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The Investing–Saving Relationship Debate Between Opposing Views: A Panel Analysis Across Main Economic Regions

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Abstract

This paper focuses on an empirical analysis of the relationship between investing and saving, taking into account various economic regions. The economic aggregates are selected following the International Monetary Fund (IMF) standard classification. The investigation is developed within the theoretical frameworks proposed by the debate between the mainstream neoclassical school of thought and the post-Keynesian school. Our approach differs from other empirical works on the subject in that we apply innovative Granger non-causality panel tests to four datasets covering a wide range of countries over the period 1980 to 2024. This is the very first time these advanced panel tests have been applied to such data. The information is valuable for defining macroeconomic policy and supporting potential credibility of one theory over another in the debate. Our empirical results are coherent with the post-Keynesian interpretation of the relationship between the variables when applied to an international context in which trade and capital movements are liberalized.

Keywords: investments; savings; panel data causality; Granger non-causality

1. Introduction

The increase in liberalization in international capital movements produced effects on the relationship between investment and (domestic) saving, spurring a considerable debate (Argimòn & Roldàn, 1994; Pata, 2018). On the theoretical side two paradigms (the post-Keynesian and the neoclassical) try to explain the nexus of the variables within a coherent framework. The fundamental difference between these views can be summarized in the mechanism that acts on the economy. In the post-Keynesian approach, the causal relationship goes from investment to saving (investments precede savings). This requires neither prior saving nor deposit (Lavoie, 2006). While for the neoclassical approach, the exact opposite is true. The different perspectives have significant practical implications going beyond mere academic interests in intellectual speculation.

The purpose of this study is to investigate the causal relationship between the variables by using several panels of countries. Each panel is built as an aggregate according to the country group IMF classification methodology. Thus, the main focus is on to explore whether the sub-samples (and therefore the basic economic conditions) differ—there is a theory that is better suited to explaining the dynamics of the economic systems in question.

The paper adds to literature in two ways. Empirically, to the best of the author's knowledge, the work contributes to the subject by applying a highly innovative Granger non-causality test that has never been applied to these specific aggregates covering such a long time span. Additionally, to fill a gap existing in the literature by focusing the analysis

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on a clear distinction between neoclassical and post-Keynesian models, it seeks to shed light on the development paths taken by countries belonging to different economic areas in order to highlight potential discrepancies.

It is also worth noting here that, overall, the empirical outcomes seem to support the post-Keynesian interpretation of the mechanism relating the two variables object of study. This is due to an interpretative variant of the model that takes into account international interactions through the link between export and imports. For both theories, in fact, it is not possible to draw a clear-cut conclusion on the basis of the standard mechanism they believe drives the various phases. From the perspective of practical economic policy implications, these results seem to support the idea that demand should drive the investment process. In this regard, governments action should prioritize programs aimed at increasing demand without placing excessive emphasis on investment, which may not find adequate outlets on the markets.

The paper is organized as follows. Section 2 gives some backgrounds on the literature pertaining the topic. Section 3 is divided into two sub-sections. The first provides a description of the data and which countries are included in each single panel that identifies the relevant economic areas (see also the Table A1 in the Appendix A.1). The second sub-section explains the methodology. Section 4 is also divided into two sub-sections. The first is focused on the panel structures, and the second presents and comments on the empirical results. Section 5 concludes.

2. Two Opposing Paradigms

The debate on the link between investment and savings stems from the different interpretative theoretical frameworks driving the underlying mechanisms. The first position is supported in the post-Keynesian heterodox school of thought (Kaldor, 1955; McCombie & Thirlwall, 2004; Robinson, 1962). The second paradigm is the one held by the economists who refer to neoclassical theory.

According to the first paradigm, the causality between investment and saving runs from the former to the latter (INV leads SAV). The demand-led characteristics of the mechanism originates from the expectations of entrepreneurs to increase their profit from a raise of the market-demand acting as a trigger (Keynes, 1936; Davidson, 2011). A noteworthy role is played by the banking system having the capacity to address the raise in credit applications (endogenous nature of money supply). The overall sequence considers that an increase in the initial investment (capital growth based on demand expectations) turns into output and income per capita growth determining the final increase in the saving rate (Nell, 2012). In this environment, demand expectations or psychological factors are crucial elements for investors' decisions (Harvey & Pham, 2023). In contrast with the hypothesis of diminishing returns, Verdoorn (1949) and Kaldor (1966) advocate for increasing returns to scale due to the positive relationship between the demand and the productivity growth.

For what concerns the dominant neoclassical paradigm supported by the mainstream economists, there exists two variants: the "endogenous" (Lucas, 1988; Grossman & Helpman, 1991) and "exogenous" version (Solow, 1956, 1957; Barro, 1997; Mankiw et al., 1992). The causality between investment and saving is exactly the opposite of the previous one (SAV leads INV). The triggering mechanism lies in the increase in saving leading to a resulting capital growth. In the "endogenous" interpretation the initial stimulus originates from a higher propensity to save. While in the "exogenous" variant there is a policy-induced intervention. Due to the law of diminishing returns, each subsequent capital growth is lower than the previous one, and the mechanism acts through changes in relative prices (the interest rate for capital and the wage rate for labor). A lower interest rate (cost of capital) pushes entrepreneurs (supply-side view) to more capital-intensive technologies

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with a resulting equilibrium characterized by a higher capital and income per capita. All savings are employed in investments (Dutt, 2006).

The progressive openness of economies to international trade and capital flows introduced further elements of complexity to the question.

From a post-Keynesian perspective, this opens up the possibility of a two-way link between the same variables when an economy operates below its maximum potential growth rate. This specific case is labeled as "the current account long-run solvency model"(Coakley et al., 1996; Nell & Santos, 2008). In such a framework the bidirectionality of the causal relationship is advocated considering that investments must generate their own savings to contribute to the sustainability of the (potential) current account deficit. Thirlwall (2002), McCombie (2004) and McCombie and Thirlwall (2004) related the import–export variables to the current account solvency.

On the contrary, in the neoclassical paradigm the direction of causality "from saving to investment" becomes a binding condition if international capital mobility is also taken into account. Capitals (or in other words, savings) flow from countries having lower productive investments to countries having the most productive ones, relaxing the domestic saving–domestic investment relation (Feldstein & Horioka, 1980). Investors/entrepreneurs may resort to foreign capital inflows to drive capital growth (Temsas, 2024). The capital flows exert a pivotal role in cross-border positions (Lane & Milesi-Ferretti, 2018).

Considering the empirical research on the subject, it should be noted that extensive research attention has been focused on the "Feldstein–Horioka puzzle", but a consensus has yet to be reached (Irandoust, 2019). The cointegration relationship between the variables is the object of analysis in Jos Jansen (1996), Payne (2005), Chakrabarti (2006) and Singh (2008). The size of the country in affecting the short-run relationship between the variables is investigated in Harberger (1980), Murphy (1984), Baxter and Crucini (1993) and Bahmani-Oskoee and Chakratbarti (2005). The influence of technological or productivity shocks in affecting the direction in causality coherently with the neoclassical paradigm is discussed in Rasin (1993), Glick and Rogoff (1995), Seshaiah and Vuyuri (2005), Roche Seka (2011) and Behera et al. (2024). Nguyen (2025) and Travkina et al. (2022) support the idea that savings play a leading role in the relationship. Instead, the empirical causal bidirectional nature of the relationship is pointed out by Mishra et al. (2010) and more recently—within a coherent theoretical framework in the post-Keynesian perspective—in Focacci (2025). Di Domenico et al. (2024) argue that the effect exerted by initial financing (the existing stock of wealth) on the investment–savings mechanism within the endogenous monetary process is temporary in nature.

3. Three Research Hypotheses

In order to clearly formalize the scope of investigation, three research hypotheses are formulated as follows:

H_1. *The strictly neoclassical framework wherein saving leads (Granger cause) investment (SAV $\Rightarrow$ INV or INV $\nRightarrow$ SAV; from here on the symbol $\Rightarrow$ will be used for "leads" or "does Granger cause", while the symbol $\nRightarrow$ will be used for "does not Granger cause").*

H_2. *The strictly post-Keynesian framework wherein investment leads (Granger cause) saving (INV $\Rightarrow$ SAV or SAV $\nRightarrow$ INV).*

H_3. *Some variants of the previous two theories wherein there is a bidirectional relationship (simultaneous Granger causality) between variables (SAV $\Leftrightarrow$ INV). As pointed out, this bidirectional relation is coherent with the post-Keynesian perspective advocated within "the current account long-run solvency model".*

4. Data and Methodology Framework

4.1. Data Description

The research goal is to develop an empirical investigation into the lead–lag relationship between investment and saving in order to understand whether such a relationship can be better described within a neoclassical or a post-Keynesian framework. As a corollary, it is possible to evidence potential existing differences in political stances across aggregates. To pursue the aim, we retrieved data from the World Economic Outlook (WEO) database (IMF, 2025a, 2025b, 2025c, 2025d). The time span covers the period from 1980 to 2024 (T), based on the availability of annual data for the Total Investment (INV) as a percentage of GDP (I/Y) and the Gross National Savings (SAV) as a percentage of GDP (S/Y). The country groups are processed following the IMF classification as reported within the WEO to have an international standard. In detail, we consider these aggregates: Major advanced economies (G7), Euro Area (EA), Emerging and developing Asia (EDA) and sub-Saharan Africa (SSA). Due to the presence of discontinuous time figures, not all units can be included. We deleted some countries to keep the specific panel balanced and to obtain the longest possible time series. The whole list of original units and the final selection in each aggregate is included in Table A1 in Appendix A.1.

To proceed in the elaboration, we first derive the rate of change (ROC) of the variables in percentage terms on an annual basis for each region. Hereafter, the ROC of INV and SAV will be used in the calculations. Their descriptive statistics are resumed in Table 1.

Table 1. Descriptive statistics of the ROC of the INV and SAV variables.

Aggregate	Units of the Panel	Variable	N	Mean	Median	SD	Min	Max	Skewness	Kurtosis
G7	7	INV	308	−0.23	0.29	4.97	−21.24	22.92	−0.36	5.77
		SAV	308	0.10	0.38	5.78	−21.35	20.44	0.16	4.14
EA	14	INV	616	−0.35	−0.10	9.60	−45.57	90.49	1.44	17.93
		SAV	616	0.54	0.43	12.36	−51.79	147.69	3.57	42.11
EDA	11	INV	484	2.29	0.74	19.29	−76.99	160.67	2.29	18.85
		SAV	484	−8.07	0.17	136.82	−2833.33	291.66	−18.48	378.08
SSA	33	INV	1452	4.26	0.00	114.43	−621.37	4132.08	32.21	1169.03
		SAV	1452	5.45	−0.58	252.10	−3710.87	5185.15	5.07	179.69

Source: Author's calculations in Eviews on IMF (2025a, 2025b, 2025c, 2025d).

4.2. Methodology

The idea behind the research process is based on a rigorous analysis of causal nexus through the lead–lag analysis between the variables. Explicit attention is paid to the bivariate framework on which theories define the mechanism of action. Potential covariates (for example, GDP per capita, trade openness, financial depth, current account balance or others) that could affect both saving and investment, as might be the case in structural models (Mouchart et al., 2020), are not included. This is a deliberate choice rooted in the theoretical framework that underlies the analysis and the debate between different views. The search is for a potential leading role of one variable over the other one within the system coherently with the two opposing paradigms. The analysis is fully data driven without any imposed constraint that might appear to skeptics as a distortion. Thus, in this specific context GDP per capita is already proxied in S. In fact, coherently with national accounts relationships, S is obtained detracting from income (Y) consumption expenditures (C) and government expenditures (G). Its inclusion is redundant and, in statistical terms, it is susceptible to collinearity issues. Additionally, the introduction of further "control variables" may appear more as an econometric artifact than as an appropriate empirical and straight investigation of the theories. The above cited Feldstein and Horioka (1980) contribution analyses the capital mobility assuming a strict one-way relationship (from saving to investment). This makes it possible to disregard the time sequence in the sub-steps that relate changes in relative prices (supply-led model) or the increases in bank credit anticipating growth expectations (demand-led model). Given these methodological premises, our procedure is proposed into two steps.

First, panel properties are investigated in order to obtain the information needed for proper elaboration. Thus, it is important to preliminarily explore the presence of specific cross-sectional dependence (CSD). CSD arises when each individual panel unit reacts not only to its own specific idiosyncratic shock but also to common shock across members. In addition, we propose the slope heterogeneity using Pesaran and Yamagata's procedure (Pesaran & Yamagata, 2008) in its robust standard errors option (Blomquist & Westerland, 2013). The importance of this test is related to the reckoning of the different dynamics that characterize the panel members in case of heterogeneity across them. In such a case, stationarity properties must be investigated by adopting the so-called "first generation panel unit root tests". To this aim, we run four widely accepted tests: the Levin et al. (2002), the Im et al. (2003) and the Fisher type procedures using ADF and PP tests (Maddala & Wu, 1999; Choi, 2001). Instead, when the panel is also characterized by the presence of CSD, the adoption of "second generation unit root tests" is more appropriated (Hurlin & Mignon, 2007; Barbieri, 2009). In detail, this second issue is accomplished by running both the Bai & Ng test (Bai & Ng, 2004, 2010) and the Pesaran (2007) procedure. The empirical significance of both heterogeneity and CSD issues in Granger panel analysis can be found in Nazilog̃lu and Karul (2024) and Lopez and Weber (2017) as well.

Second, our focus is on Granger causality between INV and SAV. The Granger model (Granger, 1969) is a well-known technique used within economic studies to investigate the lead–lag relationship between variables. In this context, the term "Granger causes" is adopted to describe a situation in which a first event x_t is said "to cause" a second event y_t if the information content of the x_t has predictive power for the y_t. To pursue our causal analysis, the very recent Juodis et al. (2021) technique (JKS) is proposed. This test fits well with both homogeneous and heterogeneous panels (Xiao et al., 2023), with the Half-Panel Jacknife approach developed by Dhaene and Jochmans (2015) as the basis for its efficiency. Xie et al. (2022) highlight that traditional bidirectional causality models tend to overlook asymptotic size (the "so called" Nickell bias) and, on this specific aspect, the JKS combined with the GMM approach of Holtz-Eakin et al. (1988) is more interesting when T is (even moderately) large. With respect to the Dumitrescu & Hurlin (D-H) non-causality test (Dumitrescu & Hurlin, 2012), which is a less recent Granger non-causality procedure, the JKS is not affected by substantial size distortion in the case of much smaller values of T than N (Xiao et al., 2023). In the present work, the D-H method is applied as a second procedure to investigate the data (related details can be found in the Appendix A.2). The D-H procedure was developed about a decade before the JKS methodology, and we thought it would be interesting to compare them.

Hereunder are the fundamental steps needed to calculate the JKS statistical indicator (W_{HPJ}). Interested readers can find further details in the seminal work by Juodis et al. (2021). The starting point of the JKS procedure is the regression equation:

$$y_{i,t} = \alpha_I + \sum_{k=1}^{K} \gamma_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} x_{i,t-k} + \varepsilon_{i,t} \text{ with i} = 1, \ldots, N \text{ and t} = 1, \ldots, T. \quad (1)$$

wherein $x_{i,t}$ and $y_{i,t}$ are the stationary observations of the variables for individual i in period t. The panel must be balanced with the lag order assumed to be identical for each individual. The coefficients are allowed to differ across individuals through the subscripts i for each period t, and they are assumed to be time invariant. The Formula (1) can be rearranged in the following form:

$$y_{i,t} = z'_{i,t}\gamma_i + x'_{i,t}\beta_i + \epsilon_{i,t} \tag{2}$$

having $z_{i,t} = (1, y_{t-1}, \ldots, y_{t-k})'$, $x_{i,t} = (x_{i,t-1}, \ldots, x_{i,t-k})'$, $\gamma_\iota = (\gamma_{0,\iota}, \ldots, \gamma_{k,i})'$ and $\beta_\iota = (\beta_{1,\iota}, \ldots, \beta_{K,\iota})'$. As in the D-H method, an average Wald statistic $\overline{W}$ is obtained from the individual W_i, through the F tests of the K linear hypothesis $\beta_{\iota!} = \cdots = \beta_{\iota K} = 0$ and the N regression from (1):

$$\overline{W} = 1/N \sum_{i=1}^{N} W_i \tag{3}$$

Coherently with the panel structure, to test the null hypothesis (H_0), the two standardized statistics ($\overline{Z}$ and $\widetilde{Z}$) can be used (Lopez & Weber, 2017):

$$\overline{Z} = (N/2K)^{0.5} \times (\overline{W} - K) \text{ the distribution } \longrightarrow N(0,1) \text{ with } T, N \longrightarrow \infty \tag{4}$$

$$\widetilde{Z} = \left(N/2K \times \frac{T-3K-5}{T-2K-3}\right)^{0.5} \times \left(\frac{T-3K-3}{T-3K-1} \times \overline{W} - K\right) \text{ the distribution } \longrightarrow N(0,1) \text{ with } N \longrightarrow \infty. \tag{5}$$

Stacking the (5) over time, the subsequent (6) is obtained:

$$y_i = Z_i\gamma_I + X_i\beta_\iota + \varepsilon_\iota \tag{6}$$

having $y_t = (y_{i,1}, \ldots, y_{i,T})'$, $Z_i = (z_{i,1}, \ldots, z_{i,T})'$, $X_i = (x_{i,1}, \ldots, x_{1,T})'$ and $\varepsilon_\iota = (\varepsilon_{I,1}, \ldots, \varepsilon_{i,T})'$. Under the null hypothesis ($\beta_i = \beta = 0$), the pooled least-squares estimator of β is equal to

$$\hat{\beta} = \left(\sum_{i=1}^{N} X'_i M_{Zi} X_i\right)^{-1} \left(\sum_{i=1}^{N} X'_i M_{Ziyi}\right) \tag{7}$$

In the (7) $M_{Zi} = I_T - Z_i(Z'_iZ_i)^{-1}Z'_i$, and Fernández-Val and Lee (2013) showed that as $N,T \longrightarrow \infty$ with $N/T \longrightarrow k^2 \in [0; \infty]$ under general conditions, this relationship holds as follows:

$$N^{1/2}(\hat{\beta} - \beta_0) \longrightarrow J^{-1}N(-kB, V) \tag{8}$$

with $J = \text{plim}_{N,T\to\infty}(NT)^{-1}\sum_{i=1}^{N} X'_iM_{Zi}X_i$, V is the variance–covariance matrix, and B is the bias related to the same order of both N and T. To address both size distortion and parametric bias, Dhaene and Jochmans (2015) proposed the Hal-Panel Jackknife estimator (HPJ, or $\widetilde{\beta}$):

$$\widetilde{\beta} = \hat{\beta} + \left[\widetilde{\beta} - 0.5\left(\widehat{\beta_{1/2}} + \widehat{\beta_{2/1}}\right)\right] = \hat{\beta} + T^{-1}\hat{B} \tag{9}$$

In the (9), the $\widehat{\beta_{1/2}}$ represents the estimator calculated as in the (7), obtained through the first half of the time series observations in all units. Correspondingly, the $\widehat{\beta_{2/1}}$ is obtained using the second half of all units included in the time series. From these steps, the Wald statistics for Granger non-causality $\widehat{W_{HPJ}}$ can be defined for $N,T \longrightarrow \infty$ with $N/T \longrightarrow k^2 \in [0, \infty]$ as:

$$\widehat{W_{HPJ}} = NT\widetilde{\beta}'\left(\widehat{J^{-1}}\hat{V}\widehat{J^{-1}}\right)^{-1}\widetilde{\beta} \longrightarrow \chi^2(P) \tag{10}$$

with $\hat{J} = (NT)^{-1} \sum_{i=1}^{N} X'_iM_{Z,i}X_i$.

We investigate both the short, medium and long run. To this aim, the analysis includes various lags in the tests (2, 5 and 9). This choice is driven by a couple of reasons. Firstly, macroeconomic policies do not have immediate impacts, and to appreciate a short-run effect a couple of years is considered a minimum reasonable time period. The other time horizons (5 and 9) are taken from economic literature on cycles (Reijnders, 2009), which considers both Kitchin (3–5 years) and Juglar cycles (7–9 years) to define the medium and long term.

5. Results and Discussion

5.1. Panels Structure Analysis

The very first analysis pertains to the CSD properties of the panels. Due to the specific structure ($T > N$), we apply the two most appropriated tests: the Breusch and Pagan Lagrange Multiplier procedure (Breusch & Pagan, 1980) and the Lagrange Multiplier (Pesaran, 2021). Outcomes are resumed in Table 2. As can be seen, the majority of cases denote the presence of CSD except for G7 and EDA in the SAV variable.

Table 2. Cross-section dependence test.

Aggregate	*N*	Dependent Variable	Breusch-Pagan LM	*p*-Value	Pesaran Scaled LM	*p*-Value
G7	7	INV	68.68	0.00	7.35	0.00
		SAV	27.08	0.17 *	0.84	0.35 *
EA	14	INV	470.17	0.00	28.11	0.00
		SAV	180.79	0.00	7.40	0.00
EDA	11	INV	105.17	0.00	4.78	0.00
		SAV	73.94	0.05 *	1.81	0.07 *
SSA	33	INV	766.07	0.00	7.33	0.00
		SAV	660.23	0.00	4.07	0.00

Source: Author's calculations in Eviews on IMF (2025a, 2025b, 2025c, 2025d). * denotes the lack of CSD at 0.05 level.

Furthermore, as explained in the previous section, the slope heterogeneity test is calculated. This information is useful for the adoption of the most appropriated unit-root test to investigate the stationary properties of the panel (Table 3).

Table 3. Pesaran and Yamagata slope heterogeneity test.

Aggregate	*N*	Dependent Variable	Δ	*p*-Value	Δ Adusted	*p*-Value
G7	7	INV	−1.50	0.13 *	−1.56	0.12 *
		SAV	1.65	0.10 *	1.71	0.09 *
EA	14	INV	3.25	0.00	3.36	0.00
		SAV	2.26	0.02	2.34	0.02
EDA	11	INV	3.65	0.00	3.78	0.00
		SAV	1.81	0.07 *	1.88	0.06 *
SSA	13	INV	4.04	0.00	4.19	0.00
		SAV	4.74	0.00	4.92	0.00

Source: Author's calculations in Stata SE 17.0 on IMF (2025a, 2025b, 2025c, 2025d). * denotes heterogeneity.

The results relating to stationarity for the various aggregates are shown in Table 4. As can be seen from the outcomes for both variables and all the aggregates, the presence of unit roots is not evidenced.

Table 4. Panel unit root tests for the various aggregates following the CSD property of each variable.

Aggregate	Variable	Test	Deterministics	ADF Lag Selection	Pooled Statistic	Prob
G7	INV	Levin et al.	Individual intercept	AIC automatic sel	t stat −13.82	0.00 *
		Im et al.	Individual intercept	AIC automatic sel	W-stat −12.74	0.00 *
		ADF-Fisher	Individual intercept	AIC automatic sel	Chi-square 154.33	0.00 *
		PP-Fisher	Individual intercept	AIC automatic sel	Chi-square 164.81	0.00 *
	SAV	Levin et al.	Individual intercept	AIC automatic sel	t stat −16.96	0.00 *
		Im et al.	Individual intercept	AIC automatic sel	W-stat −15.82	0.00 *
		ADF-Fisher	Individual intercept	AIC automatic sel	Chi-square 195.56	0.00 *
		PP-Fisher	Individual intercept	AIC automatic sel	Chi-square 196.55	0.00 *
EA	INV	Bai and Ng (PANIC)	NO constant MQC	AIC max lag = 7	+/− inf	0.00 *
		Pesaran CIPS	no costant	AIC max lag = 7	−3.45	<0.01 *
		Truncated CIPS			−3.41	<0.01 *
	SAV	Bai and Ng (PANIC)	NO constant MQC	AIC max lag = 7	+/− inf	0.00 *
		Pesaran CIPS	no constant	AIC max lag = 7	−5.58	<0.01 *
		Truncated CIPS			−5.12	<0.01 *
EDA	INV	Bai and Ng (PANIC)	NO constant MQC	AIC max lag = 6	+/− inf	0.00 *
		Pesaran CIPS	NO constant	AIC max lag = 6	−5.78	<0.01 *
		Truncated CIPS			−5.18	<0.01 *
	SAV	Levin et al.	Individual intercept	AIC automatic sel	t stat −21.29	0.00 *
		Im et al.	Individual intercept	AIC automatic sel	W-stat −20.49	0.00 *
		ADF-Fisher	Individual intercept	AIC automatic sel	Chi-square 316.31	0.00 *
		PP-Fisher	Individual intercept	AIC automatic sel	Chi-square 331.72	0.00 *
SSA	INV	Bai and Ng (PANIC)	NO constant MQC	AIC max lag = 9	+/− inf	0.00 *
		Pesaran CIPS	NO constant	AIC max lag = 9	−3.50	<0.01 *
		Truncated CIPS			−3.33	<0.01 *
	SAV	Bai and Ng (PANIC)	NO constant MQC	AIC max lag = 9	+/− inf	0.00 *
		Pesaran CIPS	Constant	AIC max lag = 9	−3.72	<0.01 *
		Truncated CIPS			−3.43	<0.01 *

Source: Author's calculations in Eviews on IMF (2025a, 2025b, 2025c, 2025d). Notes: Bai and Ng (2004, 2010)-PANIC: the * rejects the null hypothesis of no cointegration of the idiosyncratic errors (unit root null). It denotes stationarity (0.05 level). MQC is a PANIC option based on a VAR(1) representation and corrects for the serial correlation of arbitrary form through a non-parametric estimation. The automatic factor selection supports long-run variance options (Öncel et al., 2024). Pesaran (2007): the * rejects the null hypothesis of unit roots at the reported significance level. Levin et al. (2002), Im et al. (2003), ADF Fisher type test and PP test (Maddala & Wu, 1999; Choi, 2001): the * rejects the null of unit roots at the 0.05 significance level. Lag selection based on the automatic procedure based on the number of elements of the sample following the AIC criterion.

5.2. Panel Granger Non-Causality Test

In this sub-section, the outcomes from the JKS and the D-H procedures are resumed within Tables 5 and 6. The detailed calculations can be found in Appendix A.3 (Table A2a,b).

To simplify the reading of the results of the tests, hereunder we present Table 5 in a "binary logic", wherein a "1" is used when the null hypothesis is confirmed and a "0" in the opposite case.

Our results support that SAV $\nRightarrow$ INV only in the case of $SSA_{2,5}$. The subscripts 2,5 indicate the lag number selected following the logic explained in the Methodology paragraph, and in this case for SSA represent the relationship between the variables in the short (2) and medium (5) term.

To couple these results with the original research hypothesis, it is possible to advocate that they are coherent with PK framework (hypothesis labeled as H_2). An attentive reader will not fail to notice that in this sense it is the outcome for EA_2 too. Nevertheless, for the same aggregate—as can be appreciated from the Table—the very opposite holds (INV$\nRightarrow$ SAV), both relationships appear to be valid, and thus for EA in the short-run (lag 2), we cannot draw a definitive conclusion. The same interpretation holds in the case of similar results. The inverse relationship (INV $\nRightarrow$ SAV) is observed only for the $G7_5$ case. This finding is coherent with the neoclassical construct (H_1 hypothesis). The full list of other outcomes are inconclusive in detecting a clear one-way direction of the relationship. This seems to confirm or make hypothesis H_3 (INV ⇔ SAV) more likely.

Table 5. Summary of the outcomes of the JKS test.

Aggregate	Hypothesis	Lag	JKS	Aggregate	Hypothesis	Lag	JKS
G7	H_1: SAV ⇏ INV	2	0	EA	H_1: SAV ⇏ INV	2	1
		5	0			5	0
		9	-			9	0
	H_2: INV ⇏ SAV	2	0		H_2: INV ⇏ SAV	2	1
		5	1			5	0
		9	-			9	0
	H_3: INV ⇔ SAV	2	1		H_3: INV ⇔ SAV	2	1 *
		5	0			5	1
		9	-			9	1
EDA	H_1: SAV ⇏ INV	2	0	SSA	H_1: SAV ⇏ INV	2	1
		5	0			5	1
		9	0			9	0
	H_2: INV ⇏ SAV	2	0		H_2: INV ⇏ SAV	2	0
		5	0			5	0
		9	0			9	0
	H_3: INV ⇔ SAV	2	1		H_3: INV ⇔ SAV	2	0
		5	1			5	0
		9	1			9	1

Source: Author's elaboration of Table 5. Notes: the * denotes that both H_1 and H_2 cannot be rejected and a bidirectional relationship holds.

Table 6. Summary of the outcomes of the D-H test.

Aggregate	Hypothesis	Lag	D-H	Aggregate	Hypothesis	Lag	D-H
G7	H_1: SAV ⇏ INV	2	1	EA	H_1: SAV ⇏ INV	2	0
		5	1			5	1
		9	1			9	1
	H_2: INV ⇏ SAV	2	1		H_2: INV ⇏ SAV	2	0
		5	0			5	0
		9	1			9	1
	H_3: INV ⇔ SAV	2	1 *		H_3: INV ⇔ SAV	2	1
		5	0			5	0
		9	1 *			9	1 *
EDA	H_1: SAV ⇏ INV	2	1	SSA	H_1: SAV ⇏ INV	2	0
		5	0			5	0
		9	0			9	0
	H_2: INV ⇏ SAV	2	1		H_2: INV ⇏ SAV	2	0
		5	1			5	0
		9	1			9	0
	H_3: INV ⇔ SAV	2	1 *		H_3: INV ⇔ SAV	2	1
		5	0			5	1
		9	0			9	1

Source: Author's elaboration of Table 6. Notes: the * denotes that both H_1 and H_2 cannot be rejected and a bidirectional relationship holds.

For what concerns the D-H test, the results are resumed in Table 6 by using the same "binary logic" applied to Table 5.

From these latter outcomes, we draw that H_1 holds for $EDA_{5,9}$, supporting the strictly neoclassical hypothesis for this aggregate in the medium and long run, while H_2 is supported in the cases of $G7_5$ and EA_5 (medium term). The cases of $G7_{2,9}$ EA_9 and EDA_2

have the same interpretation already evidenced for EA_2 in the JKS test. In all other cases, a potential bidirectional relationship between the variables cannot be excluded.

Comparing the results, the emerging picture is rather fragmented. For example, and, in particular, we can see a completely opposite solution in the case of $G7_5$. Both the H_1 (neoclassical) and the H_2 (PK) are supported applying the tests. The PK seems the relevant result for $SSA_{2,5}$ applying the JKS test. The same outcome holds for EA_5 but, in this case, applying the D-H procedure. Finally, by running the D-H method, the neoclassical hypothesis (H_1) holds in the case of $EDA_{5,9}$.

Both the tests do not help in finding a definitive picture in supporting a net one-way relationship between the variables. Additionally, these outcomes are confirmed for different time periods captured by the lag analysis, even for the same aggregate. This can be interpreted as a non-unidirectional trend in the economic policy choices pursued over the years by different governments (probably motivated by ideologically different approaches). The H_3 hypothesis appears as the more credited by these results; thus, considering the overall picture, the post-Keynesian interpretation within the current account long-run solvency model could be the most likely and robust. At this point, the test results can be considered consistent, as they do not support the opposing hypothesis (H_1 and H_2) leading to a sort of solution by exclusion of the alternatives. Since the time series start in 1980, it is not possible to make a comparison and analysis that also includes the previous time span. We can highlight the fact that, for example, in the G7 and EA countries, a more neoclassical approach has progressively influenced government action from the 1980s and 1990s to the present day. This last impression is confirmed by the medium-term results for the $G7_5$ as shown by the JKF test. The results are different for EA aggregate. In fact, the EA_5 results with the D-H version of the non-causality test support the idea of a PK-based economic policy. It would be very interesting to run the same kind of analysis considering the 1950–1980 time span included in the whole time frame or as a separate single dataset. In the latter case, the Keynesian approach of economic policies adopted (for example in the Western countries) should be more evident.

6. Conclusions

The purpose of the study is to explore the relationship between investments and savings. By applying two panel non-causality tests, the research focuses both on the empirical investigation of the validity of the post-Keynesian or neoclassical framework and on analysis of relevant economic aggregates. The identification of the panels to select such economic aggregates follows the IMF classification as specified through specific references in the Data description sub-section. To the best of author's knowledge, this is the first work applying these innovative Granger procedures to these panels for such a long and updated time span. The detection and highlighting of any differences is a corollary to the main objectives. The research hypotheses are derived from the theoretical positions expressed by the post-Keynesian and the neoclassical school of thoughts which the academic debate originates from. The paper collects and analyzes the time span from 1980 to 2024 including the full series of data available from the international authoritative sources.

The overall findings do not highlight mixed positions across the aggregates, even if some differences can be observed. However, the main conclusions from the empirical analysis point out that it is not possible to define a clear and incontrovertible "one-way" direction between the variables as the competing theoretical mechanisms would suggest. The results are more likely to validate the hypothesis of a bidirectional relationship. Even if this outcome is not considered in the "strictly" theoretical framework by the competing schools of thought, it is included as a potential result by the post-Keynesian approach when considering the international mechanism within the context of the current account

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long-run solvency model. As most scholars observe (Bagnai, 2009), the quest to avoid excessive imbalances in the imports and exports for large economies becomes a very critical factor in preventing a destabilization of the economic equilibrium. A persistent excess of imports increases the external debt to unsustainable long-term levels. This seems worth both for "advanced" and "emerging" ones, even if from different perspectives. In some circumstances, export countries should sustain import ones (or reducing their export effort, or increasing the domestic demand, or both).

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Conflicts of Interest: The author declares no conflict of interest.

Appendix A

Appendix A.1 List of Countries

Table A1. List of the Countries included in each aggregate following IMF (2025a, 2025b, 2025c, 2025d).

Aggregate	N	Original Countries	Excluded from the Dataset Because the Series Are Discontinuous	Total Units of the Panel Set
G7	7	Canada, France, Germany, Italy, Japan, United Kingdom and United States	None	7
EA	20	Austria, Belgium, Croatia, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia and Spain.	Croatia, Estonia, Latvia, Lithuania, Slovak Republic and Slovenia	14
EDA	30	Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Fiji, India, Indonesia, Kiribati, Lao P.D.R., Malaysia, Maldives, Marshall Islands, Micronesia, Mongolia, Myanmar, Nauru, Nepal, Palau, Papua New Guinea, Philippines, Samoa, Solomon Islands, Sri Lanka, Thailand, Timor-Leste, Tonga, Tuvalu, Vanuatu and Vietnam.	Bangladesh, Bhutan Brunei Darussalam, Cambodia, Fiji, Kiribati, Lao P.D.R., Maldives, Marshall Islands, Micronesia, Myanmar, Nauru, Palau, Papua New Guinea, Samoa, Timor-Leste, Tonga, Tuvalu and Vanuatu	11
SSA	45	Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Côte d'Ivoire, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, São Tomé and Principe, Senegal, Seychelles, Sierra Leone, South Africa, South Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe	Democratic Republic of the Congo, Eritrea, The Gambia, Ghana, Guinea-Bissau, Liberia, Namibia, Nigeria, Sào Tomé and Principe, South Sudan, Uganda, Zimbabwe	33

Source: Personal elaboration from IMF (2025a, 2025b, 2025c, 2025d).

Appendix A.2 Dumitrescu_Hurlin Procedure

Dumitrescu–Hurlin non causality test (2012)

This test is effective for addressing the simultaneous presence of CSD and heterogeneity in panel data (Xie et al., 2022). Starting from Equation (1), N regressions are run to calculate an average Wald statistic $\overline{W}$ from the individual W_i resulting from the F tests of the K linear hypotheses ($\beta_{\iota,1} = \cdots = \beta_{iK} = 0$):

$$\overline{W} = \frac{1}{N}\sum\nolimits_{i=1}^{N} W_i \tag{A1}$$

Dumitrescu and Hurlin show that (A1) performs well in investigating panel causality due to good asymptotical behavior through Monte Carlo simulations. In panel analysis, Lopez and Weber (2017) argue that the test of the null hypothesis can be performed by the two following standardized statistics (labeled as $\overline{Z}$ and $\widetilde{Z}$):

$$\overline{Z} = (N/2K)^{1/2} \times (\overline{W} - K) \text{ with the distribution } \longrightarrow N(0,1) \text{ with } T, N \longrightarrow \infty \tag{A2}$$

and

$$\widetilde{Z} = [(N/2K) \times (T-3K-5/T-2K-3)]^{1/2} \times \left[(T-3K-3/T-3K-1) \times \overline{W} - K\right] \text{ in this case with the distribution } \longrightarrow N(0,1) \text{ with } N \longrightarrow \infty \tag{A3}$$

Appendix A.3 Results of the Non-Causality Tests

Table A2. (**a**) JKS Panel Granger non-causality test. (**b**) Dumitrescu–Hurlin panel Granger non-causality test.

(a)				
Aggregate	**Null Hypothesis**	**Lags**	**HPJ Wald**	***p*-Value**
G7	SAV does not GC INV	2	7.67	0.02
		5	0.00	0.00
		9	-	-
	INV does not GC SAV	2	7.62	0.02
		5	9.07	0.11 *
		9	-	-
EA	SAV does not GC INV	2	4.86	0.09 *
		5	12.90	0.02
		9	0.00	0.00
	INV does not GC SAV	2	1.00	0.61 *
		5	24.27	0.00
		9	0.00	0.00
EDA	SAV does not GC INV	2	0.00	0.00
		5	0.00	0.00
		9	0.00	0.00
	INV does not GC SAV	2	17.42	0.00
		5	388.84	0.00
		9	0.00	0.00
SSA	SAV does not GC INV	2	1.41	0.49 *
		5	6.92	0.23 *
		9	0.00	0.00
	INV does not GC SAV	2	96.02	0.00
		5	492.29	0.00
		9	0.00	0.00

Table A2. *Cont.*

(b)							
Aggregate	**Null Hypothesis**	**Lags Number**	**Wald**	**Zbar**	***p*-Value**	**Ztilde**	***p*-Value**
G7	SAV does not GC INV	2	1.53	−0.63	0.53 *	−0.70	0.49 *
		5	4.40	−0.50	0.62 *	−0.67	0.50 *
		9	9.23	0.15	0.88 *	−0.42	0.68 *
	INV does not GC SAV	2	3.32	1.74	0.08 *	1.42	0.16 *
		5	9.20	3.51	0.00	2.61	0.01
		9	15.35	3.96	0.00	2.00	0.05 *
EA	SAV does not GC INV	2	4.22	4.15	0.00	3.51	0.00
		5	7.12	2.51	0.01	1.68	0.09 *
		9	11.68	2.36	0.02	0.77	0.44 *
	INV does not GC SAV	2	5.16	5.91	0.00	5.09	0.00
		5	8.62	4.28	0.00	3.12	0.00
		9	11.97	2.62	0.00	0.95	0.35 *
EDA	SAV does not GC INV	2	3.36	2.25	0.02	1.84	0.07 *
		5	10.50	5.76	0.00	4.38	0.00
		9	15.05	4.73	0.00	2.35	0.02
	INV does not GC SAV	2	2.05	0.09	0.93 *	−0.09	0.93 *
		5	5.86	0.91	0.36 *	0.41	0.69 *
		9	13.75	3.71	0.00	1.71	0.09 *
SSA	SAV does not GC INV	2	3.92	5.67	0.00	4.77	0.00
		5	13.77	15.94	0.00	12.45	0.00
		9	20.17	15.13	0.00	8.46	0.00
	INV does not GC SAV	2	5.88	11.15	0.00	9.66	0.00
		5	13.72	15.85	0.00	12.37	0.00
		9	14.42	7.34	0.00	3.54	0.00

Source: Author's calculation in Stata on IMF (2025a, 2025b, 2025c, 2025d). Notes: - the procedure does not calculate the HPJ Wald statistics. The case of the HPJ Wald statistics equal to 0 stands for a positive figure (the number is rounded to two decimal places). The * accepts the null hypothesis at 0.05 significance level.

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