Using Econometrics to Understand the Endogenous Relationship between Life Insurance and Economic Growth

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Abstract

The aim of this research is to analyze whether or not life insurance matters for economic growth taking into account the possible endogenous relationship between economic terms of interest. Research problem that is recognized based on research to date is low treatment of potential endogeneity problem between life insurance and economic growth.To fill in this gap in literature, balanced panel data for 94 countries during the period 1994-2013 are used in this analysis. The methodology used includes static panel data estimators. Hausman test is used to decide between fixed and random effects. Moreover, Maximum likelihood estimator is used to control for potential endogeneity issue. The obtained results indicate a significant positive impact of life insurance and human capital on economic growth. Inflation and government spending are reported to have negative impact while trade openness is not reported to have a significant impact on economic growth. The model that does not control for the potential endogeneity issue tends to underestimate the impact of life insurance on economic growth.Based on the obtained results, several useful insights are given especially for policy makers and researches. The paper suggests that, in order to enhance economic growth, the government should stimulate life insurance sector, educational attainment and trade openness while it should reduce government spending and inflation.

Key words: economic growth, endogenous relationship, life insurance, panel analysis

INTRODUCTION

The relationship between life insurance and economic growth is a popular issue of debate nowadays. However, a consensus is lacking on the direction in which causality runs between them. Life insurance activity can have either a supply-leading relationship with economic growth (life insurance stimulates economic activity due to its financial intermediary role) or demand-following (life insurance just accompanies economic growth as a side-effect) (Satrovic and Muslija, 2018b).

A significant positive impact of life insurance as a financial intermediary on economic growth is reported by (Webb et al. 2002; Arena 2006; Ćurak et al. 2009; Avram 2010; Azman and Smith 2010; Ege and Bahadır 2011; Chen et al. 2011; Hou et al. 2012; Verma and Bala 2013; Cristea et al. 2014 and Dhiab and Jouili 2015). However, Patrick (1966) and Beck and Webb (2003) provide robust evidence that the economic growth has significant positive impact on life insurance. Taking into account these results, endogeneity issue is likely to occur when analyzing this relationship.

Arellano and Bond (1991) indicate that linear static panel data estimators do not provide consistent estimates if it is expected that changes in dependent may cause changes in independent variable. This is why in this paper an attempt is made to identify the estimator to control for aforementioned issue. For this purposelinear static and dynamic panel data estimators are used. Even though linear dynamic panel data estimators control for endogeneity issue and potential dynamics in growth equation, both of panel data estimators (linear static and dynamic) are used in estimation process since linear dynamic panel data estimators lead to the decrease in the number of observations (number of observed years) due to calculating first differenced and lagged values of all variables analyzed. Therefore, linear static panel data estimators are suggested initially as well as appropriate endogeneity tests. No matter what the results on the potential endogeneity issue indicate, they would be contrasted in a detail with those obtained using linear dynamic panel data estimators.

Life insurance refers to all the policies that come to payment of insured sum (benefit) in the case of termination or duration of life of one or more persons insured (Chen et al. 2011). Life insurance can be also defined as a contract between an insurance policyholder and an insurer where the insurer promises to pay a sum of money (the benefit) to designated beneficiary in exchange for a premium, upon the death of insured person (Kozarević 2010).

Economic growth may be defined as an increase in the capacity of an economy to produce goods and services and the improvement in life conditions, compared from one period of time to another (Jurković et al. 1995). Robinson (1971) defines economic growth as „increases in aggregate product, either total or per capita, without reference to changes in the structure of the economy or in the social and cultural values systems".

Life insurance companies offer different kinds of products. Therefore, they are also providing dozens types of services such as: liquidity, risk pooling and project monitoring. Thanks to these services, life insurance companies are expected to stimulate long-term savings and investment in public and private projects. Thanks to its role as financial intermediary, life insurance is expected to drive more efficient allocation of resources.

Revised Solow-Swan framework is the fundament of the empirical part of this paper. Supply-leading approach is analyzed in this paper since life insurance is expected toaffect the rate and the quality of investment, and is therefore considered as a source of economic growth. The model developed in this dissertation suggests life insurance activity to be evaluated alongside global technology growth as a source of productivity gains across economies.

LITERATURE REVIEW

Up-to-date literature pays much attention to the relationship between banking sector and economic growth. However, the research on the role of other financial institutions is of limited scope. This paper summarizes some of the most influential studies on the relationship between life insurance and economic growth.

Webb et al. (2002) use a Solow-Swan model to explore the impact of insurance and banks on economic growth. Results indicate a positive impact of life insurance on economic growth. Authors report the endogenous relationship between life insurance and economic growth. It is controlled using a three stage least squares simultaneous estimation. Exogenous instrumentals are used as key variables. It is important to emphasize that this paper does not take into account differences in cash flow between life and non-life insurance.Furthermore, rigorous robust analysis is not reported.

Arena (2006) emphasizes that insurance sector contributes to economic growth due to enabling risks to be managed more efficiently and by mobilizing long-term domestic savings. This paper uses the dynamic generalized method of moments. Panel data on 56 countries during the period between 1976 and 2004 is analyzed. The obtained results indicate endogenous relationship between life and non-life insurance and economic growth. However, it is important to notice that regional disparities are not taken into account and rigorous robust analysis is not reported.

The relationship between insurance sector development and economic growth is empirically investigated in Ćurak et al. (2009). This paper controls for additional determinants of economic growth by applying instrumental variable procedure. The obtained results indicate that insurance sector positively and significantly impacts economic growth. The results are confirmed in terms of both: life and non-life insurance, as well as, total insurance. However, it is important to emphasize that they do not take into account disadvantages of instrumental variable estimator. Very important obstacle is they do not control for possible dynamics in growth equation and rigorous robust analysis is not reported.

The purpose of the paper (Cristea et al. 2014) is to analyze the correlation between insurance and economic growth in Romania during the period between 1997 and 2012. The reported results indicate positive impact of life and non-life insurance on economic growth. However, they do not control for the endogeneity problem, therefore the relevance of the results is questionable. They do not control for the impact of stock market, banks and additional determinants of economic growth. Rigorous robust analysis is not reported.

Dhiab and Jouili (2015) empirically investigate the impact of insurance on economic growth in Tunis during the period between 1998 and 2013. According to the obtained results, insurance sector positively and significantly impacts economic growth. The results are confirmed in terms of non-life, life and total insurance.

METHODOLOGY AND MODEL SPECIFICATION

Nowadays, a number of empirical evidence highlights the strengths of revised Solow-Swan model to analyze the growth equation. Empirical section of this paper estimates this model as a basic, four extended models as well as integrated model that controls for the impact ofall key determinants of economic growth. The revised Solow-Swan model that analyzes exogenous relationship between life insurance and economic growth may be formalized as:

$$Y(t) = Z(t)A(t)K(t). \qquad [1.1]$$

where production is denoted by $Y(t)$, capital by $K(t)$. $A(t)$explains how the technology influence changes in productivity of given levels of capital and labor.$Z(t)$measures the activity of financial sector (life insurance companies in this case). Panel specification of the models estimated in this paper may be formalized as (Satrovic, 2017):

$$Y_{it} = \beta_0 + \beta_1 log\, Z_{it} + \alpha log k_{it} + \beta_1 log X_{it} + \varepsilon_{it} [1.2]$$

where change in output intensity is Y_{it}= [the average growth rate of real GDP per capita]. The capital intensity is k_{it}= [GDI as a percentage of GDP]. Life insurance penetration with respect to time is denoted by $log\, Z = log LI$. These variables are estimated in the basic model (model 1). The variables included to control for additional determinants of economic growth in extended models (models 2-5) are X_{it}= [inflation, education, government spending and trade openness]. logrefers to the logarithm of a variable. Logarithm values are calculated in order to deal with skewness and to ease interpretation. Brief explanation of variables is given below.

Economic growth (dependent variable) is approximated using average growth rate of real GDP per capita - *RGDPc*. Average growth rates of real GDP per capita are measured as differences of natural logs divided by number of years in the period. According to Webb (2000) this procedure produces rate equivalent to a compound rate of growth over the entire period. Life insurance is approximated using life insurance penetration LI. Life insurance penetration can be defined as the ratio of life insurance premium volume to GDP (Satrovic, 2018). This measure indicates the importance of insurance activity relative to the size of the economy and is expected to have a positive impact on economic growth. Capital stock in the model $[1.2]$ is considered to be the primary component of production function. This variable is expected to explain the most variation in the output. However, measuring capital stock is problematic and gross domestic investment as a share of GDP (*GDI*) denoted by k is suggested following Webb et al. (2002).This is why both positive and/or neutral effect of GDI on economic growth is assumed.

Education as a proxy of human capital is believed to play an increasingly important role in economic growth. However, adequate measuring remains controversial (Satrovic, 2017). The hypothesis that human capital plays an important role in the growth process is theoretically well substantiated in the literature, but empirical results on the matter remain mixed due to poor measurement. This is why, in view of the pros and cons of the existing variable, secondary school enrolment rate (*EDU*) is suggested since it measures the current investment in human capital that will be reflected in the stock of human capital sometime in the future. Due to this assumption, positive impact of human capital is expected.

Webb (2000) emphasizes that the degree to which the public sector dominates the economy is expected to have the crowding out effect on the more efficient private sector. In order to analyze this, government expenditure as a percentage of GDP (*GOV*) as a proxy of government consumption is included in the model. Negative impact is expected taking into account results obtained in earlier studies. Inflation (*INF*) is expected to worsen the long-run macroeconomic performance of market economies by reducing total factor productivity. In this paper, inflation is approximated using annual percentage change in the cost to the average consumer of acquiring a basket of goods and services. When it comes to trade openness it is important to emphasize that the debate on the causality between trade openness and growth is still far from being closed since most of the empirical evidence suffers serious shortcoming. It lies in the way trade openness is measured. Following Webb (2000), this paper uses net barter trade index (2000 = 100) – *TI*as a proxy of trade openness. It is defined as the sum of export and import in current year compared to year 2000. Results of up-to-date studies indicate that empirical evidence on the matter reveals mixed results.

Models are initially estimated using linear static panel data estimators (fixed and random effects estimated using least squares dummy variable and generalized least squares estimators respectively) (Satrovic and Muslija, 2018a). A rigorous robust and sensitivity analysis is conducted in order to analyze economic criteria (whether the obtained results are in accordance with a priori expectations), statistical criteria (whether the obtained results are significant) and econometric criteria (multicollinearity, heteroscedasticity, autocorrelation and endogeneity). Taking into account potential dynamic characteristic of growth process, there is a need to estimate models using linear dynamic panel data estimators and to contrast results with those obtained using linear static panel data estimators (Satrovic, 2017). Among these, special attention is given to Maximum likelihood estimator for dynamic panel. The obtained results are presented below.

RESULTS OF THE RESEARCH

In model (1) (the basic model) dependent variable is average growth rate of real GDP per capita (*RGDPc*). Independent variables are: GDI as a percentage of GDP (*GDI*) and life insurance penetration (*LI*). Model is estimated using both FE and RE. A Hausman specification test is used to decide between FE and RE (Somun-Kapetanovic et al., 2016). Hausman statistic's p value of 0.148 (Table 1.1) indicates that null hypothesis that the coefficients estimated using the efficient random effects estimator are the same as the ones estimated using the consistent fixed effects estimator cannot be rejected (for a 99% confidence). This assumption is enough for considering random effects safe to use. Robustness check is to be performed for models estimated using RE.

Table 1.1: The estimation of models (1)-(5) and integrated model, RE
(dependent variable*RGDPc*)

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (IM)
	(1) RE	(2) RE	(3) RE	(4) RE	(5) RE	(6) RE
GDI	0.688 (0.336)**	1.042 (0.333)*	0.918 (0.344)*	0.840 (0.339)**	0.784 (0.297)***	1.629 (0.448)*
LI	3.472 (1.068)*	3.013 (1.034)*	3.587 (1.055)*	3.732 (1.069)*	3.356 (1.219)*	3.065 (1.313)*
EDU		1.681 (0.363)*				1.418 (0.294)*
GOV			-2.425 (0.930)**			-2.133 (0.102)*
INF				-0.562 (0.207)*		-0.497 (0.193)*
TI					1.795 (0.654)**	1.803 (0.653)**
Constant	-0.457 (0.679)	-3.584 (0.944)*	2.086 (1.178)***	-0.240 (0.683)	-2.948 (1.056)**	-3.917 (1.436)**
chi2	15.49	37.80	22.54	23.09	21.17	37.53
chi2 (p)	0.000	0.000	0.000	0.000	0.000	0.000
Hau. spec. test	3.82	4.52	2.08	4.30	4.37	9.18
Hau. sp. test (p)	0.148	0.211	0.556	0.231	0.358	0.244
Observations	376	376	376	376	376	376
Groups	94	94	94	94	94	94

*,**,*** significance at 99%, 95% and 90% respectively. Standard errors are in parentheses.
Source: Author

Table 1.1 summarizes results of basic model and extended models estimated using RE followed by testing economic, statistical and econometric criteria. Value of regression parameter with (*LI*) presented in Table 1.1 (columns 1-5) indicates a significant positive relationship between life insurance and economic growth. Therefore the increase in life insurance penetration increases economic growth (significant at 1% level). Since the obtained result is in accordance with a priori expectations, economic criteria is considered satisfied. In addition, parameter with (*GDI*) indicates a significant impact of this variable on economic growth (for a 95% confidence). The obtained result is in contrast with Webb (2000). It is expected that violations of econometric criteria lead to this result what is tested further. Extended models indicate that education (column 2) and trade openness (column 5) are having a positive impact on economic growth. Government spending (column 3) and inflation (column 4) are reported to have a negative impact on economic growth. Since there are no much differences in terms of the sign and the significance of the results obtained with respect to the integrated model (IM) that controls for the impact of all key control variables compared to models (1)-(5), model (IM) is assumed to give support to these results obtained in models integrating control variables singly into regression equation.

Statistical criteria are tested using chi2 test (Satrovic, 2017). *p* value lower than 0.05 indicates that null hypothesis that none of the independent variables impacts dependent variablecan be rejected for all models. Since some of the independent variables have a significant impact on dependent variable (*p* values of *Z* test are lower than 0.05), model is considered significant.

The next step includes testing econometric criteria. It starts with testing multicollinearity. The assumption on no multicollinearity cannot be rejected taking into account low correlation coefficients between time-variant independent variables (Table 1.2).

Likelihood-ratio test is used to provide formal evidence on heteroscedasticity (Satrovic, 2017). Table 1.3 indicates that null hypothesis on constant variance should be rejected i.e. the assumption on homoscedasticity is rejected (for a 95% confidence).

Table 1.2: Correlation coefficients

	GDI	LI	EDU	GOV	INF	TI
GDI	1.000					
LI	0.054	1.000				
EDU	-0.272*	0.032	1.000			
GOV	0.329*	0.062	-0.215*	1.000		
INF	0.295*	0.151*	-0.117**	0.124**	1.000	
TI	0.006	-0.033	0.107**	-0.103**	-0.080	1.000

*,**,*** significance at 99%, 95% and 90% respectively.
Source: Author

Table 1.3: Homoscedasticity of residuals

Model	Characteristic values	p value
Model (1)	chi2(93) = 263.58	0.000
Model (2)	chi2(93) = 278.31	0.000
Model (3)	chi2(93) = 278.91	0.000
Model (4)	chi2(93) = 264.83	0.000
Model (5)	chi2(93) = 271.54	0.000
Model (IM)	chi2(93) = 283.39	0.000

Source: Author

Autocorrelation is formally tested for all variables and is reported to be present. Furthermore, the presence of endogenous regressor is tested. Initially, Hausman test for the exogeneity of regressors is used for this purpose. Two models are estimated. In the first model, linear static panel data estimator is used to estimate the relationship between life insurance (dependent variable) and instrumental variables. Webb (2000) suggests that religious composition of a country has a significant impact on the demand for life insurance. Joint significance of instrumental variable indicates the presence of endogeneity for a 95% confidence (Table 1.4).

Since the obtained results indicate that econometric criteria are violated, estimated regression coefficients are reported to be inefficient. In addition, Hausman test for the exogeneity of regressors suggests that *LI* might have endogenous relationship with dependent variable(for a 95% confidence). Results are interpreted after dealing with aforementioned issues, since the results obtained using linear static panel data estimators are not reported to be relevant.

Table 1.4: Hausman test for the exogeneity of regressors

Model	Characteristic values	p value
Model (1)	F(1, 372) = 6.71	0.010
Model (2)	F(1, 371) = 4.62	0.032
Model (3)	F(1, 371) = 7.58	0.006
Model (4)	F(1, 371) = 7.61	0.006
Model (5)	F(1, 371) = 7.08	0.009
Model (IM)	F(1, 378) = 4.37	0.018

Source: Author

Table 1.5: The estimation of models (1)-(5) and integrated model, Maximum likelihood estimator(dependent variable*RGDPc*)

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (IM)
	(1)	(2)	(3)	(4)	(5)	(7)
RGDPc L.1	0.226 *(0.168)*	0.139 *(0.137)*	0.262 *(0.185)*	0.135 *(0.120)*	0.149 *(0.095)*	0.274 *(0.359)*
GDI	-0.036 *(0.437)*	0.554 *(0.452)*	0.308 *(0.444)*	0.299 *(0.449)*	0.159 *(0.276)*	0.957 *(0.718)*
LI	4.443 *(1.528)**	4.541 *(1.325)**	4.201 *(1.531)**	5.370 *(1.418)**	4.913 *(1.515)**	4.133 *(1.715)**
EDU		1.819 *(0.409)**				1.488 *(0.441)**
GOV			-2.721 *(0.886)**			-1.818 *(0.569)***
INF				-0.426 *(0.257)****		-0.398 *(0.151)***
TI					0.864 *(0.318)***	0.713 *(0.225)**
Constant	-0.543 *(0.847)*	-4.303 *(1.167)**	2.303 *(1.117)***	-0.853 *(0.832)*	-1.533 *(2.847)*	-0.984 *(2.191)*
Observations	376	376	376	376	376	376
Groups	94	94	94	94	94	94

*,**,*** significance at 99%, 95% and 90% respectively. Standard errors are in parentheses.
Source: Author

The fact that life insurance activity may have endogenous relationship with economic growth complicates the specification of empirical growth models. Taking into account dynamic characteristic of growth equation as well as endogenous issue, these models are estimated using Maximum likelihood estimator for dynamic panel. Arellano-Bond and Arellano-Bover estimators for dynamic panel are not used in this particular research since they discard significant number of observations and may cause efficiency issues. Table 1.5 summarizes the obtained results.

Value of regression parameter with (*LI*) presented in Table 1.5 indicates a significant positive relationship between life insurance and economic growth in all models, significant at 1% level. In addition, *GDI* is not reported to have a significant impact on economic growth. Education and trade openness are reported to have a significant positive impact on economic growth while government spending and inflation are reported to have a negative impact on economic growth.

Statistical criteria indicate that null hypothesis that none of the independent variables impacts dependent variable can be rejected and models are considered significant. Since there are no much differences in terms of the sign and the significance of the results obtained with respect to the IM model compared to models (1)-(5), model (IM) estimated using MLE is assumed to give strong support to these results obtained in models integrating control variables singly into regression equation. Comparison of the results obtained using linear static and dynamic panel data estimators indicates that models that violate econometric criteria may provide wrong conclusion on the size of the impact.

CONCLUSION

Rigorous robustness (and sensitivity) analysis is conducted to identify efficient estimator of the relationship between life insurance and economic growth. The obtained results are interpreted and discussed below. In addition, the validity of results is explored while referring to the recent studies. Since models obtained in recent studies differ in sample size, observed time period, measurement units etc. comparison in terms of the size of the impact is not valid. However, the sign and the significance of the impact are compared.

Maximum likelihood estimator is found to be the most efficient linear panel data estimator for modeling the relationship between life insurance and economic growth in model (1). Value of regression parameter of 4.443 presented in Table 1.5 (column 1) indicates a significant positive relationship between life insurance and economic growth. Therefore the increase in life insurance penetration increases economic growth. The variable is found to be significant at 1% level. The obtained result is in accordance with (Arena 2006; Ćurak et al. 2009; Azman and Smith 2010; Ege and Sarac 2011; Chen et al. 2011; Hou et al. 2012). In addition, parameter with (*GDI*) indicates no significant impact of this variable on economic growth. The obtained result is in accordance with Webb (2000). Parameter with constant term is not significant. Parameter with *LI* in model (1) estimated using RE equals 3.472 (Table 1.1). Worthwhile noticing is that, the model that violates the econometric criteria may provide wrong conclusion on the size of the impact. Although we do not discuss the size of the impact in this analysis, that is the economic significance of the variables under consideration given the measurement issues, we emphasize the importance of conducting a rigorous robust analysis when considering the most efficient panel data estimator.

Model (2) is also estimated using Maximum likelihood estimator. Table 1.5indicates a significant positive relationship between life insurance and economic growth when education proxy variable is included. Accordingly, the increase in life insurance penetration increases economic growth, with the positive impact significant at 1% level. In addition, *GDI* is not suggested to have a significant impact on economic growth. However, close attention in the second model is paid to education. A significant positive impact of education is in accordance with up-to-date studies. Similar result is obtained for model (5) by controlling for trade openness. After resolving method of estimation issues, the sizes of the impact of *LI* and *EDU* on economic growth have increased.

Maximum likelihood estimator is found to be the most efficient linear panel data estimator for modeling the relationship between life insurance and economic growth in model (3). Value of regression parameter with (*LI*) presented in Table 1.5 (column 3) indicates a significant positive relationship between life insurance and economic growth when government spending proxy variable is included. Therefore the increase in life insurance penetration increases economic growth (significant at 1% level of significance). In addition, *GDI* is not suggested to have a significant impact on economic growth. However, close attention in the third model is paid to government spending. A significant negative impact of *GOV*is in accordance with previous studies. Similar result is obtained for model (4)by controlling for the impact of inflation.

Maximum likelihood estimator is similarly suggested to be the most efficient estimator of the integrated model (IM). Essentially, the obtained results with respect to MLE estimations are fully consistent. Specifically, the results obtained in case of an integrated model are consistent with the results obtained with respect to models (1)-(5) in terms of the sign and the significance of the estimated coefficients of the independent variables. Although some variability in the size of the coefficient is obtained (as expected), the results imply the stability of the models applied when using MLE procedure.

Based on the obtained results, several useful insights are given especially for policy makers and researches. The paper suggests that, in order to enhance economic growth, the government should stimulate life insurance sector, educational attainment and trade openness while it should reduce government spending and inflation.

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