

International Stock Market Dependencies: The Causality Approach

Uluslararası Borsa Bağımlılıkları: Nedensellik Yaklaşımı

ABSTRACT

The interaction of global capital markets is a critical concern for building diversified portfolios on an international scale, gauging the impact of global developments on the domestic market, and facilitating policy decisions. The extent of interaction has received widespread attention, particularly during periods of financial turmoil. However, a broader view may provide more useful results for long-term decisions. Thus, this research explores interconnections among the nation's stock exchanges over a more extensive time frame using indices. Factor analysis and Granger causality analysis were conducted on the weekly returns of the stock market index for selected countries. Country stock markets were grouped using factor analysis to identify integrated stock markets based on correlation, and the direction of the relationship was subsequently determined through Granger causality analysis. When factor analysis is applied to the stock markets of countries, the first observation is that the first cluster comprises the stock markets of developed countries. Emerging and vulnerable economies comprise the third group, while Asian markets represent the second category. Next, the causal relationships between countries are examined and it is found that there are significant integration relationships, both in the level of integration within each factor and in the integration between countries selected from different factors. As anticipated, dominant markets were present within each factor group, and the USA and UK held a dominant position in nearly all countries regardless of their factor distinctions.

JEL Codes: G10, G15

Keywords: International Financial Dependencies; Financial Markets; Factor Analysis, Granger Causality Test

Öz

Küresel sermaye piyasalarının etkileşimi, uluslararası çeşitlendirilmiş portföyler oluşturmak, küresel gelişmelerin yerel piyasalar üzerindeki etkisini değerlendirmek ve politika kararlarını kolaylaştırmak için kritik bir öneme sahiptir. Bu etkileşimin kapsamı, özellikle finansal dalgalanma dönemlerinde yoğun bir ilgi görmüştür. Ancak, daha geniş bir bakış açısı benimsemek, uzun vadeli kararlar için daha anlamlı sonuçlar sağlayabilir. Araştırma, borsa endekslerini kullanarak geniş bir zaman dilimi boyunca ülke borsaları arasındaki etkileşimi ele almaktadır. Seçilmiş borsa endeksleri haftalık getirilerine faktör analizi ve Granger nedensellik analizi uygulanmıştır. Faktör analizi ile ülke borsaları gruplandırılarak korelasyona dayalı entegre borsalar belirlenmiş, ardından Granger nedensellik analizi ile ilişkinin yönü tespit edilmiştir. Faktör analizinde birinci küme, gelişmiş ülke borsalarından oluşmuştur. İkinci küme bölgesel ayrışmayı işaret edecek şekilde Asya ülkelerinden oluşurken gelişmekte olan ve kırılgan ekonomiler ise üçüncü grupta yer almıştır. Daha sonra ülkeler arasındaki nedensel ilişkileri hem her faktörün kendi içinde hem de farklı faktörlerden seçilen ülkeler arasında ele alınmış ve birçok anlamlı ilişki tespit edilmiştir. Her faktör grubunda baskın piyasaların olduğu ve faktör ayrımı olmadan ABD ve İngiltere'nin neredeyse tüm ülkelerde baskın konumda olduğu gözlemlenmiştir.

JEL Kodları: G10, G15

Anahtar Kelimeler: Uluslararası Finansal Bağımlılıklar; Finansal Piyasalar; Faktör Analizi; Granger Nedensellik Testi

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Introduction

The growth of international trade, advancements in technology facilitating money transfers and telecommunication, the adoption of open-market exchange rate systems, and investor interest in developing nations have led to a global push for capital mobility. Policy makers in these countries have responded with the necessary regulations to make this possible. The term globalization, coined in the 1990s, refers to the emergence of an integrated and interdependent world economy with the free movement of goods, services, and capital (Obstfeld & Taylor, 2003). Since the late 1980s, financial markets have become increasingly integrated around the world. Investors seeking higher returns and the opportunity to diversify risk internationally have been able to do so through globalization (Parasız & Yıldırım, 1994; Agenor, 2003).

In cases where domestic savings are insufficient to provide the necessary capital accumulation, low-cost foreign capital inflows, especially foreign direct investment (FDI), will contribute to the growth of the country if properly harnessed. These flows require an economy and capital markets that are open to the world, and such openness entails international dependence and new risks - cost and volatility spillovers between markets will be greater (Agénor, 2003; Levine, 2001; Assidenou, 2011). On the other hand, it has been argued that while access to world capital markets allows countries to maintain consumption by borrowing in the event of adverse shocks and to grow through increased demand, such international risk sharing also provides stable growth and welfare gains in the long run (Obstfeld, 1994).

An internationally open capital market will not allow policymakers to engage in domestic market malpractices, such as excessive government borrowing. Insistence on such practices will lead to capital outflows and a rise in local interest rates (Obstfeld, 1998). Openness also provides an environment conducive to market efficiency in terms of the competitive environment it creates and prevents the manipulative practices that can occur in closed systems.

Conversely, significant capital inflows and swift monetary expansion, brought about by financial openness, can provoke inflationary pressures, undesirable macroeconomic impacts, such as appreciation of real exchange rate, and the expansion of current account deficits (Agenor, 2003). The integration of economies also

results in issues in one country affecting the capital markets of other countries and raising borrowing costs. The risk perception of investors would shift, and they would discriminate more in favour of countries that are comparably stable. The rise in borrowing costs for countries will also negatively impact the real sector and lead to a halt in investment.

This research aims to assess the degree of global fiscal integration within the context of capital market interactions. While geographical proximity and extensive trade engagement are often associated with international interactions, this study's findings suggest otherwise, particularly in terms of investment prospects. The following section presents the research on international integration, specifically studies that utilize Granger causality analysis. Following this, the results of the factor analysis and Granger causality analysis are presented. Market comparability is established with factor analysis while exploring interactions within and between factor groups with Granger causality analysis. The final section critically evaluates the results and concludes the report.

Literature Review

There are widespread empirical studies on international financial integration in the literature. While some studies deal with the interaction of financial markets through risk spillover and the contagion effect of crises (Longin & Solnik, 1995; Forbes & Rigobon, 2002; Phylaktis & Xia, 2009; Kotkatvuori-Örnberg et al., 2013; Bekaert et al., 2014; Akca & Ozturk, 2015), others focus on the long-term interaction by looking at the correlation, their simultaneous variation over time, or the economic relations it underlies (Agmon, 1972; Ripley, 1973; Chan et al., 1997; Bracker et al., 1999; Ghosh, 1999; Longin & Solnik, 2001; Chouldry, 2004; Graham et al., 2013; Kocaarslan et al., 2019). Although most studies indicate that interactions rise during times of economic or financial crisis, research examining long-term integration is limited. In this study, the markets are also analysed with respect to the direction of the interaction, taking into account the non-reciprocity of the causality.

Early studies with index prices include Agmon (1972) and Ripley (1973). Agmon (1972) analysed the correlation between the US, UK, Germany and Japanese stock markets by means of a regression model. His findings indicated a high degree of correlation between the stock markets of these four nations, particularly with respect to the immediate response of the other three countries to changes in the US stock market. Thus, market prices

support the single market hypothesis, indicating that the markets are extensively integrated. In comparable research, Eun and Shim (1989) evaluated the daily returns of 9 stock markets, discovering a substantial multi-directional interaction among them. Chouhdry (2004) found that a shift in the US stock market is quickly transmitted to other markets, but no market significantly affects the US market. Ripley (1973) conducted a factor analysis using the logarithmic returns from monthly stock price indices in 19 countries' local currencies. The analysis shows that Finland, Denmark, Japan and South Africa have the highest number of different movements with a uniqueness of 70%. The common feature of highly integrated countries is that they generally have markets with open capital flows.

Arshanapalli et al. (1995) conducted research into the integration between the US stock markets and six Asian nations. They utilized Granger causality and Johansen cointegration methods to analyze daily closing price data from stock market indices to assess the integration relationships. Their findings suggest that the cointegration level augmented since October 1987 and that Asian stock markets are more connected to the US stock market than the Japanese stock market, indicating less integration between Asian countries and Japan. Wu's (2020) findings reveal that the reason behind the high integration in the Asian region is due to common global factors. According to Awokuse et al. (2009), Japan and the USA have the most significant impact on the Asian markets, while Singapore and Thailand's influence has risen since the Asian financial crisis. Sheng and Tu (2000) analyse the time period prior to and during the Asian financial crisis. Evidence supports the cointegration relationship during financial crises, with stronger links between countries in South-East Asia than those in North-East Asia.

Firth et al. (2002) use cointegration and VAR models to report interdependence between the stock markets in Latin America. Diamandis (2009) and Choudhry (1997) also find evidence supporting linkages between these markets.

Gilmore and McManus (2002) investigate the short- and long-term correlation between the US stock market and the stock markets of three Central European countries (Czech Republic, Hungary, Poland) by analyzing the weekly closing prices of stock market indices from 1995-2001. They discover minimal correlation between the stock markets of the four countries in the short run, as revealed by the Johansen cointegration test. However, in the long run, no relationship is evident between the stock markets.

The authors report causality between the Hungarian and Polish markets. Similarly, Egért and Kocenda (2007) investigate the relationship among Central and Eastern European countries (Budapest, Prague, and Poland) and their connection with Western European countries (Germany, France, and the UK). Their study, using 5-minute intraday price data from stock indices between 2003 and 2005, does not reveal any cointegration relationship for any stock market. The study uncovered evidence of short-term spillover effects on both stock returns and stock price volatility. Additionally, Scheicher (2001) reported similar results that support the existence of regional linkages. A significant relationship with countries other than China was found in a study, which examined the relationship between the Spanish and Polish capital markets and the stock markets of influential global countries such as Germany, the UK, the US, and China (Jareño & Koczar, 2020). It was also observed that the relationship diverged during 2008 crisis periods.

There are various studies investigating the relations between the stock markets of Turkey and other countries (Korkmaz & Çevik, 2008; Gözbaşı, 2010; Vuran, 2010; Çelik et al., 2013; Akel, 2015). Different data frequencies are used in the studies: Some use cointegration test and Granger causality test using daily closing data of stock markets (Vuran, 2010; Çelik et al., 2013); Others use weekly (Gözbaşı, 2010; Akel, 2015) and monthly (Korkmaz & Çevik, 2008) data. Gözbaşı (2010) reports long-term cointegration relationship between Borsa Istanbul and the Egyptian, Brazilian, and Indian stock markets, a short-term interaction with the Mexican and Hungarian stock markets and no interaction between Malaysia and Argentina in the short and long-term. On the contrary, Çelik et al. (2013) find that there is no cointegration relationship between Turkey and Brazil stock markets in the long run. According to Granger causality results, they find that there is bidirectional causality between Turkey (XU100) and Brazil (Ibovespa).

Overall, the literature suggests that open capital flows increase the likelihood of financial integration. Various studies indicate that other countries tend to respond immediately to price changes in the US (Agmon, 1972; Eun & Shim, 1989; Arshanapalli et al., 1995; Bessler & Yang, 2003). Several studies exploring the relationship between various geographical regions have identified correlations through the use of causality analysis and similar methodologies (Arshanapalli et al., 1995; Sheng and Tu, 2000; Gilmore and McManus, 2002; Firth et al., 2002; Egért and Kocenda, 2007; Diamandis, 2009; Saji, 2022).

In this study, we question the dominant role of the USA in the world, prominent regional markets, and closely related market groups by factor analysis and Granger causality analysis. We identify non-integrated markets provide information on international diversification. In addition, for connected markets, we question the direction of the connection to clarify which markets to follow in the decision-making process for investors. Analysing the interconnectedness of financial markets can help to develop appropriate strategies for removing trade and financial barriers and attracting foreign investors (Tan et al., 2012). On the other hand, knowledge of closely interacting markets will be a guide for policy makers, help them take the right precautions against risks and develop growth models.

Data and Methodology

The dataset consists of stock market index data from 45 countries in their respective national currencies, covering the period from 15th August 2001 to 18th December 2019. The authors compiled the dataset from the Investing and Yahoo Finance websites, choosing the start date based on data availability.

The dataset comprises, the stock market index data of 45 countries, between 15.08.2001-18.12.2019 in national currency, compiled by the authors from Investing and Yahoo Finance websites. The start date of the dataset is dictated by availability. Akel (2015) opted to use weekly data as opposed to high-frequency daily data due to his belief that stock market indices did not move in sync on a daily basis. In addition, the speaker mentioned that it could take several days or weeks, but no longer than a month, for a shock in one country's stock market to influence the stock markets of other nations. In this paper, weekly returns were similarly calculated using the formula below, using Wednesday's closing prices for each week from the daily data. A total of 43,155 data points were obtained from 959 observations for each country over the course of the study. The formula for weekly returns is as follows:

$$R_t = \frac{V_t - V_{t-1}}{V_{t-1}} \quad (1)$$

V_t denotes the value of the variable of interest (market index) at time t , while V_{t-1} represents its value at the preceding time period $t - 1$. Accordingly, R_t captures return, reflecting the proportional change in value between two consecutive periods. This formulation is widely employed in financial analysis to quantify the rate of return over a given time interval. In this study, stock market index return is used.

First, in order to group countries with common characteristics, a correlation-based exploratory factor analysis was used. Factor analysis is a technique used to group variables into subgroups according to underlying common characteristics. The variables are analysed in terms of sources of common movement, called factors, and these factors can sometimes be interpreted as economic influences affecting the original variables. The weights of the original variables used to construct a factor indicate the relationship between the factor and the variable. Weight squares measure how much of a variable's movement is explained by a factor (Ripley, 1973). With factor weights, variables are assigned to the factor with the highest value and variables grouped under the same factor are considered to be closely related. In this study, the variables are country capital market returns.

Then, Granger causality analysis was applied to determine the direction of the relationship, if any, between the country stock markets in each factor group. Granger causality analysis tests the relationship between the selected countries and also the direction of the relationship.

After the country's stock markets underwent factorization, a causality analysis was conducted to examine the cause-and-effect relationship between them. It can be said that a causal relationship prevails among variables if lagged values of a variable have an explanatory role for another variable's current period value. Stationarity of the series is essential for conducting the Granger causality test, as proposed by Granger (1969). The formulation of the Granger causality model for two variables, x and y , is presented below:

$$y_t + \alpha_0 x_t = \delta_1 + \sum_{i=1}^n \alpha_i x_{t-i} + \sum_{k=1}^m \theta_k y_{t-k} + \varepsilon_{yt} \quad (2)$$

$$x_t + \vartheta_0 x_t = \delta_2 + \sum_{i=1}^n \gamma_i x_{t-i} + \sum_{k=1}^m \vartheta_k y_{t-k} + \varepsilon_{xt} \quad (3)$$

In this study, x_t and y_t represent the returns of the stock market indices of two countries, which are assumed to interact with each other in period t . Equation (2):

y_t : Dependent variable at time t .

x_t : Independent variable at time t .

δ_1 : Constant term.

$\sum_{i=1}^n \alpha_i x_{t-i}$: Lagged values of x_t and their coefficients.

$\sum_{k=1}^m \theta_k y_{t-k}$: Lagged values of y_t and their coefficients.

ε_{yt} : Error term.

Equation (3):

x_t : Dependent variable at time t .

y_t : Independent variable at time t .

δ_2 : Constant term.

$\sum_{i=1}^n \gamma_i x_{t-i}$: Lagged values of x_t and their coefficients.

$\sum_{k=1}^m \vartheta_k y_{t-k}$: Lagged values of y_t and their coefficients.

ε_{xt} : Error term.

If $\alpha_0 = \vartheta_0 = 0$, the model represents a simple causality model, excluding contemporaneous effects.

The null hypothesis $\sum_{i=1}^n \alpha_i = 0$ implies that x_t does not Granger cause y_t .

The alternative hypothesis $\sum_{i=1}^n \alpha_i \neq 0$ suggest that x_t Granger cause y_t .

Four different results emerge from a causality equation for two variables.

1. x, the Granger cause of y.
2. y, the Granger cause of x.
3. There is no Granger causality between x and y
4. There is bidirectional causality between x and y (Mert and Çağlar, 2019, p. 339-340).

Akaike, final prediction error (FPE) or Schwarz Information Criteria are used to determine the proper lag length (Sarıkovanlık et al., 2019, p. 113-114). The optimum lag length was determined as 2.

The initial stage involves checking the return series for a unit root, as stationarity is a prerequisite for the Granger causality test. As can be seen in Table 1, based on the Augmented Dickey Fuller (ADF) and Philips-Perron (PP) unit root test results, all of the return series exhibit stationarity at a confidence level of %1. With these results, we can proceed to the next steps.

Table 1: Unit Root Test Results

RETURN	ADF TEST		PP TEST	
	CONSTANT	TREND CONSTANT	CONSTANT	TREND CONSTANT
TURKEY (BIST 100)	-30.743	-30.778	-30.768	-30.793
USA (S&P 500)	-33.079	-33.117	-33.095	-33.141
GERMANY (DAX)	-33.914	-33.905	-33.888	-33.867
ENGLAND (FTSE 100)	-34.186	-34.173	-34.452	-34.440
CHILE (SPIPSA)	-31.235	-31.259	-31.248	-31.278
CHINA (HANG SENG)	-23.825	-23.818	-31.337	-31.324
CZECH REPUBLIC (FTSE/CZECH)	-32.300	-31.514	-32.315	-32.565
IRELAND (ISEQ)	-33.400	-33.411	-33.305	-33.317
SPAIN (IBEX 35)	-33.962	-33.948	-33.957	-33.945
ISRAEL (TA35)	-31.902	-31.906	-31.912	-31.907
SWITZERLAND (SMI)	-35.686	-35.681	-35.846	-35.845
SWEDEN (OMX STOCKHOLM 30)	-35.249	-35.236	-35.191	-35.179
ITALY (FTSE/MIB)	-33.087	-33.088	-33.051	-33.044
ARGENTINA (MERVAL)	-28.323	-29.309	-28.329	-28.315
AUSTRALIA (ALL ORDINARIES)	-31.539	-31.522	-31.553	-31.536
AUSTRIA (ATX)	-15.851	-15.869	-32.990	-32.987
BELGIUM (BEL20)	-34.082	-34.068	-34.020	-34.008
BRAZIL (IBOVESPA)	-32.048	-32.041	-32.037	-32.028
DENMARK (OMXC 20)	-33.718	-33.717	-33.619	-33.620
INDONESIA (IDX)	-16.170	-16.248	-31.302	-31.318
PHILIPPINES (FTSE/PHILIPPINES)	-32.073	-32.078	-32.052	-32.056
FINLAND (OMXH 20)	-33.707	-33.689	-33.645	-33.628
FRANCE (CAC 40)	-36.099	-36.106	-36.184	-36.213
SOUTH AFRICA (40)	-34.611	-34.624	-34.627	-34.640
SOUTH KOREA (KOSPI)	-24.656	-24.732	-32.316	-32.316
INDIA (BSESN)	-31.291	-31.305	-31.313	-31.322
CROATIA (CROBEX)	-14.258	-14.289	-26.540	-26.479
HOLLAND (AEX)	-34.448	-34.473	-34.396	-34.428
JAPAN (NIKKEI 225)	-31.466	-31.467	-31.467	-31.468
CANADA (S&P/TSX)	-31.842	-31.828	-31.837	-31.824
HUNGARY (FTSE/HUNGARY)	-31.962	-31.956	-31.947	-31.942
MALAYSIA (FTSE/MALAYSIA)	-29.292	-29.379	-29.349	-29.398
MEXICO (IPC)	-32.337	-32.462	-32.305	-32.435
EGYPT (EGX30)	-28.863	-28.931	-29.003	-29.004
NORWAY (OSE BENCHMARK)	-33.412	-33.394	-33.316	-33.300
PAKISTAN (KARACHI 100)	-18.841	-18.964	-28.972	-28.989
PERU (FTSE/PERU)	-33.665	-33.679	-33.753	-33.774
POLAND (WIG 20)	-32.986	-33.036	-32.987	-33.058
PORTUGAL (PSI ALL SHARE)	-33.323	-33.305	-33.231	-33.215
RUSSIA (IRTS)	-32.346	-32.428	-32.453	-32.431
SINGAPORE (FTSE/SINGAPUR)	-28.965	-28.963	-29.030	-29.009
SRI LANKA (CSE)	-14.947	-15.246	-30.629	-30.772
THAILAND (SETI)	-30.801	-30.832	-30.855	-30.876
NEW ZELAND (NZ 50)	-29.003	-29.011	-29.036	-29.042
GREECE (FTSE/ATHEX)	-31.981	-31.965	-31.965	-31.949

Max lag length is 21 in ADF test.

Results

Factor Analysis

Factor analysis was performed to determine the correlational grouping of country stock markets. Thus, by grouping countries under factors, the analysis for determining the causality relationship was facilitated. Kaiser-Meyer-Olkin (KMO) and Bartlett's tests were applied to determine whether the data were suitable for factor analysis. The KMO value is expected to be between 0 and 1, with values above 0.8 considered excellent. As the value increases, the strength of the relationship between variables enhances, leading to more meaningful and reliable results in factor analysis. Bartlett's test examines the correlation matrix and assesses its significance.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.981
Approx. Chi- Square	37822.123
Bartlett's Test of Sphericity	df 990
Sig.	0.000

According to Table 2, the KMO and Bartlett's values of 0.981 ($p=0.00$) indicate that the data are suitable for factor analysis. Furthermore, it is suitable for factor analysis with a factor variance explanation rate of 63.909% (>50%). Using factor analysis, we divide stock markets into five highly correlated groups according to weekly returns. The coefficients of the countries within these five factors are given. The highest coefficient indicates the factor to which the countries belong. The stock market returns of the countries are divided into 5 factors as shown in Table 3.

Table 3: Factor Analysis Rotated Component Matrix

	Components				
	1	2	3	4	5
FRANCE (CAC 40)	0.906				
HOLLAND (AEX)	0.880				
GERMANY (DAX)	0.861				
BELGIUM (BEL20)	0.858				
SWITZERLAND (SMI)	0.835				
ENGLAND (FTSE 100)	0.825				
ITALY (FTSE/MIB)	0.823				
SWEDEN (OMX STOCKHOLM 30)	0.817				
SPAIN (IBEX 35)	0.791				
FINLAND (OMXH 20)	0.789				
IRELAND (ISEQ)	0.715				
USA/SP500	0.714		0.432		
DENMARK (OMXC 20)	0.706	0.322			
PORTUGAL (PSI ALL SHARE)	0.628				
AUSTRIA (ATX)	0.621	0.320	0.353	0.321	
NORWAY (OSE BENCHMARK)	0.620	0.378	0.429		
CANADA (S&P/TSX)	0.606		0.546		
AUSTRALIA (ALL ORDINARIES)	0.557	0.550			

SOUTH AFRICA (40)	0.523	0.340	0.443	
GREECE (FTSE/ATHEX)	0.492			0.394
ISRAEL (TA35)	0.464	0.393		
THAILAND (SETI)		0.692		
SINGAPORE (FTSE/SINGAPUR)	0.413	0.676		
INDONESIA (IDX)		0.670	0.328	
MALAYSIA (FTSE/MALAYSIA)		0.650		
SOUTH KOREA (KOSPI)	0.410	0.640		
PHILIPPINES (FTSE/PHILIPPINES)		0.622		
CHINA (HANG SENG)	0.441	0.617	0.305	
INDIA (BSESN)		0.576		
JAPAN (NIKKEI 225)	0.522	0.526		
NEW ZELAND (NZ 50)	0.404	0.437		
BRAZIL (IBOVESPA)	0.330		0.654	
PERU (FTSEPERU)		0.321	0.633	
RUSSIA (IRTS)		0.302	0.591	0.328
MEXICO (IPC)	0.417	0.312	0.558	
ARGENTINA (MERVAL)			0.551	
CHILE (SPIPSA)	0.317	0.333	0.473	
TURKEY (BIST 100)		0.335	0.398	0.338
PAKISTAN (KARACHI100)				0.538
HUNGARY (FTSE/HUNGARY)	0.406		0.429	0.529
POLAND (WIG 20)	0.396		0.438	0.490
EGYPT (EGX30)		0.338		0.487
CZECH REPUBLIC (FTSECZECH)	0.347		0.409	0.422
SRI LANKA (CSE)				0.853
CROATIA (CROBEX)				0.374

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 8 iterations.

Just under half of the countries are situated in Factor 1, where developed countries with established stock markets and open capital flows are found. Asian countries were geographically placed in Factor 2. It is noteworthy that developing countries with comparable risk and return are in Factor 3. Australia, which ranks among the developed countries based on its factor scores, is near to the factor of Asian countries. Similarly, Japan, situated among other Asian nations, shares economic characteristics typical of developed countries.

Granger Causality Analysis within Factors

After the factor analysis of the grouping of countries, the determination of the direction of the relationship between the stock markets of the countries is analysed in two dimensions with the Granger causality analysis. First, the causality of countries' stock markets within each factor was examined. Next, the causality between the factors was examined by selecting two representative markets from each factor for the first three factors. All causality relationships with a p-value below the 5% significance level, along with the F-statistic measuring the impact of the independent variable on the dependent variable, are provided. The tables below show the causal relationships

and directions:

Table 4: Granger Causality Analysis Result for Markets in Factor 1

USA	→	FRANCE [8.734], HOLLAND [10.587], GERMANY [4.040] (0.017), BELGIUM [6.290] (0.001), SWITZERLAND [8.766], ENGLAND [5.438] (0.004), ITALY [3.252] (0.039), SWEDEN [5.424] (0.004), SPAIN [4.590] (0.010), IRELAND [14.571], DENMARK [9.468], PORTUGAL [4.499] (0.011), AUSTRIA [13.866], NORWAY [12.058], AUSTRALIA [21.597], GREECE [5.805] (0.003), ISRAEL [21.782] , SOUTH AFRICA [4.603] (0.010)
	→	USA [4.998] (0.006), FRANCE [9.097] , HOLLAND [10.564] GERMANY [4.419] (0.012), BELGIUM [7.519], SWITZERLAND [4.552] (0.010) ENGLAND [8.209], SWEDEN [7.160], FINLAND [6.740] (0.001) DENMARK [7.113], PORTUGAL [4.049] (0.017), AUSTRALIA [27.321] NORWAY [14.338], GREECE [4.608] (0.010), ISRAEL [13.830] SOUTH AFRICA [6.700] (0.001)
CANADA	↔	ITALY [3.208] (0.040), SPAIN [4.845] (0.008), AUSTRIA [13.207] IRELAND [11.440]
	↔	HOLLAND [4.021] (0.018)
GERMANY	→	IRELAND [3.974] (0.019), AUSTRALIA [7.690] , ISRAEL [9.221]
FRANCE	→	HOLLAND [3.167] (0.042), GERMANY [4.994] (0.007), AUSTRALIA [5.488] (0.004) ISRAEL [4.174] (0.015)
HOLLAND	→	AUSTRIA [3.172] (0.042), AUSTRALIA [5.760] (0.003), ISRAEL [5.316] (0.005)
ENGLAND	↔	GERMANY [6.392] (0.001)
	↔	AUSTRALIA [8.923]
PORTUGAL	→	ISRAEL [8.039]
PORTUGAL	→	AUSTRALIA [3.162] (0.042), ISRAEL [5.862] (0.003)
BELGIUM	→	AUSTRALIA [5.830] (0.003), ISRAEL [4.633] (0.009)
AUSTRALIA	←	FINLAND [9.626] , SWEDEN [4.103](0.016)
AUSTRIA	→	FINLAND [3.276] (0.038)
SPAIN	→	ENGLAND [3.913] (0.020)
ISRAEL	↔	SWITZERLAND [5.557] (0.004), IRELAND [4.989](0.007), DENMARK [3.783] (0.023) NORWAY [7.218] , AUSTRALIA [6.825](0.001), GREECE [3.177] (0.042)
	←	FINLAND [6.500](0.001), SWEDEN [7.416] , ENGLAND [8.039]

F and p values are in parentheses, respectively.

According to the Granger causality results in Factor 1, the USA was the Granger cause of 18 countries (except Finland and Canada), whereas only Canada was the Granger cause of the USA. This result confirmed the notion that the US is a dominant stock market, in line with some previous work (Agmon, 1972; Eun & Shim, 1989; Bessler & Yang, 2003; Chouhdry, 2004). The fact that the United States acts as the Granger cause for many countries suggests that factors such as U.S. interest rates, inflation, growth rates, and central bank policies may impact the financial markets of other nations. Therefore, it would be advisable to monitor the U.S. market when making investment decisions at the local level. The Canadian stock market also dominated this factor. It is noteworthy that there is a bidirectional causal relationship between the

Canadian stock market and the stock markets of Italy, Spain, Austria and Ireland. A bidirectional relationship also exists between Germany and the Netherlands, two of the region's advanced economies. All causal relationships in Factor 1 are shown in the table above. Democratic regimes are observed to cluster under Factor 1, indicating a high level of integration through their ability to adapt more rapidly to the process of internationalization. Economic integration, particularly among EU countries, has promote a stronger alignment with common monetary policies and has deepened interdependence between national economies.

Table 5: Granger Causality Analysis Result for Markets in Factor 2

JAPAN	→	THAILAND [4.666] (0.009), MALAYSIA [3.467] (0.031)
	↔	NEW ZELAND [3.159] (0.042), PHILIPPINES [3.940] (0.019)
CHINA	→	THAILAND [3.275] (0.038), MALAYSIA [4.587] (0.010)
	→	PHILIPPINES [4.393] (0.012), NEW ZELAND [3.900] (0.020)
INDIA	→	SOUTH KOREA [3.408] (0.033), THAILAND [3.894] (0.020), INDONESIA [8.623] , MALAYSIA [5.691] (0.003), PHILIPPINES[6.762] (0.001)
NEW ZELAND	→	SOUTH KOREA [5.239] (0.005), INDONESIA[7.370] , PHILIPPINES [8.350] , MALAYSIA [6.275] (0.002), INDIA [9.714] , THAILAND[9.868] , SINGAPORE [6.170] (0.002)
	→	THAILAND [4.361] (0.013), MALAYSIA [6.946] (0.001), SOUTH KOREA [4.190] (0.015), PHILIPPINES [8.752]
SINGAPORE	↔	INDONESIA [6.110] (0.002)
INDONESIA	→	JAPAN [4.887] (0.007), PHILIPPINES [3.375] (0.034)
MALAYSIA	↔	SINGAPORE [3.161] (0.042)
	→	PHILIPPINES [3.176] (0.042)
THAILAND	→	INDONESIA [5.046] (0.006), PHILIPPINES [3.665] (0.025)
SOUTH KOREA	→	INDONESIA [5.033] (0.006), THAILAND [5.887] (0.002)

F and p values are in parentheses, respectively.

Factor 2 comprises Asian nations. The findings indicate that Chinese stock market is not Granger-caused by any of these markets. However, it is the Granger cause of Thailand, the Philippines, Malaysia, and New Zealand. A bidirectional relationship exists between Japan-Philippines, Japan-New Zeland and Singapore-Indonesia. To some degree, Asian countries exhibit integration, however, unlike the USA and Canada in Factor 1, there is no dominant market in this regard. Similar findings were reported by Awokuse et al. (2009), highlighting the influence of Singapore. Notably, China does not exhibit a Granger causality relationship with other countries. Its authoritarian regime may have rendered it more resistant to the internationalization process and hindered the implementation of economic reforms (Frieden &

Rogowski, 1996). When China is excluded due to its authoritarian structure, the observed causal relationships among Southeast Asian countries may be attributed to their export-oriented growth strategies.

Table 6: Granger Causality Analysis Result for Markets in Factor 3

BRAZIL	→	RUSSIA [3.985] (0.018), TURKEY [5.791] (0.003), PERU [4.259] (0.014)
MEXICO	→	TURKEY [3.691] (0.025), PERU [3.857] (0.021)
ARGENTINA	→	TURKEY [4.477] (0.011)
RUSSIA	→	PERU [3.265] (0.038)
CHILE	←	TURKEY [3.023] (0.049), PERU [4.515] (0.011)

F and p values are in parentheses, respectively.

Concerning Factor 3, Turkey is found to be Granger-caused with Argentina, Mexico, Chile and Brazil. Conversely, Russia displays a significantly less substantial causal association with those nations within this grouping. It can be deduced that this assemblage comprises relatively volatile countries with comparable economies. Studies by Firth et al. (2002), Diamandis (2009), Choudhry (1997), Çelik et al. (2013), Gözbaşı (2010) have also provided evidence supporting the interconnections between these markets. It can be inferred that Russia exhibits relatively weaker causal links, likely due to its state-controlled economic structure.

Table 7: Granger Causality Analysis Result for Markets in Factor 4

HUNGARY	→	POLAND [3.577] (0.028), CZECH REPUBLIC [6.052] (0.002), EGYPT [8.778]
POLAND	→	PAKISTAN [5.026] (0.006), EGYPT [3.865] (0.021)
EGYPT	←	CZECH REPUBLIC [6.183] (0.002), PAKISTAN [3.015] (0.049)

F and p values are in parentheses, respectively.

In factor 4, Hungary serves as the Granger cause for the Czech Republic and Poland, in line with the results presented by Gilmore and McManus (2002). Although Egypt and Pakistan share a factor with European countries, they do not exhibit a Granger causality in those countries. While these African nations resemble their European counterparts, it cannot be concluded that they are entirely integrated.

Although there are unidirectional Granger causalities from Croatia to Sri Lanka in the last group (factor 5), these interactions are not supported by the factor scores.

Granger Causality Analysis between Selected Countries from each Factors

Causalities between the factors were tested in the second phase of analysis, using representative countries

chosen from the first three factors. This analysis included the USA and UK from the first factor, Japan and Singapore from the second factor, and Russia and Brazil from the third factor.

Table 8: Granger Causality Analysis Result between Selected Countries from Factors

USA	→	ENGLAND [5.438] (0.004), JAPAN [20.440] , SINGAPORE [23.876]
ENGLAND	→	JAPAN [6.202] (0.002), BRAZIL [3.444] (0.032), SINGAPORE [13.549]
BRAZIL	→	RUSSIA [3.985] (0.018), SINGAPORE [9.808]

F and p values are in parentheses, respectively.

The dominant stock markets are those of the US and UK. The UK is not the Granger cause of the USA, but the converse is true. Again, there is evidence of a one-way Granger causality relationship from the US and UK stock markets to the Japanese stock market. Singapore appears to be influenced by the United States, the United Kingdom, and Brazil. While the assumption is that factor analysis produces autonomous country clusters, it has become evident that these factor groups have interdependencies. When the direction of this interaction was determined using Granger causal analysis, it revealed that there were linkages between the factors as expected. Interactions between factors can generate negative impacts, particularly during periods of crisis. As noted by Frieden and Rogowski (1996), Edison et al. (2002), international economic crises affect countries in various ways, including financial and economic challenges such as currency crises, capital outflows, elevated external borrowing costs, trade imbalances, and declining export revenues. Developing economies are especially vulnerable to such crises.

Conclusion

Stock market interactions between countries are examined using factor analysis and Granger causality. The factor analysis suggests that country stock markets can be divided into five groups. Factor 1, which includes nearly half of the countries, comprises nations with developed stock markets and open capital flows. Additionally, Asian nations are geographically separated from the other groups and are included in Factor 2. The absence of distinct geographical separation beyond Asian nations rejects the idea of regional grouping. Notably, developing countries exhibiting comparable risks and returns are grouped in Factor 3.

During the second stage, the study explored the causal relationships between the countries within each factor and the chosen countries from those factors. Factor 1 had a large number of countries, which were all developed

countries with open capital flows, resulting in a high level of causality relationship. The evidence backing this up includes the fact that these countries are alternatives for investors in the same risk group and have extensive economic and trade links. The USA and Canada have emerged as the dominant markets within Factor 1. This result confirmed the notion that the US is a dominant stock market, in line with some previous work (Agmon, 1972; Eun & Shim, 1989; Bessler & Yang, 2003; Choudhry, 2004). It is noteworthy that none of the stock markets in any country are the Granger cause of China, which is present in Factor 2. This could be attributed to the prevalent state control in the Chinese economy. This, in turn, bolsters the hypothesis of greater integration among nations with open economies. Through an analysis of causal connections between factors, it is evident that the primary stock markets are the US and UK. These countries not only have significant links with each other but also with the other countries within their respective factor groups. The causal connections among the factors indicate that the integration of the global finance market extends beyond factor groups.

Considering the causal relationship between changes in one market and their impact on another, identifying the direction of this relationship can provide insight for investors to follow markets beyond their local one. The opening of many countries to the outside world, catalysed by the wave of globalization after the Second World War, has fostered the integration of financial markets. Although financial globalization and capital market interactions may render the economy more fragile and increase the possibility of crises, they can be transformed into opportunities with proper policies, thus boosting the country's development. However, it is interesting to contemplate how the 2008 financial crisis, the COVID-19 pandemic, and the recent wave of wars and migration in Europe will impact the global economy and integration. Internationalization influences domestic policies through trade, capital flows, and technological advancements, yielding varied outcomes under different political and economic contexts. Viner (1944) argues that state control makes complexity and tension to international relations. He argues that reducing state influence on the economy is essential to promote international cooperation. While international financial integration positively impacts economic growth and financial stability, particularly in developed countries, developing nations must strengthen their financial systems and institutional structures to fully harness its benefits. From the perspective of policymakers, it is recommended that strategic policies be developed by

considering the level of development in the factors to which countries belong and their regional partnerships. Notably, the factor comprising Asian countries, consists of geographically proximate nations with a focus on rapid growth and production. This proximity may render these countries vulnerable to regional crises, as evidenced by past crises specific to this region. In this context, developing policies that reduce the interaction of regional countries within their own group would enhance their economic resilience.

The integration of capital markets enables the real sector to access international funds under favorable conditions while offering investors a range of investment alternatives with varying risk-return profiles based on countries' levels of development. In this regard, it is expected that developing countries, in particular, will have a higher return potential to attract investors, though at the cost of higher risks. However, the benefits that capital markets provide to the real economy during stable periods may reverse during times of crisis. Therefore, policymakers should aim to build a more resilient economic structure and consider capital markets from this perspective. Regulations implemented with this objective should strike a balance that while attracting foreign investments do not increase economic vulnerability.

Classifying countries provides the opportunity to policymakers with determine appropriate strategies, investors tools for risk management and opportunity analysis, and international organizations to establish more effective support mechanisms. These classifications play a crucial role in achieving global economic balance and advancing sustainable development goals.

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Genişletilmiş Özet

Küresel sermaye piyasalarının etkileşimi, uluslararası çeşitlendirilmiş portföyler oluşturmak, küresel gelişmelerin yerel piyasalar üzerindeki etkisini değerlendirmek ve politika kararlarını kolaylaştırmak için kritik bir öneme sahiptir. Bu araştırma, sermaye piyasası etkileşimleri bağlamında küresel mali entegrasyonun derecesini değerlendirmeyi amaçlamaktadır. Ülkelerin hisse senedi piyasaları arasındaki etkileşim, 45 ülke endeksinin haftalık getirileri kullanılarak 15.08.2001-18.12.2019 arası dönemde faktör analizi ve Granger nedensellik analizi ile incelenmiştir. Faktör analizi ile ülke borsalarının uluslararası piyasada nasıl ilişkisel bir gruplama oluşturduğuna bakılmış ardından aynı faktör içerisinde yer alan ülkelerin ve her bir faktörden seçilen, bulunduğu faktörü temsil ettiği düşünülen, ülkeler arasındaki nedensellik ilişkisinin yönü belirlenmiştir. Analiz sonuçlarına göre, faktör analizi ülke borsalarını gelişmiş ve gelişmekte olan ülkeler şeklinde bir gruplama oluşturmuştur. Genel olarak bölgesel bir ayrışma görülmezken, Asya ülkelerinin bir faktörde gruplaştığı dikkat çekmektedir. Granger nedensellik analizi ile faktör içi ve faktörler arasında önemli ölçüde entegrasyon ilişkisi tespit edilmiştir. Herhangi bir nedensellik ilişkisine rastlanılmayan ülke görülmemiştir.

Faktör analizi sonuçlarına göre, ülke borsaları beş faktöre ayrılmıştır. 1. Faktör ortak hareketin neredeyse yarısını oluşturmuştur. Hisse senedi piyasaları iyi gelişmiş sermaye akışları açık olan piyasalar yer almaktadır. Faktör 2’de ise Asya ülkelerinin coğrafi bir şekilde ayrılmış olduğu görülmektedir. Faktör 3’de benzer getiri oranları ve risklere sahip gelişmekte olan ülkelerin bir arada olduğu dikkat çekmektedir. Nedensellik analizi sonuçları incelendiğinde ise, ülke borsalarının bir şekilde birbirlerine entegre olduğu sonucu çıkarılmaktadır. Bu durum uluslararası portföy çeşitlendirme imkânını azaltmaktadır. Faktör 1’de ülke sayısının çok olmasının yanı sıra bu faktörde bulunan ülkelerin sermaye akışları açık olan, gelişmiş ülkeler olması nedensellik ilişkisinin fazla olmasını sağlamıştır. Faktör 1’de ABD ve Kanada’nın baskın borsalar olduğu görülmüştür. Faktör 2’de hiçbir ülke borsasının Çin’in Granger nedeni olmadığı dikkat çekmektedir. Faktörler arası nedensellik analizinde ise ABD ve İngiltere’nin baskın borsalar olduğu görülmüştür. Entegre olmayan piyasalar arasında uluslararası portföy çeşitlendirme imkânı bulunmaktadır.