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Corporate Reinsurance Utilisation and Capital Structure: Evidence from Pakistan Insurance Industry

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The core objective of this work was to define significant determinants of corporate reinsurance utilisation in the life and non-life insurance industries in Pakistan based on the corporate demand for insurance theory, the bankruptcy cost argument, the agency cost theory, the risk-bearing hypothesis and the renting capital hypothesis. It also assessed which of these two insurance sectors has greater demand for reinsurance. Covering 33 insurance companies (6 life and 27 non-life insurance companies) over the period 2002–2012, the study outcomes show that some factors have a more significant impact on reinsurance purchases by insurance companies than others. Solvency risk, underwriting risk, firm performance, rate of interest and business mix are shown to be significant factors in defining the demand for reinsurance, but they influence reinsurance utilisation differently in the life and non-life branches. Only the variables firm size and inflation rate show similar results in both insurance branches in Pakistan, in contrast to the mixed outcomes generated by other variables of interest. The study further concluded that life insurance firms with high leverage levels lean more towards reinsurance purchases and solvency risk than non-life stock insurance firms operating in Pakistan.
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Introduction

Insurance companies differ from other industries in that they, in return for premiums, issue insurance policies to policyholders and cover the latter's risk if a pre-specified insured event occurs. The success of an insurer not only depends on charging its customers sufficient premiums to cover the levied costs but also on assuring timely payments of the insured claims. Insurance companies resort to risk-hedging activities[1] to overcome the economic and financial stress arising from the capital market's imperfections, and

[1] Shiu (2016).

reinsurance is the most common mechanism they use. Wehrhahn[2] defined reinsurance activity as a financial transaction through which the risk is transferred (ceded) from an insurer (cedant) to a reinsurer in exchange for a payment (reinsurance premium). Because insurance companies underwrite diversified risk exposures, it is they who bear the cost of reinsurance to mitigate their portfolio risks (the premium). The reinsurance market thus consists of a pyramidal organisation where primary insurers cede risk to professional reinsurers to diminish their investment risks. Coinsurance is another option, but according to Swiss Re,[3] more than 80 per cent of the global reinsurance capacity is offered by professional reinsurers.[4] Ho[5] argued that foreign insurers in China have higher property casualty reinsurance demand than domestic insurers.

In analysing reinsurance activity, economists have relied on two theoretical frameworks. The first[6] reviews reinsurance as an optimal risk-sharing mechanism among risk-averse insurers; this, however, is not the only motive behind reinsurance purchases. The second perspective, which is supported by the work of Mayers and Smith,[7] is borrowed from corporate hedging theory. This theory states that an insurer's decision to purchase reinsurance is similar to the decision of a non-financial firm to purchase insurance. This point of view stresses that reinsurers, because of their expertise in risk management, provide real service efficiencies to the cedant and alleviate agency problems among insurance corporations. Both approaches neglect some important, unexplained points, because neither provide clear-cut grounds for the pyramidal organisation of the reinsurance market, nor do they discuss the dual characteristics of reinsurance. Garven and Lamm-Tennant[8] stated that reinsurance serves not only as a risk management mechanism but also as a financing tool. They documented that the demand for reinsurance rises with financial leverage, consistent with the work of Shiu,[9] who argued that an insurer with high leverage will seek more reinsurance in order to be able to maintain a higher debt level. This contrasts with the theory of Modigliani and Miller,[10] who state that reinsurance and financing decisions are irrelevant in a world of perfect capital markets. According to them, neither hedging nor financing decisions can increase shareholder value, because corporations can always obtain external funds to finance their investment opportunities when required, at the same cost as internal funds.

Here, the question arises as to why insurers would move towards reinsurance if reinsurance and financing decisions are completely unrelated. The underlying reason is the presence of market imperfections. According to corporate demand theory, reinsurance is important because, apart from safeguarding the insurer, it enhances the underwriting

[2] Wehrhahn (2009).
[3] Swiss Re (1999).
[4] This study focuses on external reinsurance, in contrast to internal or coinsurance activity in Pakistan, due to the difficulty in unravelling external reinsurance from coinsurance activates. Insurance accounting laws in Pakistan do not require separate disclosure of such information in financial statements, and much of the reinsurance business in Pakistan is being underwritten by foreign reinsurers. For this reason, reinsurance data are considered as external reinsurance figures.
[5] Ho (2016).
[6] e.g. Borch (1968).
[7] Mayers and Smith (1990).
[8] Garven and Lamm-Tennant (2003).
[9] Shiu (2011).
[10] Modigliani and Miller (1958).

capacity of the direct insurer without increasing its capital. It reduces the firm's pre-tax income volatility, resulting in reduced tax liability and, by lowering the risk of bankruptcy and the consequent bankruptcy cost, it diminishes the firm's outgoing cash volatility. Reinsurance decreases firms' leverage levels, which in turn decreases agency cost, thus helping them to meet minimum solvency requirements; it provides real service efficiencies and efficient handling of catastrophic losses. Capital market imperfections also make value-maximising decisions about capital structure changes necessary. Titman and Wessels[11] found that firms' targeted debt ratio is affected by factors such as firm profitability and firm size. From a capital structure decision perspective, reinsurance also serves as a capital substitute; this allows the insurer to maintain an optimal underwriting risk level so that it can underwrite more business without raising new capital while still meeting the minimum capital requirement. In addition to an optimal underwriting risk level, an optimal leverage level needs to be maintained, because agency cost is directly associated with the firm's leverage. Carson and Hoyt[12] suggested that an optimal leverage level could enhance firm value, but when that level is exceeded, the value of the firm diminishes. Moreover, if the insurer continues to underwrite more business without raising further capital, the firm leverage level will rise, resulting in an increased probability of financial distress. Altuntas *et al.*[13] found that country-level factors explain a substantial fraction of cross-sectional variation in insurance companies' capitalisation level.

The insurance sector is subject to intense monitoring and state regulations because of its crucial importance to society. Insurance firms make massive efforts to enable potential insurance consumers to have direct access to insurance. Insurers, together with their agents, ensure that potential insurance consumers are reasonably treated and that insurance is beneficial to them. Pakistan's Insurance Ordinance 2000 sets the rules for insurance companies operating in Pakistan; they must comply with its provisions and furthermore sustain the minimum capital requirement of 150 million rupees in the case of life insurance firms, and 80 million rupees for property and liability insurance firms. Frequent terrorist attacks and natural disasters have emphasised the need for reinsurance in the country. To avoid extreme risks leading to bankruptcy, the Securities & Exchange Commission of Pakistan (SECP) has made it mandatory for insurance companies operating in Pakistan to cede a portion of their business to Pakistan Reinsurance Company Limited (PRCL), making reinsurance an integral part of the contingency and risk management plan.

According to State Bank of Pakistan's financial stability review during H1–CY13, steady growth in premiums continued to strengthen the asset base of the insurance sector. The life insurance business attracted 17.4 per cent higher gross premiums due to higher retention and improved coverage of the new life business. Similarly, non-life gross premiums showed healthy growth of 16.6 per cent owing to some improvement in economic activity and a revival of the auto finance business. In terms of performance, the profitability of the insurance industry surged on the back of higher returns from the booming stock market, which generally improved the soundness indictors of the industry.[14] The Pakistan Insurance Report 2016 stated that life insurance is by far the largest insurance sector in

[11] Titman and Wessels (1988).
[12] Carson and Hoyt (1995).
[13] Altuntas *et al.* (2015).
[14] http://www.sbp.org.pk/FSR/2013/FirstHalf/pdf/Chapter-7.pdf.

Pakistan, accounting for almost 65 per cent of all premiums written. This sector is expected to see the strongest growth over the forecast period, with premiums rising by over 10 per cent annually between 2016 and 2020. However, growth will be slower in the smaller non-life sector, although still positive, broadly tracking wider economic expansion in Pakistan. Basic lines will continue to dominate (particularly property and motor), but competition will restrain price increases.[15]

Thus far, researchers have not sufficiently focused on the insurance sector in Pakistan, and the reinsurance concept, specifically, has barely been touched upon. Furthermore, except for the study of Shiu,[9] the reverse relationship between reinsurance to financial leverage has never been exploited by other researchers. This work is meant to fill the gap and deliver knowledge pertaining to the dual causation between reinsurance and capital structure in the insurance industry in Pakistan. Investigating both insurance sectors at the same time provides a comparative analysis of the life and non-life industries. The studies of Bartram *et al.*,[16] Graham and Rogers[17] and Aunon-Nerin and Ehling[18] found that, with the increase in the firm leverage level, insurance companies' demand for reinsurance also increases. Hedging too has a significant positive impact on the firm's financial leverage. Dionne and Triki[19] stated that leverage affects hedging positively, but firms do not undertake hedging activities to enhance their debt level. However, Adams *et al.*[20] demonstrated that property insurance does enhance the debt capacity of a corporation, and financial leverage is not the sole factor that raises the demand for property insurance. Thus, the results reported in previous literature pertaining to the association between reinsurance and financial leverage vary. This work, therefore, aims to explore whether parallel outcomes exist with regard to Pakistan's insurance industry. Our results show that, with the increase in firm financial leverage (LEV), life insurance companies in Pakistan demand more reinsurance, consistent with the expected bankruptcy cost argument, the agency cost theory and the risk-bearing hypothesis. Moreover, reinsurance purchases made by life insurance firms play a vital role in boosting their leverage levels, which is consistent with the renting capital hypothesis. The results in the case of the non-life insurance sector show a negative relationship between reinsurance and financial leverage, consistent with the findings of Cole and McCullough[21] and Adams *et al.*[20] but inconsistent with the study expectations, highlighting that there are other factors aside from leverage that enhance the demand for reinsurance. Furthermore, the study evidenced that the life insurance sector in Pakistan is more prone to leverage and that life insurance firms' capital structures are more highly affected by their reinsurance purchases than those of non-life insurance firms. MacMinn[22] and Plantin[23] found that hedging and capital structure are interrelated and can be determined together, yet, except for the study of Shiu,[9] no work has discussed hedging and capital structure together, nor defined the dual causation between reinsurance and

[15] http://store.bmiresearch.com/pakistan-insurance-report.html.
[16] Bartram *et al.* (2009).
[17] Graham and Rogers (2002).
[18] Aunon-Nerin and Ehling (2008).
[19] Dionne and Triki (2004).
[20] Adams *et al.* (2008).
[21] Cole and McCullough (2006).
[22] MacMinn (1987).
[23] Plantin (2006).

financial leverage. This work aims to remedy that by providing the insights into the dual relationship between reinsurance and capital structure in the insurance industry in Pakistan. Bearing in mind the gaps in the existing literature, our research question is as follows:

"What is the relationship between firm financial leverage and corporate reinsurance utilisation?"

A panel data set consisting of 33 insurance companies (6 life and 27 non-life insurance companies) in Pakistan from 2002 to 2012 was used. The life and non-life insurance sectors are examined separately, which facilitates the development of a comparative analysis as to which insurance sector is more prone to leverage and which sector's firm capital structures are highly affected by its reinsurance purchases. A simultaneous equation model inspected with two-stage least-squares regression (2SLS) and fixed-effects and random-effects GLS regressions is established to address the dual causation between reinsurance and financial leverage. Hedging and debt ratios have also been determined with a two-equation model by Aunon-Nerin and Ehling,[18] Zou and Adams[24] and Bartram *et al.*[16]

The study has been organised into various sections. The first section provides the foundation of the research work, the second deals with the literature review and the third sheds light on the basic theories and propositions of the study. The fourth section is devoted to the methodology, the fifth presents the empirical results, and the last section presents the study's conclusions.

Literature review

Pure risk, as well as adequate consideration, is transferred to insurers by individuals and businesses; in turn, insurers diversify their risk by further reinsuring themselves so that the burden of pure risk is diminished. Risk coverage against losses is the fundamental element of the insurance industry, but current reinsurance capacity is inadequate for the absorption of huge catastrophic losses.[25] Corporate demand theory states that reinsurance is primarily undertaken by insurance companies as a risk-hedging tool, safeguarding the insurer from the underlying risk by diversifying its portfolios' risk and minimising the risk of ruin. It also states that reinsurance facilitates valuable positive net present (NPV) investments by indemnifying the probable losses, thus resolving the issue of underinvestment, as confirmed by the studies of Mayers and Smith[7] and Cummins *et al.*[26] The theory further suggests that reinsurance helps comply with minimum solvency requirements; stabilises yearly losses; reduces expected bankruptcy costs, underwriting risks and expected tax liability; provides real service efficiencies; and handles catastrophic losses efficiently. It helps the insurer to stabilise the shareholder's returns and avail insurers of the expert knowledge and skills possessed by the reinsurer, as supported by the study by Krvavych and Sherris.[27] Despite its stated merits, reinsurance is an expensive activity of which the

[24] Zou and Adams (2008).
[25] Cummins *et al.* (2002); Cummins and Doherty (2002).
[26] Cummins *et al.* (2008).
[27] Krvavych and Sherris (2004).

major share of the cost results from the specialised expertise that reinsurers provide.[28] There is also a relationship between reinsurance and derivative usage. Insurance companies that have a high dependence on reinsurance exhibit less reliance on derivatives for hedging risk.[1] The result supports the argument that the managers of insurance companies consider the overall risk exposure of the firm when making risk management decisions. In addition, reinsurance and the financial performance of insurance companies are interdependent.[29]

Mayers and Smith[7] analysed corporate demand for insurance and identified taxes, expected bankruptcy cost, investment incentives, optimal risk sharing and real service efficiencies as reinsurance determinants. They found that the less varied the owner's portfolio was, the greater the amount of reinsurance purchased. In contrast, firm size, credit standing and geographical concentration decrease the demand for reinsurance. The study specifically found that Lloyd's is the largest reinsurance provider, widely held stocks engage in reinsurance the least, and subsidiaries and group members reinsure more compared to other insurance providers. A cedant's underwriting risk and leverage levels have also been considered to be significant factors influencing corporate demand for reinsurance. Cummins *et al.*[26] argued that reinsurance helps in enhancing the underwriting capacity of the direct insurer, reduces the risk of insolvency, diminishes the loss ratio, limits the liability of the cedant to specific risks and provides coverage against huge catastrophic losses. They further stated that reinsurance facilitates the appropriate management of underwriting residual risk, resulting in the reduction of insolvency risk and the enhancement of the financial viability of the cedant. Culp and O'Donnell[30] argued that reinsurance aids the cedant in avoiding significant opportunity costs that they may have to face due to not writing business because of catastrophic losses. They declared that reinsurance is especially important for preserving large line capacity, enabling the insurer to retain its valuable large commercial customers. Reinsurance can affect the liquidity of the insurer, and the reverse causality effect of liquidity on reinsurance indicates that insurers with high liquidity tend to purchase more reinsurance. Similarly, insurers with high reinsurance dependence tend to maintain high liquidity.[31]

Examining the impact of financial leverage on the firm's reinsurance consumption level, Hoerger *et al.*[32] found that reinsurance purchases are affected by the insurer's surplus, specifically, that a low surplus to the premium increases demand for reinsurance in property and liability insurance. The study used the insurer's surplus to the premium as an inverse measure of financial leverage. Garven and Lamm-Tennant[8] reported that leverage has an influential role in corporate demand for reinsurance, consistent with the findings of Shortridge and Avila[33] and Powell and Sommer.[34] These studies suggest that highly levered firms need to purchase more reinsurance to protect themselves from insolvency. Shiu[9] argues that an insurer with high leverage will be attracted towards more reinsurance in order to be able to maintain a higher debt level, without increasing

[28] Froot (2007).
[29] Lee and Lee (2012).
[30] Culp and O'Donnell (2009).
[31] Liu *et al.* (2016).
[32] Hoerger *et al.* (1990).
[33] Shortridge and Avila (2004).
[34] Powell and Sommer (2007).

its solvency risk significantly. His study outcomes are consistent with the expected bankruptcy cost argument, risk-bearing hypothesis and agency cost theory. However, Adams *et al*.[20] found that leverage levels alone do not promote higher levels of reinsurance; other factors also have an impact on reinsurance purchases made by the insurance companies. Kader *et al*.[35] argued that underwriting risk, solvency risk and expected taxes play an important role in defining the level of reinsurance; hence firms with high underwriting risk tend towards more reinsurance, whereas financially sound firms have less of an inclination towards reinsurance, and high rates of taxation reduce reinsurance levels. The study asserts that the effect of underwriting risk is conjointly influenced by the insurer's insolvency risk and tax positions. In the same way, the effect of insolvency risk in relation to reinsurance is conjointly influenced by marginal tax rates, implying that making a decision pertaining to the purchase of reinsurance is quite complex. Leverage and organisational structure have opposite effects on insurers' liquidity in the lower and high quantile groups of insurers because large insurers tend to have a lower liquidity level than small insurers. Most firm-specific characteristics and macroeconomic conditions influence insurers' liquidity.[36]

Examining the reverse causation between reinsurance and capital structure, Re,[37] Baur *et al*.[38] and Pitselis[39] show that reinsurance does enhance the capacity of the cedant and enable it to accept more risks without increasing its own capital and still meet its solvency requirements. Pursuant to the renting capital hypothesis, insurance firms choosing higher debt ratios use reinsurance as a capital substitute, as evidenced by Adams[40] and Shiu.[9] A firms's reliance on reinsurance to expand its debt capacity was also evidenced by Graham and Rogers,[17] Aunon-Nerin and Ehling[18] and Bartram *et al*.[16] However, Dionne and Triki[19] find that leverage affects hedging positively but that firms do not undertake hedging activities to enhance their debt levels. Chen *et al*.[41] shed light on another perspective of the reinsurance–leverage relationship, suggesting that excessive utilisation of reinsurance could signal the presence of financial troubles. They further stated that less solvent insurers are inclined towards more reinsurance consumption, because they are not able to raise the required capital in the financial market. Although reinsurance allows the primary insurer to underwrite more business without raising new capital or even its minimum capital requirement, if it continues to underwrite more business without raising further capital, the firm's leverage level will rise, resulting in increased probability of financial distress.[12] Thus, the decision by insurance companies to purchase reinsurance will be based on their financial strength, on existing market practices and on the desire to acquire a variety of risks. Re[37] states that reinsurance does not provide a guarantee against bankruptcy, but it can be used as an instrument to diminish the risk of being ruined.

Pakistan, as a developing country, is presently facing volatile political and economic conditions where frequent terrorist attacks, natural disasters and the threat of war have

[35] Kader *et al*. (2010).
[36] Chang and Tsai (2014).
[37] Re (2002).
[38] Baur *et al*. (2004).
[39] Pitselis (2008).
[40] Adams (1996).
[41] Chen *et al*. (2001).

augmented the bankruptcy risk for current cedants, emphasising the need for reinsurance in the country. As unforeseen events occur, the liability of the direct insurer to pay the insured claim increases, and, if it is unable to fulfil claims, its risk of going bankrupt also increases. Therefore, to ensure better risk coverage, primary insurers resort to reinsurance, which provides them extra protection from ruin and allows them to underwrite huge risks while at the same time mitigating their portfolio risks. Researchers have not explored this sector enough; only a study by Malik[42] on the profitability determinants in the life and non-life insurance sectors of Pakistan was found in the literature. He observed the impact of firm-specific factors such as firm age, firm size, volume of capital, loss ratio and firm leverage on firm profitability. The results show that firm size and volume of capital are positively correlated; the loss ratio and firm leverage are negatively associated; and firm age has no relation to firm profitability. The study outcomes are consistent with those of a previous, similar study by Al-Shami,[43] who finds that insurance companies operating in Pakistan utilise reinsurance as a risk-hedging technique. The industry is unaware of the impact of the firm's leverage on its reinsurance purchases and the reverse causality between corporate reinsurance and financial leverage. Furthermore, it is not evident which insurance sector will experience high debt or which will face massive bankruptcy risks, because proper research addressing such issues is lacking.

This study aims to fill this gap by defining the dual causation between corporate reinsurance utilisation and capital structure in the insurance industry in Pakistan. It will also determine which insurance sector requires greater reinsurance consumption levels and show which sector is in greater debt and, thus, at high risk of bankruptcy. No empirical work has been found that identifies the association between financial leverage and corporate reinsurance utilisation and examines the reverse causality between reinsurance purchases and firm capital structure in the insurance industry in Pakistan. This study, by measuring both life and non-life insurance arrears with the same yardstick, provides a unique insight into the relationship between reinsurance and firm financial leverage in the insurance sector of Pakistan. The strong evidence pertaining to the examined factors available enables insurance companies to make reinsurance decisions according to their solvency risk exposures.

Theoretical framework

How financial leverage affects corporate reinsurance utilisation can be viewed from various perspectives. According to the expected bankruptcy cost argument, highly levered insurance firms are more prone to insolvency and, consequently, to high bankruptcy costs. Reinsurance diminishes the insurer's leverage levels by protecting it against huge catastrophic losses and decreasing its insolvency risk. Highly levered insurers have difficulty raising required capital in financial markets at low cost, so they resort to reinsurance to compensate for their capital deficiencies and to maintain acceptable solvency levels. Agency or informational asymmetry cost theory on the conflicting interests of

[42] Malik (2011).
[43] Al-Shami (2008).

policyholders and stockholders suggests a positive relationship between financial leverage and reinsurance. Reinsurance allows insurance companies to accept new ventures and, in so doing, boost their investment levels, but sometimes, levered insurers reject positive net present value (NPV) projects that may cause underinvestment problems due to high unexpected losses and significant bankruptcy risk, as evidenced by Mayers and Smith.[7] Levered firms forego such valuable opportunities because the threat of large losses could diminish the value of their outstanding policies and equity. Because the benefits of undertaking such positive NPV projects will accrue only to policyholders because of their prior claim over stockholders (who have a residual claim on the cash flows of the company), policyholders will wish to invest in such ventures. Reinsurance purchases help alleviate such underinvestment problems by taking over the risk of huge losses, thus diminishing agency cost.

Furthermore, the risk-bearing hypothesis suggests that, as their leverage levels move closer to solvency limits, insurers rely more greatly on reinsurance to decrease catastrophic losses, as noted by Adams.[40] Reinsurance helps insurance firms maintain their leverage levels while handling their heavy losses efficiently. Carson and Hoyt[12] argue that there is an optimal leverage level up to which the firm continues to increase its value, but once that limit is exceeded, the value of the firm declines. The positive effect of financial leverage on the demand for reinsurance purchases is supported by the expected bankruptcy cost argument, agency cost theory and risk-bearing hypothesis, which state that highly levered cedants are exposed to greater risk of insolvency, a higher degree of expected bankruptcy costs, greater agency costs and greater demand for reinsurance, consistent with the findings of Hoerger *et al.*,[32] Garven and Lamm-Tennant[8] and Powell and Sommer.[34] The two hypotheses of the study are as follows:

H1 There is a positive impact of firm financial leverage on its demand for reinsurance in the life and non-life insurance sectors of Pakistan.

H2 There is a positive impact of firm demand for reinsurance on its financial leverage in the life and non-life insurance sectors of Pakistan.

The hypothesis defining the impact of reinsurance purchases on the capital structure of insurance companies postulates that higher debt ratios are selected by insurers with higher reinsurance levels, because reinsurance eases the pressure on the capital of the insurer. Insurers can easily reach their solvency target levels either by amplifying their capitalisation level (through raising new capital) or by boosting reinsurance purchases; thus, reinsurance acts as an alternative to capital up to a certain degree of equity, as argued by Adiel.[44] Further reinsurance can be considered off-balance sheet capital because it reduces firm solvency requirements by affecting solvency margins imposed by regulations. Reinsurance activity can be viewed as the insurer renting capital from the reinsurer by ceding business to it; the cost of renting capital is the reinsurance premium it pays. If the cost of renting capital is less than the cost of debt or equity, then the insurer will primarily rely on reinsurance. Thus, reinsurance can be used by an insurer to underwrite huge catastrophic losses, and in so doing, increase its direct premiums written as well as its debt ratio. As evidenced by Graham and Rogers,[17] Aunon-Nerin and Ehling,[18] Bartram *et al.*[16]

[44] Adiel (1996).

and Shiu,[9] the positive effect of demand for reinsurance on firm financial leverage is backed by the renting capital hypothesis, which proposes that direct insurers with higher reinsurance levels usually have greater leverage levels. Corporate reinsurance utilisation can be examined using the ratio of ceded reinsurance, which helps provide knowledge regarding the volume of reinsurance transactions between the insurer and the reinsurer. The ceded reinsurance ratio is defined as the ratio of reinsurance ceded to the net premium written. Chen *et al.*,[41] Cole and McCullough[21] and Cummins *et al.*[45] developed their studies on the basis of this ratio, which defines reinsurance utilisation among insurance companies.

$$\text{Corporate (REINS)} = \text{reinsurance ceded/net premium written.}$$

Leverage or solvency risk is described by Chen *et al.*,[41] Shiu,[9] Cummins *et al.*,[45] and Lee and Lee[46] as the ratio of the net premium written to the policyholder surplus, where the net premium is the difference between the premium written and the reinsurance ceded. As a measure of financial strength and soundness, it expresses the magnitude of the risk retained in relation to the available financial resources. Highly levered firms demand more reinsurance to reduce their leverage levels, which could facilitate the underwriting of more business despite enhancing their stated capital.

$$\text{Financial leverage (LEV)} = \text{net premium written/policyholder's surplus.}$$

We take underwriting risk (UWR), firm size (LnSIZE), firm growth opportunities (GROW), firm performance (EXP), firm profitability (ROE), interest rate (INT), inflation rate (INF) and business mix as control variables. Underwriting risk is defined as the ratio of annual claims to the annual premiums reported at year end.[47] Reinsurance amplifies the insurer's underwriting capacity without jeopardising the minimum solvency requirements and aids in curtailing the risk of bankruptcy. Greater reinsurance coverage is usually acquired by insurance firms with high underwriting risk[7]; therefore, a strong positive impact is predicted for underwriting risk on demand for reinsurance. As the leverage levels of a firm increases, its demand for reinsurance increases, which in turn allows it to underwrite more business.

$$\text{Underwriting risk (URW)} = \text{net claim expense/net premium revenue.}$$

Firm size as a natural log of admissible assets is examined in relation to reinsurance utilisation in various studies.[48] The literature states that firm size has a significant negative impact on the demand for reinsurance, because large firms are less inclined towards reinsurance utilisation and small firms demand more reinsurance to protect themselves from risks. Viewing this from a different perspective, Frank and Goyal[49] argue that large firms usually possess more diversified portfolios in addition to less volatile cash flows and

[45] Cummins *et al.* (2012).
[46] Lee and Lee (2011).
[47] Kader *et al.* (2010); Lee and Lee (2011).
[48] Mayers and Smith (1990); Chen *et al.* (2001); Garven and Lamm-Tennant (2003); Cole and McCullough (2006); Lee and Lee (2011).
[49] Frank and Goyal (2009).

require lower leverage levels. However, the pecking order theory negates such a relationship between solvency risk and firm size.

$$\text{Firm size (LnSIZE)} = \log(\text{total assets}).$$

Growth opportunity is the change in the natural log of total admissible assets, according to Shiu[9] and Frank and Goyal,[49] and is predicted to have a significant positive relationship with the demand for reinsurance. As better investment opportunities encourage insurance companies towards more reinsurance purchases, the risk of catastrophic losses can easily be eliminated, while debt-related agency problems and the associated costs are likely to be higher for such firms, creating a negative relationship with the solvency risk factor.[49]

$$\text{Firm growth opportunity (GROW)} = \log(\text{total assets}).$$

As stated in the studies of Cummins *et al*.,[26] Malik[42] and Al-Shami,[43] the expense ratio can be a measure of firm efficiency; it is calculated by dividing net underwriting expenses by net premium revenue and indicates what portion of earned premiums goes to expenses related to underwriting and management activities. A significant negative impact is estimated between firm performance and solvency risk.

$$\text{Firm performance (EXP)} = \text{net underwriting expense}/\text{net premium revenue}.$$

The firm profitability measure of the return on equity has been extensively exploited in the literature (see Cummins *et al*.,[45] Kozak,[50] Malik,[42] Lee and Lee[46] and among others). The return on equity measure of firm efficiency takes the returns from every unit of the shareholder's equity to determine the ratio of profit after taxes to total equity. The literature highlights that firms with greater profitability lean away from increasing their debt levels.[49] However, the positive correlation between a firm's profitability and its solvency risk is also supported by the observation that highly profitable firms face lower expected bankruptcy costs and improve their tax benefits with every increase in their debt levels.

$$\text{Firm profitability (ROE)} = \text{profit after taxes}/\text{total equity}.$$

Lee and Lee,[46] Grace and Hotchkiss[51] and Browne and Hoyt[52] find a positive correlation between the rate of interest and solvency risk. Fluctuations in interest rates have a crucial impact on corporate reinsurance utilisation levels of insurance corporations. A 12-month Karachi Interbank Offered Rate (KIBOR) is utilised in the study based on the available year-based panel data of the insurance firms operational in Pakistan.

The consumer price index is used as a tool for measuring inflation rates in various studies such as Lee and Lee,[46] Browne and Hoyt,[52] and Grace and Hotchkiss[51]; inflation significantly impacts insurance companies' demand for reinsurance as well as their

[50] Kozak (2011).
[51] Grace and Hotchkiss (1995).
[52] Browne and Hoyt (1995).

solvency margins. Higher inflation rates make adjusting to losses with the available premiums difficult and reduces the profit margins of insurance firms.

According to Shiu[9] and Garven and Lamm-Tennant,[8] "business mix" measures the proportion of net earned premiums written in each of the four lines of business as fire and property damage; motor; marine, aviation and transport; and miscellaneous. It is assumed that business mix will positively influence the demand for reinsurance in addition to the firm leverage levels in the property and liability insurance sector.

Fire & property damage (BMIXI) = net earned premiums written in fire & property damage/total earned premiums written,

Motor (BMIXII) = net earned premiums written in motor/total earned premiums written

Marine aviation & transport (BMIXIII) = net earned premiums written in marine aviation & transport/total earned premiums written

Miscellaneous (BMIXIV) = net earned premiums written in miscellaneous/total earned premiums written.

Methodology

To test the hypotheses and examine the impact of explanatory variables on the explained variables, a set of equations is developed addressing the dual causation between the utilisation of reinsurance and financial leverage evidenced by Shiu.[9] This reverse causality will cause the ordinary least-squares (OLS) regression estimates to be simultaneously biased and inconsistent because the error term will be correlated with the explanatory variable.[53] To circumvent this obstacle, a two-stage least-square regression, in addition to fixed-effects and random-effects GLS regressions, is utilised to calculate the relationship between reinsurance consumption and firm leverage levels for both insurance sectors of Pakistan.

For the non-life insurance sector:

$$\begin{aligned}\mathrm{REINS}_{i,t} = {} & \beta_0 + \beta_1 \mathrm{LEV}_{i,t} + \beta_2 \mathrm{URW}_{i,t-1} + \beta_3 \mathrm{LnSIZE}_{i,t-1} + \beta_4 \mathrm{GROW}_{i,t-1} \\ & + \beta_5 \mathrm{EXP}_{i,t-1} + \beta_6 \mathrm{INT}_{i,t-1} + \beta_7 \mathrm{INF}_{i,t-1} + \beta_8 \mathrm{BMIXI}_{i,t-1} + \beta_9 \mathrm{BMIXII}_{i,t-1} \\ & + \beta_{10} \mathrm{BMIXIII}_{i,t-1} + \beta_{11} \mathrm{BMIXIV}_{i,t-1} + e1_{i,t} \end{aligned} \quad \text{(i)}$$

$$\begin{aligned}\mathrm{LEV}_{i,t} = {} & \beta_0 + \beta_1 \mathrm{REINS}_{i,t} + \beta_2 \mathrm{URW}_{i,t-1} + \beta_3 \mathrm{LnSIZE}_{i,t-1} + \beta_4 \mathrm{GROW}_{i,t-1} \\ & + \beta_5 \mathrm{ROE}_{i,t-1} + \beta_6 \mathrm{INT}_{i,t-1} + \beta_7 \mathrm{INF}_{i,t-1} + \beta_8 \mathrm{BMIXI}_{i,t-1} + \beta_9 \mathrm{BMIXII}_{i,t-1} \\ & + \beta_{10} \mathrm{BMIXIII}_{i,t-1} + \beta_{11} \mathrm{BMIXIV}_{i,t-1} + e2_{i,t} \end{aligned} \quad \text{(ii)}$$

[53] Wooldridge (2006).

For the life insurance sector:

$$\text{REINS}_{i,t} = \beta_0 + \beta_1 \text{LEV}_{i,t} + \beta_2 \text{URW}_{i,t-1} + \beta_3 \text{LnSIZE}_{i,t-1} + \beta_4 \text{GROW}_{i,t-1} + \beta_5 \text{EXP}_{i,t-1} + \beta_6 \text{INT}_{i,t-1} + \beta_7 \text{INF}_{i,t-1} + e1_{i,t}, \quad \text{(iii)}$$

$$\text{LEV}_{i,t} = \beta_0 + \beta_1 \text{REINS}_{i,t} + \beta_2 \text{URW}_{i,t-1} + \beta_3 \text{LnSIZE}_{i,t-1} + \beta_4 \text{GROW}_{i,t-1} + \beta_5 \text{ROE}_{i,t-1} + \beta_6 \text{INT}_{i,t-1} + \beta_7 \text{INF}_{i,t-1} + e2_{i,t}. \quad \text{(iv)}$$

Here, $\text{REINS}_{i,t}$ denotes reinsurance consumption levels underwritten in year t by insurer i, while $\text{LEV}_{i,t}$ represents the financial leverage of insurer i in year t. The two-way causation between these variables forced the construction of simultaneous equations satisfying both the order and rank conditions,[53] where the order condition is achieved by having different exogenous variables in both equations in each sector. The variable EXP expressing *firm performance* and the variable ROE for *firm profitability* are omitted from Equations (ii) and (iv), and Equations (i) and (iii), respectively, to fulfil the order condition. Meeting the order condition is necessary but not sufficient for identification, so to attain the identification, the rank condition must be met, which is a necessary and sufficient condition. The model here also satisfies the rank condition by encompassing the non-zero coefficients of the excluded variables (EXP, ROE) in their respective Equations (i), (iii), (ii) and (iv). Now, each modelled equation is identified and can be estimated by the application of a two-stage least-squares regression.[54]

Simultaneous equations denote two endogenous variables (LEV in Equations (i) and (iii) and REINS in Equations (ii) and (iv)), causing the problem of endogeneity and some exogenous variables (URW, LnSIZE, GROW, EXP, ROE, INT, INF, BMIXI, BMIXII, BMIXIII, BMIXIV) that have no correlation with the error terms ($e1_{i,t}$, $e2_{i,t}$), while these structural errors may be correlated with each other.[55] To address the issue of endogeneity, the first lags of the exogenous variables are derived to make them control variables,[56] in addition to the inclusion of instrumental variables in the model.[57] The first lag of *LEV* and the second lag of *REINS* are utilised as instrumental variables in Equations (i) and (iii) and (ii) and (iv), respectively, to calculate the estimates for 2SLS (two-stage least-squares regression).[58]

Here, the abbreviations URW, LnSISE, GROW, EXP, ROE, INT, INF and BMIX stand for *firm underwriting risk, firm size, firm growth opportunities, firm performance, firm profitability, interest rate, inflation rate* and *business mix,* respectively. Moreover, BMIXI,

[54] Greene (2008).

[55] A test for endogeneity suggested by Hausman (1978) was conducted to remove endogeneity in the models. The Durbin chi-square statistics and the *p*-value showed that the problem of endogeneity prevails because the p-values were statistically significant at the 5 per cent level in both the non-life and life insurance sector models, stating that the variable LEV in Equation (i) and (iii) and REINS in Equation (ii) and (iv) are endogenous variables.

[56] Lags were utilised for controlled variables to address the problem of endogeneity per Cole and McCullough (2006) and Shiu (2011).

[57] Control variables are taken from the previous studies on reinsurance and leverage by Hoerger *et al.* (1990), Titman and Wessels (1988), Chen *et al.* (2001), Garven and Lamm-Tennant (2003), Cole and McCullough (2006) and Shiu (2011).

[58] Tests were done to check the validity of the instruments utilising STATA, where they were reported to be valid instruments in both models.

BMIXII, BMIXIII, BMIXIV are the constituents of the *business mix* factor, which only exists in property-liability insurance representing *fire & property damage, motor, marine aviation & transport* and *miscellaneous,* respectively.

The insurance industry of Pakistan currently consists of 40 non-life and 7 life insurance companies listed in the SECP (Security and Exchange Commission of Pakistan), which together constitute a population size of 47 companies. Secondary data pertaining to all study variables are collected from the audited financial reports of these insurance companies from 2002 to 2012, while some data are drawn from the Insurance Year Books that are regularly published by the IAP (Insurance Association of Pakistan). Only those firms that were not new to the insurance industry, having had an elapsed operational tenure of seven years, were taken into consideration. In the same manner, the insurance firms that have remained inactive or whose audited financial reports have not been published or are unavailable for the last five years are not part of the compiled sample. Addressing all these issues resulted in a balanced panel data set of 27 non-life and 6 life insurance firms. Data pertaining to the economic variables were taken from the websites of the State Bank of Pakistan and the World Bank, respectively.[59] The fact that life and non-life firms' operational activities are entirely different from each other initially created comparison problems, so each sector was examined independently later.

Empirical results

Tables 1 and 2 show the descriptive statistics for the life and non-life insurance sectors of Pakistan, while Tables 3 and 4 show the correlation matrix for the life and non-life insurance sectors.

Table 3 shows that the demand for reinsurance (REINS) is negatively correlated with financial leverage (LEV) and underwriting risk (URW), with a correlation coefficient of 0.1727 and 0.0481, respectively, and is statistically significant at the 0.01 level for the non-life sector. The correlation between financial leverage (LEV) and underwriting risk (URW) is 0.2071, making this a positive correlation. With a correlation coefficient of 0.8130, the correlation between the interest rate (INT) and the inflation rate (INF), which are the economic variables and beyond one's control, is positive.

Table 4 shows that corporate reinsurance utilisation (REINS) is positively correlated with financial leverage (LEV) and is negatively correlated with underwriting risk (URW), statistically significant at the 0.01 level with correlation coefficients of 0.0581 and 0.4958, respectively are. The correlation between financial leverage (LEV) and underwriting risk (URW) is 0.2627, making this a positive correlation. There is a positive correlation between the interest rate (INT) and the inflation rate (INF), with a correlation coefficient of 0.8130.

To identify the most appropriate regression model to be employed for the study, a series of steps were performed, starting with the simple pooled ordinary least-squares (OLS)

[59] A 12-month KIBOR (Karachi Interbank Offered Rate) obtained from the State Bank of Pakistan (www.sbp.org.pk) was used for the rate of inflation. Because of the unavailability of the yearly KIBOR rates for the years 2002 and 2003, six-month average KIBOR rates were included in the study. Moreover, the consumer price index was used as a proxy for the inflation rates obtained from the data sources of the World Bank (www.worldbank.org).

Table 1 Descriptive statistics for non-life insurance sector

	Mean	*Median*	*Std. dev.*	*Min.*	*Max.*
REINS	94.35	75.13	110.64	−805.42	986.42
LEV	81.20	53.98	86.29	−0.14	547.26
URW	49.55	45.89	64.99	−212.92	968.66
LnSIZE	20.58	20.54	4.28	0.00	46.27
GROW	0.02	0.01	0.19	−0.85	2.84
ROE	12.63	12.07	23.35	−162.91	95.96
EXP	38.02	32.89	37.55	−65.96	397.96
INT	9.98	10.43	3.88	2.63	16.11
INF	10.60	9.93	5.36	2.46	19.91
BMIXI	24.10	21.23	15.19	−3.31	76.96
BMIXII	16.93	14.36	13.21	−3.84	80.78
BMIXIII	41.81	44.22	21.40	−7.11	96.45
BMIXIV	15.27	10.65	17.34	−17.07	114.26
Number of observations			297		
Number of non-life insurance firms			27		

Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), rate of interest (INT), inflation rate (INF), proportion of fire & property damage (BMIXI), proportion of motor (BMIXII), proportion of marine aviation & transport (BMIXIII), proportion of miscellaneous (BMIXIV).

Table 2 Descriptive statistics for life insurance sector

	Mean	*Median*	*Std. dev.*	*Min.*	*Max.*
REINS	−5.22	−0.13	27.14	−83.89	115.64
LEV	710.03	387.36	1715.53	0.00	13359.47
URW	32.02	28.64	21.71	0.00	89.44
LnSIZE	23.36	23.40	1.59	20.16	26.56
GROW	0.01	0.01	0.01	−0.02	0.03
ROE	17.30	19.45	32.34	−149.85	129.97
EXP	41.69	38.52	36.63	0.00	277.76
INT	9.98	10.43	3.91	2.63	16.11
INF	10.60	9.93	5.40	2.46	19.91
Number of observations			66		
Number of non-life insurance firms			6		

Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), rate of interest (INT), inflation rate (INF).

regression to fixed-effects and random-effects GLS regressions and then to a two-stage least-square regression in addition to a variety of tests. Each step is performed for all four equations (i, ii, iii, iv) developed for the study to conduct the analysis.

First, the Breusch–Pagan/Cook–Weisberg test for heteroskedasticity was performed on OLS regression models (i), (ii), (iii) and (iv), resulting in chi-square (χ^2) values of 120.36, 109.56, 18.80 and 173.96, respectively, thus confirming the presence of heteroskedasticity.[60]

[60] The Breusch–Pagan test results generated from STATA of all four equations are provided in Appendices A and B.

Table 3 Correlation matrix for non-life insurance sector

	REINS	*LEV*	*URW*	*LnSIZE*	*GROW*	*ROE*	*EXP*	*INT*	*INF*
REINS	1.0000								
LEV	−0.1727	1.0000							
URW	−0.0481	0.2071	1.0000						
LnSIZE	0.1371	0.1890	−0.0582	1.0000					
GROW	0.0302	0.1886	−0.1693	0.1474	1.0000				
ROE	0.0403	−0.0035	−0.0308	0.1000	0.0618	1.0000			
EXP	−0.0827	0.0024	0.1541	0.0508	−0.0203	−0.2404	1.0000		
INT	0.0217	−0.0843	0.0351	0.1557	−0.0035	−0.2228	0.0725	1.0000	
INF	0.0183	−0.0835	0.0248	0.1315	−0.0442	−0.3073	0.1111	0.8130	1.0000
BMIXI	−0.0175	−0.2468	−0.0990	0.0765	−0.0081	−0.0380	0.1116	0.0138	0.0327
BMIXII	0.0569	−0.1617	−0.0798	−0.0142	−0.0357	0.2024	−0.2181	−0.0968	−0.0939
BMIXIII	0.0113	0.3773	0.2734	0.2264	0.0525	−0.0316	−0.0271	0.1323	0.0512
BMIXIV	0.0564	−0.0112	−0.1063	0.1294	−0.0253	−0.0244	0.1979	0.0787	0.1157

	BMIXI	*BMIXII*	*BMIXIII*	*BMIXIV*
REINS				
LEV				
URW				
LnSIZE				
GROW				
ROE				
EXP				
INT				
INF				
BMIXI	1.0000			
BMIXII	0.0142	1.0000		
BMIXIII	−0.4126	−0.2764	1.0000	
BMIXIV	−0.1953	−0.2863	−0.4100	1.0000

Table 4 Correlation matrix for life insurance sector

	REINS	*LEV*	*URW*	*LnSIZE*	*GROW*	*ROE*	*EXP*	*INT*	*INF*
REINS	1.0000								
LEV	0.0581	1.0000							
URW	−0.4958	0.2627	1.0000						
LnSIZE	−0.1584	0.3640	0.4920	1.0000					
GROW	0.0866	−0.0897	−0.2120	−0.2928	1.0000				
ROE	0.2917	0.4556	−0.1960	0.0717	0.5499	1.0000			
EXP	0.3648	−0.0433	0.1399	0.0702	−0.1193	−0.1931	1.0000		
INT	0.0149	0.0499	0.1662	0.3335	−0.1184	−0.0513	0.1551	1.0000	
INF	0.1011	−0.0130	0.1271	0.3203	−0.1414	−0.1700	0.2704	0.8130	1.0000

Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), rate of interest (INT), inflation rate (INF).

The Hausman test was then carried out to determine which model, of the fixed-effects regression or the random-effects GLS regression, would be most suitable for each of the equations. The p-values (0.0003 for Equation (i) and 0.0000 for Equation (ii)) are less than 0.05, indicating the appropriateness of the fixed-effects (within) regression for the non-life insurance sector, while the p-values (0.0591 for Equation (iii) and 0.5015 for Equation (iv)) being greater than 0.05 indicated the suitability of the random-effects GLS regression for the life insurance sector.[61]

Furthermore, a two-stage least-square regression (2SLS) was applied to the simultaneous equations by using the second lag of solvency risk (L2.LEV) and the first lag of the corporate reinsurance utilisation (L1.REINS) variables as instrumental variables in Equations (i) and (iii) and Equations (ii) and (iv), respectively.[62]

The Durbin–Wu–Hausman test for endogeneity was also conducted to find endogeneity in our models, where we determine that the variables LEV in Equations (i) and (iii) and REINS in Equations (ii) and (iv) are the endogenous variables because of their dual causality in the model. The Durbin chi-square statistics and the *p*-values show that the problem of endogeneity prevails, because the *p*-values are statistically significant at the 5 per cent level in both the non-life and life insurance sector models.[63] To address the issue of endogeneity, two instruments—L2.LEV and L1.REINS—were introduced in Equations (i) and (iii) and (ii) and (iv), respectively.

Afterwards, tests were conducted to determine whether the incorporated instruments (L2.LEV and L1.REINS) were strong enough to be relied upon. For this, a correlation between the endogenous variable and the instrumental variable is performed, i.e. computing the Pearson correlation coefficient matrix between LEV and L2.LEV and between REINS and L1.REINS for each insurance sector. Because the endogenous variables were strongly correlated with the instrumental variables, we concluded that the incorporated instrumental variables were strong enough to be utilised in the study. Using a more formal test for the identification of strong or weak instruments, the summary statistics of the first-stage regression analysis were taken into consideration, revealing the partial F-statistics on the instruments used. Partial F-statistics greater than 10 show that L2.LEV and L1.REINS in Equations (i) and (ii) for the non-life insurance sector are strong instruments, but they are exploited as weak instruments because of the presence of partial F-statistics of less than 10 in Equations (iii) and (iv) for the life insurance sector.[64]

The results pertaining to the fixed-effects (within) regression/random-effects GLS regression in addition to the two-stage least-squares regression (2SLS) for each Equations (i) to (iv) are presented in Tables 7 and 8 for comparison, where the major focus relies upon the 2SLS model because of the production of more significant outcomes by this model compared to others.

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[61] The Hausman test results generated from STATA of all four equations are provided in Appendix A.

[62] The GMM approach was first examined for the models, which generated insignificant results with downward-biased standard errors because of the unsuitability of the approach for small samples, as evidenced by Arellano and Bond (1991).

[63] The endogeneity test results generated from STATA are provided in Appendix A.

[64] Tests determining whether the instruments used were strong or weak are provided in Appendix A.

Table 5 Effects of leverage on reinsurance in non-life insurance sector

Dependent variable = REINS			
Independent variables	*Expected signs*	*Fixed-effects (within) regression coefficients*	*Two-stage least-squares regression coefficients*
LEV	+	−0.008	−3.004***
		(−0.098)	(1.046)
URW	+	0.469***	0.681**
		(0.153)	(0.324)
LnSIZE	–	1.360	−9.871*
		(1.553)	(5.528)
GROW	+	22.508	16.481
		(24.352)	(57.394)
EXP	+	−1.780***	−1.514***
		(0.181)	(0.343)
INT	–	−3.210*	−11.777**
		(1.925)	(5.643)
INF	+	4.280***	6.173*
		(1.375)	(3.515)
BMIXI	+	0.792	2.874**
		(0.802)	(1.496)
BMIXII	+	2.711***	1.744
		(0.752)	(1.396)
BMIXIII	+	0.904*	4.967***
		(0.523)	(1.969)
BMIXIV	+	−0.558	3.680**
		(0.731)	(1.810)
L2.LEV			1.534**
			(0.679)
Constant		1.870	113.241
R^2		0.522	0.358

Based on the Hausman test results (0.0003), among the fixed effects and random effects, the fixed effects model is the better choice. Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), rate of interest (INT), inflation rate (INF), proportion of fire & property damage (BMIXI), proportion of motor (BMIXII), proportion of marine aviation & transport (BMIXIII), proportion of miscellaneous (BMIXIV).

***Significance at 1 per cent.

**Significance at 5 per cent.

*Significance at 10 per cent.

Results for the non-life insurance sector

Results for Equation (i)

Table 5 presents the fixed-effects (within) regression results and the two-stage least-squares regression (2SLS) results for Equation (i), showing the effects of leverage on reinsurance in the non-life insurance sector of Pakistan. Hypothesis H_1 pertaining to the positive relationship between corporate reinsurance utilisation (REINS) and solvency risk is not accepted here due to the appearance of negative signs in both models in the table, where 2SLS results are highly significant at a 1 per cent level of significance. The presence

of negative relationships among these variables indicates that, when firm leverage (LEV) levels increase, reinsurance consumption declines, which is consistent with the findings of Cole and McCullough.[21] The reason could be that the insurance companies in this sector have a capital structure that consists mostly of debts. They underwrite more business without raising further capital, due to which the firm leverage levels rise, resulting in an increased probability of financial distress; now, the purchase of reinsurance cannot help them further reduce their solvency risks.[12]

Regarding the control variables, a positive impact of underwriting risk (URW) on corporate reinsurance utilisation is found and the results in both models are significant at the 1 and 5 per cent significance levels, respectively, showing that, with the increase in the underwriting risk (URW) of the cedant, more reinsurance is needed to diversify its portfolio risks, as noted by Cummins *et al*.,[26] Kader *et al*.[35] and Lee and Lee.[46] A negative relationship between firm size (LnSIZE) and corporate reinsurance utilisation is demonstrated by the 2SLS model, where the results are significant at a 10 per cent level of significance, showing that small cedants rely more greatly on reinsurance consumption than do large firms, which is consistent with the findings of Mayers and Smith,[7] Chen *et al*.[41] and Garven and Lamm-Tennant.[8] Moreover, in both stated models, a negative impact of firm performance (EXP) on corporate reinsurance utilisation (REINS) that is significant at 1 per cent is seen, which is inconsistent with the findings of Cummins *et al*.,[26] Malik[42] and Al-Shami.[43] Interest rate (INT) exhibits a negative impact in both regression models, as expected, with results that are significant at 10 and 5 per cent, respectively, confirming that, as interest rates increase, the demand for reinsurance by insurance companies decreases, as noted by Lee and Lee,[46] Grace and Hotchkiss[51] and Browne and Hoyt.[52] Both stated models show a positive relationship between inflation rate (INF) and corporate reinsurance utilisation (REINS) at the 1 and 10 per cent levels of significance, suggesting that, as inflation in the country rises, the demand for reinsurance also increases, as shown by the studies of Lee and Lee[46] and Browne and Hoyt.[52] Furthermore, a positive relationship between firm business mix (BMIXI, BMIXII, BMIXIII and BMIXIV) and demand for reinsurance is seen, as noted by Shiu[9] and Frank and Goyal.[49]

The results from Equation (i) depict a negative relationship between financial leverage and demand for reinsurance. Underwriting risk, inflation rate (INF) and business mix have a positive impact, while firm size, firm performance and interest rate negatively impact the corporate demand for reinsurance in the non-life insurance sector of Pakistan.

Results for Equation (ii)

The fixed-effects (within) regression results and the two-stage least-squares regression (2SLS) results for Equation (ii) are presented in Table 6, shedding light on the effects of reinsurance on leverage in the non-life insurance sector in Pakistan. The results show that corporate reinsurance utilisation (REINS) has a negative impact on firm solvency risk (LEV) in both regression models, where the 2SLS results are highly significant at a 1 per cent level of significance. The presence of a negative relationship among these variables shows that insurers with higher reinsurance dependence have a lower level of leverage, which is inconsistent with the renting capital hypothesis but consistent with the findings of Cole and McCullough.[21] The reason could be that the insurance companies in this sector have higher debt ratios such that further acquisition of reinsurance will not help them ease the pressure on their capital. To resolve the higher debt problem, the only available solution

Table 6 Effects of reinsurance on leverage in non-life insurance sector

Dependent variable = LEV			
Independent variables	*Expected signs*	*Fixed-effects (within) regression coefficients*	*Two-stage least-squares regression coefficients*
REINS	+	−0.011	−0.283***
		(0.036)	(0.091)
URW	+	−0.084	0.484***
		(0.103)	(0.146)
LnSIZE	–	−5.056***	−1.218
		(0.983)	(1.332)
GROW	+	−29.719*	17.803
		(16.167)	(23.726)
ROE	–	−0.009	−0.054
		(0.145)	(0.209)
INT	–	−2.767**	−4.317**
		(1.276)	(1.896)
INF	+	−0.3808	0.886
		(0.950)	(1.474)
BMIXI	+	2.159***	0.483
		(0.512)	(0.478)
BMIXII	+	1.793***	0.514
		(0.493)	(0.527)
BMIXIII	+	2.332***	2.118***
		(0.314)	(0.456)
BMIXIV	+	1.963***	1.176**
		(0.429)	(0.507)
L1.REINS			0.006
			(0.076)
Constant		12.065	13.681
R^2		0.259	0.278

Based on the Hausman test results (0.0000), among the fixed effects and random effects, the fixed effects model is the better choice. Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), rate of interest (INT), inflation rate (INF), proportion of fire & property damage (BMIXI), proportion of motor (BMIXII), proportion of marine aviation & transport (BMIXIII), proportion of miscellaneous (BMIXIV).

***Significance at 1 per cent.

**Significance at 5 per cent.

*Significance at 10 per cent.

to such insurers is to raise further capital to underwrite more business, without which the firm leverage level will rise, resulting in an increased probability of financial distress, as evidenced by Carson and Hoyt.[12]

Here, the results for underwriting risk (URW) are mixed, with negative outcomes in the fixed-effects (within) regression model and, as expected, positive outcomes in the 2SLS model, which is significant at 1 per cent. This positive outcome shows that underwriting risk (URW) positively affects solvency risk, which means that, as the insurer underwrites more business, the underwriting risk increases, requiring greater reinsurance consumption, which in turn, reduces the risk of insolvency; this is in line with the findings of Cummins *et al.*[26] Furthermore, firm size (LnSIZE), firm profitability (ROE) and interest rate (INT) have a

negative relationship with solvency risk, while a positive relationship is present between business mix (BMIXI, BMIXII, BMIXIII and BMIXIV) and solvency risk in both regression models, as expected, while firm growth opportunities (GROW) and the inflation rate (INF) are considered mixed outcomes in relation to the solvency risk in both regression models.

The results from Equation (ii) depict a negative relationship between corporate reinsurance utilisation and firm capital structure, underwriting risk, inflation rate (INF) and business mix have a positive impact, while firm size, firm profitability and interest rate negatively impact Firm Leverage in the non-life insurance sector in Pakistan.

Results for life insurance sector

Results for Equation (iii)

Table 7 presents the random-effects GLS regression results and the two-stage least-squares regression (2SLS) results for Equation (iii), showing the effects of leverage on reinsurance in the life insurance sector of Pakistan. Hypothesis H_1 regarding the positive relationship between corporate reinsurance utilisation and solvency risk is accepted in both models, where

Table 7 Effects of leverage on reinsurance in life insurance sectors

		Dependent variable = REINS	
Independent variables	*Expected signs*	*Random-effects GLS regression coefficients*	*Two-stage least-squares regression coefficients*
LEV	+	0.004***	0.022***
		(−0.001)	(0.007)
URW	+	−0.834***	−1.254***
		(0.175)	(0.320)
LnSIZE	–	−1.714	−9.900*
		(2.548)	(5.523)
GROW	+	−287.719	−354.884
		(372.221)	(715.955)
EXP	+	−0.155	0.043
		(0.085)	(0.144)
INT	–	1.612	3.786*
		(1.325)	(2.298)
INF	+	0.276	0.098
		(0.972)	(1.668)
L2.LEV			0.002
			(0.003)
Constant		41.289	207.602
R^2		0.046	0.225

Based on the Hausman test results (0.0591), among the fixed effects and random effects, the random effects model is the better choice. Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), rate of interest (INT), inflation rate (INF).

***Significance at 1 per cent.

**Significance at 5 per cent.

*Significance at 10 per cent.

the results are highly significant at a 1 per cent level of significance. The presence of a positive relationship between these variables shows that cedants with higher leverage levels (LEV) require a greater level of reinsurance, which is consistent with the expected bankruptcy cost argument, the agency cost theory and the risk-bearing hypothesis. Furthermore, these results are in line with the findings of Hoerger *et al.*,[32] Garven and Lamm-Tennant[8] and Powell and Sommer.[34]

A negative impact of underwriting risk (URW) on corporate reinsurance utilisation (REINS) is seen here; the results in both regression models yield negative outcomes at the 1 per cent significance level, showing that, with an increase in the cedant's underwriting risk, the cedant has less demand for reinsurance to diversify its portfolio risks; this is inconsistent with the findings of Cummins *et al.*,[26] Kader *et al.*[35] and Lee and Lee.[46] One of the reasons for the presence of a negative relationship between these variables could be that insurers in this sector would not write business with potentially catastrophic losses, which in turn diminishes the demand for reinsurance, as evidenced by Culp and O'Donnell.[30] Another reason could be the influence of another factor on the relationship between underwriting risk and corporate reinsurance consumption, which has not been taken into consideration because Kader *et al.*[35] argued in his study that the effect of underwriting risk (URW) is conjointly influenced by insolvency risk and tax positions.

A negative relationship between firm size (LnSIZE) and corporate reinsurance utilisation (REINS) is demonstrated by both the random-effects GLS regression and 2SLS model, where the results are significant at the 10 per cent level, showing that small cedants require greater reinsurance consumption than large firms, which is consistent with previous findings.[65] Interest rate (INT) expresses a positive impact in both regression models, showing that, as interest rates increase, the demand for reinsurance by life insurance companies also increases, contrary to the findings of Lee and Lee,[46] Grace and Hotchkiss[51] and Browne and Hoyt.[52] Last, a positive relationship between the inflation rate (INF) and the demand for reinsurance is shown in both the stated models, suggesting that, as inflation in the country rises, the demand for reinsurance also increases.

The results from Equation (iii) depict a positive relationship between financial leverage and demand for reinsurance. Interest rate, firm performance and inflation rate (INF) have a positive impact, while underwriting risk (URW) and firm size (LnSize) negatively impact corporate demand for reinsurance in Pakistan's life insurance sector.

Results for Equation (iv)

Table 8 presents the random-effects GLS regression results and the two-stage least-squares regression (2SLS) results for Equation (iv), shedding light on the effects of reinsurance on leverage in the life insurance sector of Pakistan. The results show that corporate reinsurance utilisation (REINS) has a positive impact on firm solvency risk (LEV) in both regression models, where the outcomes are significant at the 1 and 5 per cent levels of significance, respectively. The presence of a positive relationship among these variables shows that insurers with higher reinsurance dependence have a higher level of leverage, consistent with the renting capital hypothesis. As greater reinsurance levels help the insurer to attain a lower capital ratio for a given level of solvency, some of the capital needed can

[65] Mayers and Smith (1990); Chen *et al.* (2001); Garven and Lamm-Tennant (2003).

Table 8 Effects of reinsurance on leverage in life insurance sector

		Dependent variable = LEV	
Independent variables	*Expected signs*	*Random-effects GLS regression coefficients*	*Two-stage least-squares regression coefficients*
REINS	+	24.473***	49.652**
		(9.458)	(23.062)
URW	+	33.682***	49.320***
		(13.428)	(17.758)
LnSIZE	–	418.842**	524.638**
		(183.285)	(239.457)
GROW	+	24184.710	42885.330
		(33119.05)	(44969.61)
ROE	–	−3.497	−9.788
		(9.012)	(11.115)
INT	–	−126.120*	−158.554*
		(89.498)	(104.340)
INF	+	5.649	−19.865
		(67.193)	(79.771)
L1.REINS			−5.814
			(16.943)
Constant		−8888.251	−11161.82
Adjusted R^2		0.0237	0.289

Based on the Hausman test results (0.5015), among the fixed effects and random effects, the random effects model is the better choice. Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), rate of interest (INT), inflation rate (INF).

***Significance at 1 per cent.

**Significance at 5 per cent.

*Significance at 10 per cent.

be rented from reinsurers. Underwriting risk (URW) here is shown to have a positive impact on the solvency risk in both regression models, where the outcomes are significant at the 1 per cent significance level. This positive outcome shows that underwriting risk positively affects the solvency risk, meaning that, as the insurer underwrites more business, its underwriting risk (URW) increases, and consequently, its demand for reinsurance as well, which in turn reduces the risk of insolvency. Furthermore, firm growth opportunities (GROW), firm profitability (ROE) and interest rate (INT) show the expected relationships with solvency risk in both models, while the firm size (LnSIZE) and inflation rate (INF) produce mixed outcomes in relation to the solvency risk in both regression models.

The results from Equation (iv) depict a positive relationship between corporate reinsurance utilisation (REINS) and firm capital structure. Underwriting risk and firm size have a positive impact, while the firm profitability (ROE), interest rate (INT) and inflation rate (INF) negatively impact the firm leverage in the life insurance sector of Pakistan.

Robustness and sensitivity test

Apart from considering a linear relationship between corporate reinsurance utilisation (REINS) and financial leverage, a quadratic specification for these was tested by taking the

square of the endogenous variables in the equations.[66] Reinsurance squared was entered in Equations (ii) and (iv), while financial leverage (LEV) squared was added to Equations (i) and (iii), as estimated through the 2SLS approach. The results remained the same and significant in both insurance sectors, as noted in the empirical section. The leverage showed a positive impact on reinsurance utilisation in the life insurance sector when the financial leverage (LEV) squared was introduced in the model. In the same way, reinsurance utilisation had a positive effect on life insurance firm leverage levels when the reinsurance squared was entered into the model.

Conclusions

The study aimed to uncover the effects of financial leverage on corporate demand for reinsurance and reverse causation between reinsurance utilisation on the firm capital structure by analysing both the life and non-life insurance sectors of Pakistan.

For the non-life insurance sector

A negative relationship between corporate reinsurance utilisation and financial leverage was found in the non-life insurance sector of Pakistan, showing that, with an increase in firm leverage levels, reinsurance purchases decrease, consistent with the findings of Cole and McCullough[21] but inconsistent with the study expectations and expectations of the previous research works of Hoerger *et al.*,[32] Garven and Lamm-Tennant,[8] Shortridge and Avila[33], Powell and Sommer[34] and Shiu.[9] The reason could be that insurance companies in this sector have a capital structure mostly consisting of debts, in which they underwrite more business without raising further capital, due to which the firm leverage levels increased, resulting in an increased probability of financial distress. Now, the purchase of further reinsurance cannot help them reduce their solvency risks, as evidenced by Carson and Hoyt.[12] Examination of the reverse causality between reinsurance and capital structure reveals that high reinsurance consumption levels have a negative impact on the firm's capital structure, conflicting with the renting capital hypothesis. Here, the negative impact states that these highly levered firms bearing a high probability of bankruptcy face difficulties in obtaining the required capital at a low cost from the capital markets.

For the life insurance sector

A positive impact is demonstrated for corporate reinsurance utilisation and firm leverage in the life insurance sector of Pakistan, showing that highly levered insurers are attracted more to reinsurance to reduce their insolvency risk and agency costs, consistent with the expected bankruptcy cost argument, agency cost theory and risk-bearing hypothesis, as evidenced by Shiu.[9] The reverse causality between reinsurance consumption levels and firm capital structure also proved to be positive, consistent with the renting capital hypothesis supported by Adams,[40] Graham and Rogers,[17] and Aunon-Nerin and Ehling.[18] Furthermore, life insurance firms, in contrast to non-life insurance firms that have high leverage levels and solvency risk, were found to be attracted to reinsurance to reduce the probability of insolvency

[66] The results pertaining to the quadratic specifications are listed in Appendix B.

and mitigate their agency problems. In the same manner, these firms with high reinsurance consumption levels were found to be more inclined towards enhancing their debt capacity by underwriting more risk without significantly increasing their insolvency risk.

The study shows that highly levered insurers tend more towards reinsurance purchases, while the insurers that exhibit high reinsurance consumption levels are inclined towards a high level of debt. Furthermore, life insurance firms, in contrast to non-life insurance firms in Pakistan that bear high leverage levels and solvency risk, were found to lean more towards reinsurance purchases to reduce the probability of insolvency and mitigate their agency problems. In the same manner, life insurance sector firms, compared to the non-life stock insurance firms of Pakistan's insurance industry that exhibit high reinsurance consumption levels, were found to be more inclined towards enhancing their debt capacity by underwriting more risk without significantly increasing their insolvency risk.

Moreover, it is also obvious that the life insurance segment of the insurance industry of Pakistan is more prone to reinsurance purchases compared to the non-life insurance segment because it consists of highly levered firms. By resorting to more reinsurance consumption, these insurance companies tend to enhance their underwriting capacities to underwrite more business while maintaining significant solvency limits in addition to capital constraints.

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Appendix A

Serial no.	*List of non-life insurance companies*	
	Name of insurance companies	*Listed at Pakistan stock exchange*
	Public sector	
1	National Insurance Company Limited	Listed
2	Pakistan Reinsurance (Pakistan Insurance Corporation Limited)	Listed
	Private sector	
3	Adamjee Insurance Company Limited (General Insurance)	Listed
4	Alpha Insurance Company Limited	
5	Asia Insurance Company Limited	Listed
6	Askari General Insurance Company Limited	Listed
7	Atlas Insurance Limited (formerly Muslim Insurance Company Limited)	Listed
8	Capital Insurance Company Limited	
9	Central Insurance Company Limited (Cyan Limited)	
10	Century Insurance Company Limited	Listed
11	East West Insurance Company Limited	Listed
12	EFU General Insurance Limited	Listed
13	Habib Insurance Company Limited	Listed
14	International General Insurance Company Limited	Listed
15	New Jubilee Insurance Company Limited	Listed
16	PICIC Insurance Limited	Listed
17	Premier Insurance Company of Pakistan Limited	Listed
18	Reliance Insurance Company Limited	Listed
19	Saudi Pak Insurance Company Limited	
20	Security General Insurance	
21	Shaheen Insurance Company Limited	Listed
22	Silver Star Insurance Company Limited	Listed
23	The Cooperative Insurance Society of Pakistan Limited	
24	The Crescent Star Insurance Company Limited	Listed

Serial no.	*List of non-life insurance companies*	
	Name of insurance companies	*Listed at Pakistan stock exchange*
25	The Pakistan General Insurance Company Limited	Listed
26	The United Insurance Company of Pakistan Limited	Listed
27	The Universal Insurance Company Limited	Listed

Serial no.	*List of life insurance companies*	
	Name of insurance companies	*Listed at Pakistan stock exchange*
	Public sector	
1	State Life Insurance Corporation of Pakistan	Listed
	Private sector	
2	Adamjee Insurance Company Limited (Life Insurance)	Listed
3	American Life Insurance Company	
4	East West Life Assurance Company	Listed
5	EFU Life Assurance Limited	Listed
6	New Jubilee Life Insurance Company Limited	Listed

For the non-life insurance sector

1. Breusch–Pagan / Cook–Weisberg test for heteroskedasticity

Ho: Constant variance
For first equation
Variables: LEV L.URW L.LnSIZE L.GROW L.EXP L.INT L.INF L.BMIXI L.BMIXII L.BMIXIIIL.BMIXIV
chi2 (11) = 120.36
Prob> chi2 = 0.0000

For second equation
Variables: REINS L.URW L.LnSIZE L.GROW L.ROE L.INT L.INF L.BMIXI L.BMIXII L.BMIXIIIL.BMIXIV
chi2(11) = 109.56
Prob> chi2 = 0.0000

2. Hausman test
Ho: difference in coefficients not systematic
For First Equation
chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 34.10
Prob>chi2 = 0.0003
(V_b-V_B is not positive definite)
For Second Equation
chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 51.87
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

3. Test for endogeneity
Ho: variables are exogenous

Durbin (score) chi2(1) = 8.56884 (p = 0.0034)
Wu–Hausman F(1,230) = 8.40688 (p = 0.0041)

4. Test for determining whether the instruments used are week or strong

a. Correlate LEV L2.LEV
(obs=243)

| L2.
| LEV LEV
---+---
LEV |
--. | 1.0000
L2. | 0.7568 1.0000

b. First-stage regression summary statistics

| Adjusted Partial Robust
Variable | R-sq.R-sq.R-sq.F(1,231) Prob> F
---+---
LEV | 0.6452 0.6283 0.5136 116.518 0.0000

c. correlate REINS L.REINS
(obs=270)

| L.
| REINS REINS
---+---
REINS |
--. | 1.0000
L1. | 0.5833 1.0000

d. First-stage regression summary statistics

| Adjusted Partial Robust
Variable | R-sq.R-sq.R-sq.F(1,258) Prob> F
---+---
REINS | 0.4266 0.4021 0.3747 11.0785 0.0010

For the life insurance sector

1. Breusch–Pagan / Cook–Weisberg test for heteroskedasticity
Ho: Constant variance
For third equation
Variables: LEV L.URW L.LnSIZE L.GROW L.EXP L.INT L.INF
chi2 (7) = 18.80
Prob> chi2 = 0.0089

For fourth equation
Variables: REINS L.URW L.LnSIZE L.GROW L.ROE L.INT L.INF
chi2 (7) = 173.96
Prob> chi2 = 0.0000

2. Hausman test
Ho: difference in coefficients not systematic
For Third Equation
chi2 (6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 12.13
Prob>chi2 = 0.0591
(V_b-V_B is not positive definite)
For fourth equation
chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 6.33
Prob>chi2 = 0.5015
(V_b-V_B is not positive definite)

3. Test for endogeneity
Ho: variables are exogenous

Durbin (score) chi2(1) = 3.15793 (p = 0.0756)
Wu–Hausman F(1,45) = 2.79507 (p = 0.1015)

4. Test for determining whether the instruments used are week or strong

a. correlate LEV L2.LEV
(obs=54)

| L2.
| LEV LEV
---+---
LEV |
--. | 1.0000
L2. | 0.1895 1.0000

b. First-stage regression summary statistics

| Adjusted Partial Robust
Variable | R-sq.R-sq.F(1,46) Prob> F
---+---
LEV | 0.2255 0.1076 0.0010 .078134 0.7811

c. correlate REINS L.REINS
(obs=60)

| L.
| REINS REINS
---+---
REINS |
--. | 1.0000
L1. | 0.7295 1.0000

d. First-stage regression summary statistics

| Adjusted Partial Robust
Variable | R-sq.R-sq.F(1,52) Prob> F
---+---
REINS | 0.6094 0.5568 0.3496 7.94055 0.0068

Appendix B: Robustness and sensitivity test

Results for Equation (i)

Effects of leverage on reinsurance in the non-life insurance sector

Dependent variable = REINS		*Two-stage least-squares regression coefficients*
Independent variables	*Expected sign*	
LEVSq	+	−0.001***
		(0.000)
URW	+	0.530***
		(0.182)
LnSIZE	−	−0.260
		(1.899)
GROW	+	23.092
		(32.214)
EXP	+	−1.648***
		(0.191)
INT	−	−3.341
		(2.644)
INF	+	4.138**
		(1.921)
BMIXI	+	0.836
		(0.676)
BMIXII	+	0.470
		(0.713)
BMIXIII	+	1.033*
		(.073)
BMIXIV	+	0.394
		(0.719)
L2.LEVSq		−0.000
		(0.000)
Constant		59.302
R^2		0.302

Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), interest rate (INT) (INT), inflation rate (INF), proportion of fire & property damage (BMIXI), proportion of motor (BMIXII), proportion of marine aviation & transport (BMIXIII), proportion of miscellaneous (BMIXIV).

***Significance at 1 per cent.

**Significance at 5 per cent.

*Significance at 10 per cent.

Results for Equation (ii)

Effects of reinsurance on leverage in non-life insurance sector

Dependent variable = LEV		*Two-stage least-squares regression coefficients*
Independent variables	*Expected sign*	
REINSSq	+	−0.000***
		(0.000)
URW	+	0.211*
		(0.142)
LnSIZE	−	−0.606
		(1.258)
GROW	+	2.518
		(23.967)
ROE	−	−0.178
		(0.202)
INT	−	−4.804***
		(1.924)
INF	+	0.6544
		(1.442)
BMIXI	+	0.177
		(0.433)
BMIXII	+	0.543
		(0.456)
BMIXIII	+	2.190***
		(0.410)
BMIXIV	+	1.535***
		(0.439)
L1.REINSSq		−0.000
		(0.000)
Constant		4.441
R^2		0.318

Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), interest rate (INT) (INT), inflation rate (INF), proportion of fire & property damage (BMIXI), proportion of motor (BMIXII), proportion of marine aviation & transport (BMIXIII), proportion of miscellaneous (BMIXIV).

***Significance at 1 per cent.

**Significance at 5 per cent.

*Significance at 10 per cent.

Results for Equation (iii)

Effects of leverage on reinsurance in life insurance sectors

Dependent variable = REINS		*Two-stage least-squares regression coefficients*
Independent variables	*Expected sign*	
LEVSq	+	0.000*
		(0.000)
URW	+	−9.071***
		(0.191)
LnSIZE	−	−0.511
		(2.940)
GROW	+	−170.478
		(456.323)
EXP	+	−0.043
		(0.090)
INT	−	1.483
		(1.383)
INF	+	0.583
		(1.062)
L2.LEVSq		0.000
		(0.000)
Constant		15.312
R^2		0.366

Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), interest rate (INT) (INT), inflation rate (INF).

***Significance at 1 per cent.

**Significance at 5 per cent.

*Significance at 10 per cent.

Results for Equation (iv)

Effects of reinsurance on leverage in life insurance sector

Dependent variable = LEV		*Two-stage least-squares regression coefficients*
Independent variables	*Expected sign*	
REINSSq	+	−0.098*
		(0.112)
URW	+	20.822*
		(14.457)
LnSIZE	−	467.737***
		(234.200)
GROW	+	4471.767
		(41573.100)
ROE	−	−0.219
		(10.186)
INT	−	−104.272
		(99.395)
INF	+	10.998
		(77.216)
L1.REINSSq		−0.165
		(0.113)
Constant		−9640.230
Adjusted R^2		0.029

Corporate reinsurance utilisation (REINS), financial leverage (LEV), firm underwriting risk (URW), firm size (LnSIZE), firm growth opportunities (GROW), firm profitability (ROE), firm performance (EXP), interest rate (INT) (INT), inflation rate (INF).

***Significance at 1 per cent.

**Significance at 5 per cent.

*Significance at 10 per cent.

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