



THE STUDY OF CO-INTEGRATION AND CASUAL RELATIONSHIP BETWEEN MACROECONOMIC VARIABLES AND INSURANCE PENETRATION RATIO

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ABSTRACT

Insurance industry plays a key role in countries growth and development. Given the significant effect of economic environment on insurance industry, researchers have always attempted to identify the variables that affect this industry. In this direction, this study aims to investigate the casual relationship between macroeconomic variables i.e. gross domestic production (GDP), Inflation, and national per capita income with the insurance penetration ratio. To study the relationship and causality between the selected variables, the study applied the Johansen and Juselius co-integration and Granger causality methodology. The required data were collected from Iranian Central Bank, Statistics Center and Central insurance for the period of 1981-2011. The study found that the underlying macroeconomics variables and insurance penetration ratio are co-integrated and in short term; there is Bidirectional causal relationship between national per capital income and the insurance penetration ratio. The results further demonstrate that there is unidirectional causal relationship from the insurance penetration ratio to the gross domestic product (GDP). In the case of inflation and insurance penetration ratio, the study found no causal relationship between them. Finally through the use of combined test, the results suggest a causal relationship between inflation, national per capita income and GDP, and insurance penetration ratio in the long-run.

Keywords: Co-integration, Granger causality test, Insurance penetration ratio, Macroeconomic variables, Vector error correction.

JEL Classification: C22, C32, E44, O11.

1. INTRODUCTION

In the first United Nations conference on trade and development (UNCTAD) in 1964, it was announced that a suitable insurance market is one of the necessary tools of economic growth (Mahdavi and Majed, 2011). The insurance industry, as a tool of risk transfer, indemnification mechanism and an institutional investor, may contribute to economic growth in the following ways (1) promoting financial stability, (2) facilitating trade and commerce (the most ancient insurance activity), (3) mobilizing domestic saving, (4) allowing different risks to be managed more efficiently, encouraging the accumulation of new capital, (5) fostering a more efficient allocation of domestic capital, and (6) helping to reduce or mitigate losses (Arena, 2008).

The last two decades have seen accelerated growth in insurance markets. As table 1 shows the average global per capita Premium was US \$661 and the global insurance penetration ratio was 6.60 % in 2011. Although, direct premiums fell globally by 0.8%, due to decrease in the value of the US dollar relative to other major currencies, the nominal premium increased by 6% (US \$6,597 billion). Life insurance premiums constituted 57% (US \$2,627 billion) of all the premiums paid, which was slightly less than the figure in 2010 when these types of premiums constituted 58% of total insurance premiums. In 2011, global life insurance premiums reached to \$2,627 billion from the \$2,520 billion of previous year. But, there was a considerable difference in the rate of life insurance income growth among the different markets. In developed markets, life insurance premiums decreased by 2.3%. Life insurance income in China and India reduced by 15% and 8.6%, respectively. Nevertheless, premium income increased in other emerging economies. For example, in the Middle East, premiums increased by 9.4% (Fan *et al.*, 2012).

In the case of Iran insurance sector based on 2011 reports of central insurance, premium per capita was US \$93 and insurance penetration ratio was reported 1.5%. It is assumed that the low ratio of insurance penetration is related to macroeconomic variables and many believed that the low value of indicators can be attributed to structural challenges in one hand and current halt in overall economy caused by harsh sanctions imposed by U.S.A and its allies.

To test this assumption, the main purpose of this paper is to investigate the relationship between macroeconomic variables and insurance penetration ratio in Iran insurance industry using Johansen and Juselius co-integration and Granger causality test. The rest of this paper is organized as follows: Section 2 provides the review of literature. Section 3 presents common methodology of co-integration and causality. Section 4 gives the results of empirical Analysis. In the end, paper concludes with conclusions.

2. LITERATURE REVIEW

The topic of factors affecting insurance is one of the most researched areas in finance literature for many years. Researchers use various economic variables in their analysis to study the determinants of insurance demand.

Beenstock *et al.* (1988) explored the relationship between liability insurance premium and GDP for 12 countries over the period of 1961 to 1996. They applied pooled time series and cross-section

analysis. Their result showed that there is a positive relationship between GDP and liability insurance premium. [Outreville \(1990\)](#) studied the relationship between insurance and economic growth and market structure. He employed cross-section analysis and found that there is a positive relationship between insurance premium and GDP. Other studies that found similar conclusions include [Cummins \(1973\)](#), [Campbell \(1980\)](#), [Fischer \(1973\)](#). [Lewis \(1989\)](#) studied the relationship of demand for life insurance with income. He found positive relationship between GDP and demand for life insurance. [Truett and Truett \(1990\)](#), [Cargill and Troxel \(1979\)](#) and [Rubayah and Zaidi \(2000\)](#), [Greene \(1954\)](#) and [Fortune \(1973\)](#) found that there is a positive relationship between income and demand for life insurance.

[Hammond et al. \(1967\)](#) found that there is a positive relationship between dependency burden and demand for life insurance. [Browne and Kim \(1993\)](#) analyzed per capita consumption insurance for 45 countries for the period of 1980 to 1987. Their result indicated that the demand for life insurance is positively related to income, dependency burden and education level. Yet, they found a negative relationship between demand for life insurance and expected inflation. [Ward and Zurbruegg \(2000\)](#) applied Granger causality to investigate the relationship between life insurance real premium and real GDP for members of OECD from 1961 to 1996. They found that insurance market make a major share of GDP in Canada and Japan. [Lim and Haberman \(2003\)](#) studied the relationship between macroeconomic variables, including national development, income, inflation, interest rate, price, net birth rate, net death rate, life expectancy, and demand for life insurance. They found that demand for life has an effective relationship with net birth rate and that inflation is negatively associated with demand for life insurance.

[Kardgar \(1988\)](#) examined the impact of expected inflation, literacy rate, net per capita income on demand for life insurance. He found that demand for life insurance has a positive relationship with income and literacy rate; there is a negative relationship between inflation and demand for life insurance. [Pajuyan and Poorpartovi \(2003\)](#) studied the impact of real per capita income, population of the country, expected inflation, literacy rate, dependency burden on demand for life insurance. Their results suggested that demand for life insurance has a positive and significant relationship with real per capita income, population of the country, literacy rate, and dependency burden; yet, it has a negative and significant relationship with expected inflation.

[Lavasani \(2005\)](#) studied the relationship of demand for life insurance with national per capita income, unemployment rate, price index and per capita payable loss, he found that dependent variable has a positive relationship with all independent variables but has a negative relationship with price index. [Sajjadi and Gholami \(2008\)](#) studied the relationship between of macroeconomic variables (GDP, financial development, interest rate, inflation rate, and insurance rate) as well as statistical variables (life expectancy) with the demand for life insurance. They found that demand for life insurance has a positive relationship with GDP and insurance rate, whereas inflation has a negative relationship with demand. Unlike they found that there is a negative relationship between life expectancy and demand for life insurance. This result may be due to the fact that the Iranian life expectancy is not markedly different from the age of retirement.

3. METHODOLOGY

3.1. Data Description

This research used Iran's annual data for the period of 1981–2011. The data were collected from Central Bank, the Iran Statistics Center and Central insurance. Most economists define inflation as the general rate of increase of the price level, or the potential for the price level to increase if it is not controlled. In the current global economic environment, inflation is such that it affects all economic systems. Inflation also has a major influence on insurance transactions, and sometimes negatively related to the demand for insurance (Pour Esmaeil Niaz, 1987), the consumer price index (CPI) of urban areas is used as an inflation proxy and 2004 index used as the base year. National per capita income in a given country is obtained through dividing the national income by the population. A majority of research indicates that this positively related to demand for insurance. Gross domestic production (GDP) is one of the measures in an economy and is defined as the value of all goods and services produced during a given period of time, usually one year, in a given country. Goods and services in this definition are the final goods and services produced at the end of the production chain, which are distributed among end users and are not bought for production of other goods and services. GDP is a macroeconomic variable that has a positive relationship with the demand for insurance. Insurance penetration ratio is defined as the ratio of premium volume to GDP. It measures the importance of insurance activity relative to the size of the economy.

To study the relationship and causality between the selected variables, four-step procedure was followed. In the first step the order of integration was tested using the Augment Dickey-Fuller (ADF) unit root tests and in the other steps were employed Johansen and Juselius Test, Vector Error Correction Model (VECM) and finally Granger Causality test.

3.2. Johansen and Juselius Co-integration Test

To investigate the long-run relationship between the variables, co-integration analysis is an appropriate method. Specifically, Johansen's maximum Eigenvalue and trace tests are suitable methods that have large enough deviations from the nominal size that researchers should be aware of the problems associated with Johansen's procedures under these circumstances and help alleviate some of the sensitivity of the Johansen procedures to deviations from the strict unit-root assumption. They do not, however, eliminate the problem (Hjalmarsson and Osterholm, 2007). The Maximum Eigenvalue test and the Trace test are applied to determine the number of co-integration vectors. The Maximum Eigenvalue statistic tests the null hypothesis of r co-integrating relations against the alternative of $r+1$ co-integrating relations for $r = 0, 1, 2, \dots, n-1$. This test statistics are computed as equation.(1)

$$LR_{\max}(r/n + 1) = -T \log(1 - \lambda) \quad (1)$$

Where λ is the Maximum Eigenvalue and T is the sample size. Trace statistics investigate the null hypothesis of r co-integrating relations against the alternative of n co-integrating relations, where n is the number of variables in the system for $r = 0, 1, 2, \dots, n-1$. This relation is shown as equation.(2) (Asari *et al.*, 2011).

$$LR_{tr}(r/n) = -T \sum_{i=r+1}^n \log(1 - \lambda) \quad (2)$$

3.3. Vector Error Correction Model (VECM)

Granger (1988) indicated that if there is a co-integration relation between two variables, there is unidirectional causality Granger at least. If there is the Granger causality relation between variables, the co-integration test cannot determine the direction of causality relationship. Engle and Granger (1987) showed that if there is co-integration relation between two variables X and Y, there is always a vector correction model between them. Therefore, a vector error correction model should be used to investigate causality relationship. The error correction model implicates that change in the dependent variable is a function of drifts from long term relationship (which is expressed by error correction element), as well as variation of other explanatory variables. This model connects the short term and long term behavior, is as follows:

$$\Delta Y_t = \alpha + \sum_{i=1}^m B_i \Delta y_{t-i} + \sum_{i=1}^n \gamma_i \Delta x_{t-i} + \lambda \varepsilon_{t-i} + u_t \quad (3)$$

In which Δ is the difference operant, Y is the dependent variable, X is the independent variables, $\lambda \varepsilon_{t-i}$ Is the error correction element, U is the equation error element, T represents time, and finally α and B are estimable parameters. The vector error correction model reveals the distinction between short term and long term causality, in addition to determine the direction of Granger causality. Insignificance of the error correction coefficient along with the summation of lags for all explanatory variables implicates the lack of long term causality relationship. Insignificance of the summation of lags for explanatory variables suggests lack of short term causality relationship (Armen *et al.*, 2008).

3.4. Granger-Causality

Granger argues that co-integration between two prices imply an inefficient market as the error correction model indicates that at least one of the prices is predictable. Therefore, the Granger-type causality procedure was applied to determine the direction of causation among the Y and X series (Goudarzi and Ramanaryana, 2011). A general specification of the Granger causality test in a bivariate (X, Y) context can be expressed as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \dots + \alpha_i Y_{t-i} + \beta_1 X_{t-1} + \dots + \beta_i X_{t-i} + \mu \quad (4)$$

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + \dots + \alpha_i X_{t-i} + \beta_1 Y_{t-1} + \dots + \beta_i Y_{t-i} + \mu \quad (5)$$

In the model, the subscripts denote time periods and μ is a white noise error. The constant parameter α_0 represents the constant growth rate of Y in the equation 4 and X in the equation 5" and thus the trend in these variables can be interpreted as general movements of co-integration between X and Y that follows the unit root process. We can obtain two tests from this analysis: the first examines the null hypothesis that the X does not Granger-cause Y and the second test examines the null hypothesis that the Y does not Granger-cause X . If we fail to reject the former null hypothesis and reject the latter, then we conclude that X changes are Granger-caused by a change in Y . Unidirectional causality will occur between two variables if either null hypothesis of equation (4) or (5) is rejected. Bidirectional causality exists if both null hypotheses are rejected and no causality exists if neither null hypothesis of equation (4) nor (5) is rejected (Asari *et al.*, 2011).

4. EMPIRICAL RESULTS

4.1. Variables Stationary Test

The analysis starts with testing for unit roots in the data. We employ the augmented Dickey-Fuller test. The results of the test are reported in table2. It could be observed from this table that null hypothesis of no unit roots for all the time series are rejected at their first difference, and all the variables achieved stationary.

4.2. Co-integration Test

The co-integration analysis is employed by the Johansen and Juselius multivariate test. The result is shown in table 3. A trace test and a maximum Eigen value test reject the null hypothesis of no co-integration among the variables. The result of the test reveals one co-integration vector. The vector results is shown as equation.(6)

$$lrev = -0.51lcpi - 1.73lgdp + 1.90li + \varepsilon \quad (6)$$

T-state (-11.09) (-1.93) (2.08)

REVL is the insurance penetration ratio, CPI is the customer price index for urban areas with the base year 2004, GDP represents the gross domestic production and I is the national per capita income. It can be observed from the equation that insurance penetration ratio is positively related national income, also is negatively related to inflation and GDP. Inflation has a coefficient of -0.51.

It means that 1% increase in inflation leads to 0.51% reduction in insurance penetration ratio. The coefficient of per capita income is +1.9; it predicts that 1% increase in per capita income leads to 1.90% increase in insurance penetration ratio. Hence, this conclusion is compatible with the economic theories and the previous research. But GDP has a coefficient of -1.73. It represents that 1% increase in GDP leads to 1.73% reduction in insurance Penetration ratio. This could be explained as the impact of sanctions, which Iran has been facing for years. These sanctions have been increased in the recent years and have caused a reduction in the Iranian money unit value and a notable increase in economic expenditures. These, in turn, have caused purchasing power to fall,

and people to mainly limit their requirements to the purchase of staple goods. This is because they do not have the ability to purchase luxury goods like insurance.

The next step is the coefficients test. The numbers inside the brackets indicate the t- statistic and the significance of the estimated coefficient. In order to test the significance of each independent variable, it is observed that the absolute value of the t (student) statistic for inflation and national per capita income is greater than 2. Therefore, at the level of 5 percent, these variables are separately significant. In other words, the influence of each of these variables could not be ignored.

4.3. Vector Error Correction Model

The VEC model can be employed because co-integration suggests the long-run relationship between variables. VECM is applied to investigate the short-run relationship between the pattern variables. The Granger causality test also was used to determine the direction of the causality between variables. The results are as following.

$$\begin{aligned}
 D(lrev) = & 0.02 * D(lrev(-1)) + 0.02 * D(lrev(-2)) - 0.3 * D(lcpi(-1)) \\
 & (0.15) \qquad (0.17) \qquad (-1.10) \\
 & -0.7 * D(lcpi(-2)) - 0.8 * D(lgdp(-1)) - 0.7 * D(lgdp(-2)) + \\
 & (0.50) \qquad (-1.17) \qquad (-1.16) \\
 & 0.29 * D(li(-1)) + 0.93 * D(li(-2)) - 0.3 * ECM + \varepsilon \qquad (7) \\
 & (0.15) \qquad (0.17) \qquad (-1.10)
 \end{aligned}$$

REV represents the insurance penetration ratio, GDP is the gross domestic product, I is the national per capita income, CPI is the consumer price index for urban areas, ECM is the error correction coefficient. The estimated equation system error correction is applied for the investigation of the short-run relationships among the pattern variables.

4.4. Granger Causality Tests

Granger causality test is employed to determine the direction of the causality relationship. Wald test is used to test the null hypothesis, which claims that the selected coefficients equal 0. The results for granger causality are reported in table 4. It could be observed from table 4 that in short run there is bidirectional causality between per capita income and insurance penetration ratio and there is unidirectional causality from insurance penetration ratio to GDP. There is no causality in either direction between insurance penetration ratio and inflation, but there is bidirectional Granger causality between national income and insurance penetration ratio in long-run. This study rejects the null hypothesis of non causality.

5. CONCLUSION

Despite the progress made in every aspect of insurance industry during the recent decades in developed and even many of the developing countries, Iranian insurance industry has not found a suitable position among Iranian householders. Researchers are continuously investigating factors which have influence on the development of Iranian insurance industry. Many factors including economic, social and psychological factors, affect the insurance industry and its growth and extension. Among the most important ones are some of the economic variables like GDP, national per capita income, inflation, depression, economic growth, etc. Therefore, given the important role of insurance industry in Iranian economy, this paper investigates the Granger causal relationship between insurance penetration ratio and macroeconomic variables during the time period 1981-2011. The conclusions drawn from error correction model indicate that both in short term and long term periods, there is bidirectional causality between national income and insurance Penetration ratio. But in short term, there is not causal relationship from GDP and inflation to insurance penetration ratio. Nonetheless, such a relationship exists in long term. Considering that in long term, the insurance penetration ratio has Granger causal relationship with national income, national per capita income and GDP, it is to acclaim that each of these economic variables has outstanding impact on demand for insurance in long term. Therefore, the insurance industry will certainly make further gradual progress through adopting suitable policies to inflation rate control, supporting domestic industry, boosting domestic productions quality and exporting them, persuasion of foreign investment, and encouraging people to support domestic production. This paper merely studied the causal relationship between insurance penetration ratio and macroeconomic variables. It is suggested that further research investigate the scale of this effect in short and long term, and propose solutions for how to make progress in Iranian insurance industry.

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Table-1. Global insurance density and insurance Penetration ratio from 2003 to 2011

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Life insurance Premium (billion)	1672181	1860158	1998702	2193175	2393089	2490421	2331566	2520072	2627168
Other premiums (billion)	1274890	1307278	1443588	1539633	1667780	1779316	1734529	1818893	1969519
Total premium (billion)	2947071	3257436	3442290	3732808	4060870	4269737	4066095	4338964	4596687
Per capita insurance premium(US\$)	470.1	502	514	564.6	607.7	633.9	595.1	627.3	661
Insurance Penetration ratio	8.07	7.94	7.49	7.72	7.49	7.07	6.98	6.89	6.60

Table-2. Dickey-Fuller unit root test (ADF)

Test result	Mackinnon critical values			ADF statistic	Number of lags	Trend	intercept	variable
	1%	5%	10%					
Stationary in 1% level	-3.679322	-2.967767	-2.622989	-5.211552	0	No	Yes	LIP
Stationary in 1% level	-3.679322	-2.967767	-2.622989	-6.609042	0	No	Yes	LGDP
Stationary in 1% level	-3.679322	-2.967767	-2.622989	-6.552409	0	No	Yes	LGNI
Stationary in 5% level	-3.679322	-2.967767	-2.622989	-2.999163	0	No	Yes	LCPI
Stationary in 1% level	-3.679322	-2.967767	-2.622989	-7.091023	0	No	Yes	LG

Table-3. Determining the number of co-integration vectors utilizing Johansen and Juselius Co-integration Test

lambda-max test			
H0	H1	Statistic	95% critical
$r = 0$	$r = 1$	56,43962	40,17493
$r \leq 1$	$r = 2$	28,39435	24,27596
$r \leq 2$	$r = 3$	10,04796	12,32090
trace test			
H0	H1	Statistic	95% critical
$r = 0$	$r \geq 1$	28,04527	24,15921
$r \leq 1$	$r \geq 2$	18,34640	17,79730
$r \leq 2$	$r \geq 3$	9,056723	11,22480

Table-4. Results obtained from estimation of vector error correction model and Granger causality test

Granger causality test/Wald test	Causality	
Direction of causality	Probe	
$LCPI \rightarrow LREV$	[0.426]	No
$LGDP \rightarrow LREV$	[0.091]	No
$LI \rightarrow LREV$	[0.005]	Yes
$LREV \rightarrow LCPI$	[0.138]	No
$LREV \rightarrow LGDP$	[0.025]	Yes
$REV \rightarrow LI$	[0.000]	Yes
Long term Granger causality test (Combined test)	[0.030]	Yes