital markets with symmetric information is relaxed as Berger (1995b) mentions; for example, Chortareas *et al.* (2011) also mention that higher capital ratios may also reflect lower risk of bankruptcy, reflected in lower funding costs, which tend to increase incentives from part of the shareholders to monitor management.
- Capital and labor intensity: the inclusion of these variables as part of the micro-determinants set is a contribution to the insurance and banking literature because they have been scarcely included in previous studies. The capital intensity is included as the ratio between fixed assets and net premiums. This ratio accounts for the weight of total fixed assets in relation to the operative earnings of the insurance firms, so it represents the amount of fixed assets used for each dollar generated in the firm. On the other hand, the labor intensity ratio is built from dividing salary expenses to net premiums. This variable represents the proportion of labor used for each dollar generated in the operational activities of the firm. We have used the wage bill (labor cost) as a proxy of labor force in line with Fecher *et al.* (1993). For each of these ratios, we have used as an outcome the net premiums.
- Claims: it represents the amount paid to the insured for the reported losses. We expect to have a negative relationship with profitability explained by the fact that higher levels of claims can lead to higher insolvency rates, therefore affecting profitability (Akotey *et al.*, 2013).
- Technical efficiency: this variable is obtained from the DEA estimation. There are several methodologies used in the bank and insurance literature to measure technical efficiency, such as parametric and non-parametric approaches. On the side of parametric methods, several authors have used the stochastic frontier analysis (Aigner *et al.*, 1977), distribution free approach (Berger, 1993) and thick frontier approach (Yuengert, 1993); nevertheless, a non-parametric technique that has also been widely used is the DEA (Fecher, *et al.* 1993; Cummins and Turchetti, 1996; Cummins and Zi, 1998). Although this linear programming method does not assume a particular function for the frontier, there is enough evidence showing that this approach is highly correlated with traditional efficiency measures. In line with Alhassan *et al.* (2016), we employ the DEA technique to measure technical efficiency. We include this variable to evaluate the ES hypothesis which states that more efficient firms have lower costs, therefore obtaining higher profits.
- Size: this variable is built considering the mean of market share by year. It takes a value of 1 if the firm has a market share above the mean of the year; otherwise, it takes a value of 0. It is included as a control variable to control for economies of scales or diseconomies of scale.

In relationship with the industry-related determinants, we have included the following determinants:

- HHI and market share: these two concentration measures are included in order to test the SCP paradigm as well as the RMP hypothesis. In line with the SCP hypothesis, a positive relation between profitability and HHI is expected, while in terms of the RMP hypothesis we expect to obtain a positive relation between profitability and market share which captures the market power of the firm, explained by the fact that firms with higher market share are able to increase prices and therefore increase their profitability level (Choi and Weiss, 2005).

We have also used some macroeconomic characteristics as determinants of the profitability, such as:

- Credit volume: it is the amount of credits in the economy measured in thousands of USD. This variable helps us to obtain a real measure of the financial environment in period *t*. Credit volume is correlated with interest rate, but because these are control variables, they do not cause a problem in the estimation.
- Cyclical output: because the insurance industry is cyclical (Doherty and Garven, 1995), meaning that it goes along with the economy cycle, we include the cyclical output in order to capture this effect. We calculate this variable using the Hodrick and Prescott (1997) filter.
- Inflation: we include the annual inflation rate to capture the variation of prices of goods and services from one year to another measure as the percentage increase on the consumer price index (IPC)[3]. This rate is a function of the unemployment in the economy, because a decrease in unemployment can increase the rates of inflation through the increase of nominal salary, and hence has a directly positive impact on the insurance profitability, as a result of the alteration on the consumption patterns. This relationship is explored by Alhassan *et al.* (2015) for the insurance market in Ghana and Shiu (2004) for the UK general insurance industry. Both found a negative and significant relationship with ROA suggesting that unexpected raises on inflation rates can affect the liabilities of insurers and also have a negative impact on the real income of the economy, reducing their sales.
- Interest rate: this variable represents the annual placement rate which captures the price that money has in financial markets. Also, in the case of life insurance, the present values of the products that are sold depend on the interest rate (Berends *et al.*, 2013). Moreover, the interest rate has a direct effect on the long-term investments of insurers. Doherty and Garven (1995) mention that underwriting profits are a measure of the average price of a traded insurance contract; this price is inversely related to changes on the interest rates in an economy, when is competitively determined, suggesting a direct effect on the insurer's equilibrium underwriting profit.

We can appreciate some interesting facts on the descriptive statistics shown in Table IV. The life insurers in our sample have an ROA that on average is 0.040 over the period 2001–2017[4]; as we can observe, there is large variation among the different insurers profitability. On the other hand, the non-life insurers have a lower ROA that is on average 0.019 over the period studied, with a minimum of −1.126 and a maximum value of 0.274; the median of this variable is 0.021[5].

When looking at the natural logarithm of net premiums, we can observe that the mean for life insurers is lower than the mean for non-life insurers because the non-life insurance in Ecuador is specialized mainly in a single product market; the segment that generates the greater revenues is the car insurance segment.

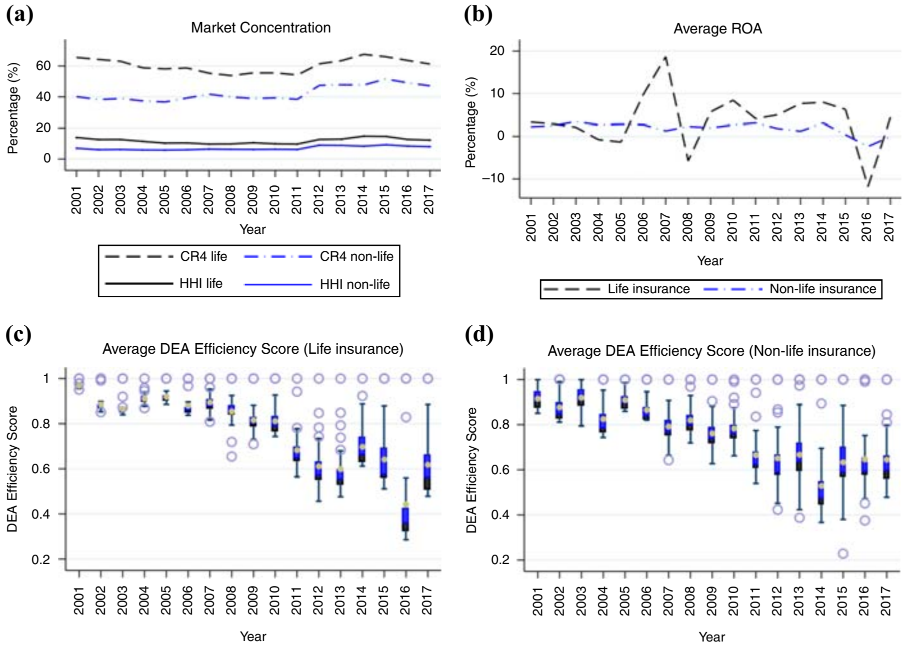
Table IV.
Summary statistics

	Life insurance					Non-life insurance				
	n	Mean	SD	Min.	Max.	*n*	Mean	SD	Min.	Max.
ROA	432	0.040	0.332	−3.867	2.813	522	0.019	0.075	−1.126	0.274
ln(PROF)[a]	350	11.890	2.052	3.129	16.744	452	12.678	1.675	6.054	16.316
ln(INV)[a]	351	10.169	2.708	1.147	15.379	511	12.066	1.737	2.603	15.729
ln(NP)	431	14.762	3.009	0.000	18.497	522	16.846	1.570	0.000	19.632
ln(TR)	410	12.692	2.407	1.917	18.373	521	15.248	1.462	5.796	19.277
LIQ	428	5.092	26.004	0.008	336.312	522	2.608	28.499	0.344	651.962
LEV	432	6.640	54.356	−8.515	821.787	522	3.170	6.317	−87.201	67.252
ETA	432	0.205	0.381	0.000	6.974	522	0.128	0.131	0.003	1.045
CI	423	3.864	69.988	0.000	1,436.906	521	0.153	0.873	0.000	12.474
LI	423	2.674	52.488	0.000	1,079.578	521	0.187	1.417	0.000	25.609
ln(CL)	432	13.185	3.534	0.000	17.416	522	15.287	2.537	0.000	18.822
HHI	432	1,177.472	167.824	970.306	1,481.366	522	705.209	120.417	579.378	922.052
MS	432	0.039	0.056	0.000	0.276	522	0.033	0.035	0.000	0.236
EFF	432	0.778	0.169	0.286	1.000	522	0.758	0.156	0.228	1.000
ln(CV)	432	16.441	0.633	15.455	17.365	522	16.489	0.621	15.455	17.365
CYCL[b]	412	0.000	0.021	−0.036	0.038	494	0.000	0.022	−0.036	0.038
INF[b]	412	3.651	3.549	0.921	15.605	494	3.500	3.362	0.921	15.605
IR[b]	412	10.178	2.181	8.170	15.532	494	10.037	2.087	8.170	15.532
Size	432	0.278	0.448	0.000	1.000	522	0.326	0.469	0.000	1.000
Multinational	432	0.271	0.445	0.000	1.000	522	0.148	0.355	0.000	1.000
Bank-related	432	0.444	0.497	0.000	1.000	522	0.379	0.486	0.000	1.000
Firms	29					38				
n	432					522				

Notes: ROA, return on assets; ROE, return on equity; ln(INV), ln(investment income); ln(NP), ln(net premiums); ln(TR), technical reserves; LIQ, liquidity; LEV, leverage; ETA, equity-to-assets; CI, capital intensity; LI, labor intensity; ln(CL), ln(claims); HHI, Herfindahl–Hirschman index; MS, market share; EFF, technical efficiency(DEA); CV, credits volume; CYCL, cyclical output; INF, inflation; IR, active interest rate. [a]These variables are also included in the section of results as dependent variable as alternative measures of profitability; [b]we do not have this information for 2017
Source: Superintendency of Companies, Securities and Insurance (SCVS)

Another interesting fact to point out is that both the life and non-life insurance sectors are unconcentrated markets according to the US Department of Justice and the Federal Trade Commission (2010)[6]. The non-life insurer sector is even less concentrated. In general, these markets are developed in competitive conditions. The market share is on average 3.9 percent for the life insurance and 3.3 percent for the non-life insurance sector. In Figure 1, we can appreciate the market structure in the Ecuadorian insurance industry through CR4 and HHI indicators across the period of study. We observe that life insurance has greater concentration than non-life insurance; on average, this concentration is 1.4 times greater than the non-life insurance sector over the period 2001–2017. The greatest concentration levels for life and non-life insurance were reached in the years 2014 and 2015, respectively; in 2014, the four largest firms in life insurance owned the 67.5 percent and for non-life sector the greatest CR4 was 51.6 percent in 2015. In terms of CR4, the industry is considered moderated concentrated but on the other hand as we already mentioned if we analyze the HHI this sector belongs to an unconcentrated market. These results are in line with the findings of Camino-Mogro *et al.* (2019).

We can also observe the evolution of ROA across time. The life insurance has an ROA that is on average 4 percent, while this ratio for the non-life insurance is on average 1.9 percent each year. The profitability, measured by ROA ratio, presents wider variation for the life insurance sector than for the non-life insurance across the period of analysis. In 2016, the ROA of life insurers experienced a drop, reaching an average ROA of 12 percent; this can be explained by the harsh economic conditions that Ecuador suffered around this year, because of the drop of oil prices and dollar appreciation, also accompanied by an earthquake event experienced in April of 2016.



Note: In graph C and D we can also observe the mean as a yellow dot
Source: Superintendency of Companies, Securities and Insurance (SCVS)

Figure 1.
Market and efficiency indicators

In Figure 1, we can appreciate briefly how the efficiency score (DEA) is distributed by year[7]. For the life insurance, the score efficiency that we estimated is highly concentrated above 80 percent until 2008. After 2008, the overall efficiency scores decreased, being the year 2016 the one with the lowest values. In this year, Ecuador suffered an earthquake and also passed through an unfortunate economic environment because of the drop in oil prices and dollar appreciation. We can also appreciate that the interquartile range increases as years go by, suggesting a wider skewed-to-the-right distribution of efficiency scores. On the side of the non-life insurance, we can also see that there is an overall decrease in efficiency scores as years pass by. In this case, the year 2014 shows that approximately the 75 percent of the firms have below 57 percent score efficiency; in this year, the law "Organic Monetary and Financial Code[8]" was issued which included among others, a minimum capital requirement, obligations of investing the technical reserves in at least 60 percent of the capital payed by the insurer and various fines.

3.2 Econometric Strategy

The estimation approaches used in this type of analysis are based on a linear function and different panel data models have been used with several features such as controls and instruments to provide a better identification (Gardner and Grace, 1993; Bajtelsmit and Bouzouita, 1998a; Shiu, 2004; Akotey *et al.*, 2013). The discussion of whether using dynamic or static models has been widely addressed in the banking sector (Athanasoglou *et al.*, 2008; Dietrich and Wanzenried, 2011; Trujillo-Ponce, 2013; Saona, 2016); however, for the insurance industry, there is greater empirical evidence supporting the usage of static models. Gardner and Grace (1993) estimated the coefficient of the factors using the generalized least square method assuming cross-sectional heteroskedasticity and autoregressive errors. Greene and Segal (2004) used a random effect model with clustered standard errors by firms to control for heteroskedasticity. Akotey *et al.* (2013) compared traditional panel data models such as fixed effects (FE) and random effects estimations. Alhassan *et al.* (2015) used a PCSE method to take into account the presence of autocorrelation or heteroskedasticity (non-spherical error terms).

Although a large amount of literature has been elaborated around the determination of factors that affects profitability in insurance companies and banks, little or none has been done for Latin American economies, particularly for developing countries. To answer our research question, we have implemented an analysis that resembles the approach made by Dietrich and Wanzenried (2011), Athanasoglou *et al.* (2008) and Akotey *et al.* (2013) considering three types of determinants: micro, industry and macro determinants, and also including some controls as well as a measure of efficiency estimated by using the DEA.

In this sense, our main specification takes the following form:

$$Y_{it} = F(\mathrm{X}_{it},\ \mathrm{Z}_{it}\ ,\ M_t) + u_{it}, \tag{1}$$

where Y_{it} contains the profitability measures used (ROA, INV or PROF) of firm i in period t; X_{it} represents the vector that contains characteristics of firm i in period t; Z_{it} is the vector with industry-related factors in period t and M_t corresponds to macroeconomic characteristics which are constant across firms in each period t. Finally, u_{it} corresponds to the error term (IID ~ $[0, \sigma^2]$) that is composed by φ_i, the time invariant insurer characteristics, λ_t the unobservable time FE and ν_{it} the idiosyncratic error. Going deeper on Equation (1), we obtain the following:

$$Y_{it} = \alpha_0 + \sum_{m=1}^{M} \alpha_m X_{it} + \sum_{r=1}^{R} \vartheta_r Z_{it} + \sum_{d=1}^{D} \rho_d M_t + \varphi_i + \lambda_t + v_{it}, \tag{2}$$

where X_{it}, Z_t and M_t are the sets of variables mention above, which are explained by the variables contained in the following empirical models:

$$\begin{aligned}\mathrm{ROA}_{it} = {} & \alpha_0 + \alpha_1 \ln(\mathrm{NP})_{it} + \alpha_2 \ln(\mathrm{TR})_{it} + \alpha_3 \mathrm{LIQ}_{it} + \alpha_4 \mathrm{LEV}_{it} \\ & + \alpha_5 \mathrm{ETA}_{it} + \alpha_6 \mathrm{CI}_{it} + \alpha_7 \mathrm{LI}_{it} + \alpha_8 \ln(\mathrm{CL})_{it} + \alpha_9 \mathrm{DEA}_{it} \\ & + \alpha_{10} \mathrm{D.SIZE}_{it} + \vartheta_1 \mathrm{HHI}_t + \vartheta_2 \mathrm{MS}_{it} + \rho_1 \ln(\mathrm{CV})_t \\ & + \rho_2 \mathrm{CYCL}_t + \rho_3 \mathrm{INF}_t + \rho_4 \mathrm{IR}_t + \varphi_i + \lambda_t + \nu_{it} \end{aligned} \quad (3)$$

$$\begin{aligned}\mathrm{INV}_{it} = {} & \alpha_0 + \alpha_1 \ln(NP)_{it} + \alpha_2 \ln(\mathrm{TR})_{it} + \alpha_3 \mathrm{LIQ}_{it} + \alpha_4 \mathrm{LEV}_{it} \\ & + \alpha_5 \mathrm{ETA}_{it} + \alpha_6 \mathrm{CI}_{it} + \alpha_7 \mathrm{LI}_{it} + \alpha_8 \ln(\mathrm{CL})_{it} + \alpha_9 \mathrm{DEA}_{it} \\ & + \alpha_{10} \mathrm{D.SIZE}_{it} + \vartheta_1 \mathrm{HHI}_t + \vartheta_2 \mathrm{MS}_{it} + \rho_1 \ln(\mathrm{CV})_t + \rho_2 \mathrm{CYCL}_t \\ & + \rho_3 \mathrm{INF}_t + \rho_4 \mathrm{IR}_t + \varphi_i + \lambda_t + \nu_{it} \end{aligned} \quad (4)$$

$$\begin{aligned}\mathrm{PROF}_{it} = {} & \alpha_0 + \alpha_1 \ln(\mathrm{NP})_{it} + \alpha_2 \ln(\mathrm{TR})_{it} + \alpha_3 \mathrm{LIQ}_{it} + \alpha_4 \mathrm{LEV}_{it} + \alpha_5 \mathrm{ETA}_{it} \\ & + \alpha_6 \mathrm{CI}_{it} + \alpha_7 \mathrm{LI}_{it} + \alpha_8 \ln(\mathrm{CL})_{it} + \alpha_9 \mathrm{DEA}_{it} \\ & + \alpha_{10} \mathrm{D.SIZE}_{it} + \vartheta_1 \mathrm{HHI}_t + \vartheta_2 \mathrm{MS}_{it} + \rho_1 \ln(\mathrm{CV})_t \\ & + \rho_2 \mathrm{CYCL}_t + \rho_3 \mathrm{INF}_t + \rho_4 \mathrm{IR}_t + \varphi_i + \lambda_t + \nu_{it} \end{aligned} \quad (5)$$

We estimate Equation (3) using a pooled ordinary least square (POLS), FE[9], feasible generalized least square (FGLS) and PCSE to check the robustness of the models. We use FGLS and PCSE to overcome temporal autocorrelation, contemporary correlation between panels, heteroskedasticity and unit root problems that we would otherwise encounter with ordinary least square estimations.

Because we lead with the presence of non-spherical errors, explained by the contemporaneous correlation across the unit and unit level heteroscedasticity[10], it is necessary to treat this problem to obtain efficient estimates; one first approach is the usage of FGLS (Parks, 1967); however, this method is not valid in situations when $N > T$ because it needs a relative large T in relation to N. In this line, this method is limited to time-series cross-section (TSCS) research.

On the other hand, Beck and Katz (1995) suggested that the FGLS model would underestimate the coefficients and introduced a more robust approach for panel data with $N > T$, which consists in estimating linear models of TSCS data through and OLS method accompanied of a heteroskedastic-consistent covariance matrix. One of the limitations of this model is that we need to consider that it does not account for unobserved heterogeneity for being of a pooling nature.

We also estimate Equations (4) and (5) with the PCSE model for being our best choice on the estimation above to compare and analyze the different profitability measures and the factors that determine each one of these indicators.

3.2.1 Efficiency estimation using DEA method. We employ the DEA technique to estimate the observe efficiency score of each one of the insurance companies in the study. To apply this technique, it is important to define the decision-making units (DMU), which in our case are the insurance firms, as well as the inputs (*m*) and outputs (*s*) that the model uses. Following the ideas proposed by Farrel (1957) and applied for the first time in a seminal work by Charnes *et al.* (1978), we estimate the technical efficiency through the maximization of the ratio of a weighted sum of outputs to a weighted sum of inputs, as we describe in the following equation:

$$\max\ h_0 = \frac{\sum_{r=1}^{s} u_r\, y_{r0}}{\sum_{i=1}^{s} v_i x_{i0}}, \tag{6}$$

subject to:

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{s} v_i x_{ij} \leqslant 0\ ,\ j = 1, 2,\ \ldots,\ n,$$

$$u_r, v_i \geqslant 0\ ;\ r = 1, 2,\ \ldots,\ s\ ;\ i = 1, 2,\ \ldots,\ m,$$

where y_{rj}, x_{ij} are positive outputs and inputs of the jth insurance firms, respectively; $u_r \geqslant 0$ is the weight of output r determined by the solution of this problem and $v_i \geqslant 0$ is the weight chosen for input i. As we can observe, the ratio obtained for each DMU is conditioned to be less than or equal to unity.

In our particular case, we deal with negative data for which we need to treat the data before applying this technique. The basic DEA model explained above is not capable of computing the analysis with negative numbers and 0 values. This is related to the positivity property which our data do not meet. However, there are some alternatives to overcome this limitation (Bowlin, 1998). We added an absolute constant to all the inputs and outputs variables that had at least one observation with a negative value and then computed the DEA model assuming variable returns to scale. This approach does not alter the efficient frontier because it is a translation invariant method (Iqbal and Seiford, 1990; Pastor, 1996). The estimations were made under the output orientation because insurers firms tend to maximize their earnings and profits to be able to face any incurred losses.

We have defined our inputs and outputs in line with Alhassan *et al.* (2015). Inputs are those resources related to the main services that these firms provide that take the form of real services, risk pooling, risk bearing and intermediation functions (Cummins and Weiss, 2000). According to the inputs used in this type of analysis, these are classified as labor (business services and labor costs) and capital inputs. We determined labor and capital inputs as salary expenses and total equity, respectively; on the other hand, the outputs we used were net premium and net profit/loss of the company following Leverty *et al.* (2004) (Table V).

4. Results

In this section, our results are presented in the form of two types of outputs. We start with the estimation of the determinants of insurance profitability for the entire Ecuadorian insurance sector contrasting different econometric approaches using ROA as the main profitability measure for the life and non-life insurance sectors. Next, we choose the PCSE approach as the best fitted model to estimate the determinants for two additional profitability measures, which have been explored in the insurance literature as proxies of profitability, namely, investment income and profit-after-taxes, in order to evaluate the differences among determinants of each one.

The estimates of the regression coefficients obtained by employing POLS, FE, FGLS and PCSE are shown in Tables VI and VII for the life and non-life insurance, respectively. We present different estimation procedures to demonstrate similar results across specifications, showing evidence that our choice of model specification and estimations methods employed are not driven the results. We include insurance-specific intercept term in each of the models to facilitate the comparison with FE models.

Table V. Input and output specification (first stage)

	Life insurance				Non-life insurance			
	Inputs		Outputs		Inputs		Outputs	
Variables	Salary expenses	Total equity	Net premium	Profit/Loss	Salary expenses	Total equity	Net premium	Profit/Loss
Mean	766,237.8	2,833,658.9	11,576,724.1	494,841.2	2,256,451.6	7,452,836.9	39,808,906.0	600,062.5
SD	1,635,663.8	5,152,560.1	17,341,309.9	1,454,659.1	2,301,563.7	8,056,643.3	46,018,925.6	1,465,799.6
Min.	0.0	−1,486,703.0	0.00	−24,061,98.4	0.0	−268,843.8	0.0	−8,408,489.7
Max.	11,740,044.4	52,745,642.2	1.080e+08	18,694,981.4	13,375,386.6	52,009,895.5	3.356e+08	12,194,267.3
Obs	432	432	431	432	522	522	522	522

Source: Superintendency of Companies, Securities and Insurance (SCVS)

	Life insurance			
	POLS		FE	
ROA	(1)	(2)	(3)	(4)
ln(NP)	0.0293 (0.0228)	0.0432 (0.0274)	0.0169 (0.0297)	0.0397 (0.0413)
ln(RT)	−0.0433 (0.0257)	−0.0440 (0.0260)	−0.0406 (0.0358)	−0.0457 (0.0390)
LIQ	0.0010 (0.0008)	0.0007 (0.0008)	0.0005 (0.0005)	0.0003 (0.0005)
LEV	−0.0005*** (0.0002)	−0.0004** (0.0002)	−0.0003*** (0.0001)	−0.0003* (0.0001)
ETA	−0.5316*** (0.0503)	−0.5292*** (0.0473)	−0.5505*** (0.0473)	−0.5463*** (0.0405)
CI	−0.0030 (0.0021)	−0.0021 (0.0024)	−0.0060** (0.0025)	−0.0041 (0.0032)
LI	−0.0004* (0.0002)	−0.0003 (0.0002)	−0.0004 (0.0002)	−0.0002 (0.0002)
Ln(CL)	−0.0088 (0.0117)	−0.0144 (0.0125)	0.0014 (0.0095)	−0.0046 (0.0099)
HHI	0.0002 (0.0001)	0.0003 (0.0003)	0.0001 (0.0001)	0.0098* (0.0053)
MS	−0.3010 (0.2767)	−1.0766* (0.5883)	−0.7790* (0.4227)	−1.7116** (0.7716)
EFF	0.6849*** (0.1666)	1.1908** (0.4368)	0.6179*** (0.1549)	1.1816** (0.4751)
ln(CV)	0.2013** (0.0798)	0.1415 (0.0935)	0.1838** (0.0839)	−28.1838* (15.2520)
CYCL	−1.1962*** (0.4140)	0.0000 (.)	−1.1237** (0.4138)	−42.6881* (22.1901)
INF	−0.0167** (0.0073)	−0.0354** (0.0168)	−0.0173** (0.0075)	−1.8027* (0.9706)
IR	0.0181 (0.0171)	0.0519 (0.0366)	0.0202 (0.0186)	1.3015* (0.7001)
Time control	No	Yes	No	Yes
Size control	Yes	Yes	Yes	Yes
F-statistic	422.61[e]	1,197.44[f]	4,937.81[e]	11,343.41[f]
Wald χ^2				
p-Value	0.0000	0.0000	0.0000	0.0000
Hausman test (*p*-value)			0.0000	
R^2	0.5195	0.5523	0.4941	0.5279
Observations	389	389	389	389
	Life insurance			
	FGLS		PCSE	
ROA	(5)	(6)	(7)	(8)
ln(NP)	0.0144 (0.0118)	0.0260** (0.0115)	0.0346 (0.0227)	0.0485** (0.0228)
ln(RT)	−0.0237*** (0.0071)	−0.0302*** (0.0068)	−0.0548*** (0.0165)	−0.0557*** (0.0158)
LIQ	0.0071** (0.0030)	0.0066** (0.0028)	0.0006 (0.0030)	0.0003 (0.0030)
LEV	−0.0003 (0.0002)	−0.0002* (0.0001)	−0.0003 (0.0002)	−0.0002 (0.0002)
ETA	−0.5492*** (0.0150)	−0.5501*** (0.0143)	−0.5488*** (0.0239)	−0.5456*** (0.0223)
CI	−0.0076 (0.0096)	−0.0067 (0.0089)	−0.0031 (0.0094)	−0.0019 (0.0089)
LI	−0.0005* (0.0003)	−0.0004* (0.0003)	−0.0002 (0.0003)	−0.0001 (0.0003)
Ln(CL)	−0.0120** (0.0060)	−0.0140** (0.0057)	−0.0069 (0.0130)	−0.0114 (0.0129)
HHI	−0.0000 (0.0001)	0.0078*** (0.0027)	0.0001 (0.0001)	0.0004*** (0.0001)
MS	−0.1257 (0.2394)	−0.7905** (0.3268)	−0.3541 (0.4969)	−1.2353** (0.5595)
EFF	0.3868*** (0.0675)	0.8603*** (0.1246)	0.6928*** (0.1316)	1.3215*** (0.2101)
ln(CV)	0.1034*** (0.0292)	−22.7238*** (7.6424)	0.2296*** (0.0563)	−0.0199 (0.0180)
CYCL	−0.3455 (0.2562)	−34.0913*** (10.6634)	−1.3626*** (0.5095)	0.0000 (.)
INF	−0.0052** 0.0026)	−1.4400*** (0.4714)	−0.0154*** (0.0049)	−0.0024 (0.0068)
IR	0.0008 (0.0075)	1.0711*** (0.3588)	0.0196 (0.0151)	−0.0763*** (0.0146)
Time control	No	Yes	No	Yes
Size Control	Yes	Yes	Yes	Yes
F-statistic				
Wald χ^2	1,795.09[d]	2,056.05[c]	873.37[b]	1,118.90[a]
p-Value	0.0000	0.0000	0.0000	0.0000
Hausman test (*p*-value)				
R^2			0.5252	0.5605
Observations	389	389	389	389

Notes: Constant, time control and size control are not reported because of space issues; however, it is important to mention that size control is not significant in any of the models proposed. Also, dummy control for year 2007 is significant on the last model proposed. One possible explanation of this fact is that the Spanish insurer MAPFRE entered the market in this year. Standard errors are in parentheses. [a]Wald χ^2(27); [b]Wald χ^2(17); [c]Wald χ^2(26); [d]Wald χ^2(16); [e]F(16,28); [f]F(26,28). $*p < 0.1$; $**p < 0.05$; $***p < 0.01$

Source: Superintendency of Companies, Securities and Insurance (SCVS)

Table VI.
POLS, FE, FGLS and PCSE estimations for life insurance sector

Table VII. POLS, FE, FGLS and PCSE estimations for the non-life insurance sector

	Non-life insurance			
	POLS		FE	
ROA	(1)	(2)	(3)	(4)
ln(NP)	0.0181 (0.0148)	0.0178 (0.0146)	0.0304* (0.0168)	0.0291* (0.0153)
ln(TR)	−0.0012 (0.0058)	−0.0022 (0.0055)	0.0006 (0.0064)	0.0005 (0.0062)
LIQ	0.0126* (0.0073)	0.0115 (0.0071)	0.0168 (0.0110)	0.0143 (0.0098)
LEV	−0.0012 (0.0008)	−0.0011 (0.0007)	−0.0009* (0.0005)	−0.0009* (0.0005)
ETA	−0.2125 (0.1397)	−0.1902 (0.1297)	−0.1914 (0.1506)	−0.1622 (0.1356)
CI	0.0074 (0.0178)	0.0060 (0.0171)	0.0297*** (0.0107)	0.0284** (0.0118)
LI	−0.0042 (0.0062)	−0.0038 (0.0056)	−0.0078** (0.0034)	−0.0073* (0.0038)
ln(CL)	−0.0066 (0.0056)	−0.0058 (0.0054)	−0.0053 (0.0055)	−0.0045 (0.0052)
HHI	0.0000 (0.0001)	0.0000 (0.0001)	0.0000 (0.0001)	0.0001 (0.0001)
MS	−0.6629** (0.2510)	−0.7648** (0.3133)	−0.5048** (0.1956)	−0.5880** (0.2535)
EFF	0.2783*** (0.0747)	0.3307*** (0.0990)	0.2368*** (0.0810)	0.3068** (0.1147)
ln(CV)	0.0614*** (0.0202)	0.0000 (.)	0.0340 (0.0202)	0.0384 (0.3127)
CYCL	0.4392*** (0.1198)	0.0000 (.)	0.4015*** (0.1098)	0.5183 (0.7059)
INF	−0.0049*** (0.0015)	−0.0002 (0.0013)	−0.0040** (0.0016)	0.0098 (0.0190)
IR	0.0133*** (0.0036)	−0.0112** (0.0042)	0.0111*** (0.0035)	0.0418 (0.0280)
Time control	No	Yes	No	Yes
Size Control	Yes	Yes	Yes	Yes
F-statistic	27.7250[a]	52.1931[b]	7.9257[a]	23.6024[b]
Wald χ^2				
p-Value	0.0000	0.0000	0.0000	0.0000
Hausman test (*p*-value)			0.0063	
R^2	0.2656	0.2917	0.2430	0.2726
Observations	493	493	493	493
	Non-life insurance			
	FGLS		PCSE	
ROA	(5)	(6)	(7)	(8)
ln(NP)	0.0026 (0.0043)	0.0014 (0.0046)	0.0198** (0.0094)	0.0192* (0.0098)
ln(TR)	0.0044 (0.0029)	0.0012 (0.0030)	−0.0004 (0.0064)	−0.0016 (0.0069)
LIQ	0.0045* (0.0026)	0.0011 (0.0026)	0.0143*** (0.0044)	0.0126*** (0.0046)
LEV	−0.0031*** (0.0006)	−0.0020*** (0.0006)	−0.0016 (0.0011)	−0.0016 (0.0010)
ETA	−0.0614** (0.0287)	−0.0096 (0.0290)	−0.2361*** (0.0674)	−0.2066*** (0.0661)
CI	−0.0157 (0.0157)	−0.0105 (0.0146)	0.0171 (0.0242)	0.0154 (0.0230)
LI	0.0004 (0.0081)	−0.0014 (0.0076)	−0.0085 (0.0112)	−0.0077 (0.0105)
ln(CL)	−0.0012 (0.0014)	0.0005 (0.0013)	−0.0066*** (0.0024)	−0.0053** (0.0023)
HHI	−0.0000 (0.0000)	0.0001** (0.0001)	0.0000 (0.0000)	0.0000 (0.0001)
MS	−0.5188*** (0.0737)	−0.7082*** (0.1050)	−0.7267*** (0.1179)	−0.9385*** (0.1398)
EFF	0.2181*** (0.0176)	0.4092*** (0.0201)	0.2947*** (0.0347)	0.4163*** (0.0403)
ln(CV)	0.0525*** (0.0081)	−0.0554 (0.1049)	0.0667*** (0.0165)	−0.0182* (0.0099)
CYCL	0.2423*** (0.0579)	0.1335 (0.2211)	0.3575*** (0.1307)	0.0000 (.)
INF	−0.0027*** (0.0006)	0.0044 (0.0056)	−0.0052*** (0.0013)	0.0001 (0.0015)
IR	0.0115*** (0.0017)	0.0637*** (0.0111)	0.0142*** (0.0034)	−0.0181*** (0.0029)
Time control	No	Yes	No	Yes
Size Control	Yes	Yes	Yes	Yes
F-statistic				
Wald χ^2	265.7683[c]	586.5250[d]	100.4562[e]	234.3265[f]
p-Value	0.0000	0.0000	0.0000	0.0000
Hausman test (*p*-value)				
R^2			0.2634	0.3122
Observations	493	493	493	493

Notes: Constant, time control and size control are not reported because of space issues; however, it is important to mention that size control is not significant in any of the models proposed. Also, dummy control for year 2007 is significant on the last model proposed. One possible explanation of this fact is that the Spanish insurer MAPFRE entered the market in this year. Standard errors are in parentheses. [a]F(16,37); [b]F (26,37), Wald $\chi^2(27)$; [c]Wald $\chi^2(16)$; [d]Wald $\chi^2(26)$; [e]Wald $\chi^2(17)$; [f]Wald $\chi^2(27)$. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
Source: Superintendency of Companies, Securities and Insurances (SCVS)

We conducted both FE and RE regressions along with the POLS method. In this line, we applied the Hausman test (Appendix 2) to examine the null hypothesis that coefficients estimated by the efficient RE estimation are the same compared to the coefficients obtained by the consistent FE estimation. We reject the null hypothesis suggesting the usage of FE model which we include in our estimations.

We examine the features of the error terms structure by applying the diagnostic tests such as groupwise heteroskedasticity, cross-section dependency and first-order autocorrelation[11] presented in Appendix 2. These limitations affect the efficiency of POLS and FE estimations but are overcome by FGLS and PCSE methods. We present the results by analyzing the three types of determinants: micro-, macro- and industry-related factors.

In relation with the micro-determinants, the factors that seem to have an explainable effect on the life insurers' profitability are: net premiums, technical reserves and ETA, while for the non-life sector these factors are the same, except for technical reserves, but including additionally the level of claims and liquidity ratio.

The net premium has a positive relationship with ROA both in life and non-life insurance markets significant at 5 and 10 percent, respectively, for the PCSE model. Despite the low magnitude and level of significance, we obtain a positive effect of net premiums over the level of profitability, which implies that higher level of premiums is related to higher levels of profitability measured by ROA. These results are in line with the results obtained by Charumathi (2012) and Akotey *et al.* (2013). In this sense, a 1 percent increase on net premiums, which captures the core operations of insurers, suggests an increase in ROA of approximately 0.05 percentage points for the life insurance and 0.02 percentage points for the non-life insurance sector.

Technical reserves are significant and negative related to ROA according to all methods executed, except for the FE and POLS models where the estimated coefficients are not significant, for the case of the life insurance. The significant negative relationship with profitability implies that when an insurer increases its technical reserves in 1 percent the ROA decreases slightly in approximately 0.06 percentage points. There is some insurance literature that studies the insurers ability to understate or overstate the reserve levels reported and therefore affect profitability (Petroni *et al.*, 2000; Beaver *et al.*, 2003; Gaver and Paterson, 2004); this can be a possible explanation of the negative relationship estimated, because insurers tend to overestimate their reserves when they are not in a healthy financial position. However, for the non-life insurance sector, this factor does not have any impact on profitability, according to the results obtained.

The liquidity ratio is not significant for the life insurance industry; however, it is significant at 1 percent for the non-life insurance sector. These results are related to the ones obtained by Shiu (2004) who mentioned that general insurance is relatively risky than life insurance because the timing and magnitude of potential claim costs is uncertain, so this sector needs more liquidity capacity for its properly performance. Despite its positive relation with ROA, the magnitude of the estimated coefficient is almost negligible, suggesting that for each one percentage point increases on the liquidity ratio the overall ROA can increase in approximately 0.01 percentage points.

ETA ratio has a negative impact on the profitability of an insurer, proxied by the ROA indicator, both in life and non-life insurance. This measure captures the financial risk of the firm in terms of capital structure, suggesting that an increase in one percentage point on this ratio would decrease ROA by approximately 0.55 percentage points for the life insurance and by 0.21 percentage points for the non-life insurance. These results imply that higher capital ratio may negatively affect the insurers' profitability, in line with the conclusions obtained by Goddard *et al.* (2004) and Chortareas *et al.* (2011) driven mainly by the ideas that greater capital induces financial institutions to take less risky and consequently earn less profit and also the opportunity cost of having high capital levels tend to discourage shareholders returns.

Claims are also another significant determinant of profitability (ROA) in the non-life sector, while in the life sector it seems to have a scarce impact. We obtain a negative relation between claims and ROA suggesting that for each 1 percent increase in claims, the profitability will be negatively affected by 0.01 percentage points, which follows the results obtained by Akotey *et al.* (2013) suggesting that higher claims can lead to higher insolvency rates for non-life insurers therefore affecting negatively the profitability.

Finally, we have significant evidence to prove the ES hypothesis for both life and non-life markets through the analysis of the estimated coefficient of efficiency score calculated by DEA methodology. This hypothesis suggests that higher profits are earned by the most efficient firms.

In terms of industry-related factors, the HHI index is significant at 5 percent for the life insurance sector. More concentrated markets can lead to higher levels of ROA for the firms that are part of the sector, therefore finding positive evidence for the SCP hypothesis in the life insurance sector. However, for the non-life insurers it seems that firms do not rely on market concentration for achieving their levels of profitability, so clearly the SCP hypothesis is not proved in this segment.

On the side of the market share, we find opposite evidence from the RMP hypothesis in both life and non-life markets. Instead of finding that firms with higher market share are more profitable, we found that for both sectors the relationship between market share and profitability is negative. One possible explanation for this result is the idea analyzed by some authors that stated that to achieve higher market shares the firms usually employ aggressive marketing strategies or take particular decisions by sacrificing resources on the short term hoping to generate profits on the long run, compromising profitability (Varadarajan, 1983; Hagigi *et al.*, 1999; O'Regan, 2002).

In relation with the macro determinants, in the case of non-life insurance, both the credit volume and the interest rate have a significant relationship with ROA at 10 and 1 percent, respectively. There is no significant evidence that suggests a relationship of inflation and cyclical output with ROA. The credit volume of the financial system has a slight significant negative impact at 10 percent. One possible explanation of this situation can be the presence of highly risky credits or outstanding loans which can compromise the financial instability of the insurer.

On the other hand, in the case of life insurance the only macro variable that seems to have impact on profitability is the interest rate. The placement or active interest rates present a negative relationship with profitability according to the results shown in Tables VI and VII. The negative relationship of the interest rate and profitability can be explained by the fact that higher interest rates affect prices in the opposite direction (Doherty and Garven, 1995); that means that the actual value of future pays and therefore the price of the premium required to the policyholder decreases, compromising the profit margin. Akotey *et al.* (2013) also suggest that despite the demand can get positively affected by the lower premium prices; this greater level of gross premiums written can be outstanding[12] negatively gnawing at profit maximization. Because prices of life insurance products are determined as a function of the interest rate, the impact of changes in interest rate on life insurance profitability is larger than in the non-life insurance sector.

In Tables VIII and IX, we show three models of PCSE estimations with different controls such as time, multinational and bank-related controls, for each of the three proposed profitability measures (ROA, INV and PROF). The bank-related control was included because of the particularity of the insurance sector in Ecuador which is highly related to financial institutions. In 2014, it was implemented a law that put into effect a regulation that did not allow banks to play insurance-related activities, but just banking-related operations.

For the life insurance sector, the net premium level is significant at 5 and 10 percent for both ROA and profit-after-taxes, respectively; however, it seems to have a scarce relationship with investment income suggesting that in the life insurance, higher investment

Table VIII.
PCSE estimations for life insurance sector with selected dependent variables

		ROA			Ln(INV)			Ln(PROF)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ln(NP)	0.0485**	0.0317	0.0508**	0.2137	0.1799	0.0832	0.5272***	0.4776***	0.4357***
	(0.0228)	(0.0239)	(0.0235)	(0.1627)	(0.1575)	(0.1597)	(0.1189)	(0.1258)	(0.1239)
Ln(TR)	−0.0557***	−0.0544***	−0.0574***	0.3631***	0.3544***	0.3793***	0.1984***	0.1901***	0.2341***
	(0.0158)	(0.0164)	(0.0155)	(0.0984)	(0.0950)	(0.0966)	(0.0674)	(0.0722)	(0.0662)
LIQ	0.0003	0.0006	0.0004	0.0104**	0.0095**	0.0088*	0.0116**	0.0110*	0.0114**
	(0.0030)	(0.0031)	(0.0030)	(0.0050)	(0.0048)	(0.0049)	(0.0050)	(0.0058)	(0.0052)
LEV	−0.0002	−0.0003	−0.0002	−0.0004	−0.0013	−0.0009	−0.0554***	−0.0601***	−0.0579***
	(0.0002)	(0.0002)	(0.0002)	(0.0071)	(0.0069)	(0.0069)	(0.0194)	(0.0210)	(0.0191)
ETA	−0.5456***	−0.5496***	−0.5418***	0.1615	0.1349	0.0778	−1.5735***	−1.8462***	−1.6212***
	(0.0223)	(0.0239)	(0.0224)	(0.2002)	(0.2035)	(0.1873)	(0.5945)	(0.6732)	(0.6065)
CI	−0.0019	−0.0033	−0.0015	0.0551**	0.0529**	0.0397*	0.0682***	0.0668***	0.0583***
	(0.0089)	(0.0094)	(0.0089)	(0.0244)	(0.0233)	(0.0238)	(0.0170)	(0.0197)	(0.0176)
LI	−0.0001	−0.0003	−0.0001	0.0041**	0.0043***	0.0031*	0.0696	0.2905	−0.0661
	(0.0003)	(0.0003)	(0.0003)	(0.0017)	(0.0016)	(0.0016)	(0.5947)	(0.6137)	(0.6327)
Ln(CL)	−0.0114	−0.0067	−0.0117	−0.0635	−0.0793	−0.0465	−0.0780	−0.0655	−0.0708
	(0.0129)	(0.0130)	(0.0129)	(0.0615)	(0.0569)	(0.0586)	(0.0603)	(0.0628)	(0.0597)
HHI	0.0004***	0.0001	0.0004***	0.0024**	0.0011	0.0021**	0.0020**	0.0009	0.0018**
	(0.0001)	(0.0001)	(0.0001)	(0.0010)	(0.0008)	(0.0010)	(0.0008)	(0.0006)	(0.0008)
MS	−1.2353**	−0.3235	−1.2867**	6.8006**	10.6547***	7.8065**	−4.3961*	1.9742	−3.0319
	(0.5595)	(0.4937)	(0.5648)	(3.4261)	(3.2202)	(3.4150)	(2.4508)	(2.3500)	(2.4468)
EFF	1.3215***	0.6954***	1.3439***	1.8114	−0.4990	1.7856	7.3254***	3.0369***	6.9387***
	(0.2101)	(0.1320)	(0.2164)	(1.3411)	(1.0536)	(1.3314)	(0.9607)	(0.7372)	(0.9793)
Ln(CV)	−0.0199	0.2302***	−0.0200	0.1120	1.3152***	0.1891	−0.0446	1.3564***	0.0028
	(0.0180)	(0.0563)	(0.0183)	(0.1570)	(0.4344)	(0.1542)	(0.1070)	(0.2932)	(0.1108)
CYCL	0.0000	−1.3607***	0.0000	0.0000	2.4615	0.0000	0.0000	−1.8002	0.0000
	(.)	(0.5099)	(.)	(.)	(3.4468)	(.)	(.)	(2.7312)	(.)
INF	−0.0024	−0.0154***	−0.0024	−0.0435	−0.0529	−0.0508	−0.0330	−0.0665**	−0.0408
	(0.0068)	(0.0049)	(0.0068)	(0.0524)	(0.0355)	(0.0509)	(0.0415)	(0.0279)	(0.0413)
IR	−0.0763***	0.0196	−0.0765***	−0.2675**	0.1737*	−0.2473**	−0.4146***	0.1090	−0.3878***
	(0.0146)	(0.0152)	(0.0146)	(0.1048)	(0.1004)	(0.1034)	(0.0739)	(0.0783)	(0.0729)

(*continued*)

Table VIII.

	(1)	ROA (2)	(3)	(4)	Ln(INV) (5)	(6)	(7)	Ln(PROF) (8)	(9)
Multinational		0.0253	0.0148		0.8672***	1.0297***		0.1762	0.2530
		(0.0274)	(0.0236)		(0.2488)	(0.2657)		(0.1792)	(0.1608)
Bank-related			−0.0398			0.4303			0.3983**
			(0.0295)			(0.2847)			(0.1606)
Time Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinational	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Bank-related	No	No	Yes	No	No	Yes	No	No	Yes
Wald χ^2	1,118.9022	917.2304	1,122.4442	8,242.2621	377.6177	9,596.1292	30,348.3713	487.3078	35,079.7663
p-Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R^2	0.5605	0.5259	0.5628	0.4503	0.4427	0.4701	0.6517	0.6268	0.6483
Observations	388	388	388	318	318	318	319	319	319

Notes: Standard errors are in parentheses. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$
Source: Superintendency of Companies, Securities and Insurances (SCVS)

Table IX. PCSE estimations for non-life insurance sector with selected dependent variables

		ROA			INV			PROF	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ln(NP)	0.0192*	0.0188**	0.0183*	0.2943***	0.3295***	0.2785***	0.1406	0.1532	0.1456
	(0.0098)	(0.0091)	(0.0095)	(0.1041)	(0.1023)	(0.1061)	(0.1606)	(0.1576)	(0.1602)
Ln(TR)	−0.0016	−0.0002	−0.0009	0.4799***	0.5049***	0.4907***	0.4877***	0.5980***	0.4826***
	(0.0069)	(0.0062)	(0.0066)	(0.1088)	(0.1000)	(0.1087)	(0.1241)	(0.1198)	(0.1224)
LIQ	0.0126***	0.0128***	0.0114***	0.1772***	0.1486***	0.1545***	0.2440***	0.2227**	0.1872**
	(0.0046)	(0.0042)	(0.0043)	(0.0501)	(0.0429)	(0.0479)	(0.0826)	(0.0886)	(0.0806)
LEV	−0.0016	−0.0015	−0.0015	−0.0100**	−0.0114***	−0.0097**	−0.1245***	−0.1308***	−0.1082***
	(0.0010)	(0.0011)	(0.0010)	(0.0041)	(0.0043)	(0.0042)	(0.0411)	(0.0421)	(0.0409)
ETA	−0.2066***	−0.2333***	−0.2038***	1.8523***	2.0927***	1.8172***	−1.5938*	−1.8961**	−1.5242
	(0.0661)	(0.0663)	(0.0652)	(0.6561)	(0.6012)	(0.6521)	(0.9602)	(0.9528)	(0.9511)
CI	0.0154	0.0170	0.0158	0.5869***	0.5998***	0.6023***	−1.2869**	−1.3799**	−0.8840
	(0.0230)	(0.0243)	(0.0231)	(0.1165)	(0.1145)	(0.1193)	(0.6208)	(0.6361)	(0.6213)
LI	−0.0077	−0.0086	−0.0078	−0.1239***	−0.1154***	−0.1310***	1.9908	2.1238	2.4498
	(0.0105)	(0.0113)	(0.0106)	(0.0422)	(0.0435)	(0.0424)	(1.6765)	(1.7057)	(1.7568)
Ln(CL)	−0.0053**	−0.0065***	−0.0052**	0.0121	0.0069	0.0159	−0.0273	−0.0436	−0.0247
	(0.0023)	(0.0024)	(0.0024)	(0.0233)	(0.0221)	(0.0231)	(0.0265)	(0.0287)	(0.0271)
HHI	0.0000	0.0000	0.0000	0.0031***	0.0021***	0.0029***	−0.0009	−0.0007	−0.0010
	(0.0001)	(0.0000)	(0.0001)	(0.0009)	(0.0007)	(0.0009)	(0.0012)	(0.0009)	(0.0012)
MS	−0.9385***	−0.7345***	−0.9514***	4.3951*	3.3344	3.7003	−7.6069**	−4.0183	−6.9984**
	(0.1398)	(0.1134)	(0.1333)	(2.2623)	(2.2655)	(2.2562)	(3.4262)	(3.0466)	(3.4223)
EFF	0.4163***	0.2921***	0.4036***	0.6708	0.5198	0.6714	8.7086***	6.1010***	8.3581***
	(0.0403)	(0.0339)	(0.0386)	(0.5920)	(0.5512)	(0.5845)	(0.8568)	(0.7097)	(0.8465)
Ln(CV)	−0.0182*	0.0644***	−0.0176*	−0.1573	0.0580	−0.1546	0.0492	2.2751***	0.0400
	(0.0099)	(0.0163)	(0.0095)	(0.1256)	(0.2584)	(0.1270)	(0.1581)	(0.3378)	(0.1573)
CYCL	0.0000	0.3695***	0.0000	0.0000	−0.0693	0.0000	0.0000	11.5341***	0.0000
	(.)	(0.1319)	(.)	(.)	(1.9401)	(.)	(.)	(2.5675)	(.)
INF	0.0001	−0.0050***	0.0003	−0.0871***	−0.0444**	−0.0842***	−0.0088	−0.1133***	−0.0041
	(0.0015)	(0.0013)	(0.0015)	(0.0308)	(0.0207)	(0.0309)	(0.0362)	(0.0271)	(0.0358)
IR	−0.0181***	0.0138***	−0.0174***	−0.0600	−0.0391	−0.0565	−0.2936***	0.4912***	−0.2841***
	(0.0029)	(0.0034)	(0.0028)	(0.0561)	(0.0533)	(0.0558)	(0.0634)	(0.0727)	(0.0625)

(*continued*)

Table IX.

	(1)	ROA (2)	(3)	(4)	INV (5)	(6)	(7)	PROF (8)	(9)
Multinational		0.0235***	0.0230***		0.5224***	0.5350***		0.6305***	0.5513***
		(0.0066)	(0.0069)		(0.1264)	(0.1291)		(0.1532)	(0.1651)
Bank-related			−0.0053			−0.0189			0.2897*
			(0.0073)			(0.1690)			(0.1537)
Time Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multinacional	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Bank-related	No	No	Yes	No	No	Yes	No	No	Yes
Wald χ^2	234.3265	121.5318	289.6633	36,146.6900	533.6519	45,975.6662	41,748.1282	470.2549	45,032.7951
p-Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R^2	0.3122	0.2699	0.3139	0.5465	0.5348	0.5489	0.5918	0.5253	0.6058
Observations	493	493	493	483	483	483	429	429	429

Notes: Standard errors are in parentheses. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
Source: Superintendency of Companies, Securities and Insurances (SCVS)

income levels are not necessarily driven by the greater generation of net premiums. Also, technical reserves are highly significant in all scenarios showed above, but this relationship is negative only for the case of ROA measure. The relationship of technical reserves with INV or PROF is positive, implying that insurers are more profitable when they have a higher level of reserves in their liabilities. This result is implicitly suggested by some authors (Shiu, 2004; Chen and Wong, 2004)[13] which states that insurers with higher level of liabilities, reflected on a high level of reserves, have a stronger capacity to encounter their, respectively, obligations and therefore are more profitable for being in a healthier position.

In terms of liquidity and leverage ratios, contrary to the results showed for the ROA estimation, we found that the first one has a significant impact on investment income at 10 percent and on profit-after-taxes at 1 percent. However, these impacts are relatively small. For each unit increase on liquidity ratio, the investment income and profit-after-taxes may be affected by an increase of 0.8 and 1.14 percent, respectively. The second ratio only has a significant negative impact on profit-after-taxes at 1 percent in line with Ahmed *et al.* (2011) and Charumathi (2012). One possible explanation of this negative relationship can be that the decrease on assets produces an increase on the leverage ratio, knowing that liabilities (mostly conformed by technical reserves) have a positive relationship with the explained variable (profit-after-taxes), and therefore affect profitability negatively.

The capital ratio shows a negative significant relationship both in ROA and profit-after-taxes at 1 percent. The capital and labor intensity are positive and significant at 10 percent when we use the investment income as a profitability measure; however, the magnitude of the impact is very low especially for the case of labor intensity, suggesting that this type of businesses does not need high levels of labor intensity to generate higher returns.

In terms of the efficiency score, we obtained evidence that suggests its significant positive impact on profit-after-tax and ROA as mention above. In general, each 0.01 increase in the efficiency score suggests an increase in profit-after-taxes of about 6.93 percent.

On the side of industry-related determinants for the life sector, HHI is positive and significant at 1 and 5 percent across all the profitability measures used, reinforcing the SCP hypothesis mentioned before. Nevertheless, the market share shows opposite results when using the investment income as a dependent variable, compared to the first profitability measure used (ROA). In this case, the results are in line with the RMP hypothesis which suggests that increases in market share might have a positive effect on profitability.

According the macro determinants, the interest rate is the only factor with a negative and significant relationship with all the three measures of profitability proposed. Also, all the other factors being equal, the multinational control seems to relate positively with the investment income generation suggesting that insurance firms that invest the most tend to be multinational corporations. Likewise, the bank-related control included in the last estimation is significant when used as a determinant of the profit-after-taxes suggesting that higher profits are achieved when the insurer has some kind of implicit relationship with any bank of the financial system, compared to the case that they are not bank-related.

We found that for the non-life insurance sector the net premium is significant at 10 percent in the case of ROA and at 1 percent in the case of INV. This factor is not significant when we do the estimation with profit-after-taxes as a dependent variable. The net premium level has a greater impact on investment income as a measure of profitability. One reason of this picture is that high premium levels can incentive a higher investing behavior by the insurer in comparison to ROA. In the case of ROA, this profitability measure includes administrative expenses, other expenses and incomes which mitigate the direct impact over income. Similarly to the life insurance, the technique reserves have also a significant positive impact both on investment income and profit-after-taxes. Indeed, this impact is greater compared to the life insurance sector explained in part by the fact that non-life insurers tend to be more cautious on the level of reserves kept because they have a less power of predictions of sudden claims. This hypothesis is also supported by the positive relation of the three profitability measures with liquidity, meaning that non-life insurance are more conservative in terms of liquidity when they struggle to turned into more profitable.

The leverage ratio has a low negative significant impact on investment income but it presents a higher negative relationship with profit-after-taxes, suggesting that an increase of 0.01 on this ratio can possibly decrease profit-after-taxes in 0.11 percent. When examining the capital ratio (ETA), it has a positive effect on investment income contrary to the relationship with ROA which is negative in the non-life sector. According to the results, we can intuit that an increase of about 0.01 on the ETA could increase investment income in approximately 1.8 percent suggesting that a higher level of capitalization induces the insurers to generate greater amounts of income from investment.

In addition, it is important to point out that higher levels of capital intensity can have a significant and positive impact at 1 percent on investment income for the non-life sector. However, in the case of labor intensity, this has a negative significant impact at 1 percent implying that greater levels of labor can possibly induce lower levels on investment income; for each 0.1 increases on LI, it will generate a decrease on the investment income of approximately 1.3 percent. Efficiency scores are also positive related to profit-after-taxes and the results found suggest that a 1 percentage point increase on efficiency scores would increase profit-after-taxes in approximately 8.4 percent.

According the HHI concentration index, this shows a positive and significant relationship with investment income in the non-life insurance sector also reinforcing the SCP hypothesis mentioned above. On the market share side, the relationship found is also significant and negative similar to the life insurance for ROA and profit-after-taxes estimations.

When we contrast the macro determinants for all the three different measures of profitability, we found that inflation has a negative significant impact on the generation of investment income contraire to the null impact on both ROA and profit-after-taxes implying that increases on inflation in approximately 1 percent will have a negative impact on investment income in 8.42 percent. The multinational control has a significant and positive impact at 1 percent across all profitability measures, in line with what most of the literature predicts. However, in the case of bank-related control this is positively significant at 10 percent when using the profit-after-taxes level as a dependent variable similar to the results obtained for the life insurance sector.

In this section, we have explained the relationship found between the different factors included in the models proposed (POLS, FE, FGLS and PCSE) and chose the PCSE as the best fitted option. We also compared this last specification across three profitability measures (ROA, INV and PROF), through specifications that include different controls such as time controls, a bank-related dummy and a multinational dummy to correct the initial specification reducing the effect of confounding variables.

5. Conclusions and policy implications

This paper analyzes the determinants of firms' profitability in the insurance industry in Ecuador during 2001–2017. We give empirical evidence, in the life and non-life insurance markets, of the effects of many microeconomic, industry-related and macroeconomic factors that affect the profitability. Our research contributes to the existing literature because we study an LAC country, which is a region that has not been analyzed in previous studies of this type to the best of the author's knowledge. We also implement a different methodology such as PCSE in order to identify the possible problems of this kind of data, and finally we introduce controls like multinational participation and a bank-related dummy to give a holistic approach in this industry, because of the advantages that bank-related insurers may have in terms of profitability.

Our study includes the analysis of three metrics of profitability: ROA, investment income and profit-after-taxes. These metrics could be considered as the main variables in terms of business and operation of the insurer. Most of the existing literature analyze these metrics separately and do not compare them; we examine the determinants of each of the profitability measures proposed. Additionally, we test the SCP, RMP and ES hypothesis in order to find evidence of firm performance.

We find that microeconomic determinants on life insurer profitability are: the net premium which has a positive effect on ROA and profit-after-taxes, the technical reserves which negatively affect the ROA but positively affect the investment income and the profit-after-taxes, the liquidity level which positively affects the investment income and profit-after-taxes, the leverage which only has a negative effect in profit-after-taxes, the ETA ratio that negatively affects the ROA and profit-after-taxes, the capital intensity ratio that positively affects the investment income and profit-after-taxes while the labor intensity ratio only has a positive effect on the investment income. Finally, the efficiency score measured as DEA positively affects the ROA and profit-after-taxes suggesting that most efficient firms have lower costs, therefore obtaining higher profits, and getting evidence in favor of ES hypothesis.

In terms of industry-related determinants on life insurer profitability, we obtain evidence in the favor of the SCP hypothesis, the HHI positively affects the ROA, investment income and profit-after-taxes, suggesting that large insurers have better opportunities to increase their profitability according to their market power. However, we do not find convincing evidence in favor of the RMP hypothesis because our results found that market share negatively affects ROA but positively affects investment income.

On the side of macroeconomic determinants on life insurer's profitability, we find that the interest rate is the only factor with a negatively and significant relationship with all the three measures of profitability proposed.

On the other hand, for non-life insurer profitability and according to the microeconomic determinants we get evidence that net premium has a positive effect on ROA and investment income, the technical reserves positively affect the investment income and profit-after-taxes, the liquidity positively affects all the three measures of profitability analyzed, the leverage has a negative effect on the investment income and profit-after-taxes, the ETA ratio has mixed results, meaning that it negatively affects ROA but positively affects investment income, also capital intensity and labor intensity have mixed results on investment income, the first affects positively and the last has a negative impact on INV; claims negatively affect ROA and finally similar to the life insurance sector, we get evidence in the favor of ES hypothesis because it positively affects ROA and profit-after-taxes.

According to the industry-related determinants in the non-life insurer profitability, we find evidence in the favor of the SCP hypothesis only when the investment income is the metric of profitability. Similar to the life insurance market, we do not find evidence in the favor of the RMP hypothesis because the market share negatively affects ROA and profit-after-taxes.

Turning to the macroeconomic determinants for non-life segment, we get evidence that inflation negatively affects investment income. These results are connected with the idea that higher rates of inflation reduce investment on the financial system therefore reducing the investment income. Similar to the life segment, the interest rate negatively affects ROA and profit-after-taxes.

Another important conclusion is that being a bank-related insurer and also having shares that belong to a multinational-owned company are important determinants on profitability insurers. Both in life and non-life segments, being a bank-related insurer affects positively the profit-after-taxes, and being a multinational related has a positive impact on investment income in the life market, and also a positive impact in all the three metrics of profitability in the non-life market.

Overall, our results are relevant for insurers and supervisory institutions of the financial sector and also the government as the main stakeholder in economic growth, so there are some direct policy implications. First, the evidence in the favor of the SCP hypothesis in the life insurance industry that suggests that higher industry concentration index increases the profitability of these firms, needs to be attended from the supervisory institution in order to promote competitive measures that comprises, among other, the entry and mobility barriers of insurers. Second, the evidence in the favor of the ES hypothesis in both segments shows that efficiency increases profitability; therefore, insurers should consider investing in new technologies; capacitation, customer service and new differentiated products.

Also, we found that some regulations are critical for improving the performance on insurers companies. In 2014, there was a regulation imposed to the insurers companies that oblige the insurers to have a minimum capital of 8m dollars. In this line, we found that a higher level of ETA (explained mainly by the higher capital levels) lowers the profitability on the insurers, because it forces the company to invest more and increase the reserves, both on the life and non-life sectors. For this reason, we propose, policy makers should evaluate regulations that are being an obstacle for improving the profitability on the insurers firms. Finally, the supervisory institution has a strong task in terms of controlling and implementing improvements since being multinational related and bank related increase the profitability in this type of firms; also, the last could be a cause of "moral hazard" problems because the banks can condition the decision of delivering loans to clients that are insured by a particular insurer with which they have some types of businesses agreement.

Notes

1. Acronym in Spanish.
2. The cyclical output was created by the authors using the PIB in real terms (base = 2007) provided by the Central Bank of Ecuador.
3. Acronym in Spanish.
4. There are 78 firms that report loses over the period 2001–2017. The 81 percent of the observations have an ROA between above 0 in the life insurance. The ROA median (or the second quartile (Q2)) is 0.063, which represents the middle value of ROA obtained from the ordered data during the period of analysis.
5. The 87 percent of the observations have an ROA above 0 in the non-life sector.
6. www.ftc.gov/sites/default/files/attachments/merger-review/100819hmg.pdf
7. See Section 3.2.1 for further details of the methodology used to obtain the efficiency score for the life and non-life insurers.
8. You can access to the official law in the following link: www.seps.gob.ec/documents/20181/25522/COMYF_2018.pdf/c9460421-8f8b-4bcb-a7ac-f4cfe312146c
9. We show Hausman test results in Appendix 2 as a support of fixed effects usage instead of random effects.
10. Tests are shown in Appendix 2. For the life insurance sector, the autocorrelation is not a problem; however, the majority of the variables are cross-sectional dependent.
11. This limitation is overcome by computing the FGLS and PCSE model with the AR(1) option indicating the presence of serial correlation. In this sense, the estimation takes the form of a Prais-Winsten estimation.
12. In insurance terminology, an outstanding premium is an unpaid premium with an expired period of maturity that can turn out as bad debt.
13. Most of the authors include this variable as a ratio with some others.

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Appendix 1

	ROA	ln(INV)	ln(PROF)	ln(NP)	ln(RT)	LIQ	LEV	ETA	CI
ROA	1.000								
ln(INV)	0.085	1.000							
	(0.113)								
ln(PROF)	0.205***	0.565***	1.000						
	(0.000)	(0.000)							
ln(NP)	0.168***	0.464***	0.684***	1.000					
	(0.000)	(0.000)	(0.000)						
ln(RT)	−0.042	0.640***	0.676***	0.790***	1.000				
	(0.393)	(0.000)	(0.000)	(0.000)					
LIQ	0.003	−0.097	−0.303***	−0.543***	−0.293***	1.000			
	(0.958)	(0.071)	(0.000)	(0.000)	(0.000)				
LEV	−0.042	0.035	−0.009	0.020	0.035	−0.019	1.000		
	(0.384)	(0.519)	(0.861)	(0.672)	(0.481)	(0.691)			
ETA	−0.640***	−0.064	−0.234***	−0.167***	−0.120*	0.003	−0.023	1.000	
	(0.000)	(0.229)	(0.000)	(0.000)	(0.015)	(0.952)	(0.635)		
CI	−0.024	−0.099	−0.137*	−0.289***	−0.375***	0.341***	−0.007	0.021	1.000
	(0.629)	(0.067)	(0.010)	(0.000)	(0.000)	(0.000)	(0.890)	(0.664)	
LI	−0.040	−0.019	−0.067	−0.261***	−0.223***	0.217***	−0.006	−0.011	−0.003
	(0.416)	(0.730)	(0.216)	(0.000)	(0.000)	(0.000)	(0.899)	(0.817)	(0.955)
ln(CL)	0.079	0.460***	0.641***	0.875***	0.755***	−0.443***	0.008	−0.138**	−0.239***
	(0.102)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.864)	(0.004)	(0.000)
EFF	0.158**	−0.144**	−0.073	−0.070	−0.198***	0.104*	−0.134**	−0.143**	0.057
	(0.001)	(0.007)	(0.173)	(0.146)	(0.000)	(0.032)	(0.005)	(0.003)	(0.245)
HHI	−0.016	0.192***	0.026	−0.185***	0.087	0.131**	0.058	−0.003	0.067
	(0.735)	(0.000)	(0.622)	(0.000)	(0.078)	(0.007)	(0.227)	(0.955)	(0.167)
MS	0.046	0.508***	0.482***	0.481***	0.578***	−0.095*	−0.038	−0.111*	−0.039
	(0.343)	(0.000)	(0.000)	(0.000)	(0.000)	(0.049)	(0.425)	(0.021)	(0.419)
ln(CV)	0.008	0.461***	0.489***	0.372***	0.525***	−0.171***	0.097*	0.033	−0.078
	(0.875)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.044)	(0.493)	(0.109)
CYCL	−0.022	0.001	0.027	0.037	0.038	−0.044	−0.057	−0.073	−0.018
	(0.656)	(0.985)	(0.630)	(0.450)	(0.458)	(0.372)	(0.250)	(0.141)	(0.718)
INF	−0.027	−0.201***	−0.318***	−0.332***	−0.269***	0.307***	−0.034	−0.055	0.181***
	(0.585)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.498)	(0.262)	(0.000)
IR	−0.002	−0.309***	−0.430***	−0.420***	−0.443***	0.274***	−0.054	−0.038	0.136**
	(0.973)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.276)	(0.448)	(0.006)

(*continued*)

Table AI. Correlation matrix for the life insurance sector

Table AI.

	LI	ln(CL)	EFF	HHI	MS	ln(CV)	CYCL	INF	IR
ROA									
ln(INV)									
ln(PROF)									
ln(NP)									
ln(RT)									
LIQ									
LEV									
ETA									
CI									
LI	1.000								
ln(CL)	−0.033	1.000							
	(0.499)								
EFF	0.025	−0.131**	1.000						
	(0.602)	(0.006)							
HHI	0.026	−0.113*	−0.285***	1.000					
	(0.595)	(0.019)	(0.000)						
MS	−0.036	0.472***	0.345***	0.023	1.000				
	(0.464)	(0.000)	(0.000)	(0.641)					
ln(CV)	−0.079	0.405***	−0.737***	0.154**	0.043	1.000			
	(0.106)	(0.000)	(0.000)	(0.001)	(0.373)				
CYCL	−0.015	0.025	−0.032	−0.113*	−0.009	0.110*	1.000		
	(0.765)	(0.612)	(0.513)	(0.021)	(0.855)	(0.025)			
INF	0.039	−0.268***	0.371***	0.306***	−0.014	−0.499***	−0.051	1.000	
	(0.435)	(0.000)	(0.000)	(0.000)	(0.769)	(0.000)	(0.305)		
IR	0.096	−0.393***	0.552***	0.255***	−0.019	−0.825***	−0.201***	0.776***	1.000
	(0.055)	(0.000)	(0.000)	(0.000)	(0.706)	(0.000)	(0.000)	(0.000)	

Notes: p-Values are in parentheses. Table of Pearson correlations coefficients. $*p < 0.05$; $**p < 0.01$; $***p < 0.001$
Source: Superintendency of Companies, Securities and Insurances (SCVS).

Table AII. Correlation matrix for non-life insurance sector

	ROA	ln(INV)	ln(PROF)	ln(NP)	ln(RT)	LIQ	LEV	ETA	CI
ROA	1.000								
ln(INV)	0.037	1.000							
	(0.409)								
ln(PROF)	0.504***	0.497***	1.000						
	(0.000)	(0.000)							
ln(NP)	0.206***	0.504***	0.430***	1.000					
	(0.000)	(0.000)	(0.000)						
ln(RT)	0.105*	0.662***	0.572***	0.818***	1.000				
	(0.016)	(0.000)	(0.000)	(0.000)					
LIQ	−0.006	−0.049	−0.078	−0.483***	−0.308***	1.000			
	(0.895)	(0.267)	(0.098)	(0.000)	(0.000)				
LEV	0.031	−0.011	−0.109*	0.118**	0.172***	−0.025	1.000		
	(0.476)	(0.800)	(0.020)	(0.007)	(0.000)	(0.563)			
ETA	−0.276***	−0.015	−0.126**	−0.575***	−0.376***	0.308***	−0.257***	1.000	
	(0.000)	(0.743)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)		
CI	−0.284***	−0.100*	−0.085	−0.487***	−0.298***	0.051	−0.255***	0.304***	1.000
	(0.000)	(0.024)	(0.073)	(0.000)	(0.000)	(0.250)	(0.000)	(0.000)	
LI	−0.164***	−0.109*	−0.047	−0.466***	−0.304***	0.119**	−0.076	0.187***	0.835***
	(0.000)	(0.013)	(0.315)	(0.000)	(0.000)	(0.007)	(0.082)	(0.000)	(0.000)
ln(CL)	0.053	0.478***	0.376***	0.786***	0.721***	−0.281***	0.045	−0.513***	−0.215***
	(0.229)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.300)	(0.000)	(0.000)
EFF	0.305***	−0.064	0.160***	0.170***	−0.040	−0.005	−0.015	−0.274***	−0.059
	(0.000)	(0.145)	(0.001)	(0.000)	(0.357)	(0.911)	(0.736)	(0.000)	(0.178)
HHI	−0.108*	0.358***	0.266***	0.025	0.329***	−0.024	0.005	0.118**	0.049
	(0.013)	(0.000)	(0.000)	(0.565)	(0.000)	(0.581)	(0.902)	(0.007)	(0.264)
MS	0.069	0.462***	0.404***	0.563***	0.558***	−0.045	0.061	−0.268***	−0.092*
	(0.117)	(0.000)	(0.000)	(0.000)	(0.000)	(0.309)	(0.164)	(0.000)	(0.035)
ln(CV)	−0.099*	0.466***	0.296***	0.179***	0.472***	0.011	−0.013	0.224***	−0.012
	(0.024)	(0.000)	(0.000)	(0.000)	(0.000)	(0.795)	(0.766)	(0.000)	(0.790)
CYCL	0.082	0.005	0.100*	0.088*	0.072	−0.015	0.000	−0.130**	−0.038
	(0.070)	(0.920)	(0.039)	(0.050)	(0.111)	(0.733)	(0.998)	(0.004)	(0.397)
INF	0.040	−0.325***	−0.084	−0.215***	−0.317***	−0.015	−0.073	−0.222***	0.160***
	(0.378)	(0.000)	(0.080)	(0.000)	(0.000)	(0.735)	(0.105)	(0.000)	(0.000)
IR	0.050	−0.402***	−0.158**	−0.252***	−0.426***	−0.018	−0.046	−0.178***	0.148***
	(0.269)	(0.000)	(0.001)	(0.000)	(0.000)	(0.693)	(0.309)	(0.000)	(0.001)

(*continued*)

Table AII.

	LI	ln(CL)	EFF	HHI	MS	ln(CV)	CYCL	INF	IR
ROA									
ln(INV)									
ln(PROF)									
ln(NP)									
ln(RT)									
LIQ									
LEV									
ETA									
CI									
LI	1.000								
ln(CL)	−0.266***	1.000							
	(0.000)								
EFF	−0.014	0.031	1.000						
	(0.749)	(0.481)							
HHI	0.011	0.208***	−0.558***	1.000					
	(0.801)	(0.000)	(0.000)						
MS	−0.082	0.457***	0.444***	0.017	1.000				
	(0.061)	(0.000)	(0.000)	(0.691)					
ln(CV)	−0.063	0.234***	−0.673***	0.737***	−0.014	1.000			
	(0.149)	(0.000)	(0.000)	(0.000)	(0.742)				
CYCL	−0.029	0.053	−0.131**	−0.015	−0.013	0.108*	1.000		
	(0.517)	(0.239)	(0.004)	(0.739)	(0.766)	(0.016)			
INF	0.122**	−0.102*	0.323***	−0.126**	0.021	−0.493***	−0.021	1.000	
	(0.007)	(0.023)	(0.000)	(0.005)	(0.636)	(0.000)	(0.644)		
IR	0.132**	−0.174***	0.483***	−0.387***	0.037	−0.825***	−0.199***	0.763***	1.000
	(0.003)	(0.000)	(0.000)	(0.000)	(0.412)	(0.000)	(0.000)	(0.000)	

Notes: p-Values are in parentheses. Table of Pearson correlations coefficients. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$
Source: Superintendency of Companies, Securities and Insurances (SCVS)

Appendix 2

Test for groupwise heteroscedasticity

We test the presence of heteroscedasticity in residuals of the FE estimation performing the modified Wald test proposed by Greene (2000) considering that the null hypothesis is homoscedasticity.

Wooldridge test for autocorrelation

Following Woldridge (2002), under the null hypothesis of no first-order autocorrelation, we found the details given in Table AIV.

Therefore, we reject the null hypothesis of no first-order autocorrelation at 1 percent for the non-life insurance sector when using ROA as the dependent variable; however, for the life insurance there is no presence of autocorrelation according to this test.

Cross-section dependence test

We examine the mean cross-section correlation of the residuals between panel units described in Pesaran (2004) for all the variables. The null hypothesis: H_o: cross-sectional independence is rejected in most of the cases as we can observe in the following table.

Weak cross-section dependence test

We also perform the weak cross-sectional dependence test described in Pesaran (2015) under the null hypothesis of having errors that are weakly cross-sectionally dependent. This test discusses the idea that in the case of large N panels, the null of weak dependence is more appropriate than the null of independence which could be quite restrictive for large panels.

In the life insurance sector, we reject the null hypothesis of weak cross-sectional dependency for most of the variables except for ROA, leverage and liquidity which indicate that these variables have some levels of weak dependency. The rest of the variables are strongly dependent. In the non-life insurance sector, we reject the null hypothesis for all the variables except for MS.

Unit root test for all the variables

We have performed the Fisher-type unit root test for all the variables based on Phillips–Perron tests. We reject the null hypothesis: H_o: all panels contain unit roots for all the variables except for the investment income, ETA, HHI and market share in the life insurance sector. Below we show the test for all the variables used in the analysis.

Hausman test

We perform the Hausman test to determine whether FE or RE is appropriate to estimate our results. Under the null hypothesis of not having a systematic difference in RE and FE coefficients, we obtained the details given in Tables AIII–AVIII.

Model	ROA	Ln(INV)	ln(PROF)
Life insurance	7,861.34***	9,507.78***	722.53***
Non-life insurance	9.1 e+05***	82.91***	818.09***

Notes: The rejection of the null hypothesis suggests the presence of heteroscedasticity. The statistic reported is χ^2. ***Denotes the rejection of the null hypothesis at 1 percent
Source: Authors

Table AIII. Groupwise heteroscedasticity test result for FE model

Table AIV.
Autocorrelation test

Insurance sector	ROA		ln(INV)		ln(PROF)	
	F(1,27)	F(1,35)	F(1,24)	F(1,35)	F(1,27)	F(1,33)
Life insurance	1.211		7.877***		14.090***	
Non-life insurance		29.871***		2.841		1.461

Note: The rejection of the null hypothesis suggests the presence of autocorrelation. ***Denote the rejection of the null hypothesis at 1 percent

Table AV.
Cross-section dependence (CD) test for life and non-life insurance

Variables	Life insurance	Non-life insurance
ROA	1.368	6.74***
ln(INV)	14.05***	43.00***
ln(PROF)	19.01***	14.35***
ln(NP)	35.09***	46.65***
ln(TR)	37.21***	49.91***
LIQ	2.65***	23.90***
LEV	−1.02	1.69*
ETA	0.70	25.362***
CI	9.47***	31.12***
LI	15.60***	46.45***
ln(CL)	26.06***	45.93***
HHI	71.81***	85.48***
MS	3.95***	−2.16**
EFF	55.76***	57.40***
ln(VC)	71.81***	85.48***
CYCL	70.39***	83.42**
INF	70.39***	83.42***
IR	70.39***	83.42***

Notes: The rejection of the null hypothesis indicates cross-sectional dependency. *,**,***Denote the rejection of the null hypothesis at 10, 5 and 1 percent, respectively

Variables	Life insurance	Non-life insurance
ROA	1.90*	5.80***
ln(INV)	12.07***	15.17***
ln(PROF)	13.82***	13.20***
ln(NP)	16.722***	18.93***
ln(TR)	12.540***	14.61***
LIQ	2.07**	12.79***
LEV	1.65*	7.84***
ETA	3.47***	16.45***
CI	2.03**	13.91***
LI	8.23***	17.07***
ln(CL)	15.07***	12.72***
HHI	11.53***	16.24***
MS	4.64***	7.06***
EFF	14.73***	21.10***
ln(VC)	13.47***	16.13***
CYCL	42.31***	56.14**
INF	17.15***	33.16***
IR	13.41***	20.64***

Notes: The rejection of the null hypothesis indicates strong dependency between residuals of panel data. *,**,***Denote the rejection of the null hypothesis at 10, 5 and 1 percent, respectively
Source: Authors

Table AVI. Weak cross-section dependence (CD) test for life and non-life insurance sector

Variable	Life insurance Test	Life insurance Non-stationary or stationary	Non-life insurance Test	Non-life insurance Non-stationary or stationary
ROA	−6.50***	ST	−9.85***	ST
ln(INV)	−1.21	NST	−14.51***	ST
ln(PROF)	−2.12**	ST	−10.97***	ST
ln(NP)	−3.77***	ST	−11.95***	ST
ln(TR)	−1.47*	ST	−7.97***	ST
LIQ	−8.59***	ST	−17.57***	ST
LEV	−5.89***	ST	−5.81***	ST
ETA	0.95	NST	−3.17***	ST
CI	−12.16***	ST	−8.68***	ST
LI	−14.07***	ST	−7.32***	ST
ln(CL)	−2.67***	ST	−12.94***	ST
HHI	1.94	NST	−5.25***	ST
MS	−0.71	NST	−5.19***	ST
EFF	−1.73**	ST	−3.02***	ST
ln(VC)	−3.14***	ST	−3.02***	ST
CYCL	−5.17***	ST	−6.21***	ST
INF	−37.69***	ST	−36.99***	ST
IR	−2.88***	ST	−4.72***	ST

Notes: The rejection of the null hypothesis indicates stationarity for all the variables except for INV, ETA, HHI and MS. Both a constant and a time trend are included. The results are reported at lag = 4. The statistic reported in the Fisher test is the inverse normal. *,**,***Denote the rejection of the null hypothesis at 10, 5 and 1 percent, respectively
Source: Authors

Table AVII. Panel unit root test results for life insurance

Table AVIII.
Hausman test for life and non-life insurance (ROA)

	Life insurance			Non-life insurance		
	ROA	ln(INV)	ln(PROF)	ROA	ln(INV)	ln(PROF)
$\chi^2(7)$	32.22***	36.11***	59.82***			
$\chi^2(21)$				40.59***	49.19***	67.71***

Notes: The rejection of the null hypothesis suggests the usage of FE model. The statistic reported is χ^2. ***Denotes the rejection of the null hypothesis at 1 percent
Source: Authors.

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