The Effect of Macroeconomic Variables on the Lapse Rate of Variable Insurance

SEED TEAM 2

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[Abstract]

This study examines the impact of macroeconomic variables on the lapse rates of variable whole life, annuity, and universal insurance after the COVID-19 pandemic, using CD rate, unemployment rate, CCI, CPI, and KOSPI index to compare with pre-pandemic studies based on the interest rate and emergency fund hypotheses. SVAR analysis found minimal short-term impact of these variables on lapse rates, suggesting that traditional hypotheses may not hold in the short-term post-pandemic. However, the lapse rate of variable whole life insurance showed sensitivity to CD rate changes, partially supporting the interest rate hypothesis. In response to a CPI shock, lapse rates of variable life and universal insurance initially rose, then declined, indicating that inflation may temporarily burden households but has limited long-term effect on policy cancellations. Variance decomposition showed that CD rate had the highest explanatory power for variable life lapse rates, while CPI held more influence over variable annuities and universal insurance, albeit to a lesser extent than before the pandemic. This suggests that personal financial conditions now play a larger role in policy lapse decisions than broader economic indicators. This suggests that insurers should consider both macroeconomic factors and individual financial conditions in future product strategies, emphasizing variable insurance's role as a potential hedge against inflation.

***Keywords*:** Lapse Rates, Variance Insurance, SVAR, Impulsive Response Analysis, Variance Decomposition

CONTENTS

1. Introduction

The COVID-19 pandemic has had a significant impact on financial markets worldwide. In Korea, in particular, the pandemic has acted as a catalyst of the rapid rise of individual investors' interest in the stock market. Under the low interest rate trend, investors have shown more aggressive investment tendencies. Despite the market instability, many saw the pandemic as an opportunity to grow their wealth, favoring high-risk assets like stocks, funds, and corporate bonds. As a result, the share of high-risk products sold by 17 domestic banks arised from 26% in 2019 to 55.5% in 2020 and further to 70% in 2021, remaining above 50% since then. As investors expect high returns through variable insurance - which offers fluctuating refund amounts based on investment performance - has gained traction as a new investment option.

Variable insurance is an insurance product that separates the investment portion of the premium from the whole premium paid by policyholders[1] and invests them in high-profitability securities such as stocks, government bonds, public bonds, and private bonds. The investment returns are directly reflected in the refunds of policyholders. These assets are managed through a special account, meaning that the insurance payments and surrender values fluctuate depending on investment performance. This feature distinguishes it from traditional insurance products, which pay maturity refunds according to a predetermined interest rate. Variable insurance consists of two components: variable payments, which fluctuate according to the special account's investment returns and basic insurance payments.

There are three primary types of variable insurance, each offering unique benefits based on investment performance. Variable whole life insurance invests a portion of the insurance premium in a fund, with the death benefit linked to investment returns, providing coverage similar to traditional whole life insurance. Variable annuity insurance is an annuity insurance designed to increase the pension amount through fund investments. In Korea, insurance companies often offer a Guaranteed Living benefits (GLB), which ensures a minimum payout if returns fall below a specific level. Variable universal insurance allows for increased insurance payouts through fund investments and offers flexibility in premium payments, changes to coverage, and withdrawals from premium reserves. Policyholders can access these reserves as emergency funds during the policy term, up to the surrender refund limit, and continue premium payments even after the mandatory payment period.

Variable insurance was introduced to Korea in 2001 but initially performed poorly due to the stock market downturn following the 9/11 attacks.. However, as the stock market recovered,

[1] people who have purchased the insurance policy

sales quickly increased. The 2008 financial crisis caused a sharp decline in variable insurance policyholders, but as the market rebounded, sales surged as investors seeking stable, long-term returns re-entered the market. The variable insurance market experienced further shifts in the unique economic circumstances of the COVID-19 pandemic. The combination of low interest rates and a strong stock market led to an increase in new subscriptions of variable insurance, and as a result, the variable insurance market expanded significantly. Between 2019 and 2021, the first premiums for variable insurance sold by domestic life insurance companies more than tripled compared to pre-pandemic levels[2]. However, despite this growth, the insurance industry has recently slowed, and it is expected that the market dominance of variable insurance will decline over the long term.

The shift in demand for variable insurance after the pandemic appears to stem from significant changes in investors' psychology and behavior, driven by increased economic uncertainty, preference for immediate liquidity, and greater demand for real assets. Unlike traditional insurance products, variable insurance is more sensitive to economic fluctuations and investor tendencies due to its investment structure involving stocks and bonds. Because variable insurance can quickly respond to economic shocks, the risk management strategies of insurance companies become crucial as it is highly responsive to various economic factors. Therefore, it is essential to reexamine the relationship between macroeconomic variables and lapse rates in light of the evolving market environment and investor tendencies following the COVID-19 pandemic.

Before the COVID-19 pandemic, extensive research analyzing the impact of macroeconomic variables on variable insurance lapse rates was conducted both domestically and internationally. Theoretically, two main hypotheses exist. The interest rate hypothesis suggests that rising interest rates lead to increased insurance lapse rates. When interest rates rise, the opportunity cost of maintaining an insurance contract increases, prompting policyholders to shift their assets to other financial assets offering higher interest rates or to insurance products with lower premiums, resulting in the termination of existing contracts. If the interest rate hypothesis holds, a positive correlation between interest rates and the lapse rate of variable insurance would be expected. The emergency fund hypothesis, on the other hand, proposes that policyholders facing financial difficulties are more likely to cancel their insurance policies to access emergency funds. It explains that the lapse rate increases during periods of economic hardship, such as recessions or rising unemployment rates. If this hypothesis is validated, a negative relationship

[2] Korea Life Insurance Association (https://www.klia.or.kr/)

would exist between the lapse rate and economic stress indicators, meaning that as the unemployment rate rises, so would the insurance lapse rate.

Research efforts have actively sought to verify these two hypotheses and compare their significance, resulting in varied interpretations. However, studies examining the relationship between macroeconomic variables and lapse rates of variable insurance in the new economic context of the COVID-19 pandemic remain limited. The relationship between economic variables and lapse rates shows inconsistencies across studies, and discrepancies have emerged when comparing pre-pandemic findings with post-COVID-19 data. For instance, while previous studies suggested that lapse rates generally increase alongside the KOSPI index, this trend did not hold in 2021.

This study, therefore, aims to provide comprehensive analysis of the macroeconomic factors affecting the variable insurance lapse rate in the aftermath of the COVID-19 pandemic, distinguishing itself from previous studies. Through this analysis, we aim to analyze the relationship between variable insurance lapse rates and macroeconomic variables post-pandemic to identify changes in the new economic environment.

The structure of this paper is as follows: Chapter II reviews relevant literature, and Chapter III details the research data and methodology. Chapter IV presents the findings of the empirical analysis, and Chapter V discusses the conclusions and implications drawn from the results.

2. Related Work and Research Question

This section reviews previous studies on key macroeconomic variables that influence the lapse rate of variable insurance. By examining research that has analyzed the impact of various economic factors such as CD rates[3], unemployment rate, interest rates, Composite Leading Indicators Index (CLI), Consumer Price Index (CPI), and KOSPI index[4] on lapse rates of variable insurance, this section aims to provide the reader with a thorough knowledge of existing literature.

[3] interest rate on a Certificate of Deposit (CD) issued by a bank, representing the return an investor earns on the amount deposited

[4] key stock market index in South Korea, representing the price fluctuations of major companies listed on the Korea Exchange

Insurance policy cancellation is significantly influenced by economic hardships and financial changes due to market fluctuations. According to a Life Insurance Propensity Survey (*2009) by the Life Insurance Association*[5], the main reasons behind insurance cancellations included difficulties paying premiums and the need for lump sum cash, with inflation also cited as a factor. This suggests that policyholders are more likely to consider canceling their insurance policies when facing financial instability. Consequently, numerous academic studies have analyzed lapse rates through the lens of the emergency fund hypothesis and the interest rate hypothesis.

Studies supporting these two hypotheses have produced mixed results, and prior research can be grouped according to which hypothesis each study validates. Dar and Dodds (1989) attempted a time-series analysis on UK's cash value life insurance from 1952 to 1985. Their findings revealed a statistically significant positive relationship between unemployment rates and lapse rates, validating the emergency fund hypothesis. However, they did not find a significant relationship with interest rates, thereby rejecting the interest rate hypothesis. Similarly, Outreville (1990) examined whole life insurance data from the US and Canada between 1966 and 1979, finding no statistical support for the interest rate hypothesis but confirming the emergency fund hypothesis, with a positive correlation between unemployment rates and lapse rates and a negative relationship with personal income.

While the two studies mentioned above support the emergency fund hypothesis, the study by Yoon Jung-sun et al. (2013) supports the interest rate hypothesis. This study analyzed the effects of macroeconomic variables on lapse rates and first premiums of variable annuity insurance. Key variables included the CPI, unemployment rates, CD rate, KOSPI index, default rates, and CLI Index. Using cointegration analysis to examine the long-term relationship between lapse rates and first premiums, they found that default rates and CD rates positively impacted lapse rates, while CPI and the KOSPI index had a negative impact, indicating that variable insurance lapse rates are closely tied to financial market fluctuations.

Some studies provide evidence for both hypotheses. Kuo, Tsai, and Chen (2003) analyzed data from 1951 to 1998 using cointegration tests, finding that unemployment rates affect lapse rates in both the short and long term, while interest rates only have a long-term effect on lapse rates.

[5] an institution in Korea that collects, investigates, and researches information on the life insurance and financial industries

Other studies have focused specifically on variable insurance products, such as variable annuity and variable universal insurance, examining how these products' lapse rates react to major macroeconomic variables like the CLI, CD rate, CPI, KOSPI index, and unemployment rates. Kwon Yong-jae et al. (2012) analyzed data from 2006 to 2011 using a Vector Error Correction Model (VECM) to study fluctuations in lapse rates. The analysis showed that both types of insurance experienced a decrease in lapse rates when CLI and CPI increased, while rising unemployment rates led to higher lapse rates. They also observed that variable annuity insurance was sensitive to changes in CD rates, whereas variable universal insurance was more influenced by KOSPI index fluctuations. Similarly, Hwang Jin-tae et al. (2015) used a Structural Vector Autoregression (SVAR) model to analyze the impact of macroeconomic variables such as CD rates, unemployment rates, Coincident Composite Index (CCI), CPI, and KOSPI index on the lapse rates of variable annuity and variable universal insurance. When comparing variable annuity and variable universal insurance, variable universal lapse rates were more responsive to changes in CD rates and CCI, while variable annuity lapse rates were more affected by CPI fluctuations. Among macroeconomic variables, CPI had the most substantial impact on variable annuity lapse rates, whereas CCI was the most significant for variable universal lapse rates.

Based on the preceding studies, this research aims to analyze how the impact of macroeconomic variables on lapse rates of variable insurance has changed in the post COVID-19 pandemic context. Specifically, it examines the influence of CPI, CCI, and KOSPI on lapse rates of variable insurance, comparing the results with existing interest rate and emergency fund hypotheses. Through this analysis, the study seeks to provide more concrete evidence on how economic uncertainty following the pandemic has altered policyholders' lapse decisions, especially in relation to their personal financial conditions.

3. Data and Method

3.1 Data

This study examines the impact of macroeconomic variables on variable insurance lapse rates, using the CD rate, unemployment rate, CCI, CPI, and KOSPI index from 2014 to 2022. We calculated the variable insurance lapse rate using the monthly counts of lapsed contracts, new contracts, inactive contracts, and existing contracts over the same period.

<Table 1> Variables

	Variable	Period	Source
Dependent Variables	Lapse Rates of Variable Whole Life Insurance	2014/01 ~2022/12	INcos (Insurance Statistics Consumer Service)
	Lapse Rates of Variable Annuity Insurance		
	Lapse Rates of Variable Universal Insurance		
Independent Variables	CD Rate		ECOS
	Unemployment Rate		
	CCI		
	CPI		
	KOSPI Index		

3.1.1 Lapse Data

In this study, data on insurance contract performance - essential for calculating variable insurance lapse rates - were sourced from the Insurance Statistics Consumer Service (INcos) provided by the Korea Insurance Development Institute (KIDI). The sample period for analysis spans from January 2014 to December 2022.

3.1.2 Macroeconomic Variables (Explanatory Economic Variables)

This study examines the impact of macroeconomic factors on the lapse rate of variable insurance, focusing on key economic indicators: the CD rate, unemployment rate, CCI, CPI, and KOSPI. The CD rate, issued by banks and sold through brokerage firms, serves as a reference rate for variable-rate bonds, stock index futures, and short-term interest rates; specifically, the 3-month CD rate underpins short-term loans and mortgage rates. The unemployment rate, representing the percentage of individuals aged 15 or older who are willing and able to work but are unemployed, serves as a crucial indicator of income trends The CPI is an index reflecting price fluctuations in consumer goods and services Changes in CPI directly influence real

purchasing power, making CPI particularly relevant for variable insurance products, such as variable pensions, which aim to protect retirement funds against inflation.[6] Additionally, the KOSPI index, which reflects the aggregated stock prices of listed companies, is crucial to this analysis, as variable insurance funds often include both stocks and bonds. Thus, stock market performance is a relevant factor for understanding lapse behaviors in variable insurance.

<Table 2> Macroeconomic Variables

	mean	sd	skewness	kurtosis
CD Rate	1.65	0.66	1.1294	5.4106
Unemployment Rate	3.62	0.39	-0.2525	3.7635
CCI	99.80	1.10	-0.9747	4.0146
CPI	99.03	4.04	0.9178	3.3151
KOSPI	2282.46	360.55	1.1947	3.5160

3.1.3 Insurance-Specific Variables

To calculate the variable insurance lapse rate, the insurance contract performance data were reorganized by calendar year and analyzed using the following equation.

$$Lapse\ Rate_t = \frac{\Delta\ Lapsed\ Contracts_t + \Delta\ Inactive\ Contracts_t}{Monthly\ Existing\ Contracts_{t-1} + \Delta\ New\ Contracts_t}$$

The lapse rate at time t is calculated as the ratio of the number of lapsed and inactive contracts to the total number of contracts held, which includes both existing and new contracts during that period.

[6] Jintae Hwang, Daegyo Seo. (2017). Examining the Relationship Between Macroeconomic Variables and the Lapse Rates of Variable Life Insurance, 18(1), 121.

<Table 3> Insurance-Specific Variables

	mean	sd	skewness	kurtosis
VL Lapse Rate	0.01	0.00	2.1046	8.6060
VA Lapse Rate	0.01	0.00	0.1125	8.3143
VU Lapse Rate	0.01	0.00	-0.3445	4.5165

* VL Lapse Rate : Lapse Rates of Variable Whole Life Insurance, VA Lapse Rate : Lapse Rates of Variable Annuity Insurance, VU Lapse Rate : Lapse Rates of Variable Universal Insurance

3.2 Method

3.2.1 Standardization

When variables in a dataset have vastly different magnitudes, it can cause numerical instability, affecting model convergence. To maintain the structure (distribution shape) of time series relationships, the data has been standardized to a mean of 0 and a standard deviation of 1. This standardization ensures that all variables are on the same scale, which helps in comparing their impacts and improves the numerical stability of the SVAR model.

<Table 4> Standardization of Variables

	mean	sd	skewness	kurtosis
CD	0.000	1.000	0.1839	5.3091
unemployment	0.000	1.000	-0.6251	4.0437
CCI	0.000	1.000	-0.0643	3.2946
CPI	0.000	1.000	0.0284	3.2267
KOSPI	0.000	1.000	0.5802	5.0410
Whole life	0.000	1.000	-1.5883	11.4838
annuity	0.000	1.000	0.3324	19.6728
insurance	0.000	1.000	0.5592	17.8842

3.2.2 Testing for Stationarity

In time series analysis, assessing the stationarity of variables is essential before conducting further analysis and model selection. A time series is considered stationary if its characteristics, such as mean, variance, and covariance, remain constant over time. Conversely, a time series with time-varying characteristics, such as a trend, is considered non-stationary. Non-stationary series have changing probability distributions over time, which complicates reliable statistical analysis. Therefore, if a time series is identified as non-stationary, the trend must be removed.

Trends can be deterministic or stochastic[7]. Achieving stationarity of a time series typically requires removing these trends, with deterministic trends controlled by including trend terms in regression analysis and stochastic trends removed by differencing the series. When the nature of the trend is unclear, differencing the series to remove the trend is generally considered a conservative approach[8].

This study uses the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test, and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test to examine the stationarity of the time series variables. The ADF and PP tests are categorized as unit root tests, assuming that a unit root is present in the data. For these tests, the null hypothesis indicates non-stationarity; rejecting it implies that the series is stationary. The ADF and PP tests differ in their treatment of error terms: the ADF test assumes normally distributed errors, while the PP test does not, assuming heteroskedasticity and autocorrelation in the error terms. In contrast, the KPSS test takes stationarity as the null hypothesis, so not rejecting it considers the time series stationary.

<Table 5> The results of the stationarity test for the time series variables

	level variable			differenced variable		
	ADF	PP	KPSS	ADF	PP	KPSS
variable whole life insurance lapse rate (%)	-3.3099 [0.0144*]	-9.2059 [0.0000***]	0.2912 [0.1000]	-7.2461 [0.0000***]	-76.8896 [0.0000***]	0.1238 [0.1000]
variable annuity lapse rate (%)	-3.8414 [0.0025*]	-9.8654 [0.0000***]	0.4397 [0.0601]	-5.0954 [0.0000***]	-76.4279 [0.0000***]	0.1180 [0.1000]

[7] Plosser, C. I., & Schwert, G. W. (1977). *Estimation of a noninvertible moving average process: The case of overdifferencing*. Journal of Econometrics, 6(2), 199-224.
[8] Plosser, C. I., & Schwert, G. W. (1978). *Money, income, and sunspots: Measuring economic relationships and the effects of differencing*. Journal of Monetary Economics, 4(4), 637-660.

variable universal lapse rate (%)	-0.5911 [0.8730]	-8.4110 [0.0000***]	1.1957 [0.0100**]	-5.4356 [0.0000***]	-82.8686 [0.0000***]	0.1073 [0.1000]
CD rate (%)	-1.4729 [0.5468]	-1.1695 [0.6866]	0.3732 [0.0886]	-6.2176 [0.0000***]	-22.7674 [0.0000***]	0.0652 [0.1000]
unemployment rate (%)	-1.5270 [0.5201]	-3.6380 [0.0051**]	0.2992 [0.1000]	-5.9415 [0.0000***]	-51.3279 [0.0000***]	0.1107 [0.1000]
log CCI	-2.8262 [0.0546]	-2.0662 [0.2583]	0.1373 [0.1000]	-7.9400 [0.0000***]	-19.7189 [0.0000***]	0.0144 [0.1000]
log CPI	1.3348 [0.9968]	2.2097 [0.9989]	1.5523 [0.0100**]	-4.7831 [0.0000***]	-24.0969 [0.0000***]	0.1689 [0.1000]
log KOSPI index	-1.7794 [0.3908]	-2.0770 [0.2538]	0.8531 [0.0100**]	-7.3801 [0.0000***]	-37.6193 [0.0000***]	0.1646 [0.1000]

* The numbers represent test statistics, and the values in [ ] indicate p-values

** Difference-in-Difference is used for differenced variables

In this study, the dependent time-series variables are lapse rates for variable whole life insurance, variable annuity insurance, and variable universal insurance. The independent variables are the CD rate, unemployment rate, log CCI, log CPI, and log KOSPI index. Applying all three tests to these variables revealed that, as shown in Table 5, indicated that all variables except for the lapse rates for variable whole life and annuity insurance were non-stationary according to at least two of the three tests. For example, the lapse rate for variable universal insurance was determined non-stationary. Although the PP test indicated stationarity by rejecting the null hypothesis at a 1% significance level, the ADF test did not reject the null hypothesis at the 5% level, and the KPSS test did reject the null hypothesis at the 5% level, both indicating non-stationarity.

Based on these results, this study concludes that the lapse rate for variable universal insurance, CD rate, unemployment rate, log CCI, log CPI, and log KOSPI index are non-stationary at the level variable stage. At the differenced variable stage, all variables were found to be stationary across all testing methods.

3.2.3 Structural Vector Autoregression (SVAR)

In this study, a Structural Vector Autoregression (SVAR) model is applied to evaluate the impact of six time series variables—CD rate, unemployment rate, CCI, CPI, KOSPI, and insurance lapse rate—on variable insurance lapse rates. To ensure the model's solvability, it requires a certain number of restrictions due to the relationship between the structural model and the reduced form VAR.

A univariate autoregression is a single-variable model where a variable's current value is explained by its own past values. In contrast, a Vector Autoregression (VAR) model is a multivariate extension where each variable is explained by its own lagged values and the lagged values of other variables.[9] VAR models come in three types: reduced form, recursive, and structural.

A **reduced form VAR** expresses each variable as a linear function of its own past values, the past values of all other variables being considered and a serially uncorrelated error term. Each equation is estimated by ordinary least squares regression. However, when variables are correlated, the error terms will also be correlated across equations, making it challenging to interpret causal relationships.

A **structural VAR** uses economic theory to sort out the *contemporaneous links* among the variables. Unlike the reduced form, SVAR uses economic theory to impose identifying assumptions, allowing correlations to be interpreted causally. By applying theoretical restrictions, the SVAR model isolates contemporaneous relationships among variables, helping distinguish immediate from lagged effects. (Stock & Watson, 2001)

The SVAR model is derived from the reduced form model by imposing constraints.For example, consider these two forms:

$$Y_t = \beta_0 + \beta_1 y_{t-1} + U_t \quad (1)$$

In the reduced form VAR (1), β stands for a matrix of coefficients for lagged values, while U_t is a vector of reduced form errors, or residuals. The reduced form VAR gives us the symmetric variance-covariance matrix of the residuals, $EU_tU_t' = \Sigma_u$ This variance-covariance matrix has n variables on the diagonal and $\frac{n(n-1)}{2}$ unique covariances off-diagonal, resulting in a total of $\frac{n(n+1)}{2}$ known elements.

$$AY_t = \beta_0 + \beta_1 y_{t-1} + \varepsilon_t \quad (2)$$

In the structural form (2), A represents the matrix of contemporaneous coefficients (or correlations) and ε_t represents the (important) *structural shocks* which are independent or

[9] Stock, J. H., & Watson, M. W. (2001). Vector autoregressions. *Journal of Economic perspectives*, *15*(4), 101-115.

exogenous. Economic intuition is used to impose restrictions on A in order to get structural shocks, ε_t. The minimum number of restrictions required is the difference between the number of unknown and known elements. Let n be the number of variables in the VAR. Diagonal elements are all equal to 1 because each variable is assumed to have a direct contemporaneous effect on itself. Thus, the number of unknown (off-diagonal) elements in A is (n^2- n).

The Structural VAR can be linked back to the reduced form VAR by multiplying each side by the inverse of A, denoted as A^{-1}.

$$A^{-1}AY_t = A^{-1}\beta_0 + A^{-1}\beta_1 y_{t-1} + A^{-1}\varepsilon_t \quad (3)$$

$$I_n Y_t = A_0 + A_1 Y_{t-1} + U_t \quad (4)$$

The reduced form errors U_t can be linked to the structural shocks ε_t as $U = A^{-1}\varepsilon_t$. By decomposing $EU_tU_t' = \Sigma_u$ into A and a diagonal matrix D of variances (i.e. $\Sigma = A^{-1}D(A^{-1})^T$), we can use Σ to infer information about A and D. The matrix A and diagonal matrix D respectively have (n^2- n) and n unknown elements. In summation, there are n^2 unknown elements.

To make a linear equation solvable, there must be at least as many equations as there are unknown variables. The variance-covariance matrix from the reduced form VAR provides a total of $\frac{n(n+1)}{2}$ known elements. Therefore, the SVAR model requires at least $n^2 - \frac{n(n+1)}{2} = \frac{n(n-1)}{2}$ restrictions to solve for A and D.

This study uses 6 time series variables - the CD rate (interest rate), unemployment rate, CCI, CPI, KOSPI, and insurance lapse rate - to evaluate the effect each macroeconomic variable has on the lapse rate. Hence, at least 15 restrictions are required for the structural model. $U = A^{-1}\varepsilon_t$ can be rewritten as $\varepsilon_t = AU$, and the matrix of contemporaneous coefficients A is defined as below.

$$\begin{bmatrix} \varepsilon_i \\ \varepsilon_u \\ \varepsilon_c \\ \varepsilon_p \\ \varepsilon_s \\ \varepsilon_l \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & k_{23} & k_{24} & 0 & 0 \\ k_{31} & k_{32} & 1 & k_{34} & k_{35} & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ k_{51} & k_{52} & k_{53} & k_{54} & 1 & 0 \\ k_{61} & k_{62} & k_{63} & k_{64} & k_{65} & 1 \end{bmatrix} \begin{bmatrix} u_i \\ u_u \\ u_c \\ u_p \\ u_s \\ u_l \end{bmatrix}$$

Each subscript; i, u, c, p, s, l represents the variables; interest rate, unemployment rate, CCI, CPI, the stock market (KOSPI), and insurance lapse rate. There are 15 '0's in total, satisfying the required restrictions, and the unknown elements k_{ij} are the contemporaneous effects to be estimated.

<Table 6> Contemporaneous effects between time series variables (SVAR)

	whole	annuity	universal
$k_{23}: c \rightarrow u$	-0.44302	-0.4422	-0.43270
$k_{24}: p \rightarrow u$	-0.15862	-0.126818	-0.122740
$k_{31}: i \rightarrow c$	0.11311	0.10837	0.10183
$k_{32}: u \rightarrow c$	0.60473	0.60095	0.604422
$k_{34}: p \rightarrow c$	-0.05275	-0.047128	-0.051929
$k_{35}: s \rightarrow c$	-0.39036	-0.3964	-0.39307
$k_{51}: i \rightarrow s$	-0.08395	-0.09316	-0.09588
$k_{52}: u \rightarrow s$	0.23602	0.25607	0.255933
$k_{53}: c \rightarrow s$	0.26047	0.2741	0.26167
$k_{54}: p \rightarrow s$	0.01921	-0.004282	-0.008214
$k_{61}: i \rightarrow l$	0.09723	0.09555	0.12767
$k_{62}: u \rightarrow l$	0.08802	-0.01625	0.003772
$k_{63}: c \rightarrow l$	0.08108	0.1319	0.01942
$k_{64}: p \rightarrow l$	-0.09007	0.024040	-0.076388
$k_{65}: s \rightarrow l$	-0.03634	-0.1193	-0.07447

3.2.4 Impulse Response Analysis

The main purpose of impulse response analysis is to describe the evolution of a model's variables in reaction to a shock in one or more variables. This feature allows to trace the transmission of a single shock within an otherwise noisy system of equations and thus, makes them very useful tools in the assessment of economic policies.

If the structural parameters denoted as $\Theta = (A_0, A_+)$, the impulse response function can be defined as a function of Θ.

$$L_0(\Theta) = (A_0^{-1}),\ L_k(\Theta) = \sum_{l=1}^{k}(A_l A_0^{-1})' L_{k-1}(\Theta) \quad \text{for} \quad 1 \leq k \leq p,$$

$$L_k(\Theta) = \sum_{l=1}^{p}(A_l A_0^{-1})' L_{k-1}(\Theta) \quad \text{for } p < k < \infty\ ,$$

The response of the i-th variable to the j-th shock after k periods is calculated using the value in the i-th row and j-th column of $L_k(\Theta)$. This indicates that determining the values of Θ allows for the calculation of the impulse response function.

3.2.5 Variance Decomposition Analysis

To assess the relative influence of external shocks, we predict future values and decompose the variance of prediction errors for each series. The prediction error of the *k*-step forecast of the *i*-th time series is

$$e_{t,k}^{(i)} = \sum_{j=1}^{m} v_{j,t+k} + \sum_{j=1}^{m} \psi_{ij,1}^{*} v_{j,t+k-1} + \cdots + \sum_{j=1}^{m} \psi_{ij,k-1}^{*} v_{j,t+-1}$$

The variance of the *k*-step forecast of the *i*-th time series is calculated as:

$$Var[e_{t,k}^{(i)}] = m + \sum_{j=1}^{m} (\psi_{ij,1}^{*})^2 + \cdots + \sum_{j=1}^{m} (\psi_{ij,k-1}^{*})^2 = \sum_{s=0}^{k-1} \sum_{j=1}^{m} (\psi_{ij,s}^{*})^2$$

The proportion of variance attributed to the *j*-th time series is given by

$$Var[e_{t,k}^{(ij)}] = 1 + (\psi_{ij,1}^*)^2 + \cdots + (\psi_{ij,k-1}^*)^2 = \sum_{s=0}^{k-1} (\psi_{ij,s}^*)^2$$

Using $Var[e_{t,k}^{(i)}]$ and $Var[e_{t,k}^{(ij)}]$, we can express the time series contribution rate.

$$R_{ij,k} = \frac{Var\left[e_{t,k}^{(ij)}\right]}{Var\left[e_{t,k}^{(i)}\right]} \times 100 = \frac{\sum_{s=0}^{k-1} (\psi_{ij,s}^*)^2}{\sum_{s=0}^{k-1} \sum_{j=1}^{m} (\psi_{ij,s}^*)^2} \times 100(\%)$$

$R_{ij,k}$ represents the contribution rate of the *j*-th time series to the variance of the *k*-step prediction error for the *i*-th series. This allows us to compare the relative importance of each time series by analyzing these contribution rates.

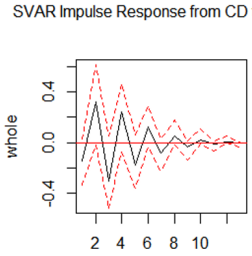
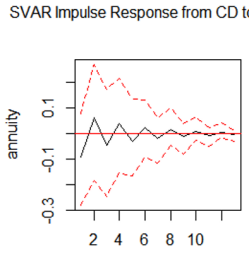
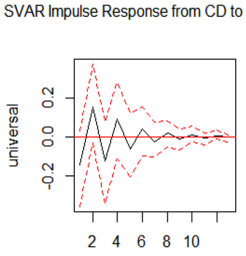
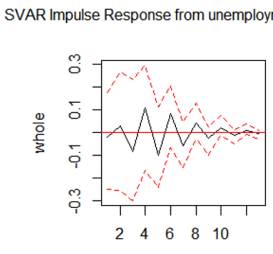
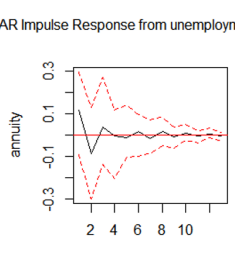
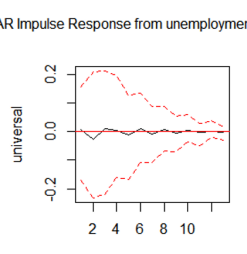
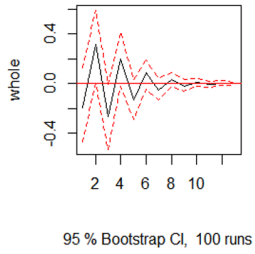
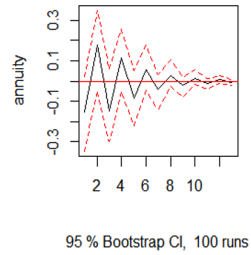
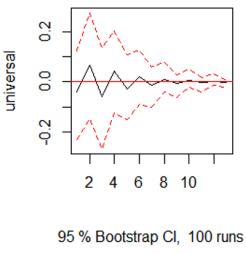
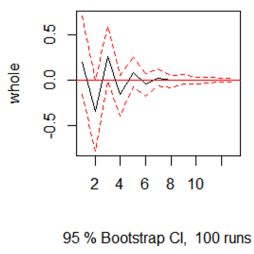
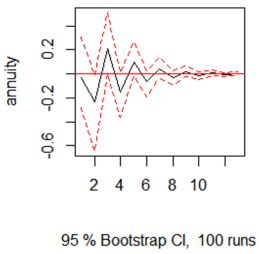
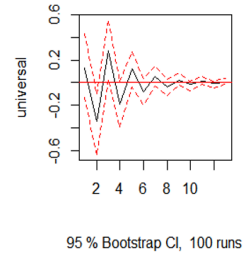
4. Results

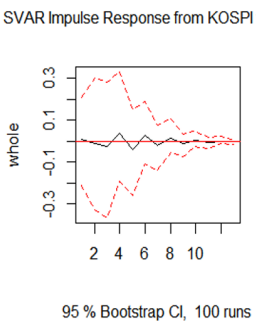
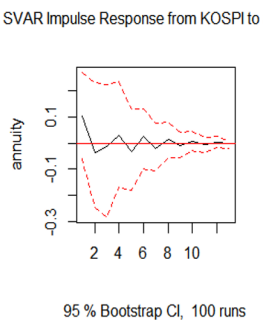
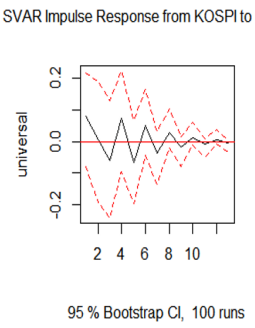
4.1 Quantitative Analysis

4.1.1 Impulsive Responsible Analysis

The impulse response function represents the dynamic path of how the rate of change in other variables within the model responds over time when a shock occurs to a particular variable. Given that second-differenced data is used, the interpretation shifts from examining the direct impact of shocks on the levels or growth rates of the variables to focusing on how shocks influence the acceleration or deceleration of these rates of change. Therefore, the impulse response function in the SVAR model shown in <Table 7> is used to examine the effects of macroeconomic variables on the speed of change in whole life insurance, variable annuity insurance, and variable universal life insurance within the model.

<Table 7> Impulsive Responsible Analysis

	Whole Life	Annuity	Universal
CD Rate			
Unemployment Rate			
CCI			
CPI			

KOSPI			

When a shock occurs in the CD rate, the lapse rate of whole life insurance initially responds in a negative direction, decreasing in the first period. After that, due to the interest rate shock, the lapse rate experiences repeated ups and downs, but this effect gradually diminishes over time and eventually stabilizes. In the early positive response phase, the confidence interval at the 95% level does not include 0, indicating a statistically significant reaction at this stage. This suggests that the CD rate shock has a temporary, meaningful impact on the lapse rate, though its influence lessens in the long term as the lapse rate stabilizes. The same pattern is observed for variable annuities and variable universal insurance. Additionally, while the shock from the CD rate shows a larger fluctuation in the lapse rate of whole life insurance, the lapse rate of variable annuities exhibits relatively smaller fluctuations and stabilizes more quickly. This indicates that the lapse rate of whole life insurance is relatively more sensitive to changes in interest rates. When interest rates rise, whole life insurance policyholders are more likely to shift their assets to other financial products offering higher returns, which can significantly impact the lapse rate of whole life insurance. In contrast, the lapse rate of variable annuities shows smaller fluctuations in response to the CD rate shock and stabilizes more quickly, suggesting that variable annuities are less sensitive to interest rate changes. This indicates that variable annuity holders are less likely to consider surrendering their policies due to interest rate changes, as they focus more on investment returns or long-term investment goals associated with their annuities. The greater responsiveness of whole life insurance lapse rates to interest rate increases supports the interest rate hypothesis, which suggests that people are more inclined to surrender whole life insurance policies and shift to higher-rating financial products when interest rates rise.

Meanwhile, both whole life insurance and variable annuities show a fluctuating pattern in response to a shock in the unemployment rate, but the fluctuation in the lapse rate of whole life insurance is relatively larger compared to variable annuities and variable universal insurance. This difference can be attributed to the nature of whole life insurance as a coverage-focused

product, which can be more easily used as a means of securing emergency funds during economic crises. In contrast, variable annuities and variable universal insurance are more investment and retirement focused, making them less sensitive to unemployment shocks. However, since neither lapse rate change is statistically significant, as shown by the black line remaining close to the 0 axis in both graphs and the 95% confidence interval including 0 for most time points, the impact of unemployment shocks on lapse rates appears limited. Thus, it is difficult to conclude that these shocks have a substantial effect on lapse rates.

When a shock occurs in the CCI, the lapse rate of whole life insurance initially rises and then quickly declines, showing a fluctuating pattern. This indicates that when the economic situation improves, people may temporarily increase or decrease their insurance rescission. After this initial reaction, the lapse rate continues to fluctuate between positive and negative before eventually stabilizing, suggesting that fluctuations in the CCI can have a short-term impact on lapse rates but tend to diminish in the long term. The variable annuity lapse rate and variable universal life insurance also shows an unstable pattern of initial ups and downs in response to the CCI shock, with a somewhat sensitive initial reaction similar to that of whole life insurance. Every lapse rate initially responds sensitively and exhibits a fluctuating pattern, which implies that changes in the CCI, reflecting the current state of economic activity, can influence people's decisions to maintain or surrender their insurance policies. Furthermore, as lapse rates stabilize over time, indicating that CCI shocks do not lead to long-term changes in lapse rates. The tendency of lapse rates to return to stable levels over time when economic conditions improve or worsen suggests that the long-term impact of economic changes on insurance products may be limited. This implies that even when the economy becomes unstable, both coverage and investment oriented insurance products tend to maintain long-term stability, suggesting that while economic downturns may have a short-term impact on lapse rates, the long-term demand for insurance is unlikely to change significantly. The finding that lapse rates can respond in the short term to changes in economic conditions is related to the emergency fund hypothesis, which suggests that people are more likely to surrender insurance policies to secure cash when facing economic hardship or liquidity constraints. When economic conditions worsen, people generally have a higher propensity to surrender their policies to secure emergency funds, which supports the emergency fund hypothesis to some extent.

When a shock occurs in the CPI, the lapse rate of whole life insurance and variable universal insurance shows a slight initial increase, followed by a declining pattern. This indicates that an inflation shock can temporarily affect people's decisions regarding policy surrender. After

the initial increase and decrease, the lapse rate shows some fluctuation, eventually stabilizing over time. This suggests that while the CPI shock has some initial impact on lapse rates, its effect diminishes in the long term. Immediately following the CPI shock, the lapse rate of variable annuities significantly drops, suggesting that holding variable annuities may act as a hedge against inflation risk. Since variable annuities have an investment-oriented nature and the returns on their invested assets (such as stocks or bonds) can increase with inflation, inflation can enhance the investment returns of variable annuities. Therefore, when inflation rises, people may prefer to keep their variable annuities rather than surrendering them as a hedge against inflation. Whole life insurance, variable annuities, and variable universal insurance exhibit initial volatility in response to CPI shocks, but they stabilize over time. They respond sensitively to changes in consumer prices in the short term but show a diminishing effect in the long term. This suggests that while inflation can temporarily increase the economic burden on households, it does not have a significant long-term impact on lapse rates.

Meanwhile, in response to a positive shock in the KOSPI growth rate, the lapse rate of whole life insurance shows a minor pattern of rises and falls. However, the amplitude of these fluctuations is small, indicating that stock market fluctuations do not have a substantial impact on the lapse rate of whole life insurance. After this initial slight up and down pattern, the lapse rate gradually stabilizes and tends to return to its original level over time, suggesting that stock index shocks do not have a long-term effect on the lapse rate of whole life insurance. Similarly, the variable annuity and variable universal insurance lapse rate initially shows minor fluctuations in response to KOSPI shocks, exhibiting a similar pattern to that of whole life insurance. After the initial reaction, the lapse rate of variable annuities also gradually stabilizes and returns to its original state over time. This indicates that KOSPI shocks do not have a lasting impact on the lapse rate of variable annuities. Overall, fluctuations in the stock market, such as the KOSPI, appear to have a limited impact on insurance lapse rates. This implies that insurance products possess characteristics as stable financial instruments that are relatively unaffected by the stock market. Even with increased volatility in the stock market, people view insurance products as long-term protection instruments, which is why lapse rates do not exhibit significant changes. Although variable annuities are investment-oriented products, they exhibit a stable response to KOSPI shocks similar to whole life insurance. This suggests that variable annuities are also viewed as long-term products and are not significantly affected by short-term fluctuations in the stock market.

4.1.2 Variance Decomposition

This study conducted variance decomposition to analyze the relative importance of the exogenous impact of each macroeconomic variable on the lapse rates of variable whole life insurance, annuity insurance, and universal insurance.

<Table 8> Variance Decomposition on Lapse Rates of Variable Insurance

	CD	Unemployment	CCI	CPI	KOSPI	Lapse Rate
Whole						
1	0.0073	0.0009	0.0087	0.0063	0.0000	0.9767
2	0.0284	0.0021	0.0216	0.0177	0.0000	0.9303
3	0.0440	0.0049	0.0284	0.0222	0.0003	0.9002
4	0.0533	0.0081	0.0314	0.0235	0.0006	0.8831
5	0.0582	0.0109	0.0326	0.0237	0.0009	0.8741
6	0.0606	0.0119	0.0331	0.0236	0.0011	0.8697
7	0.0617	0.0127	0.0332	0.0236	0.0012	0.8677
8	0.0621	0.0131	0.0333	0.0235	0.0012	0.8668
9	0.0623	0.0132	0.0333	0.0235	0.0012	0.8664
10	0.0624	0.0133	0.0333	0.0235	0.0012	0.8663
11	0.0624	0.0133	0.0333	0.0235	0.0012	0.8662
12	0.0624	0.0133	0.0333	0.0235	0.0012	0.8662
Annuity						

1	0.0056	0.0048	0.0141	0.0004	0.0050	0.9702
2	0.0057	0.0046	0.0209	0.0124	0.0037	0.9527
3	0.0059	0.0041	0.0246	0.0198	0.0034	0.9422
4	0.0062	0.0040	0.0264	0.0230	0.0037	0.9367
5	0.0064	0.0041	0.0273	0.0243	0.0040	0.9339
6	0.0066	0.0043	0.0277	0.0248	0.0043	0.9323
7	0.0067	0.0045	0.0279	0.0250	0.0044	0.9315
8	0.0067	0.0046	0.0280	0.0251	0.0045	0.9311
9	0.0068	0.0046	0.0281	0.0251	0.0045	0.9308
10	0.0068	0.0047	0.0281	0.0251	0.0045	0.9307
11	0.0068	0.0047	0.0281	0.0251	0.0045	0.9307
12	0.0068	0.0047	0.0281	0.0252	0.0045	0.9306
Universal						
1	0.0137	0.0000	0.0012	0.0055	0.0036	0.9760
2	0.0194	0.0001	0.0023	0.0295	0.0025	0.9462
3	0.0228	0.0001	0.0028	0.0409	0.0037	0.9298
4	0.0244	0.0001	0.0030	0.0453	0.0054	0.9217
5	0.0252	0.0002	0.0030	0.0470	0.0068	0.9177
6	0.0255	0.0003	0.0030	0.0476	0.0076	0.9159

7	0.0257	0.0003	0.0030	0.0479	0.0081	0.9150
8	0.0257	0.0004	0.0030	0.0480	0.0083	0.9146
9	0.0258	0.0004	0.0030	0.0480	0.0084	0.9144
10	0.0258	0.0004	0.0030	0.0480	0.0084	0.9143
11	0.0258	0.0004	0.0030	0.0480	0.0085	0.9143
12	0.0258	0.0004	0.0030	0.0480	0.0085	0.9142

As shown in <Table 8>, all macroeconomic variables for each variable insurance show an explanatory power of less than 10%. In the case of variable life insurance, CD rate shows the highest explanatory power, recording 2.8% after 2 prediction terms. After that, it shows an explanatory power exceeding 5% from the 4th prediction term. On the other hand, CD rate shows a relatively weak explanatory power of around 2% on variable universal insurance, and a low figure of 0.6% variable annuity insurance shows. This means that CD rate has a minimal explanatory power on the lapse rate of variable universal insurance, which differs from the analysis before the COVID-19 pandemic.

These results suggest that the change in interest rate environment after the COVID-19 pandemic has protectively changed policyholders' financial strategies. Low-interest rate policies were implemented at the beginning of the pandemic, but as interest rates rose due to rising inflation and CD rate increased, policyholders may have recognized CD as an attractive alternative that provides stable and fixed returns. Therefore, since the COVID-19 pandemic, policyholders have been increasingly preferring stable returns, and there is a possibility that funds will actively move from variable whole life insurance in cause of high uncertainty in investment performance to products that provide relatively fixed returns. In the case of variable annuity insurance, since there is a guaranteed living benefit, the uncertainty of insurance payment is relatively low, so it can be seen that it is insensitive to the exogenous shock of CD rates. In the case of variable universal insurance, the correlation with CD rate after the COVID-19 pandemic is presumed to have increased due to the increased volatility of investment assets. Since variable universal insurance is a liquid and investment-type insurance product that allows withdrawal, it is considered as a choice for investors who value liquidity and profitability. As the volatility of the

stock market increased, the returns from variable universal insurance became unstable, so it is possible that policyholders considered whether to cancel based on the fluctuations in the rates of highly liquid CDs.

CCI shows an explanatory power of 2-3% for variable whole life insurance and variable annuity insurance after 2 terms, and its explanatory power is close to 0 for variable universal insurance. This contrasts with previous studies in which CCI showed a high level of explanatory power for variable insurance before the COVID-19 pandemic. CPI shows an explanatory power of 4% for universal insurance and 2% for whole life insurance and annuity insurance. This is inconsistent with the analysis of previous studies in which CPI exceeded 50% and 18% for annuity insurance and universal insurance, respectively, before the COVID-19 pandemic.

The fact that the CPI and CCI, which indicate the economic status, do not explain the variable insurance lapse rate sufficiently implies that policyholders decide to cancel based on their personal financial circumstances rather than the economic situation after COVID-19. As financial uncertainty has expanded since the COVID-19 pandemic, it is assumed that policyholders have considered variable insurance as a long-term countermeasure regardless of economic fluctuations.

The unemployment rate and KOSPI were found to have very little explanatory power for each insurance. In the case of the unemployment rate, it showed 1% explanatory power for whole life insurance, but its explanatory power was close to 0 for universal insurance. In the case of the KOSPI, on the contrary, it showed about 0.8% explanatory power for universal insurance, but its explanatory power for whole life insurance converged to 0.

5. Conclusion

Unlike previous studies, this study analyzed the impact of macroeconomic variables on the lapse rates of variable whole life insurance, variable annuity insurance, and variable universal insurance, focusing on the period after the COVID-19 pandemic. This study selected CD rate, unemployment rate, CCI, CPI, and KOSPI index as macroeconomic variables to compare the results with studies before the pandemic which are based on the existing interest rate hypothesis and emergency fund hypothesis.

First, this study analyzed the short-term impact using SVAR analysis, which showed almost no relationship between macroeconomic variables and insurance lapse rates. This finding suggests that the short-term effects after the COVID-19 pandemic do not support the interest rate hypothesis or the emergency fund hypothesis. Additionally, the study examined the response of variable insurance lapse rates to exogenous shocks in macroeconomic variables through impulse response function analysis. The lapse rate of variable whole life insurance showed a significant response to the increase of CD rate, lending some support to the interest rate hypothesis. In response to a CPI shock, the lapse rates of variable life insurance and variable universal insurance initially rose and then declined. This pattern suggests that inflation may temporarily increase the financial burden on households but does not significantly motivate cancellations of variable insurance in the long-term.

We evaluated the explanatory power of the variable insurance cancellation rate focusing on macroeconomic variables through variance decomposition analysis. The results of the analysis showed that the CD rate showed the highest explanatory power for the lapse rate of variable life insurance. This seems to be due to the tendency of policyholders to prefer stable income as the uncertainty in the financial market increased after the COVID-19 pandemic. The CPI showed a higher explanatory power than other macroeconomic variables for variable annuity insurance and variable universal insurance, but its explanatory power decreased compared to before the pandemic. This explains that policyholders decided to cancel their insurance products based on their personal financial status rather than economic conditions after COVID-19.

This study suggests that the limited short-term impact of macroeconomic variables on variable insurance lapse rates after the COVID-19 pandemic indicates that the traditional interest rate and emergency fund hypotheses may apply only partially in the post-pandemic context. While specific macroeconomic variables like the CD rate still significantly influence lapse rates for variable whole life insurance, the findings reveal a trend where individual policyholders prioritize their personal financial conditions over broader economic indicators when making lapse decisions amid heightened economic uncertainty. Additionally, the stability shown by variable annuities and variable universal life insurance in response to inflation highlights the potential role of variable insurance as a hedge against inflation, underscoring its value as a long-term financial instrument. Consequently, these results suggest that insurers should consider both macroeconomic factors and individual financial conditions in future variable insurance product strategies.

Based on these findings, insurers should consider developing tailored products that align with individual financial conditions, offering flexible payment options and contract structures. Emphasizing variable insurance as a hedge against inflation, insurers could enhance asset

allocation strategies to maximize returns in inflationary periods. They should also prepare adaptive strategies for interest-sensitive products, such as providing retention benefits or offering stability-focused alternatives in rising rate environments. Implementing data-driven risk management systems linking macroeconomic indicators with customer behavior can improve responsiveness during economic crises. Finally, strengthening customer education and advisory services will help clients appreciate the long-term value of insurance, encouraging sustained policy retention amid economic uncertainty.

6. References

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