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Unveiling the Determinants of Saving-Consumption Relationship: A Panel Data Approach

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Abstract

The impact of uncertainty on saving is termed as precautionary saving. Thus, the main objective of this study is to investigate the effect of external global uncertainties on determining the saving-consumption relationship. In particular, we seek to compare the effect of two types of uncertainties, namely the monetary policy versus economic policy uncertainties in determining the behavior of saving-consumption. The results are compared between the top trade openness versus the least trade openness countries. Besides, the study also seeks to check for the existence and hence the effect of cross-section dependency in the relationship. For this purpose, the mean group (MG), pooled mean group (PMG) and common correlated effects mean group (CCEMG) estimators are applied. The data is from the year 1985 to 2017. The results reveal the existence and significance effect of cross-section dependence among countries and uncertainties matter in the saving-consumption relationship. The main factors that contribute to savings are the GDP per capita and the economic policy uncertainty while the main factors that contribute to consumptions are the GDP per capita and the monetary policy uncertainty.

Keywords: precautionary saving theory; uncertainty; cross-dependency effect; panel data analysis.

1 Introduction

The theory of precautionary savings due to uncertainty is a long-standing question, with many different studies over the years. Theoretically, without the presence of uncertainty, the optimal consumption is dependent on the permanent income. However, over years, economists have recognized the role of uncertainty in determining the behavior of saving-consumption, the investment decision, and the overall economic outcomes. Due to this, some of the newer models have considered the situation when the future income is not certainly known, indicates the presence of uncertainty, this gives a role to the degree of uncertainty in affecting the consumption and saving pattern. The presence of a large uncertainty can push agents to reallocate part of their consumption from the present to the future, thus increasing savings, and by this, uncertainty generates the precautionary saving.

Saving is an inter-temporal decision of households based on given current and expected future income [11]. In a two-period microeconomic model, households decide their consumption and saving rationally based on their anticipated of next period's resources and economic condition at the current time. Since each household is from a different economic and social background, their decisions may reflect different preferences and income levels over time. In the extended life cycle hypothesis where income uncertainty is present, expected income and relative change included, increased income uncertainty and negative income expectations should increase the level of saving. However, households may not able to clearly distinguish the difference between transitory and permanent income change. Each household has different degrees of income uncertainty and different expectations about future income. If the household is not sure about future income or facing increased income uncertainty, the life cycle model may not be reasonable in terms of households distinguishing between transitory income changes and permanent income changes [2].

Psychological evidence from many empirical and theoretical studies indicated that both expectations about future income change and income uncertainty affect inter-temporal saving decisions. People resist reducing current consumption in response to negative expectations about uncertain future income change. The influence of expected income changes on saving and consumption can be positive or negative; the effect of negative expected future income changes is relatively larger than that of positive changes [1]. Such an effect depends on the degree of uncertainty.

In this study, we seek to explore the effect of uncertainty on the saving-consumption pattern by comparing two groups of economies, namely the high opened versus the low opened economies. Our main objective is to examine the impact of uncertainty on the saving-consumption behavior that might constrain by trade-openness factor. In particular, we compare two types of uncertainties, the global economic uncertainty, and the monetary policy uncertainty. Lastly, we consider the cross-section dependency effect in the model by applying the augmented mean group (AMG) and common correlated effects mean group (CCEMG) estimators. Such a cross-section dependency effect is always neglected in many studies. Neglecting such an effect may lead to less accurate and biased results. Our study contributes to new insights as a comparison between high versus low trade openness groups has not yet been explored by any study. Inclusion of cross-section effect and other control factors might reveal the main factors that influence the saving-consumption behavior relative to the uncertainties.

2 Theoretical Reviews

Economic uncertainty refers to when the economy has incomplete or asymmetric information. The earlier theories did not concern the effect of uncertainty. Some of these theories include Keynes's General Theory, Kuznet Paradox, Relative Income Hypothesis, Life-Cycle Model, and Permanent-Income Hypothesis. Some factors included in these theories include income, consumption, and saving. For instance, Keynes's General Theory indicated consumption as a function of disposable income. Higher income will stimulate higher consumption. The relative income hypothesis assumed an individual consumption function depends on the current income of other people. The life-cycle model assumed that income is constant until retirement zero thereafter, hence consumption is also constant. On the other hand, the Kuznet paradox assumed that consumption is a proportion rather than a function to income. All these theories are subject to some weaknesses. For instance, the life-cycle model may not explain well the real situation. In real, individuals do not have a constant percentage of consumption. This theory also fails to recognize the presence of liquidity constraints in determining consumption [7]. Since the permanent income and life cycle models do not address cases with uncertainty, which implicated the convexity on the consumption behavioral. The optimal response is to consider uncertainty and expectation, where the higher the income uncertainty, which leads to the higher the risk aversion which leads to lower consumption and more prudent behavior.

To improve the weaknesses found in the earlier theories, the effect of uncertainty on consumption is included in the precautionary saving theory [14]. To see how this theory works, consider the lifetime utility function of a consumer:

$$V = \sum_{t=0}^{\infty} (1+\rho)^{-t} E_t[U(c_t)], \tag{1}$$

with ρ indicates to the discount rate, c_t as the period t consumption and $U(\bullet)$ refers to the instantaneous utility. A consumer might want to maximize the utility subject to the following budget constraint,

$$\sum_{t=0}^{\infty} (1+\rho)^{-t} c_t = A_0 + \sum_{t=0}^{\infty} (1+\rho)^{-t} y_t, \tag{2}$$

where A_0 indicates to the initial wealth and y_t is the same measure of income in t period ([14]). The model assumes that $U(\bullet) > 0$ and $U"(\bullet) < 0$, [14].

As indicated in many studies, the convexity of the marginal utility $(U'''(\bullet) > 0)$ may lead to increasing saving in income uncertainty. In other words, there exists a precautionary saving [10]. If the sign $U'''(\bullet)$ is invariant when the level of c_t changes, this result shows the convexity of marginal utility. Two partially different tests can be applied to study the effects of uncertainty by referring to consumption growth and to the saving rate. The following model on the optimal consumption path [8] is given by:

$$E_t[\Delta \ln c_{t+1}] = \frac{r-\rho}{\theta} + \frac{\theta}{2}(\Delta \ln c_{t+1} - E_t[\Delta \ln c_{t+1}])^2, \tag{3}$$

where coefficient θ indicates to the relative risk aversion and the term $\left(\frac{\theta}{2}\right)(\Delta \ln c_{t+1} - E_t[\Delta \ln c_{t+1}])^2$ relates the precautionary premium to uncertainty in income.

In general, a larger uncertainty may lead to higher savings, but it does not raise consumption growth. This is because the degree of uncertainty is time-varying. The larger uncertainty in t implies that s_t grows, c_t is reduced and c_{t+1} is raised [14]. This means that a further increase in uncertainty in $t+1$ implies that s_{t+1} grows and reducing c_{t+1}. Obviously, if the uncertainty does not change in $t+2$ then Δc_{t+2} is larger than Δc_{t+1}. It is obvious that in this case, only an equation studying the relationship between uncertainty and saving can test the conclusions of the precautionary saving theory.

3 Empirical Reviews

As uncertainty is not observable, different approaches were applied to generate uncertainty and to test on the precautionary saving hypothesis. The precautionary saving theory suggested that uncertainty on future output growth affects the decisions on consumption and saving patterns significantly. In order to empirically test for this conclusion, it is necessary to compute an appropriate measure of uncertainty on GDP dynamics in OECD countries [14]. The measure to be used is not just a measure of the variability of output growth but is a measure computed based on the deviations of output growth from its expected value. Menegatti [14] discussed the data generation procedure in three steps. First, the GDP growth series were examined. They were estimated separately with a set of different autoregressive moving average (ARMA) processes. Second, the estimates obtained are compared in order to find the best fit of estimates by referring to the Schwartz information criterion (SIC). Finally, the series of expected output growth is determined, for each country, by looking at the selected stochastic process. After that, the uncertainty (UNC) can be computed. He evidently showed that higher uncertainty leads to higher savings. However, a less clear conclusion is obtained with regard to the effect of uncertainty on consumption growth.

As discussed in Christelis et al. [3], different approaches were applied to study the precautionary saving caused by uncertainty. In the first group of studies, the main focus is on estimating the income risk on consumption or wealth. The measures of income risk can be expressed in terms of occupational risk. This approach reported mixed findings. Although a positive relationship was reported by majority studies, the magnitude of income risk might differ across studies. This approach also revealed evidence either support or against precautionary saving.

On the other hand, the second group is matching the simulated data to the observed data in wealth and consumption. One of the weaknesses in estimating the Euler equation is the expected data for consumption growth and consumption risk are not observable. The study by Christelis et al. [3] also supported the precautionary saving theory, which is similar to Menegatti [14], but the approach of this study is employing the Euler equation to study the effect of uncertainty on precautionary saving. The main contribution of this study as compared to Menegatti [14] is the application of Euler equation that used the subjective expectations of consumption.

While Menegatti [14] and Christelis et al. [3] did not provide evidence on the impact of uncertainty on consumption behavior, Masayuki et al. [13] managed to reveal the impact of uncertainty on consumption and saving behavior. This study concluded that individuals are highly uncertain about social security policies, and such uncertainty may affect their saving and consumption behavior. However, the major problem of this study is that the data is cross-sectional survey-based information, which does not present the quantitative impact of policy uncertainty.

As contrast from the above studies which concentrated on the impact of uncertainty on the precautionary saving theory, the study by Eason [4] focused on the analysis of consumption sensitivity to tax policy uncertainty in the U.S. The outcome of this study is that current consumption is increased under increasing tax policy uncertainty.

A study proposed by Effiom and Samuel [6] provided an empirical analysis undertaken to determine the effect of trade openness on the determinants of factors that induce economic growth in Nigeria. These factors are the accumulation of productive resources (savings); a technological change which enhances the efficiency with which those resources are used; labor which expands with population growth; physical capital which expands through investment; and human capital which expands through education, training, and experience [6]. Technological change may take place through learning by doing or by directed investments in technological progress.

On the other hand, Lugilde et al. [12] provided a review of the empirical works related to precautionary saving, where higher uncertainty stimulates higher extra saving. When consumers are uncertain about the prices of goods, they prefer to wait and see. Also, investors who are not certain about the market condition tend to wait and save money in the bank until they are clearer about the market movement. This condition will lead to higher precautionary saving. Table 1 is the simplified summary as reported in Lugilde et al. [12]. This table shows different approaches were used to measure uncertainty. However, majority studies found the hold of the precautionary saving theory, i.e. higher uncertainty leads to higher savings.

Table 1: Summary from empirical works.

Authors	**Dependent variable**	**Uncertainty**	**Results**
Baiardi *et al.* (2013)	Consumption growth	Financial risk and environmental risk	Both financial risk alone and the interaction between financial and environmental risks affect consumption
Bande & Riveiro (2013)	Saving rate and consumption growth rate	Expected variance of future regional output growth and unemployment rate	Existence of an important precautionary savings motive
Benito (2006)	Consumption	Job loss risk: subjective probabilities and predicted probabilities from a probit model	Evidence of precautionary savings when using the predicted measure but not using the self-reported measure
Guariglia & Kim (2003)	Savings	Time-varying measures of consumption growth variability	Strong evidence of precautionary saving
Guariglia & Rossi (2002)	Consumption growth	Variance of the earnings equation residuals	Strong precautionary motive for saving
Mishra *et al.* (2013)	Wealth	Variance of income	Households facing higher income uncertainty accumulate more wealth
Mody *et al.* (2012)	Household net saving rate	Unemployment rate, GDP volatility and stock market volatility	More than 40% of the increase in savings can be directly related to the increase in unemployment risk and GDP volatility

Lugilde *et al.* (2016)	Consumption	Self-perceived income shock, expectations about future income, subjective probability of job loss, job insecurity indicator, unemployment rates by five-year age groups	Evidence of precautionary savings and also that the uncertainty sources change along the business cycle.

Source: Simplified from Lugilde et al. [12]

The study that examined the trade openness effect in the saving-consumption relationship is very limited. There is a study [18] that focused on studying the empirical evidence on the causal relationship between trade openness and income level. This study proposed that an increase in trade openness increases the share of total profits received by the most productive entrepreneurs (the exporters) who have the highest saving rates. This leads to a large increase in aggregate saving and investment which contributes to the overall increase in aggregate income. The methodology employs the use of OLS in cross-sectional data and panel regression on the trade openness ratio (trade/GDP). The main key takeaway from this study is that there is a strong relationship between openness and the saving rate in a cross-section and a panel of countries. These results provided evidence that higher aggregate saving rate following an increase in trade openness is responsible for the observed positive relationship between capital accumulation and trade openness.

In contrast, the study by Silajdzic and Mehic [17] proposed that the relationship between trade openness and economic growth is more ambiguous and controversial from both theoretical and empirical points of view. The study argued that low liberalization in the trade may not always lead to better economic outcomes for less advanced economies. This is due to the constraint or low capabilities in technology, coordination of trade and development, etc. [17].

To be concluded, there is a strong causal relationship between economic uncertainty and saving and consumption behavior, where the degree of uncertainty will, to a certain extent, affects the saving and consumption behavior. Another key takeaway is that trade openness should be included in factors that affect economic growth, because to a certain extent, there is a causal relationship between trade openness and saving and consumption behavior. The major limitation from previous studies is that all data used are mainly focused on either cross-sectional data or time-series data. There are very few studies that focus on the panel data analysis on the causal relationship between trade openness or economic uncertainty on the saving and consumption behavior.

4 Data

The data obtained in this study is from the World Bank, which is under the portal of the World Development Indicators in Data Bank. These include the final consumption expenditure per capita (annual %, NPISH), gross domestic product per capita (annual %, GDP) and gross domestic saving per capita (% of GDP).

Uncertainty is the state of feeling uncertain or doubtful about something. In terms of economics perspective, uncertainty might due to the feeling of unsure about the market condition, movement of economic indicators, etc. Since uncertainty is unobservable, it is very hard to measure uncertainty. Baker, Bloom, and Davis are the three main persons who pioneered the research team in measuring uncertainty indices. They have constructed different types of uncertainty indices for several countries. In this paper, we employed their uncertainty indices based on the U.S. as proxies for economic policy uncertainty and monetary policy uncertainty. The uncertainty indices are obtained from the economic policy uncertainty website at the following link: (http://www.policyuncertainty.com/index.html).

4.1 Economic Policy Uncertainty Indices

There are 2 policy uncertainty indices constructed for the US, which are the Three-Component Index and News Based Policy Uncertainty Index. The Three Component Index is constructed using three components, including (i) the search results from 10 large newspapers, (ii) reports with the lists of temporary federal tax code provisions by the Congressional Budget Office (CBO) and (iii) the survey on Professional Forecasters from the Federal Reserve Bank of Philadelphia. Each of the components is normalized by its deviation prior to January 2012. Then the average of the components is computed using the weights of 0.5 and 1/6 on the broad news-based policy uncertainty index and other three components respectively.

4.2 Monetary Policy Uncertainty Indices

Besides the economic policy indices, there are two monetary policy indices, which are the BBD MPU Index Based on Access World News and BBD MPU Index Based on 10 Major Papers. The Baker-Bloom-Davis Monetary Policy Uncertainty (BBD MPU) Index is calculated based on a few criteria. First of all, newspaper articles are screened to detect the following terms:

i. E: economic, economy.

ii. P: congress, legislation, white house, regulation, federal reserve, deficit.

iii. U: uncertain, uncertainty.

iv. M: federal reserve, the fed.

Secondly, two monthly monetary policy indices are constructed based on the criteria (i) to (iv) on two different sets of newspapers:

i. Hundreds of daily newspapers covered by Access World News.

ii. A balanced panel of 10 major newspapers: USA Today, the Miami Herald, the Chicago Tribune, the Washington Post, the Los Angeles Times, the Boston Globe, the San Francisco Chronicle, the Dallas Morning News, the Houston Chronicle, and the Wall Street Journal.

And finally, in each case, raw counts of articles that meet the E, P, U and M criteria across newspapers were summed and divided by the summed count of all articles in the same newspapers and month. Then, scaled frequency counts are normalized to have an average value of 100 from January 1985 through December 2010. With each monthly update, data from the preceding few months may be revised slightly. These revisions arise because there can be delays in populating the digital archives with the full set of newspaper articles. The annual index for both the BBD MPU Index Based on Access World News and BBD MPU Index Based on 10 Major Papers are then obtained by summing up all the months in a year and divided by twelve to obtain an average index for the year. Thus, the annual data is obtained from the year 1985 to 2017. The variables obtained for each country that will be used in this study are summarized in Table 2. Economic policy uncertainties are proxy by LINDEX and LNEWS while monetary policy uncertainties are represented by LAWN and LMP.

Table 2: List of variables.

Variable	**Description**
NPISH	Households and NPISHs Final consumption expenditure per capita (annual %).
GDP	Gross domestic product per capita (annual %).
SAVING	Natural log of gross domestic savings (% of GDP).
LAWN	Natural log of BBD MPU Index Based on Access World News.
LMP	Natural log of BBD MPU Index Based on 10 Major Papers.
LINDEX	Natural log of three Component Index of policy uncertainty.
LNEWS	Natural log of News Based Policy Uncertainty Index.

4.3 Categorization of Countries

In order to determine the top 10 countries and the bottom 10 countries, this study refers to The Global Economy website, which ranks all countries globally based on the different economic indicators. The following are the top 10 and bottom 10 countries chosen based on trade openness:

Top 10 trade openness countries:
1. Luxembourg
2. Hong Kong
3. Singapore
4. Ireland
5. Vietnam
6. Slovak Republic
7. Hungary
8. Belgium
9. Netherlands
10. Czech Republic

Bottom 10 trade openness countries:
1. Sudan
2. Brazil
3. Pakistan
4. Colombia
5. Bangladesh
6. Cameroon
7. Kenya
8. Indonesia
9. Uruguay
10. India

5 Methodology

In this study, the main focus is to perform estimation on the effect of uncertainties on saving and consumption equations:

Saving function: SAVIMG=F(GDP, LINDEX, LNEWS, LAWN, LMP).

Consumption function: NPISH= F(GDP, LINDEX, LNEWS, LAWN, LMP).

The estimation is based on three estimators namely mean group (MG), augmented mean group (AMG) and common correlated effect mean group (CCEMG). According to Eberhardt and Teal [5], the MG model is the Pesaran and Smith [16] Mean Group estimator, which assumes that cross-section independence, as well as the presence of nonstationary variable series. The MG model also allows for parameter heterogeneity. The regression can be explained as below:

$$y_{it} = a_i + b_i x_{it} + c_i trend + e_{it}, \tag{4}$$

where t denotes a linear trend with coefficient c_i and a_i is the constant term, i indicates to the cross-section of country. The linear trend is included in order to capture unobserved idiosyncratic processes. The MG estimates are obtained by averaging the individual country estimates.

According to Eberhardt and Teal [5], the AMG model captures the potential cross-section dependence through a 'common dynamic effect' in the country regression. This variable is obtained through the year dummy coefficients of the pooled regression in first differences in the first stage regression, followed by encompassing the specific cointegrating relation that formed by the unobserved common factors in the second stage regression. This cointegrating relation can differ across countries.

AMG Stage 1:

$$\Delta y_{it} = b\Delta x_{it} + \sum_{s=2}^{T} c_s \Delta D_s + \Delta e_{it}. \tag{5}$$

AMG Stage 2:

$$y_{it} = a_i + b_i x_{it} + \kappa_i \hat{\mu}_t^{\bullet} + c_i trend + e_{it}, \tag{6}$$

$$\hat{b}_{AMG} = N^{-1} \sum_i \hat{b}_i.$$

In the first stage of regression, the year dummy coefficients are labelled as $\hat{\mu}_t^{\bullet}$. In the second stage regression, the AMG estimates are obtained through averaging the individual country estimates. The AMG model shares the same concept very similar to the Pesaran [15] Common Correlated Effects (CCEMG) estimator.

For CCEMG we obtain N country regression equations, each of which contains the cross-section average terms for y and x.

CCEMG:

$$y_{it} = a_i + b_i x_{it} + c_{1i}\bar{y}_t + c_{2i}\bar{x}_t + c_{3i} trend + e_{it}, \tag{7}$$

$$\hat{b}_{CCEMG} = N^{-1} \sum_{i} \hat{b}_i.$$

As stated above, the cross-section averages can account for unobserved common factors with heterogeneous factor loadings. The CCEMG estimates are then averaged across countries. Heshmati [9] discussed the differences between these three estimators. The MG method implements the ordinary least squares (OLS) estimates to each panel separately by including a linear trend as a capture of the time-invariant unobservable. On the other hand, the AMG and CCEMG estimators consider a cross-sectional dependence effect and heterogeneous impact due to time-variant unobservable. Both estimators also include information on common factors through averaging country estimates. However, this feature cannot find in the MG estimator. The MG estimator is consistent for large T and large N but the CCEMG is very robust to structural breaks, non-stationary and non-cointegrated even with a satisfactory small sample. The advantage of the AMG estimator over the CCEMG estimator is AMG treats the unobservable common factors as a common dynamic process. Besides, the AMG estimator is unbiased and most efficient for different combinations of T and N. However, MG estimators can be biased under increases in T and decreases in N. So MG estimator is more suitable for a panel where $N > T$.

6 Results

Prior to the estimation, the cross dependence test and unit-root tests are performed. The results are as summarized in Table 3 and Table 4. We use *, ** and *** to indicate the significance of results at 10%, 5% and 1% level respectively.

From Table 3, notice that all the test statistics for all 3 cross-dependence test, which are the Breusch-Pagan LM, Pesaran Scaled LM, and Pesaran CD, shows significance. Therefore, we will reject the null hypothesis of there is no cross dependence within the Top 10 countries and Bottom 10 countries and conclude that there exist cross-dependence within the Top 10 and Bottom 10 countries. As there are pieces of evidence of cross-section dependence, such an effect should be included in the model during regression. Therefore, AMG and CCEMG are used to include a cross-section effect in the regression as compared to the baseline MG estimator (without cross-section effect).

Table 3: Cross dependence test for Top 10 and Bottom 10 countries.

Tests	**Test Statistics**			
	Top 10 Countries (Consmption)	**Bottom 10 Countries (Consumption)**	**Top 10 Countries (Savings)**	**Bottom 10 Countries (Savings)**
Breusch-Pagan LM	62.8987**	61.0429*	267.0598***	303.1726***
Pesaran Scaled LM	1.8867*	1.6911*	23.4072***	27.2138***
Pesaran CD	-0.0922	0.1132	3.7369***	-1.6953***

Prior to the estimation, all variables are checked for unit-root stationarity tests (refer Table 4). These tests include the Levin, Lin & Chu, Im, Pesaran & Shin, ADF-Fisher and PP-Fisher. In all cases, the null hypothesis of unit-root is rejected, hence signifying that all variables are stationary. So we can proceed with estimation using these variables in their stationary form.

Table 4: Results of unit-root tests.

Group	**Variable**	**Test statistics**			
		Levin, Lin & Chu	**Im, Pesaran & Shin**	**ADF-Fisher**	**PP-Fisher**
Top open	GDP	-8.8418***	-7.9802***	102.4970***	113.1820***
Top open	NPISH	-7.4799***	-7.2207***	89.6636***	87.7611***
Top open	SAVING	-2.5548***	-3.0843***	38.7679***	46.4837***
Least open	GDP	-6.4566***	-7.0397***	89.8146***	107.8050***
Least open	NPISH	-9.5596***	-9.2974***	120.8080***	125.118***
Least open	SAVING	-2.9228***	-2.4034***	37.5230***	32.4163***
U.S.	LAWN	-3.6668***	-5.0209***	58.8582***	52.6548***
U.S.	LINDEX	-3.3782***	-5.2602***	63.0307***	38.2616***
U.S	LMP	-3.8079***	-4.7156***	55.2593***	57.1314***
U.S.	LNEWS	-5.0198***	-3.7760***	44.7488***	50.9210***

The results of the estimation are summarized in Table 5 (saving) and Table 6 (consumption). Comparing the results across three estimators, we observe that AMG is the best estimator with the smallest root mean square error (RMSE) value in top openness countries in saving equation while CCEMG is the best estimator in the bottom openness countries in both saving and consumption equations and saving equation for bottom openness countries. Both AMG and CCEMG show significant effect on the cross-section dependence ($\hat{\mu}_t^{\bullet}$ and mean_SAVING or mean_NPISH), implying the existence of cross-sectional dependence among countries. Ignoring such effects may lead to biased results.

Table 5: Results of estimation - saving.

Variable	**Top 10 countries**			**Top 10 countries**		
	MG	**AMG**	**CCEMG**	**MG**	**AMG**	**CCEMG**
GDP	0.2053***	0.1236	0.1018	0.0901	0.0203	0.0222
LINDEX	1.1305	-1.6431	-2.1809	8.0201**	0.1160	-0.1832
LNEWS	2.4529	0.4098	1.6671	-5.8660**	0.5813	-1.0049
LAWN	-7.8412**	5.9369***	-0.5669	1.1382	-0.9651	-0.0552
LMP	7.4076**	-1.9365**	1.4797	-0.7493	-0.2273	0.1473
Constant	12.3763***	-0.0757	-6.3539	10.4162	23.2535***	-0.6636
Trend	-0.5162***	0.0499	-	0.1037	0.0013**	-0.0070
$\hat{\mu}_t^{\bullet}$	-	1.0174***	-	-	1.0815***	-
mean_SAVING	-	-	1.1690***	-	-	1.1128***
mean_GDP	-	-	-0.2127*	-	-	-0.1090
mean_LINDEX	-	-	-	-	-	-
mean_LNEWS	-	-	-0.0562	-	-	1.1297
mean_LAWN	-	-	-	-	-	-
mean_LMP	-	-	-	-	-	-
RMSE	2.8142	1.8939	2.1080	2.2408	1.8713	1.8641

The following discussions are based on the results of the best estimator. In both Table 5 and Table 6, the results of the estimated coefficient are provided with the first column as the names of

variables (GDP, LINDEX, LNEWS, LAWN, LMP), constant term, $\hat{\mu}_t^{\bullet}$ as dependency effect under AMG estimator and the remaining variables are dependency effects under CCEMG estimator (see Equation (6) and (7)). A positive coefficient indicates that the increase of an explanatory variable leads to the higher independent variable (SAVING or NPISH) while the negative coefficient indicates that the increase of one unit of an explanatory variable leads to the lower independent variable.

From Table 5, AMG shows that the monetary policy uncertainties of LAWN and LMP lead to a different impact on saving. The monetary policy uncertainty based on access world news (LAWN) leads to higher savings while the monetary policy uncertainty based on the 10 main papers causes lower savings in the top openness countries. This could be due to higher fluctuation in LAWN which explains to higher uncertainty. Since high uncertainty may cause high volatility in prices, households tend to wait and see by keeping more savings. On the other hand, LMP based on the U.S. main papers exhibits a more positive expectation for the monetary policy, hence households tend to spend more and save less. Comparing the results to the bottom 10 countries, we observe that all factors have weak explanatory power on the saving in the bottom openness countries, the large influence is from the cross-sectional dependency effect.

Moving to Table 6, the results show that GDP is able to explain the consumption behavior, higher GDP stimulates to higher consumption in both groups of economies. Apart from this, results from the best estimator (CCEMG) do not detect any significant effect from any factor except the cross-sectional dependency effect and GDP. The cross-sectional dependency leads to higher consumption in both groups of countries.

Table 6: Results of estimation - consumption.

Variable	**Top 10 countries**			**Top 10 countries**		
	MG	**AMG**	**CCEMG**	**MG**	**AMG**	**CCEMG**
GDP	0.6590***	0.6517***	0.7332***	0.9322***	0.9289***	0.9434***
LINDEX	-1.5749	1.0605	0.3033	-0.2192	-1.9276	-0.2103
LNEWS	0.2357	0.7016	-1.9354	1.3952	2.8478	-1.2647
LAWN	1.8313**	0.8505	0.6410	-0.5139	-2.3418	0.3550
LMP	-0.9102	-0.6088	-0.7194	-1.3871	-0.0689	0.0264
Constant	8.8543***	0.0680	2.2722	2.9842	13.5794**	0.0689
Trend	0.0738*	0.0632	0.0306	-0.6074	-0.0429	0.0072
$\hat{\mu}_t^{\bullet}$	-	1.0054***	-	-	0.7959***	-
mean_NPISH	-	-	0.9459***	-	-	0.9871***
mean_GDP	-	-	-0.6552***	-	-	-0.8548**
mean_LINDEX	-	-	-	-	-	-
mean_LNEWS	-	-	1.0674	-	-	1.7318
mean_LAWN	-	-	-	-	-	-
mean_LMP	-	-	-	-	-	-0.6676
RMSE	1.9178	1.6476	1.5428	2.9200	2.6033	2.4823

On the other hand, if we compare the results across individual countries, we can observe that the impacts of uncertainties on saving and consumption might vary across countries. Table 7 and Table 8 show the results of saving and consumption for an individual country. The first 10 countries are the closed countries followed by the remaining 10 open countries. As observed, the effects of different types of uncertainties can have a different impact on saving-consumption across an individual country. The effect can be positive or negative, depending on how sensitive or relevance and optimistic the households in facing such uncertainties.

Table 7: Results of saving - individual country.

Variable	Bangladesh	Brazil	Colombia	Cameroon	India
GDP	-0.6957	-0.0387	-0.1329	0.4822***	-0.0596
LNEWS	2.1201	-6.3607	0.0000	0.8327	-14.8850***
LAWN	1.4458	-0.2065	-5.3998***	-0.6292	7.9749***
LINDEX	-1.8102	0.7019	5.5921	-0.6794	7.5060**
LMP	-1.2452	0.0000	2.2767	0.0000	-5.6098***
Variable	**Indonesia**	**Kenya**	**Pakistan**	**Sudan**	**Uruguay**
GDP	0.1724	-0.0538	-0.2675	0.0886	0.1005
LNEWS	0.0000	3.1786	0.0000	9.5662	-4.5008
LAWN	-7.8418***	-8.5684***	9.5116***	3.8445	-0.6837
LINDEX	-0.4907	-1.0720	-14.4430**	-10.5762*	7.4398*
LMP	0.0000	7.4463**	0.0000	0.0000	-1.3948
Variable	**Belgium**	**Czech Rep.**	**Hungary**	**Hong Kong**	**Luxembourg**
GDP	0.0721	0.0125	-0.0559	0.1363	-0.1950
LNEWS	0.0000	-2.4240	12.9112**	3.5090	0.0000
LAWN	-3.1384*	3.0416	-0.3068	0.5175	-7.0996*
LINDEX	-2.9910	2.7550	-12.3710***	-2.0413	-0.2025
LMP	4.2983*	-2.1898	-3.3222	-3.2696	4.8238
Variable	**Netherland**	**Ireland**	**Singapore**	**Slovak Rep.**	**Vietnam**
GDP	0.4298***	0.4024**	0.1485	0.1634	-0.0956
LNEWS	0.0000	-1.5978	4.2724	0.0000	0.0000
LAWN	-1.0388	-13.0390***	-2.0574	7.3623**	10.0891
LINDEX	1.4820	1.2179	1.8638	-7.8664	-6.6555
LMP	0.6254	19.1962***	3.5190	-3.4345	-5.4493

Table 8: Results of consumption - individual country.

Variable	Bangladesh	Brazil	Colombia	Cameroon	India
GDP	1.3990***	0.5583***	1.0663***	1.2212***	0.5470***
LNEWS	-3.5471	-11.2484*	-1.4236	0.0000	0.9666
LAWN	1.2802	7.8812***	0.4225	-2.3945	-1.2990
LINDEX	3.1704	7.1286	1.6126	-0.3105	-1.1077
LMP	0.0000	0.0000	-0.5446	0.0000	0.0000
Variable	**Indonesia**	**Kenya**	**Pakistan**	**Sudan**	**Uruguay**
GDP	0.7353***	1.1605***	1.2019***	0.3316	1.2129***
LNEWS	1.0317	15.3264*	0.0000	-16.3055	2.5533
LAWN	-0.3995	-2.7194	-3.3576	6.4656	-2.3298
LINDEX	-3.0965	-11.9875	-6.4870	10.9430	-1.9685
LMP	0.1752	-0.0006	0.6337	0.0000	0.0000
Variable	**Belgium**	**Czech Rep.**	**Hungary**	**Hong Kong**	**Luxembourg**
GDP	0.8247***	1.2867***	0.7883**	0.7429***	0.3132**
LNEWS	-0.5781	0.0000	-14.4383*	-4.2950	2.7154
LAWN	0.3390	4.8194	-0.3821	3.0243	3.6367*
LINDEX	0.9102	0.3595	8.8952*	8.8581**	-5.1139
LMP	-1.5302	-6.0645	5.1642	-4.6820**	-2.8865
Variable	**Netherland**	**Ireland**	**Singapore**	**Slovak Rep.**	**Vietnam**
GDP	0.9168***	0.1952**	0.5787***	0.9193***	0.7662*
LNEWS	2.7991	1.8767	3.1760	0.0000	-10.6102
LAWN	-0.1357	-1.6092	-1.4427	-4.8659*	3.0268
LINDEX	-4.7623***	-3.8507	-2.7842	-9.2415**	9.7615**
LMP	0.0000	2.1510	-0.6006	0.6745	0.5805

While the effects of uncertainties are detected, it is still ambiguous to conclude if uncertainties can lead to increases or decreases in saving and consumption. However, the results have revealed that the cross-sectional effect is crucial in determining the saving-consumption behaviour. The common dynamic effect from AMG, which represents the evolvement of unobserved common factors across all countries may increase the current savings and consumption. CCEMG reveals that the common corrected effect represented by the mean of cross-country saving tends to improve current saving while the mean of cross-country consumption tends to stimulate current consumption. In addition, the common corrected effect represented by the mean of cross-country GDP tends to reduce the current consumption.

7 Conclusions

The precautionary saving-consumption theory recognized the role of uncertainty in affecting the behavior of households either to save or spend. In this study, we conduct an empirical analysis to verify how true the precautionary theory holds. Utilizing the uncertainty indices constructed by a group of researchers, we compare the effects of different types of U.S. monetary policy and economic policy uncertainties on saving and consumption in two groups of countries, the high openness versus the low openness countries. In filling the gaps from the previous studies that suffering from low accuracy results for not consider the cross-section dependency effect in the modeling, this study applies the mean group (MG), augmented mean group (AMG) and common correlated effect mean group (CCEMG). Our results reveal evidence of cross-sectional dependence effect in both groups of countries with either AMG or CCEMG as a better estimator compared to the non-cross sectional dependent effect estimator of MG. Among the uncertainties, the monetary policy uncertainties are influential in affecting the saving behavior in the top openness countries but not in that of low openness countries. On the other hand, consumption behavior is determined mainly by the GDP growth. In all cases, the cross-sectional dependent effect is significant, indicating that the cross-country dependency effect is crucial in affecting the saving-consumption behavior. Overall, our results reveal the cross-sectional dependency among countries in determining the saving-consumption behavior. The cross-sectional dependency is an important factor contributing to the decision of saving and consumption. On the other hand, the effect of uncertainties is ambiguous across the individual country. In terms of the panel group, the monetary policy uncertainties (LAWN and LMP) have significant impact on saving in the top openness economies but not in the closed economies. None of any uncertainties show significant effect on consumption in both groups of economies. Consumption behavior is highly affected by GDP, higher GDP leads to higher consumption in both groups of economies. The impact of GDP is much larger in the closed economies.

The trade agreement, technology transferred, and knowledge sharing can be a good option to strengthen the good-partnership and dependency among members or trade partners. This engagement will benefit to both countries involved to enhance economic stability and growth.

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