Asymmetric dynamics of insurance premium: The impacts of output and economic policy uncertainty

Rangan Gupta
University of Pretoria, South Africa
Rangan.Gupta@up.ac.za

Amine Lahiani
LEO (UMR CNRS 7322), Université d'Orléans, Orléans, France
Montpellier Business School, Montpellier, France
amine.lahiani@univ-orleans.fr

Chi-Chuan Lee
School of Management, Beijing Normal University Zhuhai, Zhuhai, China
leechichuan@bnuz.edu.cn

Chien-Chiang Lee*
Department of Finance, National Sun Yat-sen University, Kaohsiung, Taiwan
Phone: 886-7-5252000 ext. 4825
Fax: 886-7-5254899
Email: cclee@cm.nsysu.edu.tw

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* Corresponding author. **Chien-Chiang Lee,** E-mail: cclee@cm.nsysu.edu.tw (C.-C. Lee).

Abstract

This paper investigates the asymmetric and nonlinear transmission of real output and economic policy uncertainty to insurance premiums for the US economy over the annual period of 1980-2014. Using most up-to-date nonlinear autoregressive distributed lags (NARDL) framework developed by Shin et al. (2014), we simultaneously examine short- and long-run asymmetric responses of the insurance premiums through positive and negative partial sum decompositions of changes in the explanatory variables. Our empirical results reveal that real output and economic policy uncertainty affect insurance premiums in an asymmetric and nonlinear manner, but the transmission mechanism is not the same. As to the impact of real output, we find that an increase in real output leads to enhancing the insurance premiums, while a decrease in output has a greater impact causing insurance premiums to move down. For the impact of economic policy uncertainty, the results also suggest that total and non-life insurance premiums increase with uncertainty increases, while life insurance premiums decrease with uncertainty increases. These results have significant implications for insurance-related econometric analysis, investment decisions, forecasting, and policy-making.

Keywords: Insurance premiums, Real output, Economic policy uncertainty, NARDL.

JEL classification: C32, F42, G22, O16.

1. Introduction

It is widely recognized that the rapid economic development has led to an increase in people's purchasing power and living standards, thus resulting in growing demand for physical and economic security. For the period 1985–2015, the world's total written real insurance premiums have increased by approximately 7.2 times from US$0.63 trillion to US$4.55 trillion (Swiss Reinsurance Company, 1980–2016). The rapid growth of insurance premiums not only increases insurers' role as providers of risk transfer, indemnification and financial intermediation, but also raises their importance as institutional investors. Despite the critical role that insurance sector plays in economic system, it is often ignored in the finance–growth literature, whereas other components of the financial sector, i.e., banking sector and stock market, attract abundant attention. These ideas prompted the initial motivation for this study, where we investigate the dynamic behavior of the insurance premiums.

Since insurance premium rates are usually based on projected investment income and expected losses, which are subject to business cycles, it may be reasonable to expect a significant interrelationship between the insurance premiums and macroeconomics (Guo et al., 2009; Lee and Chiu, 2012). With the surge in interest, there is a growing strand of theoretical and empirical literature assessing the linkage between the insurance premiums as a proxy for activities of the insurance market and real output as a proxy for economic development, but lacks any form of consensus due to the inconclusive results therein. Some previous studies, for instance, support the positive effect of real output (e.g., Beck and Webb, 2003; Li et al., 2007; Lee et al., 2010), while others find that a different degree of income growth has a distinct influence on insurance markets' activities (e.g., Enz, 2000; Feyen et al., 2011; Lee and Chiu, 2012). This begs the question as to the particular effects of real output on insurance premium which is somewhat unresolved and needs further investigation.

However, it is not only the effect of real income or output that is likely to differ. Existing research dealing with aggregate insurance regressions at the country level has primarily focused upon the economic factors driving insurance purchases, with little focus on economic policy-related uncertainty. The effect of uncertainty about economic policy on real economic activity, such as business cycle, inflation, investment, employment, and economic growth, has also been emphasized in the literature (Bloom, 2009; Julio and Yook, 2012; Carrière-Swallow and Céspedes, 2013; Jones and Olson, 2013; Bloom et al., 2014; Kang et al., 2014; Wang et al., 2014, Gulen and Ion, 2016). A key connection that may arise here is that if economic policy uncertainty does have significant impacts on these economic activities, then it would also be expected to have real impacts on insurance purchasing behavior. In this regard, this paper complements previous research relating to the dynamic behavior of the insurance premium as it adds to the limited number of studies pertaining to economic policy uncertainty index.

Overall, this paper aims to provide a robust perspective and a clear picture of the dynamic behavior of the insurance premium by addressing some major concerns commonly placed on economic models. As noted by Lee and Chiu (2012) and Chang and Lee (2012), most existing literature uses a conventional linear model to examine the insurance-growth relationship with a strong assumption that different degree of economic growth has the same effects on insurance markets' activities. Unlike previous studies of using conventional linear model, the current study implements an alternative approach by examining the asymmetric impact of real output and economic policy uncertainty on insurance premiums within the most up-to-date nonlinear autoregressive distributed lags (NARDL) model developed by Shin et al. (2014). In contrast to the standard cointegration techniques, one salient feature of this method is that the inference of long-run relationship can be achieved by a pragmatic bounds-testing procedure regardless of the integration orders of the variables in the system (Pesaran et al., 2001). When comparing with the advanced threshold cointegration framework, the NARDL appears to be superior since it accounts for short- and long-run asymmetries simultaneously while the threshold model accounts only for the long-run asymmetry (Hoang et al., 2016). In addition, the so-derived asymmetric cumulative dynamic multipliers allow one to quantify the asymmetric adjustment patterns following positive and negative shocks to the explanatory variables. By doing so, we are able to analyze the asymmetric responses of the insurance premium to positive and negative variations of the explanatory variables. Therefore, we can draw more accurate inferences to the asymmetric dynamics of insurance premium.

Using annual data for the US economy over the period of 1980-2014, the present study simultaneously bridges the gaps in the literature by incorporating the problems of potential nonlinearity and the omission of variable bias. To the best of our knowledge, this paper is the first to empirically examine asymmetric effects between insurance premium, real output and economic policy uncertainty through a novel NARDL framework. The rest of the paper is organized as follows. Section 2 briefly reviews the relevant literature concerning the insurance-growth nexus. Section 3 discusses the econometric methods. Section 4 introduces the data source and variable definitions. Section 5 discusses the empirical results. Finally, Section 6 reviews our conclusions and implications, while also outlining some of the implications based on the empirical findings from this extensive research.

2. Why does non-linearity matter for insurance premium?

A growing volume of empirical studies has been devoted to analyzing and discussing the dynamic of insurance premium in both the theoretical and empirical literature due to its relevance to an economic system. Many previous studies, such as Ward and Zurbruegg (2000) and Kugler and Ofoghi (2005), have carried out an extensive investigation of the relationship between insurance market development and economic growth based on conventional linear model specifications. However, the existence of nonlinearities in macroeconomic variables has also been addressed in the literature. In financial markets, for example, the presence of market frictions and transaction costs, as well as the interaction between heterogeneous traders may cause non-linear behavior for asset returns (McMillan, 2003).

Several theoretical and empirical studies have more precisely indicated that the adjustment dynamics of the insurance may be variable, asymmetrical, and non-linear (Harrington and Niehaus, 2000). As supposed by Beenstock et al. (1986), there are several reasons explaining why the desired amount of insurance protection is likely to vary with income. On the one hand, as income rises, more can be afforded; on the other hand, the higher the income levels, the more hardship dependents are likely to experience in the event of premature death. Jawadi et al. (2009) also note that competition between insurers and heterogeneous expectations from insurers who assume different and distinct costs will cause asymmetrical and non-linear adjustment dynamics in insurance premiums. Given the cross-country variations in insurance consumption, the literature has widely accepted that factors shaping the insurance premium are complex and varied from one country to another (Hwang and Gao, 2003; Lee and Chiu, 2012; Chang and Lee, 2012). Therefore, it is essential not to turn a blind eye to the fact that the roles played by the insurance sector in the economy may vary depending on different economic development and characteristics.

Reviewing the investigation of existing literature, there have been only a few studies to date examining the possible non-linear interaction between insurance premiums and real output. Carter and Dickinson (1992) and Enz (2000) develop a logistic model to characterize the S-curve relationship between insurance premiums and real GDP per capita. This S-curve pattern indicates that income elasticities of insurance premiums are not constant. Following this vein, Zheng et al. (2008) extend Enz's model to more recent data and identify the world insurance growth S-curve with 95 countries and districts over the 1980-2006 period. Instead of imposing a functional form a priori, Lee and Chiu (2012) employed a panel smooth transition regression (PSTR) model to examine the nonlinear relationship between insurance premiums and real income per capita for 36 selected countries from the period 1979–2007. Results show that different income elasticities of life and non-life insurance premiums exist for countries with high- and low-income levels. The impacts of real GDP on life and non-life insurance premiums present J-shaped and U-shaped patterns, respectively.

3. Empirical strategy and methodology

We employ the recently developed NARDL model by Shin et al. (2014) to investigate the asymmetric influence of real output and economic policy uncertainty on the dynamics of insurance premium. The most general version of the NARDL model that includes both long- and short-run asymmetries is specified as follows:

$$\Delta IP_t = \mu + \rho_{IP} IP_{t-1} + \rho^{+}_{GDP} GDP^{+}_{t-1} + \rho^{-}_{GDP} GDP^{-}_{t-1} + \rho^{+}_{EPU} EPU^{+}_{t-1} + \rho^{-}_{EPU} EPU^{-}_{t-1} + \sum_{i=1}^{p-1} \alpha_i \Delta IP_{t-i} + \sum_{i=1}^{q-1} (\beta_i^{+} \Delta GDP^{+}_{t-i} + \beta_i^{-} \Delta GDP^{-}_{t-i}) + \sum_{i=1}^{q-1} (\gamma_i^{+} \Delta EPU^{+}_{t-i} + \gamma_i^{-} \Delta EPU^{-}_{t-i}) + \varepsilon_t \quad (1)$$

where IP stands for TOTAL, LIFE and NONLIFE insurance premiums, respectively. The explanatory variables reported in Eq. (1) are real GDP (Gross Domestic Product) and EPU (Economic Policy Uncertainty). The subscripts + and – designate respectively the partial sum processes of positive and negative changes of the variables. For example for the GDP variable GDP_t^{+} and GDP_t^{-} are defined as follow:

$GDP_t^+ = \sum_{i=1}^{t} \Delta GDP_j^+ = \sum_{i=1}^{t} \max(\Delta GDP_j, 0)$ and $GDP_t^- = \sum_{i=1}^{t} \Delta GDP_j^- = \sum_{i=1}^{t} \min(\Delta GDP_j, 0)$

The long term association between insurance premium and explanatory variables can be tested by employing the bounds test methodology of Pesaran et al. (2001). This method for testing cointegration among variables has some advantages as compared to previously used methods such as Engle and Granger (1987), Johansen (1988, 1991) among others. First, the NARDL approach is suitable when the sample size is small while a large data sample is required if the Johansen's cointegration test is used. Second, the Johansen cointegration test requires the variables to have the same order of integration but the NARDL model is able to associate variables having different orders of integration, i.e I(0) and I(1) variables. Third, the NARDL allows capturing hidden cointegration. The latter is encountered when time series seem to be not cointegrated but their components are cointegrated.

The long-run positive and negative coefficients can be computed as $\theta_{GDP}^+ = -\rho_{GDP}^+/\rho_{IP}$ and $\theta_{GDP}^- = -\rho_{GDP}^-/\rho_{IP}$, respectively for GDP and as $\theta_{EPU}^+ = -\rho_{EPU}^+/\rho_{IP}$ and $\theta_{EPU}^- = -\rho_{EPU}^-/\rho_{IP}$, respectively for EPU. The long-run symmetry of the influence of GDP and EPU are tested using the Wald test of the respective null hypotheses $\rho_{GDP}^+ = \rho_{GDP}^-$ and $\rho_{EPU}^+ = \rho_{EPU}^-$. Similarly, short-run symmetry of the respective impacts of GDP and EPU on insurance premium is tested using the Wald test of the respective null hypotheses $\beta_i^+ = \beta_i^-$ and $\gamma_i^+ = \gamma_i^-$ for $i = 1,2, \dots, q-1$.

When the Wald test detects asymmetry (either in the long-run, in the short-run or in both) the dynamic asymmetric responses of insurance premium to positive and negative shocks (positive or negative variations) of explanatory variables are assessed by employing respectively the positive and negative dynamic multipliers associated with unit changes of GDP^+, GDP^-, EPU^+ and EPU^-, respectively as follows:

$m^{+}_{GDP,h} = \sum_{j=0}^{h} \frac{\partial IP_{t+j}}{\partial GDP^{+}_{t}}$, $m^{-}_{GDP,h} = \sum_{j=0}^{h} \frac{\partial IP_{t+j}}{\partial GDP^{-}_{t}}$, $m^{+}_{EPU,h} = \sum_{j=0}^{h} \frac{\partial IP_{t+j}}{\partial EPU^{+}_{t}}$ and $m^{-}_{EPU,h} = \sum_{j=0}^{h} \frac{\partial IP_{t+j}}{\partial GDP^{-}_{t}}$

By construction $m^{+}_{GDP,h} \to \theta^{+}_{GDP}, m^{-}_{GDP,h} \to \theta^{-}_{GDP}, m^{+}_{EPU,h} \to \theta^{+}_{EPU}$ and $m^{-}_{EPU,h} \to \theta^{-}_{EPU}$ when $h \to \infty$. Dynamic adjustment paths from the initial equilibrium between variables to a new equilibrium following a unit shock are depicted in Figures (1) to (3) below.

4. Data Description

The three models for the three insurance premiums (total, life and non-life) considered separately contains two other variables, namely a measure of output and a measure of economic uncertainty for the US economy. Output is measured by real Gross Domestic Product (GDP), where we deflate the nominal GDP by the GDP deflator with a base period of 2010. Data on both nominal GDP and the GDP deflator is obtained from the FRED database of the Federal Reserve Bank of St. Louis. The nominal insurance premiums as obtained from Swiss Re: Sigma annual reports, and is also deflated by the GDP deflator to convert them into their corresponding real values.

The measure of aggregate uncertainty used in this study is based on the economic policy uncertainty (EPU), which corresponds to the historical measure of uncertainty for the US economy as developed by Baker et al. (2016).[1] The authors use two overlapping sets of newspapers to create this series. The first spans 1900 - 1985 and is comprised of the Wall Street Journal, the New York Times, the Washington Post, the Chicago Tribune, the LA Times, and the Boston Globe. From 1985 until 2014, they use the previously mentioned newspapers along with USA Today, the Miami Herald, the Dallas Morning Tribune, and the San Francisco

[1] While there are other measures of economic uncertainty which are based on estimation of structural models (see for example, Jurado et al., (2015)), we rely on a news-based approach, since the former method is likely to be driven by the variables included in the econometric framework. The reader is referred to Strobel (2015) for a detailed discussion of various approaches used in measuring economic uncertainty.

Chronicle.

To construct the index, Baker et al. (2016) perform month-by-month searches of each paper, starting in January of 1900, for terms related to economic and policy uncertainty. In particular, they search for articles containing the term ‘uncertainty’ or ‘uncertain’, the terms ‘economic’, ‘economy’, ‘business’, ‘commerce’, ‘industry’, and ‘industrial’ as well as one or more of the following terms: ‘congress’, ‘legislation’, ‘white house’, ‘regulation’, ‘federal reserve’, ‘deficit’, ‘tariff’, or ‘war’. In other words, to meet their criteria for inclusion, the article must include terms in all three categories pertaining to uncertainty, the economy and policy.[2] The data is available for download from: https://www.policyuncertainty.com/us_monthly.html. Note that this data is available at a monthly frequency, so we compute annual values of the series by taking twelve-months averages to come up with an annual value for this index. Based on data availability of all the variables, our annual period covers the years 1980 to 2014. We work with natural logarithms of the insurance premiums, real GDP and economic policy uncertainty. A summary statistics for the variables have been provided in Table A1, while the data have been plotted in Figure A1 in the Appendix of the paper.

5. Empirical Results

5.1 The basic discovery

Before estimating the pass-through effects of real output and policy uncertainty to insurance premiums, it is important to select the best specification of the NARDL model for each insurance market. Table 1 reports the Wald statistics and their

[2] To deal with changing volumes of news articles for a given paper over time, Baker et al. (2016) divide the raw counts of policy uncertainty articles by the total number of news articles containing terms regarding the economy or business in the paper. They then normalize each paper’s series to unit standard deviation prior to December 2009 and sum each paper’s series.

corresponding p-values for the test that examines the hypotheses of long-run (W_{LR}) and short-run (W_{SR}) symmetries in the NARDL model which is provided in Eq. (1). The results of the long-run asymmetry tests indicate that GDP strongly affects total insurance and non-life insurance premiums in asymmetric and nonlinear manners. As to the impacts of policy uncertainty, evidence shows that EPU has a strong asymmetric effect on life insurance and a weak (at the 10% level) asymmetric effect on non-life insurance premiums.

[Insert Table 1 about here]

However, the short-run asymmetry test fails to reject the null of symmetry for the impact of GDP and EPU on total insurance and life insurance premiums. These results suggest that, in the short-run, GDP and EPU pass through to total insurance and life insurance premiums in a symmetric and linear manner. In contrast, GDP has a strong asymmetric effect on non-life insurance and EPU has a weak (10% level) asymmetric effect on non-life insurance premiums in the short-run. In short, the results of the asymmetry test suggest that both the short-run and long-run asymmetry only exist in non-life insurance premiums, while it is only with the long-run asymmetry for total and life insurance premiums. These results have significant implications for insurance-related econometric analysis, investment decisions, forecasting, and policy-making, as it suggests that ignoring the nonlinearity and asymmetry in modeling the relationship between insurance premium, real output and economic policy uncertainty may lead to spurious conclusions.

The above results are reasonable as researchers have recently suggested that the adjustment dynamics of insurance premium, especially for non-life insurance, might be asymmetrical and nonlinear due to the feature of underwriting cycle (Harrington and Niehaus, 2000; Higgins and Thistle, 2000; Sephton and Mann, 2015). Higgins and Thistle (2000) provide a theoretical foundation for asymmetric behavior of property-liability insurance. Their model reveals that insurance market behaves differently under various phases of the underwriting cycle. Jawadi (2009) have likewise argued in favor of abnormal, asymmetrical, and nonlinear character of the non-life insurance premium dynamics. Given the cost and the degree of competition are not identical among insurers, the behaviors and expectations of insurers are heterogeneous. After an exogenous shock, insurers may not react readily at the same time, thus inducing some persistence in the premium dynamics. Our findings are consistent with those obtained in past studies.

From the significance of the results of the asymmetry test exhibited in Table 1, we can specify a restricted NARDL model in which long- and short-run symmetries are imposed. The following three NARDL models are then estimated for total insurance, life insurance and non-life insurance premiums, respectively.

$$\Delta TOTAL_t = \mu + \rho_{TOTAL} TOTAL_{t-1} + \rho_{GDP}^{+} GDP_{t-1}^{+} + \rho_{GDP}^{-} GDP_{t-1}^{-} + \rho_{EPU} EPU_{t-1} + \sum_{i=1}^{p-1} \alpha_i \Delta TOTAL_{t-i} + \sum_{i=1}^{q-1} \beta_i \Delta GDP_{t-i} + \sum_{i=1}^{q-1} \gamma_i \Delta EPU_{t-i} + \varepsilon_t, \quad (2)$$

$$\Delta LIFE_t = \mu + \rho_{LIFE} LIFE_{t-1} + \rho_{GDP} GDP_{t-1} + \rho_{EPU}^{+} EPU_{t-1}^{+} + \rho_{EPU}^{-} EPU_{t-1}^{-} + \sum_{i=1}^{p-1} \alpha_i \Delta LIFE_{t-i} + \sum_{i=1}^{q-1} \beta_i \Delta GDP_{t-i} + \sum_{i=1}^{q-1} \gamma_i \Delta EPU_{t-i} + \varepsilon_t, \quad (3)$$

$$\Delta NONLIFE_t = \mu + \rho_{NONLIFE} NONLIFE_{t-1} + \rho_{GDP}^{+} GDP_{t-1}^{+} + \rho_{GDP}^{-} GDP_{t-1}^{-} + \rho_{EPU}^{+} EPU_{t-1}^{+} + \rho_{EPU}^{-} EPU_{t-1}^{-} + \sum_{i=1}^{p-1} \alpha_i \Delta NONLIFE_{t-i} + \sum_{i=1}^{q-1} (\beta_i^{+} \Delta GDP_{t-i}^{+} + \beta_i^{-} \Delta GDP_{t-i}^{-}) + \sum_{i=1}^{q-1} (\gamma_i^{+} \Delta EPU_{t-i}^{+} + \gamma_i^{-} \Delta EPU_{t-i}^{-}) + \varepsilon_t, \quad (4)$$

Table 2 shows that the estimated coefficients of all the three pass-through models are highly significant at the 1% and 5% levels, thus indicating that GDP and EPU are important drivers of insurance. According to the AIC and SIC information criteria and Wald symmetry tests, the NARDL (6,2) specification with GDP long-run asymmetry is the most suitable model for the total insurance premium.[3] The results of the best-suited model show that the long-run coefficient on the positive partial sum of GDP is positive (0.813) and significant at the 5% level, indicating that GDP increases cause the total insurance premium to move up. Likewise, the long-run coefficient on the negative partial sum of GDP is positive (4.991) and significant at the 5% level suggesting that when GDP decreases, insurance premiums decrease. The latter coefficient is larger than that on the positive partial sum indicating that a decrease of GDP has a greater impact on total insurance premium. Moreover, the long-run coefficient on EPU is positive (0.167) and significant at the 5% level indicating that an increase (decrease) of EPU will lead total insurance premium to move up (down). We also find that a contemporaneous increase (decrease) in GDP has a positive (negative) effect on total insurance premium change, while changes in EPU have no significant impact on total insurance premium changes.

[Insert Table 2 about here]

As for the life insurance premiums, results reported in Table 1 together with the AIC and SIC information criteria indicate that the best suited model is the NARDL (5,2) with EPU long-run asymmetry. Estimation results reported in Table 2 indicate that GDP has a significant positive long-run effect on life insurance premiums (1.828). In addition, an increase in EPU is found to decrease significantly (at the 10% level) life insurance premiums while a decrease in EPU has no long-run effect on life insurance premium. Similar to total insurance premiums contemporaneous GDP increase leads to an increase of life insurance premium while EPU changes have no significant impact on life insurance premiums in the short-run.

Results regarding the non-life insurance premiums indicate that the NARDL (7,2) model with GDP and EPU asymmetries in the long- and short-run asymmetries is the

[3] The best model is the one that has the lowest AIC and SIC values.

most suitable for this data. Decrease in GDP has a significant positive long-run effect on non-life insurance premiums while an increase of GDP has no long-run impact on non-life insurance premiums. On the other side an increase of EPU significantly increases non-life insurance premiums whereas a decrease of EPU does not impact non-life insurance premiums. In the short-run, a contemporaneous increase (decrease) of GDP moves down non-life insurance premiums while a one-period lagged increase on EPU would decrease non-life insurance premiums. Results in Table 2 also show that GDP has a greater short-run effect on non-life insurance premium than that of EPU.

Overall, according to above findings, we confirm that in the long-run, insurance premium is significantly affected by real output and economic policy uncertainty, but their influences are different and asymmetric. For the impact of real output, an increase of GDP will generally lead insurance premium to move up, while a decrease of GDP has a greater impact causing insurance premium to move down. According to a comprehensive survey by Outreville (2013), most previous studies dealing with aggregate insurance regressions at the country level have shown that real output appears to be by far the most important driver of insurance development (proxied by insurance premium). Extant studies document that an increase in real income leads to enhancing the insurance premiums (e.g., Browne and Kim, 1993; Ward and Zurbruegg, 2000; Beck and Webb, 2003; Li et al., 2007; Lee et al., 2010). Our findings further indicate that insurance premiums display an asymmetric response to positive and negative shocks of real output.

As far as the effect of economic policy uncertainty is concerned, the results show that the higher the degree of economic policy uncertainty is, the higher the level will be for total and non-life insurance premiums. Differently, we find that life insurance premiums move down in face of increasing policy uncertainty. Given that life and non-life insurance protect households and corporations from different kinds of risks, it seems reasonable to expect EPU to have different effects on insurance premiums. Life insurance indemnifies individuals, usually to their family members, against the loss of life and health in suddenly unexpected events and thus stabilizes the family life. Non-life insurance, on the other hand, covers the damage of property for individuals and corporations by providing money in the event of a financial loss (Lee et al., 2013; Liu et al., 2016). When individuals and corporations perceive a higher degree of economic policy uncertainty, economic risk are more sensitive than those of mortality and longevity risk. Thus, higher EPU will have a significantly positive effect on the demand for total and non-life insurance leading to a higher insurance premiums.

Taking the asymmetric effects into account, we find that in the short-run, a contemporaneous decrease of GDP exerts a much stronger effect, leading to a decrease in non-life insurance premiums. For the impact of economic policy uncertainty, results show that one-period lagged increase on economic policy uncertainty would decrease non-life insurance premiums. Previous research has found that consumers, investors and firms are reluctant to invest and spend when they perceive a higher degree of economic policy uncertainty (Bernanke, 1983; Julio and Yook, 2012; Kang et al., 2014; Wang et al., 2014; Baker et al., 2016; Gulen and Ion, 2016). When a high level of uncertainty is observed in the economy, the delay in insurance spending in the short-run can have a negative impact on its price.

5.2 Asymmetric dynamic multipliers

The asymmetric adjustments from an initial long-run equilibrium to a new long-run equilibrium after a negative or a positive unitary shock affecting the insurance market can be learned from the dynamic multipliers. Figures 1-3 show the predicted dynamic multipliers for the adjustment of total insurance premiums following shocks hitting GDP (left-hand graph) and EPU (right-hand graph) under the three NARDL specifications we consider. The asymmetry curve represents a linear combination of paths following a positive and a negative shock. The positive and negative change curves provide the information about the asymmetric adjustment to positive and negative shocks at a given forecasting horizon, respectively. Lower and upper bands are the 95% confidence interval for the asymmetry curve.

[Insert Figures 1–3 about here]

Overall, the asymmetric path shows a greater effect of a unitary decrease of GDP. The cumulative price reactions are significantly negative as shown by their confidence bands. This confirms previous results about the greater long-run effect coefficients GDP_{t-1}^{-} (see Table 2). Similarly, Figure 2 also shows that the cumulative price responses of life insurance premium to a unitary EPU shock are significantly negative, which confirms the negative values of EPU_{t-1}^{+} coefficients. Regarding the responses of non-life insurance premium to unitary shocks of GDP and EPU, Figure 3 reveals that the asymmetry reaction curve to GDP is significantly negative while the asymmetry reaction curve to EPU is insignificant during the two first years following the shock and becomes significantly positive beyond year two.

6. Conclusions and Implications

As the global economy has experienced substantial increased risks and uncertainties, insurance sector has grown in quantitative importance as part of the general advancement of financial sectors. While there is a growing body of literature on the relationship between insurance premiums and real output in recent years, the empirical results, however, have shown a lack of consensus among researchers. Previous studies mainly focus on conventional linear conventional, linear, and systematic approaches to analyze short- and long-run relationships between insurance premiums and real output, while few in the literature investigate the possible non-linear interaction among them. Furthermore, there is little knowledge about the impact of economic policy-related uncertainty on insurance premiums. How economic policy uncertainty exert an influence on insurance premium still awaits an investigation.

To deal with the above problems, applying the most up-to-date nonlinear autoregressive distributed lags (NARDL) model developed by Shin et al. (2014) to the US economy over the annual period of 1980-2014., this paper is the first to empirically investigate asymmetric effects between insurance premiums, real output and economic policy uncertainty in a non-linear fashion. The main advantage of this modeling is that it allows us to discern not only the non-linear but also the simultaneous short- and long-run asymmetric relationship among these variables. In this regard, we are able to analyze the asymmetric responses of the insurance premiums to positive and negative variations of the explanatory variables and draw more reliable inferences concerning the asymmetric dynamics of insurance premium.

Our empirical results first reveal that non-linearity and asymmetry do matter for insurance premium, suggesting that a one-size-fits-all linear approach is unsuitable for modeling the growth process and thus justifying the use of NARDL method. Evidence shows that both the short-run and long-run asymmetry only exist in non-life insurance premiums, while it is only with the long-run asymmetry for total and life insurance premiums. These findings are consistent with those obtained in past studies, such as Harrington and Niehaus (2000), Higgins and Thistle (2000), and Sephton and Mann (2015), to mention a few.

Second, both real output and economic policy uncertainty are relevant to the insurance premiums, but their influences are different and asymmetric. For the impact of real output, the results show that an increase in real output leads to enhancing the insurance premiums, while real output has a greater impact when real output decreases then when output increase causing insurance premiums decrease. Some previous studies support the view that real income may affect insurance market (e.g., Browne and Kim, 1993; Ward and Zurbruegg, 2000; Beck and Webb, 2003; Li et al., 2007; Lee et al., 2010). Our findings further indicate that insurance premiums display an asymmetric response to positive and negative shocks of real output. For the impact of economic policy uncertainty, the results also suggest that total and non-life insurance premiums increase with uncertainty increases, while life insurance premiums decrease with uncertainty increases. Given that life and non-life insurance protect households and corporations from different kinds of risks (Lee et al., 2013; Liu et al., 2016), economic risk (mainly affecting the non-life insurance premiums) are more sensitive than those of mortality and longevity risk (mainly affecting the life insurance premiums) when facing a higher degree of uncertainty.

Finally, the dynamic multipliers allow us to further quantify the asymmetric adjustment patterns from an initial long-run equilibrium to a new long-run equilibrium after a negative or a positive unitary shock affecting the insurance market. Results show that the asymmetric path confirms previous results about the estimated coefficients of all the three pass-through models. Our results show that biased and inconsistent results might be obtained by using the linear insurance premiums models. The implications derived from these results are that policymakers should not ignore the nonlinearity and asymmetry character of the insurance premiums in order to better forecast future dynamics of insurance market performance and make an effective insurance policy.

Note that, there is data for the news-based measure of uncertainty available also for other developed and developing countries. However, the lack of long-span annual data on the measure of uncertainty for these economies prevented us from considering them in a time series framework, even though data on real insurance premiums and real GDP of these countries are available from 1980. Given this as part of future research, one could look at a wider range of countries using the asymmetric causality approach in a panel setting as in Hatemi-J et al., (2016a, b). However, the asymmetric causality approach in the panel setting has been primarily developed to detect direction and sign of causal relationships, and does not allow us to conduct impulse response functions at this stage. Nevertheless, it could be used as an extension to our current analysis by looking a broad sample of developed and developing countries for which uncertainty data is available.

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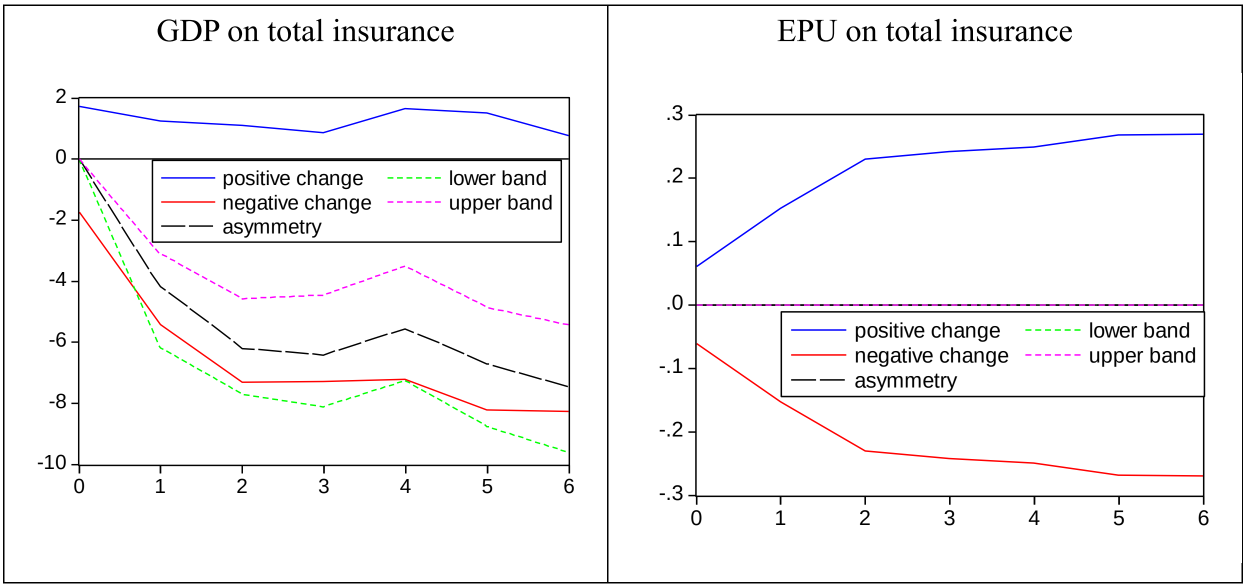

Figure 1. Response of total insurance to shocks of GDP and EPU.

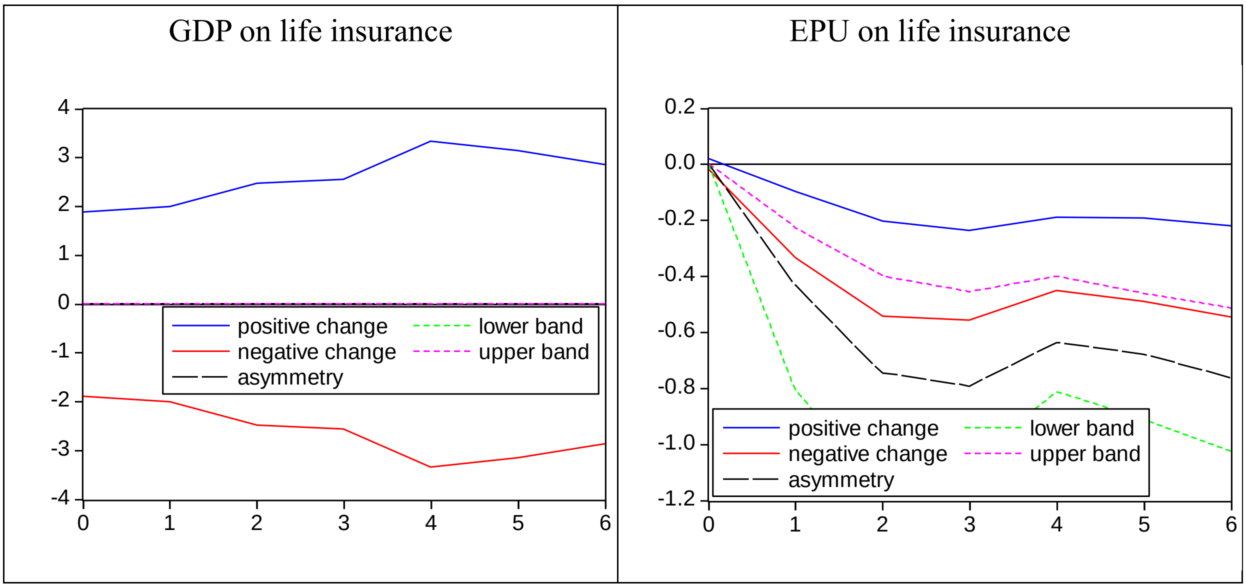

Figure 2. Response of life insurance to shocks of GDP and EPU.

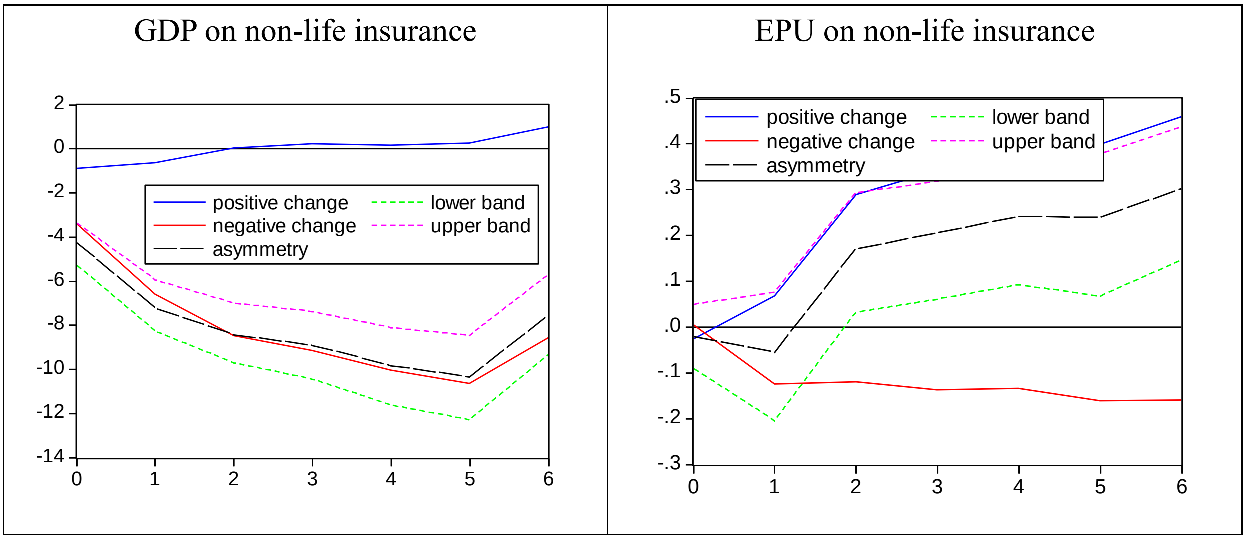

Figure 3. Response of non-life insurance to shocks of GDP and EPU.

Table 1

Long-run and short-run asymmetry tests

	W_{LR}	W_{SR}
Total insurance		
GDP	29.81***	3.307
	[0.001]	[0.107]
EPU	0.386	2.014
	[0.552]	[0.194]
Life insurance		
GDP	1.654	0.891
	[0.223]	[0.364]
EPU	18.33***	0.637
	[0.001]	[0.440]
Non-life insurance		
GDP	18.6***	10.03**
	[0.003]	[0.013]
EPU	3.716*	3.577*
	[0.090]	[0.095]

Notes: WSR and WLR refer to the Wald statistics for the short- and long-run symmetry null hypotheses. The numbers in the brackets are the p-values. ***, **, and * indicate rejection of the null of symmetry at the 1%, 5%, and 10% levels, respectively.

Table 2

Estimation results for GDP and EPU to insurance premiums

Total insurance		Life insurance		Non-life insurance	
GDP LR asymmetry		EPU LR asymmetry		GDP & EPU LR & SR asymmetries	
$TOTAL_{t-1}$	-0.722**	$LIFE_{t-1}$	-0.706**	$NONLIFE_{t-1}$	-0.711**
	(-0.319)		(-0.266)		(-0.135)
GDP^{+}_{t-1}	0.813**	GDP_{t-1}	1.828**	GDP^{+}_{t-1}	0.272
	(-0.364)		(-0.942)		(-0.191)
GDP^{-}_{t-1}	4.991**	EPU^{+}_{t-1}	-0.124*	GDP^{-}_{t-1}	6.825***
	(-2.081)		(-0.067)		(-1.504)
EPU_{t-1}	0.167**	EPU^{-}_{t-1}	0.304	EPU^{+}_{t-1}	0.280***
	(-0.076)		(-0.218)		(-0.071)
$\Delta TOTAL_{t-4}$	0.339*	$\Delta LIFE_{t-1}$	0.440*	EPU^{-}_{t-1}	0.098
	(-0.161)		(-0.237)		(-0.057)
ΔGDP_{t}	1.729***	$\Delta LIFE_{t-4}$	0.392**	$\Delta NONLIFE_{t-6}$	-0.596**
	(-0.469)		(-0.149)		(-0.145)
Constant	9.542**	ΔGDP_{t}	1.892*	ΔGDP^{+}_{t}	-0.878*
	(-2.416)		(-0.974)		(-0.459)
		Constant	8.477**	ΔGDP^{-}_{t}	3.386**
			(-3.197)		(-1.038)
				ΔEPU^{+}_{t-1}	-0.207**
					(-0.069)
				Constant	9.293***
					(-1.740)
$L_{GDP^{+}}$	1.126***	L_{GDP}	2.589***	$L_{GDP^{+}}$	0.383
$L_{GDP^{-}}$	-6.908***	$L_{EPU^{+}}$	-0.176**	$L_{GDP^{-}}$	9.588***
L_{EPU}	0.232**	$L_{EPU^{-}}$	0.432**	$L_{EPU^{+}}$	0.394***
				$L_{EPU^{-}}$	0.138
AIC	-126.757	AIC	-108.638	AIC	-164.413
SIC	-106.774	SIC	-90.422	SIC	-137.768
J-B	0.061 [0.969]	J-B	2.124 [0.345]	J-B	0.650

Notes: Only significant short-run coefficients are reported in this Table. Standard errors of the estimated coefficients are in parenthesis. The p-values of statistical tests are in brackets. $L_{X^{+}}$ and $L_{X^{-}}$ indicate the positive and negative long-run coefficients, respectively. Lag orders of the three NARDL models are selected according to the Akaike and Schwarz Information criteria. Optimal lag orders are p = 7 and q = 2 for total and non-life insurance premium models; and p = 5 and q = 2 for life insurance premium model. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Appendix:

Table A1.
Summary statistics of variables.

Statistic	Real Total Insurance Premium	Real Non-Life Insurance Premium	Real Life Insurance Premium	Real GDP	Economic Policy Uncertainty
Mean	13.6768	13.1242	12.8108	16.1894	4.9602
Median	13.715	13.115	12.919	16.2166	4.9418
Maximum	14.0681	13.4633	13.3086	16.587	5.3313
Minimum	12.9828	12.5547	11.9129	15.6797	4.6769
Std. Dev.	0.3552	0.2923	0.453	0.2938	0.1711
Skewness	-0.722	-0.6233	-0.7725	-0.2846	0.3429
Kurtosis	2.34	2.3406	2.3593	1.7403	2.2557
Jarque-Bera	3.6763	2.9003	4.08	2.7867	1.4939
Probability	0.1591	0.2345	0.13	0.2482	0.4738
Observations			35		

Note: Std. Dev. stands for standard deviation; Probability corresponds to the Jarque-Bera test, which has a null of normality.

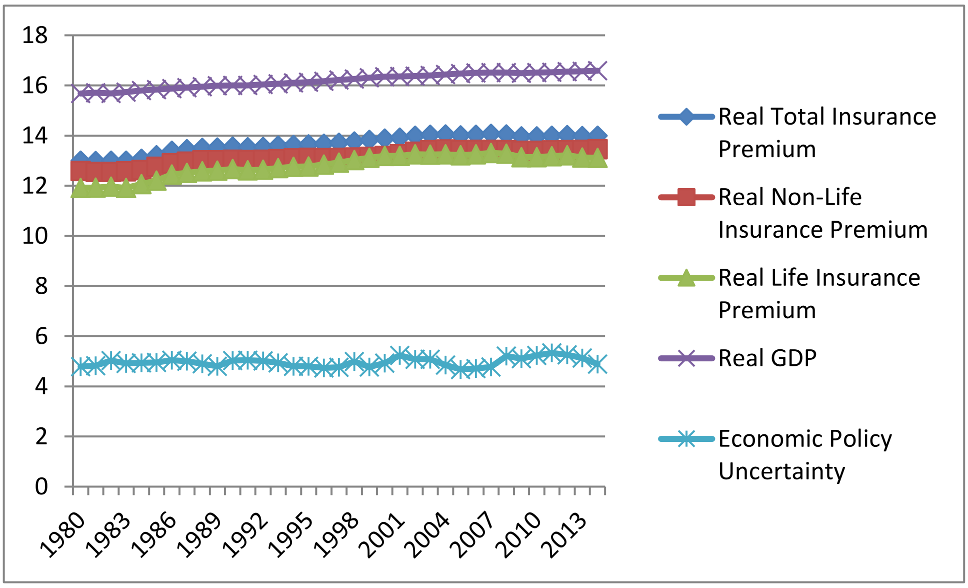

Figure A1. Data Plots.