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Causal Nexus between Economic Growth, Inflation, and Stock Market Development: The Case of OECD Countries

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Highlights

- **This paper examines the linkages between economic growth, inflation, and stock market development. We study 34 OECD countries over 1960-2012 and employ a panel vector auto-regressive model for detecting the direction of causality.**
- **The study uses three indicators of stock market development to investigate cointegration relationships and Granger causality nexus between the three set of variables.**
- **Our novel panel data estimation methods allow us to identify important causal links among the variables, both in the short run and in the long run.**

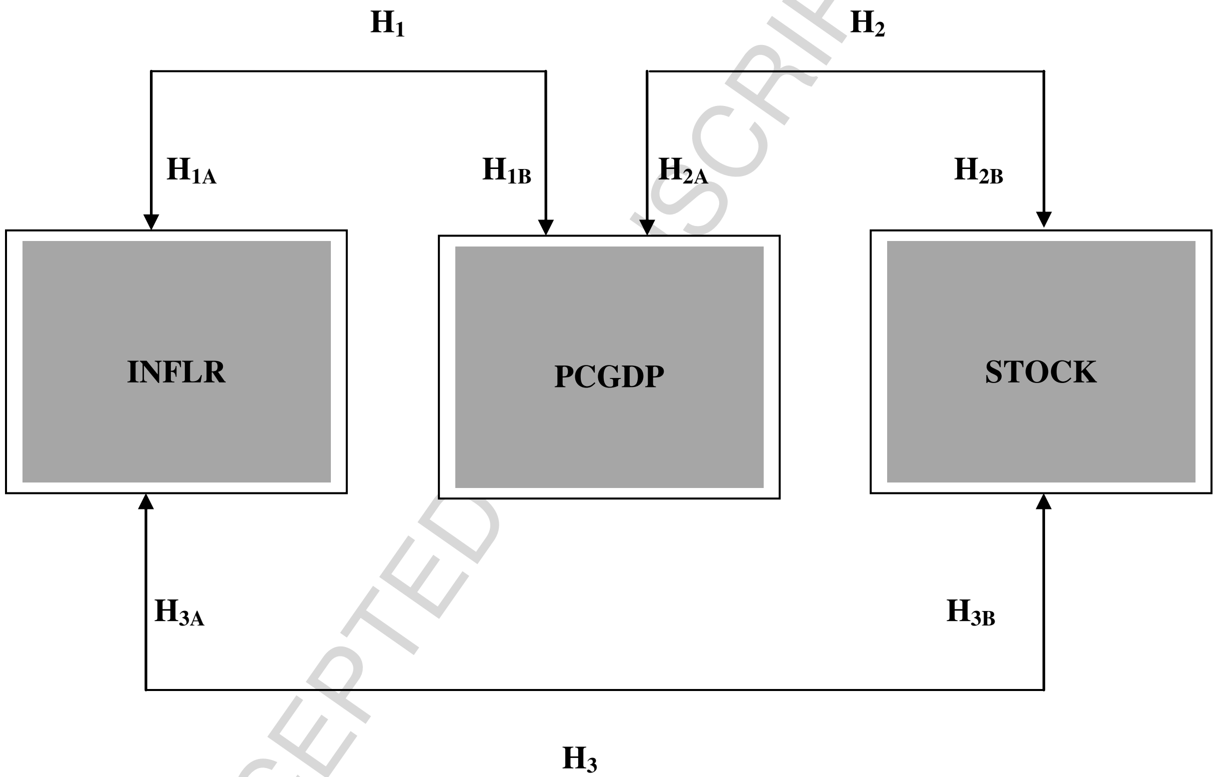
Abstract

This paper investigates cointegration relationships and Granger causality nexus in a trivariate framework among economic growth, inflation, and stock market development. Utilizing three measures of stock market development and employing a panel vector autoregressive model, we study 34 OECD countries over the time period of 1960-2012. Our novel panel-data estimation method allows us to identify important causal links between the variables both in the short run and in the long run.

Keywords: Inflation, Stock market development, Economic growth, Panel-VAR, Granger causality, OECD countries

JEL Classification: O43, O16, E44, E31

Graphical Abstract: For Review



Note 1: STOCK: stock market development; PCGDP: per capita economic growth rate; INFLR: inflation rate.

Note 2: STOCK is defined as MARCC, TURNR, or TRADS.

Note 3: MARCC: Market capitalization; TURNR: Turnover Ratio; TRADS: Traded stocks.

Figure: Proposed Model and Graphical Abstract

1. Introduction

Almost every macroeconomics textbook contains a discussion of the empirical determinants of economic growth. The list of variables includes savings and investment, the degree of financial stability, the quality of financial institutions, trade openness, government spending on financial infrastructure, foreign aid and foreign direct investment, inflation, and the state of financial development of the economy (see, for instance, Fischer, 1993; Mankiw et al., 1992; Kormendi et al., 1985). The purpose of this paper is not to examine all the possible determinants of economic growth. Rather, the purpose of this paper is to focus on the relationship between economic growth and two variables that have received much attention in recent years: inflation and stock market development.

Most economists agree that inflation has consequences for economic growth (see Jalil et al., 2014; Barro, 2013; Boujelbene and Boujelbene, 2010; Boschi and Cirardi, 2007; Leigh and Rossi, 2002). For example, numerous studies have shown that mild and stable inflation makes it easier for businesses to make investment decisions and for wages to rise. Furthermore, the case for supporting stock market development for the sake of fostering economic growth has been stated in a bourgeoning literature on growth and development (see, for instance, Hou and Cheng, 2010; Arestis et al., 2001; Rousseau and Wachtel, 2000; Enisan and Olufisayo, 2009; Domac and Yucel, 2005; Levine and Zervos, 1996; Levine, 1991; Okun, 1971). Of course, it is evident that stock market development itself may be linked to inflation. For example, studies have demonstrated that easier investing practices may have consequences for prices economy-wide. Thus, stock market development may affect economic growth both directly, through the usual expenditure channels, and indirectly through its effect on inflation.

Parallel to these investigations has been the development of the endogenous growth theory, which has been a subject of considerable academic scrutiny over the past few decades. Montes and Tiberto (2012), Rousseau and Yilmazkuday (2009), Cole (2008), Li (2007), Liu and Hsu, 2006), Mauro (2003), Udegbunam (2002), Wongbangpo and Sharma (2002), Chowdhury (2002), Levine (1997), and others in this body of literature stress that stock market development is key in fostering long-run economic growth since it facilitates efficient inter-temporal allocation of resources, capital accumulation, and technological innovation.

The beneficial effects on investment and economic growth, from the existence of growing financial markets, has been underscored by several authors, most notably King and Levine (1993). However, as Barro and Sala-i-Martin (1999) state, the development of these markets is endogenous since they are a normal part of the process of economic growth. Thus, while stock market development may lead to economic growth, the latter may itself lead to further stock market development. Despite the existence of several papers on this subject, which is discussed next in the literature review, the exact nature of the relationship is still open to question, since empirical studies do not find uniform results. More importantly, none of these studies distinguish between the possible short-run and long-run causal links.

This paper aims to explore the possible short-run and long-run causal relationships between the three key variables in our analysis: economic growth, inflation, and stock market development. Unlike other studies, which consider possible links between two of these variables at a time, we investigate the possible nexus between all three using a trivariate framework. Furthermore, and contrary to earlier work, this paper reports on the causal relationships among the three variables by using panel cointegration and causality tests. Our novel panel-data estimation method allows for more robust estimates by utilizing variation between countries as well as variation over time. We find interesting and relevant causal links among the variables deriving uniquely from our innovations using a sample of 34 OECD countries over 1960-2012. To our knowledge, neither this group of countries nor this time period has been the subject of investigation by other researchers in this literature.

The remainder of this paper is organized as follows. Section 2 provides a literature overview on three branches of the literature which we meld in our investigation. This section also motivates our study by summarizing the remarkable features of the present study. Section 3 introduces our three indicators of stock market development and the data source used in the analysis. Section 4 explains our empirical methodology. Section 5 describes the results and Section 6, the final section, concludes.

2. Literature Survey and Main Contributions of this Paper

The relationship between inflation and economic growth, stock market development and economic growth, or inflation and stock market development has drawn the attention of many researchers, both theoretically and empirically. As is evident from our review below, there are mixed findings throughout the literature. The present paper brings together these branches of the literature by considering the possible causal relationship between all three variables simultaneously, both in the short-run and in the long-run. In the studies we review below, there are three possible hypotheses (see, for instance, Samargandi et al., 2015; Jedidia et al., 2014; Ngare et al., 2014; Pradhan et al., 2014): unidirectional causality between two variables, known as the supply-leading hypothesis or demand-following hypothesis, bidirectional causality, known as the feedback hypothesis in which there is the existence of both the supply-leading hypothesis and the demand-following hypothesis, and no causality, known as the neutrality hypothesis.

2.1 Studies on causality between inflation and economic growth

The supply-leading hypothesis (SLH) contends that inflation causes economic growth. Pradhan et al. (2013) and Darrat (1988) find results in support of a SLH. The demand-following hypothesis (DFH) suggests that causality runs instead from economic growth to inflation. Kim et al. (2013) and Nguyen and Wang (2010) support the existence of a DFH. The feedback hypothesis (FBH) maintains that economic growth and inflation can reinforce each other, making inflation and economic growth mutually causal. Nguyen and Wang (2010), Andres and Hernando (1997), Klasra (2011), Andr´es et al. (2004), Andres and Hernando (1997) and Baillie et al. (1996) find results in support of a FBH. The final hypothesis, the neutrality hypothesis (NLH), suggests that inflation and economic growth do not cause one another to occur. A few studies (Vaona, 2012, Billmeier and Massa, 2007, and Chowdhury, 2002) support this hypothesis.

2.2 Studies on causality between stock market development and economic growth

Here, some studies contend that stock market development, as well as overall financial development, cause economic growth. Kolapo and Adaramola (2012), Tsouma

(2009), Enisan and Olufisayo (2009) and Nieuwerburgh et al. (2006) find results in support of this SLH. Other studies maintain that causality runs from economic growth to stock market development, as well as overall financial development. Kar et al. (2011), Panopoulou (2009), Odhiambo (2008), Ang et al. (2007), Liang and Teng (2006), Kwon and Shin (1999) support a DFH. The feedback hypothesis suggests that economic growth and stock market development can reinforce each other, making stock market development and economic growth mutually causal. Cheng (2012), Zhu et al. (2011), Hou and Cheng (2010), Rashid (2008), Darrat et al. (2006), Nishat and Saghir (1991) all find results in support of a FBH. Lastly, the neutrality hypothesis maintains that no causality exists between stock market development and economic growth. Pradhan et al. (2013), Rousseau and Xiao (2007) present evidence lending support to a NLH.

2.3 Studies on causality between inflation and stock market development

In this literature, a number of papers contend that inflation causes stock market development. The supporters of this hypothesis are Dritsaki (2005) and Ibrahim (1999). On the other hand, other authors suggest that causality runs instead from stock market development to inflation. Shahbaz et al. (2008), Han et al. (2008), Liu and Sinclair (2008), Wei and Yong (2007), Akmal (2007) and Zhao (1999) are all in favor of a DFH. While other researchers support the existence of a feedback suggesting that stock market development and inflation can complement and reinforce each other, making inflation and stock market development mutually causal. Cakan (2013), Pradhan (2011), and Morley (2002) support a FBH. Finally, Lu and So (2001) are in favor of a NLH, supporting the case of no causal relations between inflation and stock market development.

2.4 Main contributions of this paper

Unlike the earlier studies, this paper explores the causal link between all three variables simultaneously, which has not been done before. We first use Pedroni's panel cointegration test to reveal whether the variables are cointegrated; that is, whether there is a long-run equilibrium relationship among them. We then use a panel Granger causality test to present new evidence on the nature of the short-run and long-run causal relationship between the variables.

There are two main contributions of this paper as there are two novel features of this particular study. First, we use a large sample of countries, both developed and emerging, over a long time period, 1960-2012. Second, we utilize sophisticated econometrics, and certainly empirical approaches heretofore not taken in this literature, to answer questions concerning the nature of the causal relationship between the variables, both in the short run and long run.

3. Variables and Panel of Countries

There is no single quantitative measure to account for the many activities in the stock market (see, for instance, Abu-Bader and Abu-Qarn, 2008; Naceur and Ghazouani, 2007; Beck and Levine, 2004; Rousseau and Wachtel, 1998; Levine and Zervos, 1998). Hence, this study utilizes three commonly used measures of stock market development: stock market capitalization, turnover ratio, and volume of traded stocks (TRADS). Our first variable uses the market capitalization, which is the product of share price and the number of shares outstanding for all the stocks traded in the particular country. In order to put this in perspective, we divide the market value of listed shares by the gross domestic product. The variable used in our analysis is MARCC, which gives the percentage change in this ratio. Our second variable is the turnover ratio which equals the value of the traded shares on domestic exchanges divided by the total value of listed shares. This captures the trading volume of the stock market relative to its size. We then calculate the percentage change in the value for each and denote it by TURNR. Our third variable is the value of traded stocks, which is the product of market price and the number of shares traded. Again, this is measured relative to the gross domestic product and the percentage change calculated for each country and year. The latter variable is denoted by TRADS. These variables are summarized under Table 1. Other variables used in our analysis also appear under Table 1. They are: inflation, measured by the percentage change in the consumer price index, denoted by INFLR, and economic growth, measured by the growth rate of per capita gross domestic product and denoted by PCGDP. We adopt the World Bank definition of all the variables and use the data published by the World Bank's *World Development Indicators*. Figure 1 shows the conceptual framework of the possible causal patterns between these variables. As is evident, stock market development could be represented by one of these three indicators MACC, TURNR, and TRAD, as defined above.

The variables used are transformed to their natural logarithm forms for our estimations. Table 2 provides summary statistics for the variables, while Table 3 shows the correlation matrix. The correlation coefficients in Table 3 suggest that the stock market development indicators, MARCC, TURNR, and TRADS, are not highly correlated, except for TRADS and TURNR. This means we can simultaneously consider

MARCC and TURNR as well as MARCC and TRADS along with inflation and economic growth. Hence, we proceed by examining the nexus between inflation, economic growth, and each of the stock market development indicators separately, as well as with two of the indicators jointly.

Our empirical analysis is based on an unbalanced panel of 34 OECD countries over 1960-2012.[1] The countries considered are selected based on data availability. The countries are: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea Republic, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

The study intends to test the following hypotheses:

H_1: Inflation (INFLR) Granger-causes economic growth (PCGDP). This is termed the INFLR-led PCGDP hypothesis.

H_2: Stock market development (STOCK)) Granger-causes economic growth. This is termed the STOCK-led PCGDP hypothesis.

H_3: Stock market development Granger-causes inflation. This is termed the STOCK-led INFLR hypothesis.

As stated above, STOCK has three separate indicators: MARCC, TURNR, and TRADS. Figure 2 depicts our hypotheses in both broad and more specific terms.

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[1] That is, for some countries data covers the entire 1960-2012 period, while for others, data covers less than a 53 year span.

4. Econometric Model and Estimation Procedure

The panel Granger causality test proposed by Holtz-Eakin et al. (1988) is employed to examine the long-run causal relationship between inflation, growth, and stock market development. We estimate the following dynamic panel regressions using pooled data on the 34 OECD countries:

$$\begin{bmatrix} \Delta \ln INFLR_{it} \\ \Delta \ln PCGDP_{it} \\ \Delta \ln STOCK_{it} \end{bmatrix} = \begin{bmatrix} \eta_{1j} \\ \eta_{2j} \\ \eta_{3j} \end{bmatrix} + \sum_{k=1}^{p} \begin{bmatrix} \alpha_{1ik}(L)\beta_{1ik}(L)\delta_{1ik}(L) \\ \alpha_{2ik}(L)\beta_{2ik}(L)\delta_{2ik}(L) \\ \alpha_{3ik}(L)\beta_{3ik}(L)\delta_{3ik}(L) \end{bmatrix} \begin{bmatrix} \Delta \ln INFLR_{it-k} \\ \Delta \ln PCGDP_{it-k} \\ \Delta \ln STOCK_{it-k} \end{bmatrix} + \begin{bmatrix} \lambda_{1i} ECT_{1it-1} \\ \lambda_{2i} ECT_{2it-1} \\ \omega_{3i} ECT_{3it-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \\ \varepsilon_{3it} \end{bmatrix} \quad \mathbf{(1)}$$

where

Δ is a first-difference operator (I – L) applied to the variables;

P is lag lengths;

i represents country *i* in the panel (*i* = 1, 2…., N);

t denotes the year in the panel (*t* = 1, 2, …., T) ;

INFLR is inflation rate in the economy (in percentage);

PCGDP is the economic growth rate (in percentage);

STOCK is stock market development, which has three different indicators;

ECT is error correction term which is derived from the cointegration equation;

ε_{it} is a normally distributed random error term for all *i* and *t* with a zero mean and a finite heterogeneous variance.

We look for both short-run and long-run causal relationships among the variables. Short-run causal relationships are measured through F-statistics and the significance of the lagged changes in the independent variables. Long-run causal relationships are measured through the significance of t-tests associated with the lagged ECTs. Based on equation (1), Table 4 presents various possible hypotheses concerning the causal nexus between stock market development, inflation, and economic growth.

The above econometric specification, as presented in equation (1), is meaningful if the time-series variables are integrated of order one, denoted by I (1), and cointegrated. If the variables are I (1) and not cointegrated, then the ECT component will be removed in the estimation process. Thus, the pre-condition, and critical step, to the estimation process is to check the order of integration and cointegration among the variables, We employ the Levin-Lin-Chu (LLC) panel unit root test (Levin et al., 2002) and Pedroni panel cointegration test (Pedroni, 2003) to check for I (1) and cointegration between each stock market development indicator, inflation, and economic growth. A brief discussion on these two techniques appears below.

4. 1 Testing for the Order of Integration

The present study uses the LLC test to ascertain the order of integration, where a time series variable attains stationarity. The test uses the principles of the conventional augmented Dickey-Fuller (ADF) test and allows for heterogeneity of the intercepts across members of the panel. The test involves the estimation of the following equation:

$$\Delta Y_t = \mu_i + \gamma_i Y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta Y_{it-j} + \lambda_i t + \varepsilon_{it} \qquad \textbf{(2)}$$

where

i = 1, 2…., N represents the country in the panel;

t = 1, 2…., T represents the year in the panel;

Y_{it} is the series for country i in year t;

μ_i represents country-specific effects;

p_i is the number of lags selected for the ADF regression;

Δ is the first difference filter;

ε_{it} is an independently and normally distributed random error with a zero mean and a finite heterogeneous variance (σ_i^2).

The model allows for fixed effects, unit-specific time trends, and common time effects. The coefficient β_j of the lagged dependent variable is restricted to be homogenous across all of the units of the panel.

4. 2 Panel-Data Cointegration Tests

A cointegration test is used to check for the presence of a long-run equilibrium relationship among the variables. In other words, if two or more series are cointegrated, it is possible to interpret the variables in these series as being in a long-run equilibrium relationship. Lack of cointegration, on the other hand, suggests that the variables have no long-run relationship, meaning that in principle, they can move arbitrarily far away from one another.

If integration of 'order one' is implied for the variables, the next step is to employ cointegration analysis in order to establish whether there exists a long-run relationship among the set of such possibly 'integrated' variables. To check for this, an estimated cointegration equation of the following form is used:

$$Y_{it} = \beta_{i0} + \beta_{i1} X_{i1t} + \beta_{i2} X_{i2t} + ... + \beta_{ik} X_{ikt} + \varepsilon_{it} \quad \textbf{(3)}$$

This equation may be re-written as:

$$\varepsilon_{it} = Y_{it} - (\beta_{i0} + \beta_{i1} X_{i1t} + \beta_{i2} X_{i2t} + ... + \beta_{ik} X_{ikt}) \quad \textbf{(4)}$$

with the cointegration vector defined as:

$$\left[1 - \beta_{i0} - \beta_{i1} - \beta_{i2} .... - \beta_{ik}\right] \quad \textbf{(5)}$$

We note that, as set up by Johansen (1988), the above test cannot deal with a panel setting. Thus, we use an enhancement, the Pedroni (1999, 2000, 2004) panel cointegration test, in order to test for the existence of cointegration among the variables. The Pedroni panel cointegration test is applied to the following time-series panel regression set-up:

$$Y_{i,t} = \alpha_i + \sum_{j=1}^{p_i} \beta_{ji} X_{jit} + \varepsilon_{it} \quad \textbf{(6)}$$

$$\varepsilon_{it} = \rho_i \varepsilon_{i(t-1)} + w_{it} \quad \textbf{(7)}$$

where Y_{it} and X_{jit} are the observable variables; ε_{it} represents the disturbance term from the panel regression; α_i allows for the possibility of country-specific fixed effects and the coefficients β_{ji} allow for variation across individual countries. The null hypothesis of no cointegration of the pooled, within-dimension, estimation is:

H_0: $\rho_i = 1$ for all i against H_1: $\rho_i = \rho < 1$. **(8)**

Under the first hypothesis, the within-dimensional estimation assumes a common value for ρ_i (= ρ). In sum, this procedure excludes any additional source of heterogeneity between individual country members of the panel. The null hypothesis of no-cointegration of the pooled, between-dimensions, estimation is expressed as

H_0: $\rho_i = 1$ for all i against H_0: $\rho_i < 1$. **(9)**

Under the alternative hypothesis, the between-dimensions estimation does not assume a common value for ρ_i. Therefore, it allows for an additional source of possible heterogeneity across individual country members of the panel.

Pedroni suggests two types of tests to determine the existence of heterogeneity of the cointegration vector. First, is a test which uses the within-dimension approach (i.e., a panel test). This test uses four statistics which are panel *v*-statistic, panel ρ-statistic, panel PP-statistic, and panel ADF-statistic. These statistics pool the autoregressive coefficients across different panel members for the unit root tests to be performed on the estimated residuals. Second, is a test which is based on the between-dimensions approach, which is a group test that includes three statistics: a group ρ-statistic, a group PP-statistic, and a group ADF-statistic. These statistics are based on estimators that simply average the individually-estimated autoregressive coefficients for each panel member (for more details, see Pedroni, 2000).

5. Empirical Results

We present our results in three stages. First, we reveal the nature of stationarity of the time series variables. Second, we uncover the nature of cointegration among them. Finally, we provide evidence on the direction of Granger causality between the cointegrated variables.

The estimation process involves examining five different cases. Model 1 (M1) describes the causal nexus between inflation, economic growth, and MARCC. Model 2 (M2) deals with the causal connection between inflation, economic growth, and turnover ratio (TURNR). Model 3 (M3) explores the causal relation across inflation, economic growth, and traded stocks (TRADS). Model 4 (M4) is concerned with the causal nexus between inflation, economic growth, market capitalization (MARCC), and the turnover ratio (TURNR). Finally, Model 5 (M5) deals with causality across inflation, economic growth, MARCC, and TRADS.[2] The results are shown in Tables 5 and 6. They indicate that all the variables are integrated of order one, because they become stationary after first differencing, as well as being cointegrated. These results suggest the presence of a long-run equilibrium relationship between inflation, economic growth, and the stock market development indicators. Remarkably, this is true in all the five models, no matter which stock market development indicator(s) we use.

The existence of I (1) and cointegration among these variables imply the possibility of Granger causality among them. Hence, we perform a causality test, using a vector error correction model (VECM) and utilizing equations (1), the results of which are

[2] As is evident, we have not considered a model with a combination of TRADS and TURNR since this would pose a multicolinearity problem, given that these variables are highly correlated (see the dissuasion of Section 3).

shown in Table 7. This table reports the panel Granger causality test results for both the short-run, represented by the significance of the F-statistic, and the long-run, represented by the significance of the lagged error correction term (ECT). A summary of the short-run results for our five specifications is as follows:

Model 1: In the case of this model there exists bidirectional causality between inflation and economic growth [INFLR <=> PCGDP] and between stock market capitalization and economic growth [MARCC <=> PCGDP]. Additionally, we find unidirectional causality from stock market capitalization to inflation [MARCC=> INFLR].

Model 2: Here, there is bidirectional causality between inflation and economic growth [INFLR <=> PCGDP].

Model 3: Our results here support bidirectional causality between inflation and economic growth [INFLR <=> PCGDP] and between traded stocks and economic growth [TRADS <=> PCGDP]. There is also the presence of unidirectional causality from inflation to traded stocks [INFLR => TRADS].

Model 4: Here, we identify the existence of bidirectional causality between inflation and economic growth [INFLR <=> PCGDP], between stock market capitalization and inflation [MARCC <=> INFLR], between stock market capitalization and economic growth [MARCC <=> PCGDP], and between stock market capitalization and turnover ratio [MARCC <=> TURNR].

Model 5: Here, we uncover the existence of bidirectional causality between inflation and economic growth [INFLR <=> PCGDP], between stock market capitalization and inflation [MARCC <=> INFLR], and between stock market capitalization and economic growth [MARCC <=> PCGDP]. We also find the presence of unidirectional causality from traded stocks to economic growth [TRADS => PCGDP].

The short-run causality results presented above are useful. However, more important are the long-run causality results which we now comment on. From Table 7, in Models 1-5, when ΔINFLR serves as the dependent variable, the lagged error correction term is statistically significant at the one per cent level. This implies that INFLR tends to converge to its long-run equilibrium path, in response to changes in its regressors. The significance of the ECT_{-1} coefficient in the ΔINFLR equation in each of the five models confirms the existence of long run equilibrium between INFLR and its determinants, which are always economic growth and, in most models, the various indicators of stock market development. In other words, we can generally conclude that both economic growth and stock market development Granger-cause inflation in the long run. However, despite a myriad of short-run causal connections between the three variables, there is no evidence that either stock market development or inflation contributes to the economic growth of OECD countries in the long run.

6. Conclusion

This study reveals the linkages between economic growth, inflation, and stock market development for a group of 34 OECD countries over 1960-2012. This important group of countries has not hitherto been considered in studies such as ours. Indeed, there is dearth of advanced panel cointegration and causality tests in this literature. Furthermore, in contrast to other papers, we examine the relationship between the three variables simultaneously. We first establish that there is a long-run equilibrium relationship among all three variables, no matter which indicator of stock market development is used. We also discover a wide range of remarkable short-run and long-run causal links between economic growth, inflation, and stock market development. Our key result is that there is unidirectional causality running from both economic growth and stock market development to inflation in both the short run as well as the long run. Thus, the argument that stock market development spurs economic growth is not supported in our study, at least not in the long run. The latter result may not be surprising, given that the countries considered in this study are relatively developed. Hence, further stock market development does not play a statistically significant role on spurring further economic growth. We suspect that results may be different for developing counties who do not have well-developed stock markets. This remains an open area for future research.

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Table 1. Definition of Variables

VARIABLES	DEFINITION
INFLR	**Inflation rate**: Percentage change in the consumer price index
PCGDP	**Per capita economic growth**: Percentage change in real per capita gross domestic product, used as our indicator of economic growth
MARCC	**Market capitalization:** Percentage change in ‘market capitalization of the listed companies divided by gross domestic product’
TURNR	**Turnover ratio:** Percentage change in this ratio is used. The ratio is found by dividing the value of traded stocks by the total value of the listed stocks
TRADS	**Traded stocks:** Percentage change in ‘total value of traded stocks divided by gross domestic product’

Note: All monetary measures are in US dollars.

Table 2. Summary Statistics for the Variables

Variable	Mea	Med	Max	Min	Std	Ske	Kur	JB	Probability
INFLR	0.94	0.89	2.05	-0.28	0.21	1.97	11.1	2413	0.00
PCGDP	1.22	1.23	1.40	-0.02	0.10	-4.13	44.2	52194	0.00
MARCC	1.64	1.68	2.51	-0.62	0.41	-0.75	4.37	122.9	0.00
TURNR	1.70	1.78	2.61	-0.84	0.48	-2.08	9.59	1793	0.00
TRADS	1.32	1.40	2.65	-1.64	0.67	-0.77	3.96	97.98	0.00

Note 1: INFLR: inflation rate; PCGDP: per capita economic growth rate; MARCC: Market capitalization; TURNR: Turnover Ratio; TRADS: Traded stocks.

Note 2: Mea: Mean; Med: Median; Max: Maximum; Min: Minimum; Std: Standard Deviation; Ske: Skewness; Kur: Kurtosis; JB: Jarque Bera.

*Note 3***:** Values reported here are the natural logs of the variables defined under Table 1. Natural log forms are used in our estimation.

Table 3. The Correlation Matrix

Variables	INFLR	PCGDP	MARCC	TURNR	TRADS
Case 1: For INFLR, PCGDP, MARCC					
INFLR	1.00	0.08	-0.49		
PCGDP		1.00	0.05		
MARCC			1.00		
Case 2: For INFLR, PCGDP, TURNR					
INFLR	1.00	0.08		0.00	
PCGDP		1.00		-0.00	
TURNR				1.00	
Case 3: For INFLR, PCGDP, TRADS					
INFLR	1.00	0.08			-0.30
PCGDP		1.00			0.01
TRADS					1.00
Case 4: For INFLR, PCGDP, MARCC, TURNR, TRADS					
INFLR	1.00	0.08	-0.49	-0.00	-0.30
PCGDP		1.00	0.05	-0.00	0.01
MARCC			1.00	0.13	0.68*
TURNR				1.00	0.80*
TRADS					1.00

Note 1: INFLR: inflation rate; PCGDP: per capita economic growth rate; MARCC: Market capitalization; TURNR: Turnover Ratio; TRADS: Traded stocks.

Note 2: * indicates statistical level of significance at the 1% level.

Table 4. Hypotheses Tested in this Study

Causal Flow	Restrictions
STOCK => INFLR	$\beta_{1ik} \neq 0$; $\lambda_{1i} \neq 0$
PCGDP => INFLR	$\delta_{1ik} \neq 0$; $\lambda_{1i} \neq 0$
STOCK => PCGDP	$\beta_{2ik} \neq 0$; $\lambda_{2i} \neq 0$
INFLR => PCGDP	$\delta_{1ik} \neq 0$; $\lambda_{1i} \neq 0$
PCGDP => STOCK	$\beta_{3ik} \neq 0$; $\lambda_{3i} \neq 0$
INFLR => STOCK	$\delta_{3ik} \neq 0$; $\lambda_{3i} \neq 0$

Note 1: STOCK: stock market development; PCGDP: per capita economic growth rate; INFLR: inflation rate.

Note 2: STOCK is defined as MARCC, TURNR, or TRADS.

Note 3: MARCC: Market capitalization; TURNR: Turnover Ratio; TRADS: Traded stocks.

Table 5. Results of Panel Unit Roots Test

Variable	Levels	LLC-t	ADF-FC	PP-FC	Findings	Inferences
INFLR	LE	-2.59	-80.32	107.4		
	FD	-22.20*	508.3*	779.4*	Stationary	I (1)
PCGDP	LE	-1.20	36.4	51.5		
	FD	-24.5*	556.9	862.8*	Stationary	I (1)
MARCC	LE	1.24	26.3	26.1		
	FD	-21.2*	485.2*	691.2*	Stationary	I (1)
TURNR	LE	2.43	38.2	40.2		
	FD	-19.9*	437.5*	650.2*	Stationary	I (1)
TRADS	LE	2.23	34.2	37.8		
	FD	-17.4*	359.4*	502.7*	Stationary	I (1)

Note 1: INFLR: inflation rate; PCGDP: per capita economic growth rate; MARCC: Market capitalization; TURNR: Turnover Ratio; TRADS: Traded stocks.

Note 2: LE: indicates level data; FD: indicates first difference data; LLC-t: Levin- Lin-Chu- t statistics; ADF-FC: ADF Fisher Chi-Square test; PP_FC_ PP Fisher Chi-Square test.

Note 3: The Levin- Lin- Chu (LLC) test statistics are reported at no intercept and trend.

Note 4: * indicates statistical significance at 1%; I (1) indicates integration of order one.

Table 6. Results of Pedroni Panel Cointegration Test

Test Statistics	No Intercept & Trend	Only Intercept	Both Intercept & Trend
Model 1: INFLR, PCGDP, MARCC			
Panel v- Statistics	-1.15 [0.87]	-1.44 [0.92]	-2.72 [0.99]
Panel ρ- Statistics	-2.79 [0.00]	-0.19 [0.42]	-0.75 [0.77]
Panel PP- Statistics	-5.04 [0.00]	-2.98 [0.00]	-5.31 [0.00]
Panel ADF- Statistics	-2.34 [0.05]	-0.17 [0.43]	-2.34 [0.01]
Group ρ- Statistics	-2.51 [0.00]	0.01 [0.51]	2.11 [0.98]
Group PP- Statistics	-8.32 [0.00]	-5.36 [0.00]	-5.15 [0.00]
Group ADF- Statistics	-6.04 [0.00]	-4.06 [0.00]	-3.04 [0.00]
Model 2: INFLR, PCGDP, TURNR			
Panel v- Statistics	-1.14 [0.87]	-2.17 [0.98]	-2.65 [0.99]
Panel ρ- Statistics	-0.98 [0.16]	0.73 [0.77]	-0.25 [0.39]
Panel PP- Statistics	-3.20 [0.00]	-2.21 [0.01]	-5.84 [0.00]
Panel ADF- Statistics	-1.81 [0.03]	0.28 [0.61]	-3.51 [0.00]
Group ρ- Statistics	-0.85 [0.19]	-0.42 [0.34]	1.10 [0.86]
Group PP- Statistics	-6.59 [0.00]	-6.42 [0.00]	-6.99 [0.00]
Group ADF- Statistics	-6.35 [0.00]	-4.54 [0.00]	-4.14 [0.00]
Model 3: INFLR, PCGDP, TRADS			
Panel v- Statistics	-1.48 [0.93]	-2.29 [0.99]	-3.26 [0.99]
Panel ρ- Statistics	-2.49 [0.00]	0.49 [0.69]	0.31 [0.62]
Panel PP- Statistics	-4.47 [0.00]	-2.42 [0.01]	-5.42 [0.00]
Panel ADF- Statistics	-2.81 [0.00]	-0.45 [0.32]	-2.52 [0.01]

Group ρ- Statistics	-2.07 [0.02]	-0.43 [0.33]	1.24 [0.89]
Group PP- Statistics	-7.89 [0.00]	-6.27 [0.00]	-6.72 [0.00]
Group ADF- Statistics	-6.54 [0.00]	-4.65 [0.00]	-3.47 [0.00]
Model 4: INFLR, PCGDP, MARCC, TURNR			
Panel v- Statistics	-1.99 [0.97]	-2.35 [0.99]	-3.07 [0.99]
Panel ρ- Statistics	-0.56 [0.29]	1.20 [0.89]	1.97 [0.98]
Panel PP- Statistics	3.88 [0.00]	-2.24 [0.01]	-5.36 [0.00]
Panel ADF- Statistics	-0.91 [0.18]	1.01 [0.84]	-2.01 [0.02]
Group ρ- Statistics	0.41 [0.65]	1.56 [0.94]	3.38 [0.99]
Group PP- Statistics	-6.99 [0.00]	-5.02 [0.00]	-5.67 [0.00]
Group ADF- Statistics	-4.86 [0.00]	-2.90 [0.00]	-1.99 [0.02]
Model 5: INFLR, PCGDP, MARCC, TRADS			
Panel v- Statistics	-2.35 [0.99]	-2.52 [0.99]	-3.12 [0.99]
Panel ρ- Statistics	-0.35 [0.36]	1.42 [0.92]	1.94 [0.97]
Panel PP- Statistics	-3.57 [0.00]	-2.08 [0.02]	-5.38 [0.00]
Panel ADF- Statistics	-1.22 [0.11]	1.48 [0.93]	-1.78 [0.04]
Group ρ- Statistics	0.09 [0.53]	1.64 [0.95]	3.43 [0.99]
Group PP- Statistics	-7.24 [0.00]	-4.93 [0.00]	-5.23 [0.00]
Group ADF- Statistics	-4.57 [0.00]	-2.71 [0.00]	-1.63 [0.05]

Note 1: INFLR: inflation rate; PCGDP: per capita economic growth rate; MARCC: Market capitalization; TURNR: Turnover Ratio; TRADS: Traded stocks.

Note 2: Figures in square brackets are probability levels indicating statistical significance.

Table 7. Granger Causality Test Results

Dependent Variable	Independent Variables			Lagged Error Correction Coeff
Model 1: VECM with INFLR, PCGDP , MARCC				
	ΔINFLR	**ΔPCGDP**	**ΔMARCC**	**ECT_{-1}**
ΔINFLR	------	5.82*	13.6**	-3.69*
ΔPCGDP	16.5*	------	219.8**	10.8
ΔMARCCC	2.76	6.08*	------	1.59
Model 2: VECM with INFLR, PCGDP , TURNR				
	ΔINFLR	**ΔPCGDP**	**ΔTURNR**	**ECT_{-1}**
ΔINFLR	------	6.33*	0.48	-4.03*
ΔPCGDP	46.1*	------	1.11	10.1
ΔTURNR	1.69	0.88	------	1.11
Model 3: VECM with INFLR, PCGDP , TRADS				
	ΔINFLR	**ΔPCGDP**	**ΔTRADS**	**ECT_{-1}**
ΔINFLR	------	6.08*	1.56	-3.92*
ΔPCGDP	38.4*	------	20.0*	10.6
ΔTRADS	8.39*	5.52*	------	1.82

Model 4: VECM with INFLR, PCGDP , MARCC, TURNR

	ΔINFLR	***ΔPCGDP***	***ΔMARCC***	***ΔTURNR***	***ECT_{-1}***
ΔINFLR	*------*	*5.36**	*13.4**	*0.24*	*-3.52**
ΔPCGDP	*15.9**	*------*	*218**	*1.88*	*11.0*
ΔMARCC	*3.26**	*4.04***	*------*	*8.45**	*1.17*
ΔTURNR	*1.48*	*0.31*	*8.10**	*------*	*0.98*

Model 5: VECM with INFLR, PCGDP , MARCC, TRADS

	ΔINFLR	***ΔPCGDP***	***ΔMARCC***	***ΔTRADS***	***ECT_{-1}***
ΔINFLR	*------*	*5.74**	*12.2**	*0.03*	*-14.5**
ΔPCGDP	*16.3**	*------*	*189**	*0.40*	*10.8*
ΔMARCC	*3.54***	*3.65***	*------*	*11.5**	*1.42*
ΔTRADS	*1.86*	*2.42*	*84.7**	*------*	*0.73*

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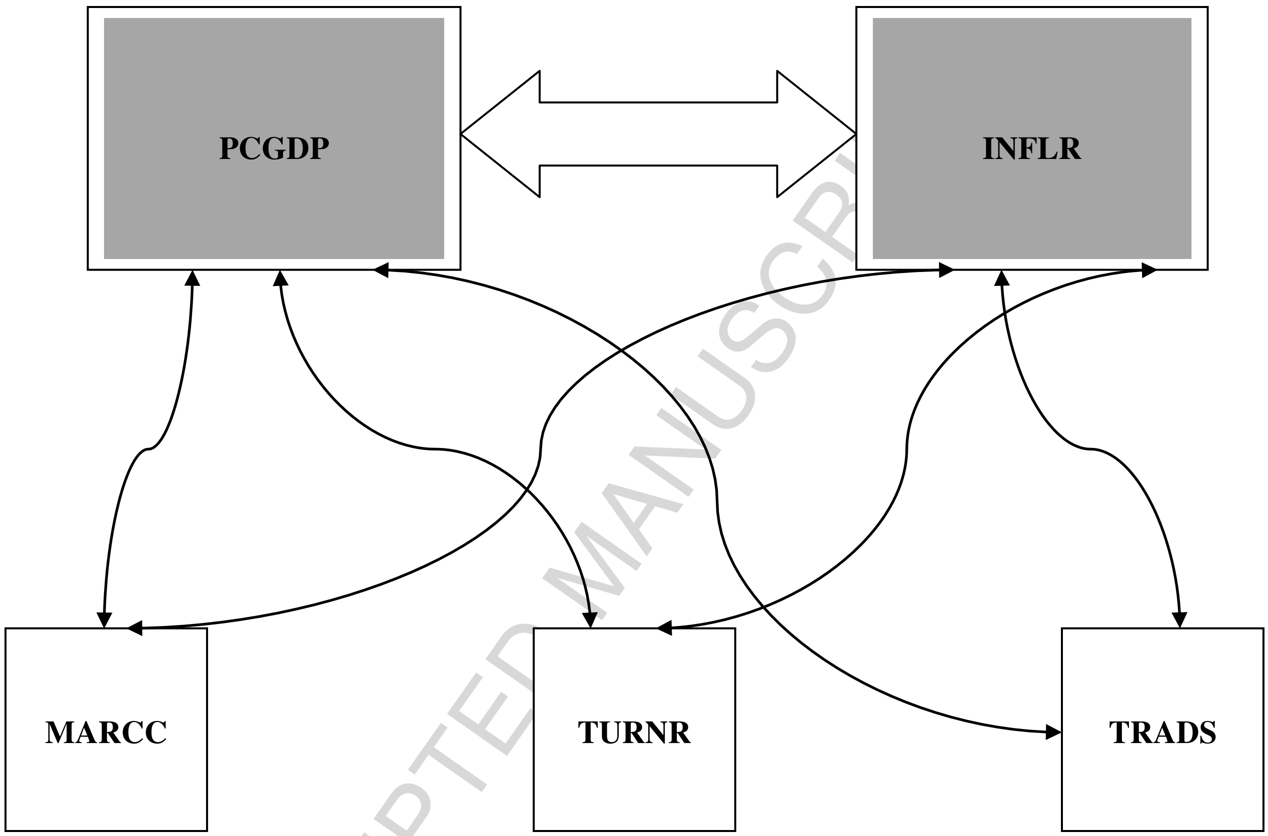
Note 1: INFLR: inflation rate; PCGDP: per capita economic growth rate; MARCC: Market capitalization; TURNR: Turnover Ratio; TRADS: Traded stocks.

Note 2: VECM: vector error correction model; ECT: error correction term.

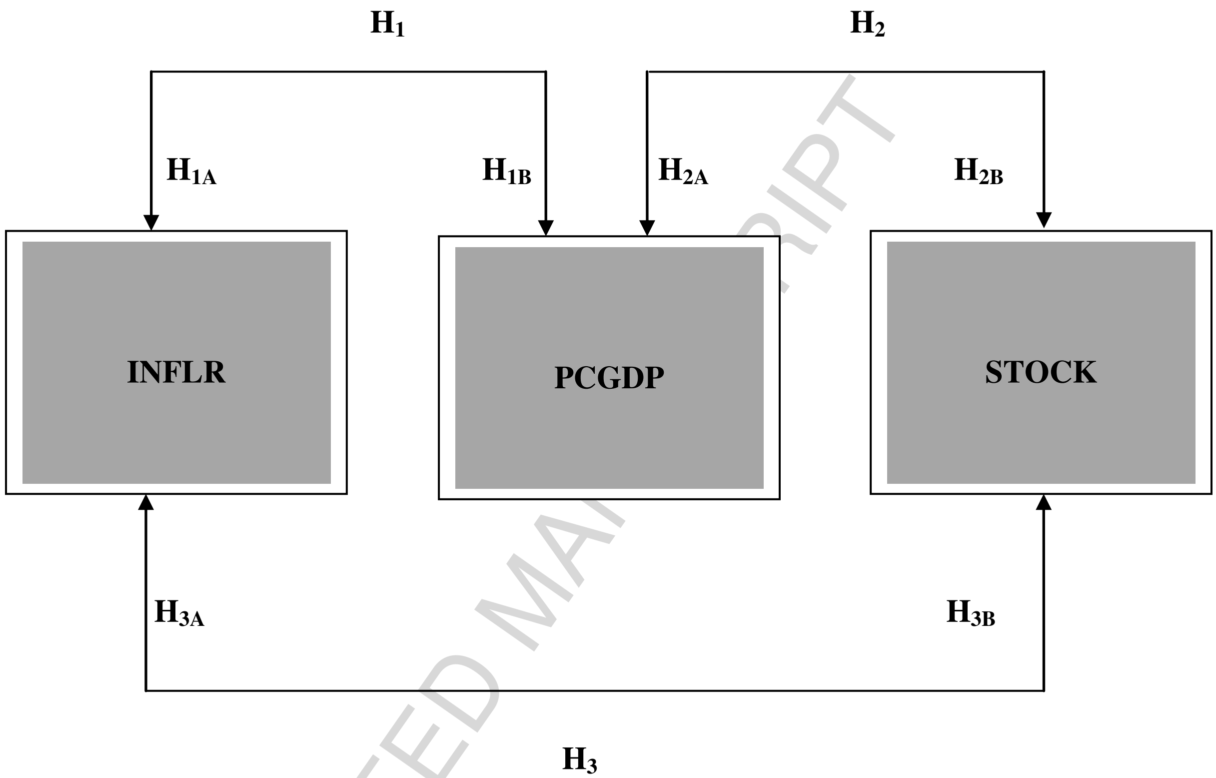
Note 3: * indicates significance at 1% level; ** indicates significance at 5% level.



Note 1: INFLR: inflation rate; PCGDP: per capita economic growth rate; MARCC: Market capitalization; TURNR: Turnover Ratio; TRADS: Traded stocks.

Note 2: Variables are defined in Table 1.

Figure 1: Conceptual Framework of the Possible Causal Patterns between Inflation, Economic Growth, and Stock Market Development



Note 1: STOCK: stock market development; PCGDP: per capita economic growth rate; INFLR: inflation rate.

Note 2: STOCK is defined as MARCC, TURNR, or TRADS.

Note 3: MARCC: Market capitalization; TURNR: Turnover Ratio; TRADS: Traded stocks.

Note 4: Variables are defined in Table 1.

Figure 2: Proposed Model and Hypotheses