CAUSAL RELATIONSHIP BETWEEN SAVINGS AND ECONOMIC GROWTH IN COUNTRIES WITH DIFFERENT INCOME LEVELS.

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Abstract

This paper addresses the relationship between domestic savings and economic growth for various economies with different income levels. Using time series annual data, the Granger causality test was conducted. The study seeks to determine whether the direction of causality in these economies is different based on their income class: namely low–income, low–middle income, upper–middle income, and high–income countries.

1.0 INTRODUCTION

The conventional perception is that savings contribute to higher investment and hence higher GDP growth in the short run (Bacha, 1990; DeGregorio, 1992; Jappelli and Pagano, 1994). The central idea of Lewis's (1955) traditional development theory was that increasing savings would accelerate growth. Kaldor (1956) and Samuelson and Modigliani (1966) studied how different savings behaviors induced growth. On the other hand, many recent studies have concluded that economic growth contributes to savings (Sinha and Sinha, 1998; Salz, 1999; Anoruo and Ahmad, 2001). Caroll, Overland, and Weil (2000) demonstrated that "if utility depends partly on how consumption compares to a *habit stock* determined by past consumption, an otherwise-standard growth model can imply that increases in growth can cause increased saving." Edwards (1995) found that per capita growth is one of the most important determinants of both private and public savings.

To formally examine the relationship between savings and economic growth, this study investigates whether the causality is from savings to economic growth or vice versa. This paper uses Granger causality to compare the no causality or unidirectional/bi-directional causality relationship between savings and economic growth. This study also attempts to determine whether the income level of the economy plays an important role in influencing the direction of causality. This paper differs from other studies in the literature primarily in dividing the countries under investigation into low-income (LIC), low-middle income (LMC), upper-middle income (UMC) and high-income (HIC). The primary hypothesis that the study intends to test is whether the income level of the economy influences the direction of causality between economic growth rate and savings. Furthermore, the study includes 25 countries, including ten HICs. Typically, HICs have lower savings and economic growth rate. Generally, most of the literature focused on developing countries.

Different savings behaviors, the club convergence theory, or the catching up effect to a higher steady state level, in different economies based on their initial income per capita, provides a basis to hypothesize different directions of causality for different economic income classes. The empirical result of Quah's (1993) study revealed that middle-income countries are slowly vanishing. The catching up effect, as the countries are in transition to reach a similar steady state as the HICs, provide us a basis to anticipate different directions of causality. For a HIC, which represents an economy that is closer to a steady state, the growth rate is comparatively slower, thus one could expect the directions of causality to differ.

2.0 LITERATURE REVIEW

The relationship between savings and economic growth is studied using contemporaneous correlation and dynamic models. In this section, some of the studies that attempted to correlate the savings rate and economic growth are presented. Bacha (1990), Otani and Villanueva (1990), DeGregorio (1992), and Jappelli and Pagano (1994) conducted Ordinary Least Squares (OLS) regression on cross-section data and concluded that a higher savings rate (ratio of savings to GDP) led to higher economic growth. A recent study of 32 countries by Krieckhaus (2002) notes that a higher level of national savings led to higher investment and consequently caused higher economic growth.

Many recent studies focused on the dynamic relationship of savings and economic growth using the concept of Granger causality. Caroll and Weil (1994), using five-year averages

of the economic growth rate and savings for OECD countries as well as a larger sample, found that economic growth rate Granger caused savings in the larger sample. On the other hand, when time dummies were not included, savings Granger caused growth in the OECD countries. However, Attanasio et al. (2000) criticized the robustness of Caroll and Weil's results, finding that using annual data rather than the five-year average increased precision and statistical significance of the estimates as well as changing the pattern of causation.

Sinha (1996) presented evidence that economic growth Granger causes growth rate of savings in Pakistan. Further, Sinha and Sinha (1998) found that causality was from the economic growth rate to growth rate of savings in Mexico. Sinha (1999) examined the relationship between the growth rate of savings and economic growth in Sri Lanka. In this study, the causality was from growth rates of gross domestic savings to economic growth rate. However, Sinha (2000) did similar studies in the Philippines and found causality from economic growth rate to growth rate of domestic savings.

Saltz (1999) argued that the higher the income per capita, the higher the consumption and savings rates. This study investigated the direction of causality in 17 third world countries, using the Vector Error Correction (VEC) model for eight countries and Vector Auto Regressive (VAR) model for the other nine countries. The study found that for nine countries the causality was from the economic growth rate to growth rate of savings. For only two countries was the direction of causality reversed. There were four countries where no causality was identified, and for the other two countries bidirectional causality was detected. The author concluded that higher growth rates of real GDP contribute to a higher growth of savings.

Anoruo and Ahmad (2001) investigated the causality of savings and economic growth in seven African countries using VEC. The authors found that in four out of seven countries, economic growth Granger causes the growth rate of domestic savings. However, they obtained a bi-directional causality in Cote d'Ivoire and South Africa. Only in the Congo, did the opposite result prevail: the growth rate of domestic savings Granger caused economic growth.

Mavrotas and Kelly (2001) used the Toda and Yamamoto method to test for Granger causality. Using data from India and Sri Lanka, the relationships among gross domestic product, gross domestic savings, and private savings was examined in this study. The authors found no causality between GDP growth and private savings in India. However, bi-directional causality was found in Sri Lanka.

Baharumshah et al. (2003) investigated growth rate of savings behavior in five Asian countries: Singapore, South Korea, Malaysia, Thailand, and the Philippines. Based on time series data from 1960-1997, using VEC, the authors found that growth rate of savings does not Granger cause economic growth rate in the countries, except for Singapore.

3.0 DATA

The current study used annual data from 1960 to 2001. All data came from World Development Indicators online 2003. Some of the missing observations were updated with comparable data from the World Bank International Financial Statistics or statistical offices in respective countries. Variables used in this study and the definitions are LogGDS (log of Gross Domestic Savings) and LogGDP (log of Gross Domestic Product).

Gross domestic savings are calculated as GDP less final consumption expenditure (total consumption). GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is

calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

The aim of this study is to identify the causality between the two variables in each country. Thus, all the data used are in terms of a constant local currency unit (constant LCU). The countries for each income class were selected based on data availability. The number of countries selected in each income class is limited because of missing observations or missing variables.

4.0 EMPIRICAL METHODOLOGY

Granger (1969, 1980) became well known for his GC test. He developed Robert Wiener's idea into a general definition of cause in dynamic stochastic systems (Hoover, 1988). The GC method regresses variable X on its own lagged values (X_{t-i}) and the lagged values of another variable Y (Y_{t-i}). Thus, serial correlation in the pair of variables is eliminated, and all that remains is the correlation between them. If the coefficients of the lagged values of Y are significant, then Y Granger causes X. Similarly, to substantiate the reverse possibility, one regresses Y on its own lagged values and lagged values of X. X Granger causes Y if the coefficients of the lagged values of X are significant. In summary, GC tests can be placed in one of four categories: No causality, X causes Y only, Y causes X only, and a bi-directional causality, i.e., X causes Y and Y causes X simultaneously.

Though Granger must be credited for laying the foundation, work by Sims (1972, 1980) helped promote and operationalize the GC test. Though many econometricians criticize the GC test, primarily due to problems of misleading inference, it is still important in helping to ascertain whether the current value of X influences future values of Y when Y's past is considered.[1]

The following are an overview of the steps involved in implementing the GC test. Detail descriptions of each step will follow in the subsequent sections:

   i. Test for the presence of a unit root using Augmented Dickey-Fuller Test (ADF).
   ii. Difference the data in the presence of unit root and conduct the ADF test again on the differenced data.
   iii. Exclude the countries where one of the variables is non-stationary and the other is stationary.
   iv. Estimate co-integration using the same order of integrated variables.
   v. Based on the co-integration results, use VAR or VEC to test causality.

The first step in the testing procedure is to determine whether the data have unit roots indicating the data is non-stationary. To formally test for the presence of a unit root, the ADF test is used. The regression equations below are used to test for a unit root.

$$\Delta X_t = \beta X_{t-1} + \sum_{i=2}^{p} \eta_i \, \Delta X_{t-1+i} + \varepsilon_t \tag{8}$$

$$\Delta X_t = \alpha_o + \beta X_{t-1} + \sum_{i=2}^{p} \eta_i \, \Delta X_{t-1+i} + \varepsilon_t \tag{9}$$

$$\Delta X_t = \alpha_o + \beta X_{t-1} + \delta t + \sum_{i=2}^{p} \eta_i \, \Delta X_{t-1+i} + \varepsilon_t \tag{10}$$

where Δ is the first difference operator

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[1] See Zelner (1988) for a detailed discussion.

X is logGDP (or logGDS)

p is the maximum lag length

ε is the stationary random error

t is the time.

In the absence of deterministic elements, α_o the drift term (intercept), and δt the linear time trend, equation 8 is a test for pure random walk. Basically, one would use the most general case and estimate a regression with both the drift term and linear time trend (equation 10), and step-by-step estimate the restricted equations 9 and 8, if the tests fail to reject the null hypothesis. The null hypotheses is that $\beta=0$ (unit root present). If β is negative and statistically significant, this indicates that the series has no unit root or is stationary.

In choosing maximum augmented lag length level p, six augmentation terms were used, and the lag-length is chosen based on the Schwarz Bayesian Criterion (SBC). Table 1 shows the ADF test results, indicating that LogGDP and LogGDS are non-stationary for 22 out of the 25 countries under investigation. In the presence of unit roots, LogGDP and LogGDS need to be first differenced. Results of testing the null hypothesis of the differenced series (DlogGDP and DlogGDS) are also given in Table 1. The results indicate that the unit root null hypothesis can be rejected at the 1% or 5% level in all but three cases of the differenced series. This implies that both variables are stationary after converting the series through first differencing. For Egypt, Malaysia, and the United States, one of the variables is non-stationary and the other is stationary. These three countries need to be excluded from the analysis because the causality test would lead to misspecification. The asymptotic distributions of the Granger causality test statistics are non-standard with non-stationary time series.

Given the results of unit roots, the second step is to estimate co-integration using the same order of integrated variables.[2] Each of the two variables that is I(1) in the 22 economies needs to be tested for co-integration.[3] To test for co-integration, the Johansen (1988) method was applied. The following λ_{trace} and λ_{max} test statistics were used to estimate the co-integration rank r, i.e., the number of independent co-integrating vector.

$$\lambda_{trace} (r) = -T \sum_{i=r+1}^{n} \ln (1-\lambda i) \qquad (11)$$

$$\lambda_{max} (r, r+1) = -T \ln(1-\lambda_{r+1}) \qquad (12)$$

where λ_i is the estimated values of characteristic root or the eigenvalues.

T is the number of usable observations.

For λ_{trace} statistics, the null hypothesis is that the number of co-integrating vectors is less than or equal to r against a general alternative. For example, if r = 0, a general alternative is r = 1,2,3,4….. For the λ_{max} statistics, the null hypothesis is the number of co-integrating vectors r against the alternative co-integrating vectors r + 1. For example, if r = 0, the alternative is r = 1. To test the hypothesis, Johansen critical values table based on simulation was used. The distribution of the statistics is subject to whether a constant or a drift term is included in the co-integrating vector and the number of non-stationary components under the null hypothesis.

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[2] A series is integrated of order (d) or I(d), if after being differenced d times, it becomes stationary.

[3] In the case where X_t and Y_t are both I(d) and linear combination exists, $Z_t = aX_t + bY_t$, and characteristic roots (c<0), X_t and Y_t are co-integrated.

The results of the Johansen test are presented in Table 3. If the rank of r is zero, the variables are not co-integrated. The null hypothesis of no co-integration was rejected at a maximum of one or two co-integrating vector at the lag length of p = 2 or 4 for the 18 countries. The two variables are not co-integrated for Nigeria, Chile, Colombia, and Canada.[4] The VAR method would be used to investigate causality in these four countries. On the other hand, for the 18 countries for which the two variables are co-integrated, the VEC was used to test causality.

The VAR model can be written as the following:

$$d \begin{bmatrix} \log GDP_t \\ \log GDS_t \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} + \sum_{i=1}^{s} d \begin{bmatrix} \phi_{11i} & \phi_{12i} \\ \phi_{21i} & \phi_{22i} \end{bmatrix} \begin{bmatrix} GDP_{t-i} \\ GDS_{t-i} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \tag{13}$$

where   d is the first difference or (1-L).

e_{it} is the white noise error.

s is the optimal lag length obtained from the SBC.

Determining appropriate lag length is important because a small value of optimal lag length s would lead to a misspecified model. On the other hand, a larger value of s would waste degrees of freedom. Usually for quarterly data, a lag length of 12 would be a good starting point. In this study, the data were available only annually; so a lag length of six was chosen. In all the countries under investigation, the optimal lag length was less than three.

The following SBC criterion was used to determine the appropriate lag length:

$$\text{SBC} = T \log \left| \Sigma \right| + N \log(T) \tag{14}$$

where $\left| \Sigma \right|$ = determinant of the variance/covariance matrix of the residuals.

N = total number of parameters estimated in all equations.

If the lag length is s, each of the n equations has *ns* coefficients plus the intercept, $N = n^2 s + n$.

Christiano and Ljungquist (1988) pointed out that if the variables are co-integrated, a VAR model in differences is misspecified.   The VEC model suggested by Engle and Granger (1987) is the appropriate choice and can be written as follows:

$$d \begin{bmatrix} \log GDP_t \\ \log GDS_t \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} + \sum_{i=1}^{s} d \begin{bmatrix} \phi_{11i} & \phi_{12i} \\ \phi_{21i} & \phi_{22i} \end{bmatrix} \begin{bmatrix} \log GDP_{t-i} \\ \log GDS_{t-i} \end{bmatrix} + \begin{bmatrix} \lambda_1 \\ \lambda_2 \end{bmatrix} [Z_{t-1}] + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \tag{15}$$

where, d is the first difference or (1-L).

e_{it} is the white noise error.

s is the optimal lag length obtained from the SBC as above.

Z_{t-1} is the error correction term lagged by one period (co-integration vector from Johansen test).

5.0 EMPIRICAL ANALYSIS

The hypothesis in the introduction of this study tested the direction of causality between economic growth and savings in different economic income classes. The ADF test indicates that both logGDP and logGDS have unit roots in the level data.   In the presence of unit roots, the variables need to be differenced in order for the series to be stationary. Without differencing the data, a causality test would lead to misspecification. By differencing logGDS, the series becomes

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[4] Based on Enders (1995) p.393, the conclusion was drawn for Nigeria and Colombia on the basis that λ_{max} test has a better alternative hypothesis and is preferred.

the growth rates of savings. Because of this technicality in the estimation issue, instead of looking at the causation direction between savings and economic growth, the hypothesis focuses instead on causation direction between the growth rates of savings and economic growth rate in countries with different income level.

Previous studies have either used gross domestic savings or ratio of savings to GDP (S/Y). Most of these studies used simple OLS estimation and cross-section data. Recent studies that use the Granger causality test to determine the relationship between savings and economic growth have to use the growth rate of savings, instead of savings, because of the unit root (non-stationary) problem. The asymptotic distributions of the Granger causality test statistics are non-standard with non-stationary time series.

Using the results of the Johansen test in Table 2, the logGDP and the logGDS of 18 countries that were co-integrated were estimated using the VEC model. In the four economies for which LogGDP and LogGDS were not co-integrated, VAR was used to estimate the Granger causality.

In looking at all the results in Table 3, only two countries (India and Ecuador) showed no obvious causality in either direction. Overall empirical results revealed that the economic growth rate Granger caused the growth rate of savings in 13 countries. On the other hand, in two cases (Indonesia and Singapore) the growth rate of savings Granger caused economic growth rate. Finally, five nations showed a bi-directional causality.

In the short run, the traditional view is that higher savings leads to higher investment and higher economic growth. The empirical results, however, do not provide evidence supporting the conventional view. Instead, in most countries under investigation, the empirical results show that the causality is from economic growth rate to growth rate of savings. This finding is in agreement with Sinha and Sinha (1998), Salz (1999), Sinha (1999), Sinha (2000), Anoruo and Ahmad (2001), and Baharumshah et al. (2003).

Turning to the results according to economic income class of countries, the major points to note are as follows: for the nine HICs under investigation (United States excluded), the empirical results provide some evidence on the direction of causality. For eight countries, the causality runs from economic growth rate to growth rate of savings. Only in Singapore, does the causality run from growth rate of savings to economic growth rate. The result is not surprising because Singapore has the forced savings system, Central Provident Fund.[5] In addition, gross domestic savings as a percentage of GDP in Singapore is around 50%, one of the highest savings rates in the world.

In UMCs (excluding Malaysia), the empirical results indicate that all of the countries show a bi-directional causality. This is an interesting finding since World Bank (1999) showed that the savings and economic growth for UMCs are generally high. The empirical results perhaps suggest that the countries are in transition to reach a similar steady state as the HICs. This is consistent with Quah's (1993) study, which revealed that middle-income countries are slowly vanishing.

Empirical results for LMCs also favor the notion that the causality runs from economic growth rate to growth rate of savings. Economic growth rate Granger causes growth rate of savings in Algeria, Thailand, and Colombia. However, there appears to be no causal relationship between the two variables in Ecuador. In all the LMCs under investigation (excluding Egypt), none show a causality that runs from growth rate of savings to economic growth rate.

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[5] In this enforced savings plan 40% of an employee's wages is saved; the employee contributes 20%, and the employer matches with another 20%.

In LICs, the empirical results were mixed. Senegal and Nigeria have a causality that runs from economic growth rate to growth rate of savings. However, no causal relationship exists in India. Only in Cote d'Ivoire was a bi-directional relationship found. These mixed results are probably correlated with the income divergence; Baumol (1986) empirically found that low-income countries diverge over time.

The primary goal of this study was to determine whether the direction of causality differs for countries with different income: namely LICs, LMCs, UMCs, and HICs. Based on the empirical results, the main conclusion of this study is that in LICs, a firm conclusion cannot be drawn in determining the direction of causality. In all of the LMCs, the causality is from economic growth rate to growth rate of savings. In all of the HICs, except Singapore, the causality is from economic growth rate to growth rate of savings. However, it appears that in UMCs bi-directional causality is more prevalent. The empirical evidence appears to favor the hypothesis that the economic growth rate causes growth rate of savings. In Table 3 is a summary of the direction of causality based on the empirical results.

6.0 CONCLUSION

Theoretically, the Solow model and the club convergence theory provide a basis for expecting different causality for various income per capita levels. A number of cross-country studies showed the catching up effect to various clubs based on a nation's initial per capita income. The primary purpose of this paper was to investigate the relationship between the domestic savings and economic growth for various economies. Using time series annual data, Granger causality tests were conducted. The objective was to determine whether the direction of causality in these economies differed according to their income class: namely LIC, LMC, UMC, and HIC. In general, empirical results suggest that the economic growth rate Granger causes growth rate of savings in 13 countries. The opposite results prevailed in two countries. In five countries, a bi-directional causation was found. In this study, the direction of causality is somewhat consistent with the theory, especially in the case of UMCs and HICs.

In summary, based on the results, the study favors the hypothesis that the causality is from economic growth rate to growth rate of savings. Based on the empirical results, the main conclusion of this study is that income class of a country does play an important role in determining the direction of causality. In LICs the empirical results were mixed. In most of LMCs, the causality is from economic growth rate to growth rate of savings. In all HICs except Singapore, the causality is from economic growth rate to growth rate of savings. However, it appears that in UMCs, bi-directional causality is more prevalent.

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Table 1: Results of ADF Test

Ho: Unit root vs H1: No unit root										

Low-Income (LIC)

	Cote d'Ivoire		Indonesia		India		Nigeria		Senegal	
Variable	ADF		ADF		ADF		ADF		ADF	
LogGDP	-1.71		-2.71		-2.78		-1.09		-2.41	
D(LogGDP)	-5.31	***	-4.52	***	-6.45	***	-7.68	***	-8.18	***
Log GDS	-2.33		-3.51		-2.12		-1.33		-2.91	
D(LogGDS)	-5.79	***	7.75	***	-6.08	***	-6.09	***	-3.11	**

Lower-Middle income (LMC)

	Algeria		Colombia		Ecuador		Egypt		Thailand	
Variable	ADF		ADF		ADF		ADF		ADF	
LogGDP	-1.09		-0.28		-0.12		-2.07		-1.65	
D(LogGDP)	-7.68	***	-4.37	***	-4.99	***	-3.71	**	-3.82	**
Log GDS	-1.32		-1.55		-1.77		-3.70		-2.95	
D(LogGDS)	-6.09	***	-6.22	***	-5.96	***	-	**	-5.66	***

Upper-Middle Income (UMC)

	Argentina		Brazil		Chile		Malaysia		South Africa	
Variable	ADF		ADF		ADF		ADF		ADF	
LogGDP	-2.03		-0.46		-1.02		-1.97		-2.15	
D(LogGDP)	-5.51	***	-3.98	**	-4.63	***	-5.18	***	-5.18	***
LogGDS	-1.76		-0.91		-1.88		-5.06	***	-2.25	
D(LogGDS)	-5.19	***	-4.99	***	-8.00	***	-		-5.27	***

High-Income (HIC)

	Canada		Finland		Iceland		Japan		Korea	
Variable	ADF		ADF		ADF		ADF		ADF	
LogGDP	-2.01		-2.10		-2.63		-1.96		-1.06	
D(LogGDP)	-4.59	***	-3.64	**	-3.96	***	-4.22	***	-6.06	***
LogGDS	-2.51		-2.65		-2.61		-1.53		-2.59	
D(LogGDS)	-5.26	***	-5.13	***	-7.58	***	-3.69	**	-11.28	***

	Norway		Singapore		Sweden		United Kingdom		United States	
Variable	ADF		ADF		ADF		ADF		ADF	
LogGDP	-1.19		-1.56		-3.45		-3.45		-4.07	
D(LogGDP)	-3.85	**	-3.69	**	-4.11	***	-4.45	***	-	**
LogGDS	-1.88		-1.40		-1.69		-2.56		-2.30	
D(LogGDS)	-5.06	***	-3.65	**	-4.76	***	-5.42	***	-5.48	***

Note: ADF regression equation: $\Delta X_t = \alpha_o + \beta X_{t-1} + \delta t + \sum_{i=2}^{p} \eta_i \, \Delta X_{t-1+i} + \varepsilon_t$

***   denotes significant at 1% critical value.

**   denotes significant at 5% critical value.

LogGDP and LogGDS are series in level.

D(LogGDP) and D(logGDS) are first differenced series.

Table 2: Co-integration Results

Country	λTrace	λmax
India	23.51***	21.14***
Indonesia	30.10***	20.56***
Senegal	23.13***	17.91***
Cote d' Ivoire	21.36***	20.16***
Nigeria[#]	16.63**	12.49
Algeria	20.56**	18.67**
Thailand	18.38***	11.76**
Colombia[#]	15.20**	10.94
Ecuador	22.41**	16.36**
South Africa	24.81***	16.94**
Brazil	17.98***	16.61***
Argentina	25.22***	20.90***
Chile	11.01	9.09
Norway	20.68***	15.22**
Canada	9.18	9.13
Japan	31.57***	26.44***
Singapore	24.08***	18.23**
Korea	33.20***	21.78***
United Kingdom	18.83***	12.27**
Finland	29.01***	23.58***
Iceland	21.18***	14.44**
Sweden	25.03***	17.88**

Note: ****, ** denote significant at 1% and 5%, respectively.*
 # According to Enders (1995) λ_{max} test has a
better alternative hypothesis and preferred .

Table 3: Granger Causality Results Based on Income Classification

Country	Growth rate of savings to economic growth rate	Economic growth rate to growth rate of savings
Low- Income (LIC)		
India	No	No
Indonesia	Yes	No
Senegal	No	Yes
Cote d' Ivoire	Yes[#]	Yes [#]
Nigeria	No	Yes
Lower-Middle Income (LMC)		
Algeria	No	Yes
Thailand	No	Yes
Colombia	No	Yes
Ecuador	No	No
Egypt	--	--
Upper-Middle Income (UMC)		
Malaysia	--	--
South Africa	Yes[#]	Yes[#]
Brazil	Yes#	Yes#
Argentina	Yes[#]	Yes[#]
Chile	Yes[#]	Yes[#]
High-Income (HIC)		
United States	--	--
Norway	No	Yes
Canada	No	Yes
Japan	No	Yes
Singapore	Yes	No
Korea	No	Yes
United Kingdom	No	Yes
Finland	No	Yes
Iceland	No	Yes
Sweden	No	Yes

Note: **#**   bi-directional causality
       --   excluded

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