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A Cross-country Analysis of the Determinants of Insurance Supply and Demand

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ABSTRACT

Past studies in international insurance have not adequately addressed the importance of the relationship between the forces of supply and demand and assumed away any relationship between life and non-life insurance. Towards gaining a better understanding of this still under-researched area, a two-insurance market model is developed. In the empirical estimation of the model, the technique of three stage least square is employed. The empirical findings suggest that life and non-life insurance are complements, both in the demand and supply sides. A number of variables from the broad classes of economic, socio-political and regulatory variables were found to be significant in determining insurance supply and demand. Of specific variables different than those found in previous studies, the lack of civil liberty was found to negatively affect non-life insurance demand while a mandatory reinsurance cession requirement negatively affects non-life insurance supply

ABSTRAK

Kajian lepas dalam bidang insurans antarabangsa masih belum lagi mengambil kira secukupnya kepentingan perhubungan kuasa penawaran dan permintaan, dan telah mengandaikan bahawa hubungan tidak wujud antara insurans hayat dan insurans am. Untuk memahami bidang insurans yang masih belum diterokai sepenuhnya ini, satu model teoretikal pasaran dua insurans telah dibentuk. Dalam anggaran empirikal model ini, teknik ganda dua terkecil tiga peringkat telah digunakan. Penemuan empirik menunjukkan insurans hayat dan insurans am adalah barangan penggenap baik dari segi permintaan mahupun penawaran. Beberapa variabel dari kelas am ekonomi, sosio-politik dan kawalan telah didapastikan mempengaruhi tawaran dan permintaan. Daripada beberapa variabel yang berlainan daripada yang ditemui oleh kajian-kajian sebelum ini, variabel ketiadaan kebebasan sivil didapati mempunyai kesan negatif terhadap permintaan insurans am, manakala variabel insurans semula mandatori didapati mempunyai kesan negatif terhadap penawaran insurans am.

INTRODUCTION

Implicit in all the leading theories of insurance is the assumption that consumer and supplier behaviors in relation to insurance are universal. Although mostly silent on this matter, international insurance[1] studies are largely aimed at corroborating this implicit assumption. Not unlike previous studies in international insurance, this study seeks to establish the universal determinants of insurance consumption and supply. One difference distinguishes this from the earlier studies. Where previous studies examine the determinants of insurance consumption in a polar fashion, i.e. either those of life or non-life insurance[2] separately, this study examines the determinants under the assumption that life and non-life insurance are gross complements. This study begins with a discussion of the theoretical model that serves as the foundation to the analysis.

THE THEORETICAL MODEL

Assume a simple world with a market that consists of two related commodities, life and non-life insurance. The two-commodity market (two-insurance market) is in equilibrium and the prevailing supply and demand relationships can be described as follows:[3]

$$Q_L^S = Q_L^D \text{ or } Q_L^S - Q_L^D = 0 \equiv E_L \tag{1}$$

$$Q_N^S = Q_N^D \text{ or } Q_N^S - Q_N^D = 0 \equiv E_N \tag{2}$$

$$Q_L^D = D_L(P,H,Y,B)\left(\frac{\partial D_L}{\partial P} < 0; \frac{\partial D_L}{\partial Y} > 0; \frac{\partial D_L}{\partial Y} > 0\right) \tag{3}$$

$$Q_L^S = S_L(P,A)\left(\frac{\partial S_L}{\partial P} > 0; \frac{\partial S_L}{\partial A} > 0\right) \tag{4}$$

$$Q_N^D = D_N(P,H,Y,R)\left(\frac{\partial D_N}{\partial H} < 0; \frac{\partial D_N}{\partial Y} > 0; \frac{\partial D_N}{\partial R} > 0\right) \tag{5}$$

$$Q_N^S = S_N(H,A)\left(\frac{\partial S_N}{\partial H} > 0; \frac{\partial S_N}{\partial A} > 0\right) \tag{6}$$

where

Q_L^S, Q_L^D = Life insurance quantity supplied and demanded respectively

Q_N^S, Q_N^D = Non-life insurance quantity supplied and demanded respectively

E_L, E_N = Equilibrium position of life and non-life insurance respectively

$D_L(\ ), D_N(\ )$ = Life and non-life demand function respectively

$S_L(\ ), S_N(\ )$ = Life and non-life supplly function respectively

Y = Consumer income

B = Bequest motive

A = Independent insurance agent

R = Mandated non-life insurance coverage

P, H = Price of life and non-life insurance respectively

The general functions described above are simple representations of the insurance marketplace. Insurance demand is assumed to be a function of price, consumer income and variables believed to relevant in inducing demand. Supply is assumed to be general function of insurance price and independent agents.

In the two-insurance market model above, both the supply and demand functions are assumed to be continuous and have continuous derivatives.

Restrictions are placed on the supply and demand equations in order that they may mimic normal market conditions. In demand equation (3), for example, the partial derivative restriction demand $\frac{\partial D_L}{\partial P} < 0$ is to ensure that life insurance demand is a decreasing function of price (P), while the partial restriction $\frac{\partial D_L}{\partial Y} > 0$ assumes life insurance to be normal good, i.e., an increasing function of income (Y). The restrictions $\frac{\partial S_L}{\partial P} > 0$ and $\frac{\partial S_L}{\partial A} > 0$ in equation (4) restricts supply to be an increasing function of P and A (independent agents).

To prove the presence of functional dependence among the equations and hence justify the usage of the simultaneous equation system, based on the implicit function theorm, equations (3) through (6) must satisfy the condition of non-zero Jacobian determinant.[4] For the purpose of setting up the equations to be solveable for the Jacobian determinant, the following simplifications are made. Let $Q_L = Q_L^D = Q_L^S$ and $Q_N = Q_N^D = Q_N^S$ Equations (3) through (6) are next expressed and rearranged in the following form.

$$F^1(P,H,Q_L,Q_N,Y,B,A,R) = D_L(P,H,Y,B) - Q_L = 0 \quad (7)$$

$$F^2(P,H,Q_L,Q_N,Y,B,A,R) = S_L(P,A) - Q_L = 0 \quad (8)$$

$$F^3(P,H,Q_L,Q_N,Y,B,A,R) = D_N(P,H,Y,R) - Q_N = 0 \quad (9)$$

$$F^4(P,H,Q_L,Q_N;Y,B,A,R) = S_N(H,A) - Q_N = 0 \quad (10)$$

The Jacobian determinant is then found as follows:

$$|J| = \begin{vmatrix} \frac{\partial F^1}{\partial P} & \frac{\partial F^1}{\partial H} & \frac{\partial F^1}{\partial Q_L} & \frac{\partial F^1}{\partial Q_N} \\ \frac{\partial F^2}{\partial P} & \frac{\partial F^2}{\partial H} & \frac{\partial F^2}{\partial Q_L} & \frac{\partial F^2}{\partial Q_N} \\ \frac{\partial F^3}{\partial P} & \frac{\partial F^3}{\partial H} & \frac{\partial F^3}{\partial Q_L} & \frac{\partial F^3}{\partial Q_N} \\ \frac{\partial F^4}{\partial P} & \frac{\partial F^4}{\partial H} & \frac{\partial F^4}{\partial Q_L} & \frac{\partial F^4}{\partial Q_N} \end{vmatrix}$$

$$= \begin{vmatrix} \frac{\partial D_L}{\partial P} & \frac{\partial D_L}{\partial H} & -1 & 0 \\ \frac{\partial S_L}{\partial P} & 0 & -1 & 0 \\ \frac{\partial D_N}{\partial P} & \frac{\partial D_N}{\partial H} & 0 & -1 \\ 0 & \frac{\partial S_N}{\partial H} & 0 & -1 \end{vmatrix}$$

$$= \left(\frac{\partial D_L}{\partial P} - \frac{\partial S_L}{\partial P} \right)\left(\frac{\partial S_N}{\partial H} - \frac{\partial D_N}{\partial H} \right) + \frac{\partial D_L}{\partial H}\frac{\partial D_N}{\partial P} \tag{11}$$

In evaluating expression (11), one critical point should be noted. Arising from the assumption that life and non-life insurance are normal goods, expression (11) will always be non-zero. The assumption of normal goods causes the first two terms of expression (11), always to be negative. The integrity of this non-zero state does not depend on the qualitative outcome of the term $\frac{\partial D_L}{\partial H}\frac{\partial D_N}{\partial P}$ Since expression (11) does not equal zero, satisfying the implicit function theorem condition of $|J| \neq 0$, it can then be deduced that the usage of the two-insurance market model to simultaneously represent life and non-life insurance supply and demand behavioral equations is appropriate.

BASIC EMPIRICAL MODEL

The literature suggests that the possible determinant set is indeed large, although for practical purposes, particularly in the cross-country context, the set is limited by data availability It therefore can be postulated that insurance supply and demand are functions of a multitude of determinants, some of which may be unique to either supply or demand, while others may be common to both. In broad terms and for the purpose of this research, these determinants are classified as sociological, economic and regulatory The general form of the functional relationship between insurance supply and demand with their respective determinants can be expressed as follows:

$$\begin{matrix}\text{Insurance}\\\text{Demand}\end{matrix} = f\begin{pmatrix}\text{Demand} & & \text{Demand} & & \text{Demand}\\ \text{inducing} & & \text{inducing} & & \text{inducing}\\ \text{socio-political} & + & \text{economic} & + & \text{regulatory}\\ \text{variables} & & \text{variables} & & \text{variables}\end{pmatrix}$$

$$\begin{matrix}\text{Insurance}\\\text{Supply}\end{matrix} = g\begin{pmatrix}\text{Supply} & & \text{Supply} & & \text{Supply}\\ \text{inducing} & & \text{inducing} & & \text{inducing}\\ \text{socio-political} & + & \text{economic} & + & \text{regulatory}\\ \text{variables} & & \text{variables} & & \text{variables}\end{pmatrix}$$

Based on the general functional relationship above, the behavioral equations tested in this study are as follows:

$$\begin{aligned}LIFE\_D_{it} = {} & \alpha_0 + \alpha_1 GDP\_POP_{it} + \alpha_2\ INTDL\_L_{it}\\ & + \alpha_3 IND\_SER_{it} + \alpha_4 KID_{it} + \alpha_5 LIEXP\_L_{it}\\ & + \alpha_6 PRICE_{it} + \in_1\end{aligned} \tag{12}$$

$$\begin{aligned}LIFE\_S_{it} = {} & \beta_0 + \beta_1 INTDL\_L_{it} + \beta_2 QM\_GDP_{it}\\ & + \beta_3 LIFCAP\_L_{it} + \beta_4 MONO_{it} + \beta_5 MREIN_{it}\\ & + \beta_6 NLIFE\_S_{it} + \in_2\end{aligned} \tag{13}$$

$$\begin{aligned}NLIFE\_D_{it} = {} & \delta_0 + \delta_1 GDP\_POP_{it} + \delta_2 PRICE_{it} + \delta_3 CIV_{it}\\ & + \delta_4 NADMIT_{it} + \delta_5 IND\_SER_{it} + \delta_6 INDTL\_L_{it} + \in_3\end{aligned} \tag{14}$$

$$\begin{aligned}NLIFE\_S_{it} = {} & \lambda_0 + \lambda_1 PRICE_{it} + \lambda_2 INT_{it} + \lambda_3 QM\_GDP_{it}\\ & + \lambda_4 MONO_{it} + \lambda_5 NADMIT_{it} + \lambda_6 MREIN_{it}\\ & + \lambda_7 NLCAP\_L_{it} + \lambda_8 LIFE\_S_{it} + \in_4\end{aligned} \tag{15}$$

$$LIFE\_D = LIFE\_S \tag{16}$$

$$NLIFE\_D = NLIFE\_S \tag{17}$$

where $LIFE\_S_{it}$, $LIFE\_D_{it}$	=	Life insurance supply and demand respectively, for country i at time t
$NLIFE\_S_{it}$, $NLIFE\_D_{it}$	=	Non-life insurance supply and demand respectively, for country i at time t
GDP_POP_{it}	=	Per capita consumer income for country i at time t
$INTDL\_L_{it}$	=	Life insurance price (ratio of deposit to lending rates of interest) in country i at time t
INT_{it}	=	Lending interest rate in country i at time t
QM_GDP_{it}	=	Financial market liquidity (ratio of quasi money to GDP) in country i at time t
$LIFCAP\_L_{it}$	=	Life insurance capacity in country i at time t
$NLCAP\_L_{it}$	=	Non-life insurance capacity in country i at time t
$PRICE_{it}$	=	Non-life insurance price in country i at time t
IND_SER_{it}	=	State of industrialization in country i at time t
KID_{it}	=	Dependency ratio in country i at time t
$LIEXP\_L_{it}$	=	Life expectancy in country i at time t
CIV_{it}	=	Civil liberty in country i at time t, 1 if country i has a Gastil ranking of 3 or greater, 0 otherwise
$NADMIT_{it}$	=	Status of non-admitted insurance in country i at time t, 1 if allowed, 0 otherwise
$MONO_{it}$	=	Insurance market type in country i at time t, if market is monopolistic, 0 otherwise
$MREIN_{it}$	=	Mandatory reinsurance cession in country i at time t, 1 if required, 0 otherwise

In the model above, behavioral equations (12) and (13) depict the life insurance demand and supply functions respectively, while equations (14) and (15) represent the non-life demand and supply functions. Indentity (16) and (17) represent the respective life and non-life equilibrium positions.

In this study, equations (12) through (15) are collectively labelled Model I. A model consisting of equations similar to Model I, except for the variable consumer income in the demand equations, is labelled Model II. In this model, consumer income is decomposed into permanent and transitory incomes. In the empirical tests, all continous variables are expressed in their logarithmic forms. The variables in the behavioral equations and the data sources are briefly defined in Appendix 1. A summary of the hypotheses associated with the variables is given in Table 1

TABLE 1. Summary of expected sign of hypothesis

Dependent Explanatory	LIFE_D	LIFE_S	NLIFE_D	NLIFE_S
Dependency ratio (KID)	+			
Civil liberty (CIV)			–	
Life expectancy (LIEXP_L)	+			
Consumer inc. (GDP_POP)	+		+	
Permanent inc. (INC_PER)	+		+	
Transitory inc. (INC_TRA)	?		?	
Lending rate of interest (INT)				+
Life insurance price (INTDL_L)	–	+	–	
Financial market liquidity (QM_GDP)		+		+
Non-life insurance price (PRICE_L)	–		–	+
Life insurance qty supplied (LIFE_S)				+
Non-life insurance qty supplied (NLIFE_S)		+		
Life insurance capacity (LIFCAP_L)		+		
Non-life insurance capacity (NLCAP_L)				+
Industrialization (IND_SER)	+		+	
Monopolistic market (MONO)		–		–
Mandatory reinsurance (MREIN)		–		–
Non-admitted insurance (NADMIT)			–	–

METHODOLOGY

THE DATA

The time-window for this study is 1983-1986. The choice of the 1983-1986 time-window was largely influenced by data availability. In general, while it was possible to obtain past and recent insurance data for most developed countries, the same cannot be said for developing countries. The earliest cross-country insurance data of quality were for the year 1983, while the most recent were for 1986 (UNCTAD 1990a). Besides UNCTAD, this study relied on insurance data published by OECD and SwissRe. Availability of a country's insurance data however did not amount to the availability of other socio-economic data. To overcome this problem of "data gaps" this research relied on the method of first-order correction[5] to estimate the missing observations (Maddala 1977; Pindyck & Rubinfeld 1981). Given these data problems, out of the possible 138 countries, appropriate data were available only for 75 developed and developing countries. The countries forming the sample are listed in Appendix 2. Sources of other data are described in Appendix 1.[6]

STATISTICAL METHOD

The statistical technique considered suitable to estimate the models is three-stage least squares (3SLS) of Zellner and Theil (1962). A simplified description of 3SLS is provided by Pindyck and Rubinfeld (1981) who characterized 3SLS as the application of the Zellner (1962) estimation, or the method of seemingly unrelated regression (SUR), to "a system of equations, each of which has first been estimated using 2SLS" (p. 334). Fomby, Hill and Johnson (1984) proposed that 3SLS estimation is more efficient than 2SLS.

STATISTICAL ISSUES

The presentation of equations (12) through (15) presupposes that it is appropriate to pool the available cross-sectional and time-series data. In testing whether such an assumption is valid, the Chow test is applied (see Damhoeri (1992) for details). At the 5 percent level of significance, the null hypotheses of constant inter-temporal intercept was rejected both for the life and non-life supply equations and the non-life insurance demand equation in Model II. Similarly, the null hypothesis of constant intercept across groups of countries was rejected for life insurance demand and supply equations in both Model I and II. Consequently, time and country grouping dummy variables were included where necessary. The results discussed in the next section incorporate these modifications.

The countries in the sample vary drastically in their insurance consumption patterns and other economic characteristics. Accordingly, it was expected that heteroscedasticity (non-constant error variance) would be present in the regression models. In determining whether heteroscedasticity was present in Models I and II, the Goldfeld-Quandt test was applied to equations (31a) through (32d) (see Damhoeri (1992) for details). At the 5 percent level of significance, the F-test statistics suggests that the null hypothesis of homoscedasticity in all equations of Models I and II cannot be rejected.

In general, multicollinearity tends to be inherent in economic data. On this matter, Koutsoyiannis (1977) maintained that while multicollinearity causes estimation difficulties, it does not impair the theoretical validity of the function under consideration. In the case of estimating a single regression model, many remedial measures are possible to correct for multicollinearity [6] However, their usage in the context of 3SLS is unclear. Accordingly, variables were examined for multicollinearity if the symptoms that Greene (1990) described were present.

The usage of time-series data normally gives rise to the problem of autocorrelation, where, the successive error values are correlated i.e., $E(\mu_i\mu_j)$ 0 for i j. The problem of autocorrelation is normally detected through the Durbin-Watson test (see typical description of test in Greene (1990)). However, in this study, the application of the Durbin-Watson test is not possible since each country in the sample has only three years of observations (the Durbin-Watson statistics usually starts at the minimum of six observations for a regression model with one explanatory variable). Hampered by this practical limitation, this study accordingly assumed that autocorrelation will not be a problem that confounds empirical findings.

The issue of equation identifiability is critical in 3SLS, since the whole exercise will be rendered meaningless if one of the equations in the system is underidentified. This is because at the theoretical level, it is impossible to obtain parameter estimates from underidentified equations. There are two rules to identifying an equation. The first rule, the order condition, is necessary but not sufficient, and needs to be augmented by a second rule, the rank condition. Towards meeting the identification conditions, this study applied the identification tests of Greene (1990, 608) and Maddala (1988, 301-304). The tests suggest that all equations are overidentified.

RESULTS

This section highlights and interprets the results of 3SLS. For the reason of estimation efficiency the results of 3SLS will be the standard against which results of 2SLS are discussed. In the case where the results of 3SLS are ambiguous, inferences are deferred to section two where comparisons are made with the results of 2SLS.

THREE-STAGE LEAST SQUARES

In explaining life insurance demand, the proxy for life insurance price, INTDL_L, is negative in both models. However, similar to the finding of Diacon (1980) who used a better price proxy, this variable is not significant. In this relation, this finding lends credence to the postulate of Diacon (1980) that consumers purchasing life insurance cannot readily ascertain its price. To conclude that price is not a major determinant in life insurance consumption is however a tenuous contention in the context of the consumer who is invariably faced with a budget constraint. In light of this reality, the non-significance of INTDL_L may therefore be attributed — after ruling out the problem of multicollinearity — to two possible sources of measurement errors. First, it is likely that the consumers do not evaluate life insurance price in the same manner as hypothesized. Second, even if consumers internationally were to process life insurance price in the manner similar to the construction of INTDL_L, it is possible that the non-significance of INTDL_L arises because the interest rates data used in this analysis have not been wholly perfect.

Lending support to the contention that life and non-life insurance are complements, INTDL_L in both Model I and II is negative and statistically significant in explaining non-life insurance demand. The price proxy for non-life insurance, PRICE, provides stronger evidence of complementarity In both models, this variable is negative and highly significant in explaining both life and non-life insurance demand.

Proxies for insurance quantities supplied (LIFE_S and NLIFE_S) also provide an interesting insight into the relational behavior of the two forms of insurance. In the supply side, life and non-life insurance can also be deduced to be complements. In both models, NLIFE_S is positive and highly significant in explaining life insurance supply Conversely, LIFE_S is positive and highly significant in the non-life supply equation. If there is an important inference that can be drawn from this finding, it is that the data validate lay observations. In the scheme of insurance supply and market development, life and non-life insurance are probably symbiotic.

In Model I, per capita income GDP_POP is positive and highly significant in explaining both life and non-life insurance demand. Similarly, permanent income INC_PER in Model II is positive and highly significant. Transitory income INC_TRA, on the other hand is not statistically significant in explaining either life or non-life insurance demand.

The state of a country's economic development as reflected by IND_SER is insignificant in explaining life and non-life insurance demand in both models. After ruling out multicollinearity, the non-significance of IND_SER could be attributed to the inclusion of the country grouping dummy variable, OECD, into the model, that, possibly overshadowed the effect of IND_SER.

The variable OECD is highly significant in explaining life insurance supply and demand in both Model I and II. OECD however exhibits an unexpected sign in that it is negative, which is contrary to common intuition about insurance consumption in OECD countries. After ruling out the possible effect of multicollinearity, it is reasonable to postulate that the negative effect of OECD could possibly indicate that the life insurance markets in the OECD countries are already saturated relative to non-OECD countries. Alternatively, it could also be argued that the incidence of life insurance consumption in the period covered by the data is lower in the OECD countries due to the availability of pervasive social welfare programs.

In both models, INT is not significant in explaining non-life insurance supply Examination of the correlation estimates does not suggest that INT is highly correlated any other variables. The measure of an economy's financial sophistication, QM_GDP, is highly significant in explaining life insurance supply In contrast, QM_GDP is statistically insignificant in explaining non-life insurance supply Although this finding does not correspond completely with the expectation about QM_GDP, it is not entirely baffling. The time horizon that a life insurer deals with is longer than that of a non-life insurer. For this reason, the relative sophistication of a financial market should be of greater importance in the operations of a life insurance company that it would for a non-life company

LIFCAP_L is positive and highly significant in the life insurance supply equation. NLCAP_L is similarly positive and highly significant in explaining non-life insurance supply

The result for the dependency ratio, KID, conforms with the null hypothesis about the variable. In both Models I and II, KID is negative and is not statistically significant in explaining life insurance demand. Examination for multicollinearity reveals that in both Models I and II, KID is correlated with LIEXP_L(0.60).

In both models, LIEXP_L is insignificant in explaining life insurance demand. Notwithstanding the presence of multicollinearity, a credible explanation of this result is possible. If we associate high life expectancy with life annuities, a component of life insurance, it can be inferred that such an association does not hold across the globe. More plausibly, it can be inferred that life insurance is not a dominant vehicle to provide for old age income.

The variable CIV which reflects the lack of civil liberty in acountry exhibits symptoms of multicollinearity Contrary to expectation. CIV in both models is not significant in explaining non-life insurance demand. Examination of the correlation estimates indicate that in Models I and II, CIV is correlated with LIEXP_L (–0.54). No inference about this variable is made at this juncture. The possible effect is considered in the next section when this finding is contrasted with the results of 2SLS.

Of the three regulatory variables, only mandatory reinsurance cession, MREIN, produces unambiguous results. In both models, MREIN is negative but insignificant in explaining life insurance supply On the other hand, MREIN is highly significant in the non-life insurance supply equation. This finding reflects the relative importance of reinsurance in the scheme of insurance supply Whereas the underwriting results of a life portfolio are relatively stable, the variations in the underwriting results of a non-life portfolio can be severe. Accordingly, non-life insurance supply will be inhibited in markets where free access to reinsurance is restrained.

Examination of the correlation of estimates for MONO reveals that in Model I, this variable is correlated with LIFE_S (0.54). In both models, MONO is insignificant in explaining life insurance supply In contrast, MONO is highly significant in the non-life insurance supply equation. Altough this result is not intuitively obvious, a review of the countries with monopolistic insurance markets suggests credible explanations. Countries with monopolistic markets are relatively underdeveloped. To the extent that life insurers are financial intermediaries and the products they offer are savings instruments, any restraints on the competition in the life insurance market will only exacerbate matters. MONO fosters organizational lethargy As things are, in relation to consumer savings, insurers are not the institutions of first resort.

NADMIT, the variable representing the state of discrimination against non-admitted insurers, is not statistically significant in explaining either the supply or demand of non-life insurance. NADMIT is positive in both equations. A practical explanation of this direction of effect follows.

Non-admitted insurers are typically used in the case where regular insurers, for various reasons, are unable to provide coverages. Ordinarily, this would occur in the case of "exotic" risks. Where insurance regulation prohibits non-admitted insurers, consumers will then have to resort to "second best coverages." Premium monies otherwise not captured in the domestic gross premiums tabulation will then remain at home and be counted.

The inclusion of time dummies T1985 and T1986 is not by design, but by necessity dictated by the nature of the pooled data. In both Models I and II, times dummies T1985 and T1986 are negative but not significant in "explaining" life insurance supply In contrast, T1986 is positive and significant in the non-life insurance supply equation. T1986 is also positive and significant in the non-life insurance demand equation of Model II. Summaries of the results are given in Tables 2 and 3.

TWO-STAGE LEAST SQUARES

Whereas in 3SLS confounding results due to multicollinearity are difficult to rationalize because some of the correlations are occurring among variables across equations, the effects in 2SLS are easier to discern. Primarily, this is because in 2SLS the effects of multicollinearity are localized to variables within the same equation. For example, as regards CIV, there is some degree of ambiguity in 3SLS but it is quite clear through 2SLS that CIV is statistically significant in explaining non-life insurance demand. In both Models I and II, the variable CIV is not highly correlated with any variable.

The results for GDP_POP, INC_PER and INC_TRA are generally similar with those of 3SLS. There are however some minor differences. Whereas in the 3SLS, INTDL_L is significant in explaining non-life insurance demand in both Models I and II, the same variable in this analysis is not significant. Examination of the correlation of estimates suggests the presence of mild multicollinearity between

TABLE 2. MODEL I: Results of three-stage least squarc (3SLS)

	LIFE_D	LIFE_S	NLIFE_D	NLIFE_S
INTERCEPT	–20.333 (0.0001)	–1.2612 (0.0001)	–8.8213 (0.0001)	8.2075 (0.0002)
T1985		0.0337 (0.7753)		0.0929 (0.3421)
T1986		0.03161 (0.7844)		0.1844 (0.0411)
KID	–0.0407 (0.8780)			
CIV			–0.0647 (0.4455)	
LIEXP_L	0.0275 (0.9796)			
GDP_POP	1.4515 (0.0001)		1.1992 (0.0001)	
INT				0.0572 (0.3902)
INTDL_L	–0.6269 (0.3765)	0.3970 (0.3357)	–0.7010 (0.0110)	
QM_GDP		0.1975 (0.0008)		0.0581 (0.2672)
PRICE	–2.8193 (0.0013)		–0.7254 (0.0159)	1.9978 (0.0011)
LIFE_S				0.4605 (0.0001)
NLIFE_S		1.0439 (0.0001)		
LIFCAP_L		0.2497 (0.0001)		
NLCAP_L				0.6124 (0.0001)
IND_SER	0.5444 (0.3956)		0.3691 (0.2437)	
MONO		–0.0165 (0.9174)		0.2781 (0.0432)
MREIN		–0.1728 (0.1558)		-0.2282 (0.0082)
NADMIT			0.0768 (0.2543)	0.0814 (0.3893)
OECD	–0.5020 (0.0515)	–0.6151 (0.0035)		

System weighted $R^2 = 0.941$

Note: Figures in parenthesis are the probability values for the t-statistics (Prob > |T|).

TABLE 3. MODEL II: Results of three-stage least squares (3SLS)

	LIFE_D	LIFE_S	NLIFE_D	NLIFE_S
INTERCEPT	–19.999 (0.0001)	–1.2079 (0.0001)	–9.0611 (0.0001)	6.4008 (0.0001)
T1985		–0.0426 (0.7524)	0.1022 (02354)	0.1229 (0.1642)
T1986		–0.1111 (0.4058)	0.1811 (0.0340)	0.2738 (0.0012)
KID	–0.0521 (0.8547)			
CIV			–0.0572 (0.5567)	
LIEXP_L	0.1277 (0.9085)			
INC_PER	1.5467 (0.0001)		1.2114 (0.0001)	
INC_TRA	–0.0805 (0.2893)		–0.0324 (0.4387)	
INT				0.0617 (0.2790)
INTDL_L	–0.7978 (0.3017)	0.3917 (0.3453)	–0.8641 (0.0092)	
QM_GDP		0.1946 (0.0011)		0.0510 (0.2685)
PRICE	–2.5539 (0.0029)		–0.7768 (0.0256)	1.5747 (0.0005)
LIFE_S				0.3757 (0.0001)
NLIFE_S		1.0501 (0.0001)		
LIFCAP_L		0.2441 (0.0001)		
NLCAP_L				0.6798 (0.0001)
IND_SER	0.8969 (0.2077)		0.5837 (0.1219)	
MONO		–0.0575 (0.7227)		0.2730 (0.0241)
MREIN		–0.1467 (0.2333)		–0.2098 (0.0059)
NADMIT			0.0775 (0.3157)	0.0750 (0.3785)
OECD	–0.5435 (0.0462)	–0.6245 (0.0034)		

System weighted $R^2 = 0.935$

Note: Figures in parenthesis are the probability values for the t-statistics (Prob > |T|).

INTDL_L with IND_SER. In Model I the magnitude of correlation is –0.52 while in Model II the correlation is –0.50.

Other dissimilarities relate to variables OECD, MREIN and T1986. Whereas OECD is significant in explaining life insurance demand in 3SLS, OECD is now insignificant in explaining life insurance demand and has a positive sign. MREIN is also insignificant in explaining non-life insurance supply despite maintaining the expected sign of effect. Neither variable is highly correlated with any other variables. T1986 in the non-life supply equation of Model I is insignificant, possibly owing to the mild correlation with T1985 (0.56). Summary of the results is presented in Tables 4 and 5.

CONCLUSIONS

The determinants of insurance supply and demand have been the subject of many theoretical and empirical analyses. Although thay have been approached from a diversity of perspectives, it does not appear that these determinants have been examined under the scenario of possible interdependence between life and non-life insurance. Based on the premise that both forms of insurance are normal goods, and elementary intuitions about their relationship, it is then reasonable that these goods are depicted in a two-commodity market model. From comparative static analysis of the resulting model, it is plausible to deduce that, at the theoretical level, life and non-life insurance are gross complements.

Although varied motives for life and non-life insurance consumption preclude any strong conclusion about the nature of the relationship at the theoretical level, a cross-country empirical analysis of insurance consumption offers an avenue for corroboration. The following are the significant empirical findings.

1. Demand for life insurance is influenced by consumer income and the price of non-life insurance.
2. Demand for non-life insurance is influenced by consumer income, its own price, the price of life insurance and the degree of civil liberty prevailing in a country
3. Supply of life insurance is influenced by the relative sophistication of a country's financial market, insurer capacity and the supply of non-life insurance.
4. Supply of non-life insurance is influenced by insurer capacity, its price, if a market is monopolistic, if there is a mandatory reinsurance cession requirement and supply of life insurance.

The empirical evidence suggests that in the scheme of individual consumption, life and non-life insurance are gross complements. To the extent that the quantities of life and non-life insurance demanded are statistically explained by changes in the prices of non-life and life insurance respectively, it can be asserted

TABLE 4. MODEL I: Results of two-stage least squares (2SLS)

	LIFE_D	LIFE_S	NLIFE_D	NLIFE_S
INTERCEPT	–34.9191 (0.0001)	–0.3780 (0.2627)	–8.8012 (0.0001)	6.9346 (0.0040)
T1985		0.1464 (0.3918)		0.0351 (0.8292)
T1986		0.0973 (0.5637)		0.2064 (0.1831)
KID	0.1364 (0.8471)			
CIV			–0.2263 (0.0422)	
LIEXP_L	4.2599 (0.0.418)			
GDP_POP	0.7692 (0.0059)		1.1321 (0.0001)	
INT				0.1300 (0.2007)
INTDL_L	–0.7670 (0.4968)	0.4666 (0.3081)	–0.3854 (0.2308)	
QM_GDP		0.3298 (0.0001)		0.0080 (0.9233)
PRICE	–3.3536 (0.0015)		–0.8948 (0.0051)	1.9143 (0.0041)
LIFE_S				0.2698 (0.0094)
NLIFE_S		0.7408 (0.0001)		
LIFCAP_L		0.3994 (0.0001)		
NLCAP_L				0.9099 (0.0001)
IND_SER	1.2372 (0.3092)		0.3937 (0.2803)	
MONO		–0.3387 (0.1379)		0.4443 (0.0407)
MREIN		–0.1369 (0.4165)		–0.1521 (0.2639)
NADMIT			0.1258 (0.2350)	0.0598 (0.7117)
OECD	0.0730 (0.8903)	–0.4525 (0.0517)		
R^2	0.64	0.88	0.91	0.84

Note: Figures in parenthesis are the probability values for the t-statistics (Prob > |T|).

TABLE 5. MODEL II: Results of two-stage least squares (2SLS)

	LIFE_D	LIFE_S	NLIFE_D	NLIFE_S
INTERCEPT	−35.5934 (0.0001)	−0.3634 (0.2833)	−9.3616 (0.0001)	5.1838 (0.0032)
T1985		0.1498 (0.3806)	0.2296 (0.0579)	0.0925 (0.4654)
T1986		0.1000 (0.5528)	0.2986 (0.0130)	0.2406 (0.0474)
KID	0.1054 (0.8814)			
CIV			−0.2499 (0.0495)	
LIEXP_L	4.5297 (0.0286)			
INC_PER	0.7429 (0.0201)		1.1028 (0.0001)	
INC_TRA	0.0164 (0.8928)		−0.0157 (0.7361)	
INT				0.1023 (0.1916)
INTDL_L	−0.8175 (0.4649)	0.4368 (0.3345)	−0.5357 (0.1487)	
QM_GDP		0.3304 (0.0001)		0.0160 (0.8056)
PRICE	−3.3041 (0.0017)		−1.0664 (0.0042)	1.4292 (0.0032)
LIFE_S				0.2137 (0.0110)
NLIFE_S		0.7295 (0.0001)		
LIFCAP_L		0.4042 (0.0001)		
NLCAP_L				0.9131 (0.0001)
IND_SER	1.3317 (0.2714)		0.5596 (0.1760)	
MONO		−0.3427 (0.1329)		0.3675 (0.0307)
MREIN		−0.1387 (0.4099)		−0.1563 (0.1406)
NADMIT			0.1435 (0.2343)	0.0518 (0.6797)
OECD	0.1172 (0.8241)	−0.4403 (0.0590)		
R^2	0.64	0.88	0.91	0.84

Note: Figures in parenthesis are the probability values for the t-statistics (Prob > |T|).

that and non-life insurance are complements. However, to the extent that the changes in the price of life insurance are not statistically significant in explaining its own quantity demanded, it can be said that life insurance may have little price elasticity of demand. The notion of interdependence between life and non-life insurance has significant implications in the sense of insurance product designs. Depending on the direction and strength of the relationship, products can be bundled or unbundled to enhance their marketability

The empirical evidence suggests the possible symbiotic nature of life and non-life insurance. The quantities supplied of one form (used in the context of signals of agent effectiveness and consumer receptiveness) positively influences the supply of the other. In light of this evidence, and with other things being equal, it may be synergistic for an insurer to supply both life and non-life insurance. The immediate implication in this setting is that the "fire-walls" between life and non-life insurance supply as dictated by insurance regulators in some countries are economically impeding. The organizational economic efficiency, and by extension consumer surplus, resulting from any synergy in supplying both life and non-life insurance is never allowed to take effect. It should, on the other hand, be allowed to develop to its fullest potential.

Policymakers should be cognizant of the complementary nature of life and non-life insurance. Given that private insurance could to some extent release governmental resources from welfare programs, the objective for policymakers should be to free as much resources as possible via encouraging private insurance consumption. It is therefore to the benefit of the country as whole if policy-makers do not formulate, or if they could reconsider policies that unfavorably impact the price or availability of either life or non-life insurance. A policy that on the surface causes a disequilibrium in only one form of insurance will necessarily upset the balance of the other. As the consuming public revises its insurance consumption according to the resultant changes, the burden of providing the benefits afforded by insurance falls on the government. In a sentence, it can perhaps be said that regulatory policies toward insurance supply and demand should be directed at enhancing consumer surplus.

Appendix 1

Lending interest rate (INT)

Data for this variable were obtained from the International Monetary Funds [IMF] (1990).

Dependency ratio (KID)

This variable was measured as the percentage of the population between the ages 0-14 divided by the percentage between ages 15-64. The 1985 cross-country data for this variable were obtained from Schumacher et al. (1989). Because of data limitations, the value for 1985 was assumed also to be applicable to both 1984 and 1986.

Life expectancy (LIEXP_L)

Data for this variable were obtained from the World Bank (1990).

Financial market liquidity (QM_GDP)

Measured as quasi-money relative to GDP Data for quasi-money were obtained from the World Bank (1990).

State of industrialization (IND_SER)

The measure for this variable is the ratio of manufacturing plus service activities to GDP The measure is intended to reflect a country's state of industrialization. Data for this variable were obtained from the World Bank (1990).

Dependent Variables

Emulating the usage as illustrated by Grace and Skipper (1991), insurance quantities supplied and demanded are defined as follows:

$$\text{Life Insurance Supply/Demand} = \frac{\text{Gross Life Premiums}}{\text{Population}}$$

$$\text{Non-life Insurance Supply/Demand} = \frac{\text{Gross Non-life Premiums}}{\text{Population}}$$

Civil Liberty (CIV)

This study used the cross-country civil liberty ranking of Gastil (1987). Gastil ranked civil liberty on a scale of 1 through 7, with 1 being most liberal (e.g., USA) and 7 being most repressive (e.g., Vietnam). Gastil's explanation of his concept of civil liberty is lengthy and thus is not summarized here. In this study, countries with a ranking of 3 or greater are coded '1' and '0' otherwise.

Consumer income (GDP_POP, INC_PER and INC_TRA)

GDP_POP is per capita GDP expressed in US dollars. Following Giannaros and Lee (1987), INC_PER in this study was measured as a three year moving average of per capita GDP INC_TRA was measured as the absolute value of current income minus INC_PER. GDP data were obtained from the World Bank (1990).

Life insurance price (INTDL_L)

INTDL_L is a proxy for the price of life insurance. It is measured as the ratio of deposit to lending interests rates (INTDL_L). Data for lending and deposit rates were obtained from the IMF (1990).

Price of non-life insurance (PRICE)

PRICE approximates the price of non-life insurance. It is the inverse of the loss ratio or gross premiums divided by incurred losses. Data for this variable were obtained from two sources. For developing countries, the loss ratio data were obtained from UNCTAD (1990), while SwissRe (1988b) was the data source for most OECD countries.

Insuring capacity (LIFCAP_L and NLCAP_L)

In this study, LIFCAP_L, the per capita life premiums at time t-1, and, NLCAP_L, the per capita non-life premiums at time t-1 are used as proxies for life and non-life insurance capacity respectively

Monopolistic insurance market (MONO)

In come insurance markets, the supply is often either a virtual monopoly or limited to a few state-owned companies. In UNCTAD(1980) these markets are deemed monopolistic. Data for this variable were obtained from UNCTAD (1980) and Crockford(1990). In this study, countries with monopolistic markets are dummy coded '1', otherwise '0'

Mandatory reinsurance cession (MREIN)

Mandatory cession refers to that regulatory requirement that insurers obtain reinsurance coverage from designated reinsurers which frequently are state-owned. Data for this variable were obtained from Crockford (1990). Mandatory cession is dummy coded '1' if a country has this regulatory requirement, '0' otherwise.

Prohibition of non-admitted insurance (NADMIT)

Data for this variable were obtained from Crockford (1990). Countries which allow non-admitted insurance are coded '1' and '0' otherwise.

Appendix 2

Countries Forming The Sample

1. Argentina
2. Australia
3. Austria
4. Burundi
5. Belgium
6. Bahamas
7. Brazil
8. Barbados
9. Botswana
10. Burkina Faso
11. Central African Republic
12. Canada
13. Chile
14. China
15. Cameroon
16. Costa Rica
17. Cyprus
18. Germany
19. Denmark
20. Dominican Republic
21. Ecuador
22. Egypt
23. El Salvador
24. Ethiopia
25. Finland
26. Fiji
27. France
28. Ghana
29. Greece
30. Guatemala
31. Honduras
32. Indonesia
33. India
34. Ireland
35. Iceland
36. Italy
37. Jamaica
38. Japan
39. South Korea
40. Kuwait
41. Luxembourge
42. Morocco
43. Mexico
44. Malta
45. Mauritania
46. Malawi
47. Malaysia
48. Nigeria
49. The Netherlands
50. Norway
51. New Zealand
52. Oman
53. Peru
54. Philippines
55. Portugal
56. Rwanda
57. Sudan
58. Singapore
59. Spain
60. Sri Lanka
61. Sweden
62. Seychelles
63. Syria
64. Switzerland
65. Thailand
66. Trinidad and Tobago
67. Tunisia
68. Turkey
69. United Kingdom
70. United States of America
71. Venezuela
72. Yugoslavia
73. Zaire
74. Zambia
75. Zimbabwe

NOTES

1. There is no known standard definition of international insurance. An inference of the subject matter can be made from the observations of Bar-Niv and Bickelhaupt (1986). International risk and insurance studies can be classified as to their purpose and methodology into five major types: (a) descriptive-qualitative, (b) descriptive-quantitative. (c) normative, (d) economic risk theory construction and (e) quantitative models. As for research perspective, Bar-Niv and Bickelhaupt made there classifications: (a) one country, (b) cross-country and (c) global.

2. The term "life insurance" will carry the board connotation as used by Black and Skipper (1987, 13), where life insurance is described as:

   ... a social device whereby individuals transfer the financial risk associated with loss of life or health to a group of persons and which involves the accumulation of funds by the group from these individuals to meet the uncertain financial loss of life or health.

   "Non-life insurance" is used as a comprehensive descriptor of a board range of devices that indemnify an individual or a firm in the event of losses associated with the ownership of physical and financial assets. Bickelhaupt (1979, 47) observed that non-life insurance mitigates risk in two general ways:

   The first indemnifies the insured in the event of loss growing out of damages to, or destruction of, his or her own property The second form pays damages for which the insured is legally liable, the consequence of negligent acts that result in injuries to other persons or damage to their property

   Non-life insurance is often used interchangeably with the terms "general insurance," "property and casualty insurance."

3. This two-commodity market model is based on the general n-commodity market equilibrium model. Chiang (1984) described the general model as $E_i \equiv Q_{di} - Q_{si} = 0$ for $i = 1, 2, \ldots, n$. The mathematical formulations of this paper have benefited much from the concept and illustrations found in chapters six through eight of Chiang (1984).

4. See explanation of the Jacobian determinant condition in Chiang (1984).

5. For the purpose of first-order correction, regression models with the highest R^2 were deemed suitable. The following variables required corrections: (a) gross life insurance premiums, (b) gross non-life insurance premiums, (c) lending and deposit rates of interest, (d) loss ratio, (e) service sector output, (f) manufacturing sector output and (g) quasi-money

6. Damhoeri (1992) discussed the issues surrounding the choice of the dependent variables in greater details.

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