Emerging Markets Finance & Trade, 54:410–429, 2018

ISSN: 1540-496X print/1558-0938 online
DOI: https://doi.org/10.1080/1540496X.2016.1247348

Routledge
Taylor & Francis Group

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Do Stock Index Futures Affect Economic Growth? Evidence from 32 Countries

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ABSTRACT: This article investigates the relationship between stock index futures markets development and economic growth using time-series methods for 32 developed and developing countries. Evidence of cointegration between stock index futures and real economy in 29 countries suggests the presence of co-movements among the variables, indicating long-run stationarity in those countries. Our findings show that there is Granger-causality from stock index futures markets development to economic growth for middle-income countries with relatively low real per capita GDP, and Granger-causality in the reverse direction for the countries with high real per capita GDP. Variance decomposition and impulse-response function (IRF) analyses results support the existence of a relationship between stock index futures and real economy.

KEY WORDS: economic growth, financial development, stock index futures

JEL CLASSIFICATION: G10, O16, O40

Several studies have shown that there is a positive relationship between a country's economic growth and development of its financial markets.[1] It is intuitive that well-developed financial intermediaries in a country with well-functioning financial markets increase the efficiency with which a greater amount of capital accumulation is facilitated and a greater amount of funds is allocated to profitable investments. However, researchers have not yet thoroughly investigated the underlying mechanisms that suggest a positive relationship between the degree of development of the financial system and economic growth. For instance, does the development of derivative contracts contribute to economic growth?

One major function of financial markets is to reallocate risk between different economic agents. On the one hand, reallocation of risk enables borrowers to tailor their risk portfolios and therefore to achieve greater access to capital. On the other hand, savers become better able to diversify their risk and make more funds available for borrowing. As a result, an economy unquestionably gains from this efficient capital allocation generated from improved risk sharing. In a financial system, innovations such as derivatives are viewed as mechanisms to share risk and to allocate capital efficiently.

Derivatives markets are an integral part of a financial system. They allow markets to provide information about market clearing price, which is an essential component of an efficient economic system. In particular, futures markets widely distribute equilibrium prices that reflect demand and supply conditions, and knowledge of those prices is essential for investors, consumers, and producers to make informed decisions. As a result, investments become more productive and lead to a higher rate of economic growth. In addition, derivative instruments provide an opportunity for hedging risk, which in turn leads to economic growth.

Although—to the best of our knowledge—there is no study in the literature that directly links stock index futures markets to economic growth, there are studies that demonstrate the link between financial risk and economic growth. On the theoretical side, Acemoglu and Zilibotti (1997) show that reducing financial risk through holding diversified portfolios allows agents to invest in high-return

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projects with a positive influence on growth. Angeletos and Calvet (2006) illustrate that improvements in entrepreneurial risk sharing through the introduction of new hedging instruments will have a positive effect on savings and medium-run growth. Moreover, Turnovsky and Bianconi (2005) and Storesletten, Telmer, and Yaron (2004) show that idiosyncratic risks play an important role in aggregate risk; thus, reducing the idiosyncratic risks of economic agents leads to economic growth. Krebs (2002) also shows that a reduction in the variation in firm-specific risk decreases the ratio of physical to human capital and increases the total investment return and growth.[2]

On the empirical side, there are various studies that have investigated the relationship between financial development and economic growth. Goldsmith (1969) is one of the leaders of the view that financial intermediation contributes to economic growth, stating that there is a positive correlation between the sizes of financial systems and the supply and quality of financial services. Among many others, King and Levine (1993), Beck, Levine, and Loayza (2000), and Levine, Loayza, and Beck (2000) examine the relationship between financial intermediary development, namely banking sector development, and economic growth.[3] Moreover, Atje and Jovanovic (1993), Demirgüç-Kunt and Levine (1996a, 1996b), Harris (1997), Levine and Zervos (1998), Rousseau and Wachtel (1998), and Arestis, Demetriades, and Luintel (2001) studied the relationship between stock market development and economic growth. Baier, Dwyer, and Tamura (2004) investigated the connection between the creation of stock exchanges and economic growth and documented an increase in economic growth after a stock exchange opens. Beck and Levine (2004) investigated the impact of both stock markets and banks on economic growth applying the generalized-method-of moments (GMM) techniques developed for dynamic panels.[4] As a result of these studies, it is now a common belief that well-functioning financial intermediaries and markets ameliorate information and transaction costs to promote efficient resource allocation, and, hence, economic growth. However, researchers have not thoroughly examined the underlying mechanisms that lead to the positive relationship between the degree of development of the financial system and economic growth. Although the relationship between the banking sector, stock market, and economic growth has been extensively examined in the literature, the effect of the development of derivative markets on economic growth has not been examined thoroughly. For instance, is it only the banking sector or also the stock market within the financial system that contributes to economic growth? Does the development of derivatives markets contribute to economic growth as well? Our main contribution in this study is to investigate whether or not derivatives markets, more specifically the stock index futures markets, contribute to the economic growth. The answer to this question has important policy implications because clarifying the role of stock index futures in economic growth may lead governments to support developing their derivatives markets in order to promote economic growth.

Haiss and Sammer (2010) applied the Merton and Bodie (1995) functional framework in the discussion of the spheres of derivatives' influence in the finance–growth nexus. They examined the impact of derivatives markets on asset management and the economy through three transmission channels: (1) the volume channel, (2) the efficiency channel, and (3) the risk channel. In their study, Haiss and Sammer (2010) tried to answer the question whether the growing importance of derivatives changed the financial sectors' ability to support economic growth and development in the US. The authors found only a weak correlation of the financial sector and derivatives in particular with economic growth and suggested further research on the subject. [5]

In our study, we use the time-series approach to examine the relationship between stock index futures markets development and economic growth in 32 developed and developing countries. We try to answer the question whether the developments in stock index futures markets contribute to economic growth. We also try to find the direction of the causal link between stock index futures and the economy. As Lin, Sun, and Jiang (2009) mention, governments are active in the process of emergence and development of appropriate financial institutional arrangements. They argue that the efficient operation of financial institutions requires a well-functioning legal system, wise regulations, and suitable supervision, which are all responsibilities of the government. In their article, Lin, Sun, and Jiang (2009) propose a hypothesis that the optimal financial structure in an economy depends on its stage of economic development. A financial structure is optimal for a country at some stage of economic development only when the characteristics of the financial structure match the characteristics of the optimal industrial structure determined by the endowment structure in the economy. On the other hand, developing countries have been advised to develop financial systems similar to the model in advanced economies. However, the optimal financial structure for less-developed countries is likely to be systemically different from that for advanced economies, and imitating the financial model of advanced economies will not generate better economic performance in those countries.

Especially in emerging markets, most of the production takes place in privately held small firms where risk sharing is absent most of the time.[6] Thus, promoting financial markets and services that ease risk sharing in these countries may result in welfare increase.

Our findings show that there is unidirectional Granger-causality from stock index futures markets development to economic growth in seven countries, most of which are middle-income countries and have relatively low real per capita GDP levels, while this relationship is the reverse for 15 high per capita income countries. Our findings are intuitive in the following sense. Futures markets widely distribute equilibrium prices that reflect demand and supply conditions, and knowledge of those prices allows investors, consumers, and producers to make informed decisions. Consequently, the amelioration of information and transaction costs fosters efficient resource allocation, thus leading to economic growth. Middle-income economies benefit more from the increase in the efficiency of resource allocation. Our findings have important policy implications. Government policies to promote derivative markets may help lead to a higher economic growth, especially for middle-income countries.

Data

We perform time-series analyses to examine the relationship between stock index futures markets development and economic growth for 32 developed and developing countries. As a proxy for the "stock index futures" variable (hereafter FUTURES), we use the total value of quarterly stock index futures contracts to quarterly seasonally adjusted nominal Gross Domestic Product ratio for each country. We obtain the total value of stock index futures contracts by multiplying the volume of contracts traded by the contract prices in each period. Since futures markets are relatively new markets among other financial instruments, there is the issue of data limitations. As data source we used Datastream. The 32 countries in our sample are all the countries that have stock index futures data in Datastream. Again due to data limitations, we preferred to use stock index futures data rather than other futures markets data. In this respect we refer to Kenourgios, Samitas, and Drosos (2008), who show that stock index futures contract is an effective tool for hedging risk by using the S&P 500 stock index futures data in their study.

"Real economy" (hereafter RGDPC) is measured by the logarithm of quarterly seasonally adjusted real per capita GDP. Index futures values and GDP data are in the countries' national currencies. Our source for the GDP data is also Datastream.

For the time-series analyses, we use quarterly data for different time periods for 32 countries.[7] The longest data period is 1982:Q3–2015:Q4 for the United States. We present the names of the countries, futures exchanges, and time periods for each country in Table 1. Descriptive statistics by country are presented in Table 2.

Time-Series Analyses

To examine the relationship between stock index futures markets development and economic growth for individual countries through time, we run the following time-series tests using quarterly data: unit root tests to see whether the series are stationary or not, cointegration tests to see the co-movement of variables in the long run, and to select a vector error correction model (VECM), causality tests to analyze the direction of causalities, variance decompositions to break down the variance of the forecast error for each variable into components, and impulse-response function (IRF) analysis to trace the

Table 1. Countries, futures exchanges, and time periods.

Market	WB income group	Index name	Exchange	Period
Australia	High income	SPI 200 INDEX	Sydney Futures Exchange (SFE)	2000Q3–2015Q4
Austria	High income	ATX INDEX	Vienna Stock Exchange	1992Q4–2014Q1
Belgium	High income	BEL20 INDEX	Euronext.liffe Brussels	1994Q1–2015Q4
Brazil	Upper middle income	BOVESPA INDEX	Bolsa de Mercadorias & Futuros	1986Q2–2015Q4
Canada	High income	S&P/TSX 60 INDEX	Montreal Exchange	1999Q4–2015Q4
China	Upper middle income	CSI 300 INDEX	China Financial Futures Exchange	2010Q3–2015Q4
Denmark	High income	OMXC20 CAP INDEX	Nordic Exchange	2012Q1–2015Q4
France	High income	CAC 40 INDEX	Euronext.liffe Paris	1999Q2–2015Q4
Germany	High income	DAX INDEX	EUREX	1991Q1–2015Q4
Greece	High income	FTSE/ASE-20	Athens Derivatives Exchange	1999Q4–2015Q4
Hong Kong, China	High income	HANG SENG INDEX	Hong Kong Futures Exchange	1986Q3–2015Q4
Hungary	High income	BUX INDEX	Budapest Stock Exchange	1995Q2–2015Q4
India	Lower middle income	S&P CNX NIFTY	National India	2000Q3–2015Q4
Italy	High income	FTSE MIB INDEX	Italian Derivatives Market	2004Q2–2015Q4
Japan	High income	NIKKEI 225 INDEX	Osaka Securities Exchange	1988Q4–2015Q4
Korea, Rep.	High income	KOSPI 200 INDEX	Korea Futures Exchange (KOFEX)	1996Q1–2015Q4
Malaysia	Upper middle income	KLCI	Kuala Lumpur	2000Q1–2015Q4
Mexico	Upper middle income	IPC INDEX	Mexican Derivatives Exchange	1999Q3–2015Q4
The Netherlands	High income	AEX INDEX	Euronext.liffe Amsterdam	1989Q1–2015Q4
Norway	High income	OBX INDEX	Oslo Stock Exchange	1992Q4–2015Q4
Poland	High income	WIG 40	Warsaw Stock Exchange	2007Q2–2015Q4
Portugal	High income	PSI 20 INDEX	Euronext.liffe Lisbon	1996Q3–2015Q4
Russian Federation	Upper middle income	RTS INDEX	Russian Trading System	2005Q4–2015Q4
Singapore	High income	MSCI SINGAPORE INDEX	Singapore Exchange—Derivatives Trading Division	1998Q4–2015Q4
South Africa	Upper middle income	ALL SHARE 40 INDEX	South African Futures Exchange	1990Q3–2015Q4
Spain	High income	IBEX 35 PLUS INDEX	MEFF Renta Variable	1992Q3–2015Q4
Sweden	High income	OMXS30 INDEX	OM Nordic Exchange	2005Q2–2015Q4
Switzerland	High income	SMI INDEX	EUREX	1991Q1–2015Q4
Thailand	Lower middle income	MINI SET50 INDEX	Thailand Futures Exchange	2006Q3–2015Q4
Turkey	Upper middle income	ISE 30	Turkish Derivatives Exchange	2005Q2–2015Q4
United Kingdom	High income	FTSE 100 INDEX	Euronext.liffe London	1984Q3–2015Q4
United States	High income	S&P 500 INDEX	Chicago Mercantile Exchange	1982Q3–2015Q4

effect of a one-time shock to one of the endogenous variables on the current and future values of itself and the other endogenous variables.

Table 2. Descriptive statistics.

	FUTURES					RGDPC				
Country	**Obs.**	**Mean**	**St. dev.**	**Min.**	**Max.**	**Obs.**	**Mean**	**St. dev.**	**Min.**	**Max.**
Australia	61	0.680	0.268	0.001	1.287	132	9.480	0.192	9.128	9.751
Austria	73	0.019	0.012	0.002	0.053	76	9.025	0.081	8.845	9.118
Belgium	83	0.041	0.033	0.001	0.113	80	9.022	0.079	8.852	9.113
Brazil	82	0.175	0.129	0.028	0.589	76	7.135	0.115	6.991	7.323
Canada	64	0.249	0.124	0.013	0.447	132	9.216	0.147	8.928	9.428
China	21	0.226	0.197	0.072	0.792	16	11.429	0.134	11.175	11.674
Denmark	15	0.010	0.004	0.000	0.016	80	11.280	0.059	11.142	11.373
France	66	0.753	0.202	0.471	1.442	132	8.815	0.139	8.557	8.980
Germany	99	1.365	1.127	0.005	4.352	96	8.892	0.090	8.753	9.050
Greece	64	0.063	0.040	0.003	0.160	80	8.437	0.128	8.218	8.645
Hong Kong, China	117	0.005	0.005	0.000	0.016	132	17.671	0.318	16.993	18.207
Hungary	81	0.010	0.012	0.000	0.046	80	13.123	0.154	12.844	13.306
India	61	0.479	0.359	0.000	1.422	75	9.430	0.293	9.012	9.937
Italy	46	0.386	0.154	0.000	0.699	80	8.814	0.046	8.731	8.890
Japan	87	0.380	0.222	0.142	0.985	84	13.782	0.045	13.695	13.865
Korea, Rep.	77	3.559	2.370	0.052	9.083	132	15.090	0.524	13.977	15.779
Malaysia	23	0.000	0.000	0.000	0.000	20	15.882	0.054	15.799	15.973
Mexico	65	0.015	0.012	0.000	0.034	88	10.128	0.071	9.952	10.230
The Netherlands	83	1.056	0.502	0.232	2.484	76	9.102	0.076	8.905	9.200
Norway	92	0.038	0.031	0.000	0.114	132	11.738	0.196	11.338	11.977
Poland	34	0.001	0.001	0.000	0.003	80	8.867	0.300	8.314	9.283
Portugal	77	0.028	0.049	0.001	0.218	80	8.297	0.063	8.123	8.376
Russian Federation	39	14.201	9.482	0.533	34.428	48	11.102	0.135	10.802	11.246
Singapore	68	0.000	0.000	0.000	0.001	132	16.129	0.383	15.416	16.684
South Africa	101	0.760	0.597	0.021	2.344	132	9.400	0.088	9.271	9.555
Spain	83	0.811	0.564	0.250	2.968	80	8.614	0.090	8.407	8.734
Sweden	42	0.936	0.242	0.202	1.612	88	11.379	0.139	11.102	11.540
Switzerland	99	0.849	0.629	0.004	2.597	132	9.744	0.103	9.536	9.900
Thailand	37	0.000	0.000	0.000	0.000	88	17.038	0.191	16.708	17.359
Turkey	41	0.206	0.127	0.000	0.409	68	5.807	0.155	5.561	6.037
United Kingdom	125	0.542	0.465	0.002	1.580	132	8.590	0.193	8.189	8.836
United States	133	0.316	0.233	0.013	1.014	132	10.609	0.172	10.241	10.833

Notes: FUTURES: Total value of quarterly stock index futures contracts to quarterly seasonally adjusted nominal GDP ratio, RGDPC: Logarithm of quarterly seasonally adjusted real per capita GDP.

Unit Root Tests

The existence of a stationary linear combination between nonstationary series suggests the existence of a cointegrating relationship between them. Therefore, stationarity of the series should be tested. We use the Augmented-Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests to determine the stationarity of FUTURES and RGDPC. Both tests have the null hypothesis of existence of a unit root, rejection of which indicates stationarity. We choose lags that minimize the Akaike Information Criterion (AIC) for the ADF test. The Newey–West bandwidth automatic selection is used for the PP unit root test. Both ADF and PP tests *fail to reject* the null hypothesis of unit root for 31 countries in level series, indicating non-stationarity (except for Sweden). Both ADF and PP tests *reject* the null hypothesis for 31 countries in first differenced series, indicating stationarity (except for Spain). For Sweden and Spain there is inconsistency between the two tests. Therefore, we run a third unit root test, the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test, for the series that showed inconsistency between the ADF and PP tests for those two countries. The KPSS test results confirmed non-stationarity of the level series and stationarity of the first differenced series for Sweden and Spain.[8] Table 3 presents the results of the ADF and PP unit root tests for 32 countries in levels and first differences.

Cointegration Tests

Although individual series are nonstationary, a linear combination of these series may be stationary. We run Johansen's cointegration tests (Trace test) to determine whether the nonstationary series FUTURES and RGDPC move together over time and whether cointegration exists among them. Table 4 presents the results of the Johansen cointegration tests, which has a null hypothesis of "no cointegration". Rejection of the null hypothesis indicates the existence of at least one cointegrating equation. Evidence of cointegration between FUTURES and RGDPC for 29 countries (except for Germany, Switzerland, and the United States) suggests the presence of co-movements among the stock index futures and the real economy in those countries, indicating long-run stationarity between the two variables.

Causality Tests

We perform Granger Causality/Block Exogeneity Wald Tests to see the direction of a causal link between stock index futures markets development and economic growth. Our regressions are as follows:

$$\Delta RGDPC_t = \sum_{i=1}^{n} \pi_{11} \Delta RGDPC_{t-i} + \sum_{i=1}^{n} \pi_{12} \Delta FUTURES_{t-i} + u_t \tag{1}$$

$$\Delta FUTURES_t = \sum_{i=1}^{n} \pi_{22} \Delta FUTURES_{t-i} + \sum_{i=1}^{n} \pi_{21} \Delta RGDPC_{t-i} + v_t \tag{2}$$

where Δ is the change operator, and u and v are the error terms. For the right-hand side of the above equations, we try lags between 1 and 12 and choose the lag that gives the lowest value of AIC. The null hypotheses are that change in FUTURES does not Granger-cause change in RGDPC, in the first regression, and that change in RGDPC does not Granger-cause change in FUTURES in the second regression. Table 5 presents the results of Granger Causality/Block Exogeneity Wald Tests. Our results show unidirectional Granger-causality between stock index futures and real economy in 22 countries. We observe significant causality from ΔFUTURES to ΔRGDPC in Australia, Brazil, China, Hungary, India, Mexico, and South Africa, most of which have relatively low real per capita GDP levels among the countries in our sample. For example, in Hungary, stock index futures market started its operation in the second quarter of 1995 and has grown significantly since then. In the first years of its operation, especially in 1995, 1996, and 1997, the stock index futures market in Hungary experienced an enormous growth as a percentage of GDP; afterward, on an average, it grew by 28.5% between 1998 and 2014. While GDP grew by 0.2% and gross fixed capital formation grew by 1.9% between 1992 and 1995, after stock index futures market started its operation in Hungary, GDP grew by 2.2% and gross fixed capital formation grew by 3.3% between 1996 and 2014[9]. Futures market allowed for greater and more efficient risk sharing, thereby making it possible for firms to undertake relatively riskier projects and promoted economic growth.

We observe unidirectional Granger-causality in the reverse direction, i.e. from ΔRGDPC to ΔFUTURES, in Austria, France, Germany, Greece, Hong Kong-China, Italy, Japan, the Netherlands, Poland, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom, which have high real per capita GDP levels. The bidirectional causality in Belgium and Norway suggests the interdependence of futures market development and economic growth (ΔRGDPC ⇔ ΔFUTURES) in these two countries.

Table 3. Unit root tests.

Country		Test	FUTURES t-stat.	FUTURES p-value	RGDPC t-stat.	RGDPC p-value
Australia	Level	ADF	−2.406	0.373	−1.562	0.803
		PP	−2.366	0.393	−1.373	0.864
	F. D. (Δ)	ADF	−8.630	0.000	−6.079	0.000
		PP	−8.615	0.000	−8.494	0.000
Austria	Level	ADF	−1.693	0.749	−2.659	0.256
		PP	−1.555	0.806	−1.592	0.791
	F. D. (Δ)	ADF	−4.091	0.008	−5.147	0.000
		PP	−11.776	0.000	−7.211	0.000
Belgium	Level	ADF	−2.556	0.107	−1.128	0.917
		PP	−1.475	0.541	−0.993	0.939
	F. D. (Δ)	ADF	−2.728	0.074	−4.383	0.004
		PP	−9.184	0.000	−4.059	0.011
Brazil	Level	ADF	−2.511	0.322	−2.161	0.503
		PP	−2.152	0.509	−2.125	0.523
	F. D. (Δ)	ADF	−5.752	0.000	−4.915	0.001
		PP	−5.715	0.000	−7.444	0.000
Canada	Level	ADF	−1.561	0.497	−1.348	0.606
		PP	−1.583	0.485	−0.903	0.785
	F. D. (Δ)	ADF	−3.247	0.022	−6.689	0.000
		PP	−7.947	0.000	−6.600	0.000
China	Level	ADF	−1.693	0.749	−2.659	0.256
		PP	−1.555	0.806	−1.592	0.791
	F. D. (Δ)	ADF	−4.091	0.008	−5.147	0.000
		PP	−11.776	0.000	−7.211	0.000
Denmark	Level	ADF	−1.693	0.749	−2.659	0.256
		PP	−1.555	0.806	−1.592	0.791
	F. D. (Δ)	ADF	−4.091	0.008	−5.147	0.000
		PP	−11.776	0.000	−7.211	0.000
France	Level	ADF	−2.431	0.361	−1.051	0.932
		PP	−2.370	0.392	−0.655	0.974
	F. D. (Δ)	ADF	−9.137	0.000	−5.590	0.000
		PP	−9.135	0.000	−5.595	0.000
Germany	Level	ADF	−1.302	0.626	−0.271	0.924
		PP	−1.222	0.663	−0.054	0.951
	F. D. (Δ)	ADF	−10.674	0.000	−7.063	0.000
		PP	−10.704	0.000	−7.054	0.000
Greece	Level	ADF	−1.693	0.749	−2.659	0.256
		PP	−1.555	0.806	−1.592	0.791
	F. D. (Δ)	ADF	−4.091	0.008	−5.147	0.000
		PP	−11.776	0.000	−7.211	0.000
Hong Kong, China	Level	ADF	−0.734	0.833	−1.403	0.579
		PP	−0.955	0.767	−1.286	0.635
	F. D. (Δ)	ADF	−6.346	0.000	−2.642	0.088
		PP	−11.066	0.000	−14.047	0.000
Hungary	Level	ADF	−2.042	0.569	−1.275	0.887
		PP	−2.251	0.455	−0.887	0.952
	F. D. (Δ)	ADF	−4.992	0.001	−4.578	0.002
		PP	−9.236	0.000	−4.534	0.003

(*Continued*)

Table 3. Unit root tests. (Continued)

Country		Test	FUTURES t-stat.	FUTURES p-value	RGDPC t-stat.	RGDPC p-value
India	Level	ADF	–1.075	0.924	–2.516	0.320
		PP	–1.297	0.879	–2.528	0.314
	F. D. (Δ)	ADF	–4.701	0.002	–8.592	0.000
		PP	–7.435	0.000	–8.592	0.000
Italy	Level	ADF	–2.128	0.235	–1.520	0.518
		PP	–2.171	0.219	–1.418	0.569
	F. D. (Δ)	ADF	–5.725	0.000	–4.108	0.002
		PP	–5.725	0.000	–4.122	0.002
Japan	Level	ADF	–2.076	0.255	–1.708	0.424
		PP	–1.987	0.292	–1.261	0.644
	F. D. (Δ)	ADF	–9.989	0.000	–7.646	0.000
		PP	–10.196	0.000	–7.659	0.000
Korea, Rep.	Level	ADF	–0.834	0.957	–1.334	0.875
		PP	–0.705	0.969	–1.355	0.869
	F. D. (Δ)	ADF	–9.686	0.000	–10.279	0.000
		PP	–9.680	0.000	–10.277	0.000
Malaysia	Level	ADF	–1.693	0.749	–2.659	0.256
		PP	–1.555	0.806	–1.592	0.791
	F. D. (Δ)	ADF	–4.091	0.008	–5.147	0.000
		PP	–11.776	0.000	–7.211	0.000
Mexico	Level	ADF	–1.217	0.662	–1.455	0.552
		PP	–1.092	0.714	–1.085	0.719
	F. D. (Δ)	ADF	–4.871	0.000	–5.694	0.000
		PP	–10.142	0.000	–5.331	0.000
The Netherlands	Level	ADF	–1.693	0.749	–2.659	0.256
		PP	–1.555	0.806	–1.592	0.791
	F. D. (Δ)	ADF	–4.091	0.008	–5.147	0.000
		PP	–11.776	0.000	–7.211	0.000
Norway	Level	ADF	–1.522	0.518	–0.451	0.985
		PP	–1.817	0.370	–0.593	0.978
	F. D. (Δ)	ADF	–8.831	0.000	–15.829	0.000
		PP	–12.871	0.000	–15.644	0.000
Poland	Level	ADF	–2.698	0.244	–1.648	0.765
		PP	–2.378	0.384	–1.494	0.824
	F. D. (Δ)	ADF	–3.824	0.029	–10.109	0.000
		PP	–8.156	0.000	–10.507	0.000
Portugal	Level	ADF	–2.414	0.370	–2.271	0.444
		PP	–2.923	0.161	–1.923	0.633
	F. D. (Δ)	ADF	–7.311	0.000	–4.397	0.004
		PP	–7.185	0.000	–7.221	0.000
Russian Federation	Level	ADF	–1.693	0.749	–2.659	0.256
		PP	–1.555	0.806	–1.592	0.791
	F. D. (Δ)	ADF	–4.091	0.008	–5.147	0.000
		PP	–11.776	0.000	–7.211	0.000
Singapore	Level	ADF	–1.998	0.287	–1.607	0.476
		PP	–1.751	0.401	–1.485	0.538
	F. D. (Δ)	ADF	–4.411	0.001	–3.681	0.005
		PP	–8.936	0.000	–9.088	0.000
South Africa	Level	ADF	–2.895	0.169	–2.316	0.422

(*Continued*)

Table 3. Unit root tests. (Continued)

			FUTURES		RGDPC	
Country		Test	t-stat.	*p*-value	t-stat.	*p*-value
		PP	−3.107	0.110	−2.219	0.475
	F. D. (Δ)	ADF	−10.938	0.000	−4.308	0.004
		PP	−10.933	0.000	−6.857	0.000
Spain	Level	ADF	−3.147	0.103	−2.086	0.545
		PP	−2.988	0.142	−1.014	0.936
	F. D. (Δ)	ADF	−5.743	0.000	−4.219	0.007
		PP	−11.766	0.000	−2.517	0.319
Sweden	Level	ADF	−2.868	0.185	−0.983	0.940
		PP	−3.472	0.056	−1.198	0.904
	F. D. (Δ)	ADF	−7.455	0.000	−4.953	0.001
		PP	−7.547	0.000	−6.979	0.000
Switzerland	Level	ADF	−2.646	0.262	−2.923	0.159
		PP	−2.475	0.340	−2.331	0.414
	F. D. (Δ)	ADF	−13.864	0.000	−6.580	0.000
		PP	−13.781	0.000	−6.542	0.000
Thailand	Level	ADF	2.109	1.000	−0.598	0.865
		PP	1.371	0.999	−0.598	0.865
	F. D. (Δ)	ADF	−3.847	0.006	−9.156	0.000
		PP	−3.674	0.009	−9.156	0.000
Turkey	Level	ADF	−1.360	0.858	−2.849	0.186
		PP	−1.254	0.885	−2.509	0.323
	F. D. (Δ)	ADF	−7.167	0.000	−6.002	0.000
		PP	−7.167	0.000	−6.011	0.000
United Kingdom	Level	ADF	−0.987	0.757	−2.054	0.264
		PP	−1.199	0.674	−2.407	0.142
	F. D. (Δ)	ADF	−10.579	0.000	−4.309	0.001
		PP	−17.959	0.000	−5.977	0.000
United States	Level	ADF	−1.693	0.749	−2.659	0.256
		PP	−1.555	0.806	−1.592	0.791
	F. D. (Δ)	ADF	−4.091	0.008	−5.147	0.000
		PP	−11.776	0.000	−7.211	0.000

Notes: ADF: Augmented Dickey–Fuller Test and PP: Phillips–Perron Test. Both tests have the Ho: There is unit root. Constant and trend are included in the ADF and PP test equations. F. D. (Δ):First difference operator, the change in the variable. We perform Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test for the series that showed inconsistency between the ADF and PP tests for Spain and Sweden. KPSS test results confirmed the existence of unit root of the level series and stationarity of the first differenced series. Results of KPSS tests are available upon request.

Our results are in line with the existing literature. Rioja and Valev (2004) propose that financial development and economic growth relationship may vary according to the level of financial development, and the authors add that: in the countries with very low levels of financial development, in the low region, additional improvements in financial markets have an uncertain effect on growth, whereas in the intermediate region, financial development has a large, positive effect on growth. Our findings are also consistent with Calderon and Liu (2003), who find that financial deepening contributes more to the causal relationship in developing countries than in industrialized ones .[10] Similarly, Shen and Lee (2006) state that the relationship between financial development and economic growth may not be linear, but rather be dependent on the economic and financial conditions.

Table 4. Johansen cointegration tests (trace test).

Series	FUTURES and RGDPC				
Country	Hypothesized number of CE(s)	Eigenvalue	Trace statistics	0.05 Critical value	*p*-Value
Australia	None	0.412	24.699	15.495	0.002
	At most 1	0.018	0.830	3.841	0.362
Austria	None	0.431	41.506	15.495	0.000
	At most 1	0.100	6.532	3.841	0.011
Belgium	None	0.146	17.595	15.495	0.024
	At most 1	0.076	5.881	3.841	0.015
Brazil	None	0.172	14.199	15.495	0.078
	At most 1	0.036	2.318	3.841	0.128
Canada	None	0.239	15.282	15.495	0.054
	At most 1	0.038	1.882	3.841	0.170
China	None	0.815	25.784	15.495	0.001
	At most 1	0.369	5.533	3.841	0.019
Denmark	None	0.861	20.124	15.495	0.009
	At most 1	0.233	2.392	3.841	0.122
France	None	0.151	14.542	15.495	0.069
	At most 1	0.075	4.696	3.841	0.030
Germany	None	0.065	6.244	15.495	0.667
	At most 1	0.005	0.432	3.841	0.511
Greece	None	0.235	20.471	15.495	0.008
	At most 1	0.093	5.475	3.841	0.019
Hong Kong, China	None	0.125	15.923	15.495	0.043
	At most 1	0.008	0.933	3.841	0.334
Hungary	None	0.258	22.551	15.495	0.004
	At most 1	0.019	1.392	3.841	0.238
India	None	0.279	15.231	15.495	0.055
	At most 1	0.003	0.156	3.841	0.693
Italy	None	0.870	61.548	15.495	0.000
	At most 1	0.012	0.366	3.841	0.545
Japan	None	0.190	16.010	15.495	0.042
	At most 1	0.008	0.611	3.841	0.435
Korea, Rep.	None	0.223	24.087	15.495	0.002
	At most 1	0.106	7.401	3.841	0.007
Malaysia	None	0.998	106.639	15.495	0.000
	At most 1	0.889	28.587	3.841	0.000
Mexico	None	0.263	18.353	15.495	0.018
	At most 1	0.054	2.819	3.841	0.093
The Netherlands	None	0.146	19.328	15.495	0.013
	At most 1	0.105	7.951	3.841	0.005
Norway	None	0.239	29.672	15.495	0.000
	At most 1	0.070	6.226	3.841	0.013
Poland	None	0.641	37.906	15.495	0.000
	At most 1	0.503	15.365	3.841	0.000
Portugal	None	0.269	24.315	15.495	0.002
	At most 1	0.082	5.219	3.841	0.022
Russian Federation	None	0.897	84.921	15.495	0.000
	At most 1	0.631	25.902	3.841	0.000
Singapore	None	0.345	21.972	15.495	0.005
	At most 1	0.000	0.008	3.841	0.928

(*Continued*)

Table 4. Johansen cointegration tests (trace test). (Continued)

Series	FUTURES and RGDPC				
Country	Hypothesized number of CE(s)	Eigenvalue	Trace statistics	0.05 Critical value	*p*-Value
South Africa	None	0.134	13.606	15.495	0.094
	At most 1	0.000	0.034	3.841	0.853
Spain	None	0.162	16.379	15.495	0.037
	At most 1	0.059	4.185	3.841	0.041
Sweden	None	0.724	35.221	15.495	0.000
	At most 1	0.017	0.459	3.841	0.498
Switzerland	None	0.081	8.325	15.495	0.431
	At most 1	0.006	0.519	3.841	0.471
Thailand	None	0.942	69.034	15.495	0.000
	At most 1	0.026	0.635	3.841	0.426
Turkey	None	0.958	116.142	15.495	0.000
	At most 1	0.678	30.623	3.841	0.000
United Kingdom	None	0.162	20.852	15.495	0.007
	At most 1	0.015	1.627	3.841	0.202
United States	None	0.032	6.412	15.495	0.647
	At most 1	0.018	2.285	3.841	0.131

Notes: CE is the abbreviation for cointegrating equation.

Vector Error Correction Models, Variance Decomposition, and IRF Analyses

A cointegration in stock index futures and the real economy indicates long-run stationarity, but provides no information about the speed of adjustments of the variables to deviations from their common stochastic trend. Existence of cointegration between FUTURES and RGDPC series in 29 countries leads us to use the VECM in those countries to correct the deviation from the long-run equilibrium, as Engle and Granger (1987) suggest. We construct the following VECM. The fourth component of each equation is the error correction term (ECT) that is formed with the cointegrating vector. Sign and size of the coefficient of the ECT in each equation reflect the direction and speed of adjustments in the dependent variable to deviations from the linear long-run relationship.

$$\Delta FUTURES_t = d_1 + a_{11}(L)\Delta FUTURES_{t-1} + a_{12}(L)\Delta RGDPC_{t-1} + g_1(FUTURES_{t-1} + b_{12}RGDPC_{t-1} + c_0) + \varepsilon_{1t} \quad (3)$$

$$\Delta RGDPC_t = d_2 + a_{21}(L)\Delta FUTURES_{t-1} + a_{22}(L)\Delta RGDPC_{t-1} + g_2(FUTURES_{t-1} + b_{12}RGDPC_{t-1} + c_0) + \varepsilon_{2t} \quad (4)$$

where Δ is the change operator; d_1, d_2, and c_0 are constants; L is the lag operator $[a_{11}(L): a_{11.0}\, L^\circ + a_{11.1}\, L^1 + \ldots$(a polynomial in L)]; g_1 and g_2 are the adjustment parameters; and b_{12} is the cointegration coefficient. For the other three countries, namely Germany, Switzerland, and the United States, where we could not observe cointegration between FUTURES and RGDPC, we simply used the Vector Autoregression Model (VAR). VECMs and VARs are used in the calculations of variance decomposition and IRF among stock index futures market and real economy.

In 22 countries, namely in Australia, Austria, Brazil, China, France, Greece, Hungary, India, Italy, Malaysia, Mexico, the Netherlands, Norway, Poland, Russian Fed., Singapore, South Africa, Spain, Sweden, Thailand, Turkey, and the United Kingdom, variance decomposition results suggest innovations in FUTURES explain substantial amounts of the variation in RGDPC as the number of periods

Table 5. Granger-causality/block exogeneity Wald tests.

	Dep.Var.: ΔRGDPC Excluded: ΔFUTURES ΔFUTURES ⇒ ΔRGDPC			Dep.Var.: ΔFUTURES Excluded: ΔRGDPC ΔRGDPC ⇒ ΔFUTURES		
Country	Chi-square statistics	df	*p*-Value	Chi-square statistics	Df	*p*-Value
Australia	12.733	1	0.001	0.620	1	0.434
Austria	0.526	9	0.848	3.547	9	0.002
Belgium	2.658	3	0.055	2.264	3	0.089
Brazil	2.684	4	0.040	1.609	4	0.183
Canada	1.822	11	0.102	1.332	11	0.263
China	9.592	4	0.097	1.185	4	0.505
Denmark	0.676	3	0.689	4.852	3	0.319
France	2.231	2	0.117	3.836	2	0.028
Germany	0.620	1	0.433	11.525	1	0.001
Greece	1.747	10	0.117	2.309	10	0.039
Hong Kong, China	1.735	2	0.181	3.926	2	0.023
Hungary	4.313	8	0.001	0.753	8	0.645
India	4.771	2	0.013	1.866	2	0.165
Italy	1.547	5	0.210	2.376	5	0.067
Japan	0.122	1	0.727	4.731	1	0.033
Korea, Rep.	1.149	2	0.323	0.156	2	0.856
Malaysia	0.361	5	0.849	2.510	5	0.240
Mexico	2.117	12	0.057	0.755	12	0.687
The Netherlands	0.297	1	0.588	3.378	1	0.070
Norway	1.994	12	0.044	1.783	12	0.077
Poland	0.481	6	0.810	2.549	6	0.085
Portugal	1.244	8	0.293	1.782	8	0.090
Russian Federation	0.511	11	0.813	0.677	11	0.730
Singapore	0.487	3	0.693	4.867	3	0.004
South Africa	2.598	2	0.080	0.954	2	0.389
Spain	0.328	5	0.894	2.022	5	0.088
Sweden	2.023	9	0.144	3.614	9	0.029
Switzerland	0.926	2	0.400	2.409	2	0.096
Thailand	0.090	10	0.997	1.021	10	0.591
Turkey	0.141	12	0.979	12.139	12	0.221
United Kingdom	0.453	3	0.716	2.570	3	0.058
United States	1.756	2	0.177	1.797	2	0.170

Notes: Ho: (i) change in FUTURES does not Granger-cause change in RGDPC, (ii) change in RGDPC does not Granger-cause change in FUTURES, respectively. 1–12 lags are tried, the lag minimizing the Akaike Information Criterion (AIC) is chosen. F. D. (Δ): First difference operator, the change in the variable.

increase. In 21 countries, namely in Austria, Canada, China, France, Germany, Greece, Hong Kong Ch., India, Italy, Japan, Poland, Portugal, Russian Fed., Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, and the United Kingdom, variance decomposition results suggest innovations in RGDPC explain substantial amounts of the variation in FUTURES as the number of periods increases. These findings imply interdependence of the stock index futures and the real economy. Variance decompositions analyses results are presented in Table A1. To reinforce our results, we perform the Residual Serial Correlation LM Test, which has a null hypothesis of no serial correlation. Test results show that we observe no serial correlation in all countries in almost all lags. Residual Serial Correlation LM Test results are presented in Table A2.

For a robustness check we perform IRF analyses. Our results indicate that stock index futures markets development and economic growth affect each other. We observe that one standard deviation FUTURES innovation affects RGDPC, and one standard deviation RGDPC innovation affects FUTURES for the analysis period of 12 quarters for the countries in our data set. Exceptionally for Denmark, the effect of one standard deviation RGDPC innovation to FUTURES is almost zero.[11]

Conclusion

In this article, we investigate the relationship between stock index futures markets development and economic growth using time-series methods for 32 developed and developing countries. Evidence of cointegration between stock index futures markets and real per capita GDP in the countries in our sample suggests the presence of co-movements among the variables, indicating long-run stationarity. Our results show unidirectional Granger-causality between stock index futures markets development and economic growth in 22 countries. We observe significant causality from futures markets development to economic growth in Australia, Brazil, China, Hungary, India, Mexico, and South Africa, most of which are middle-income countries and have relatively low real per capita GDP levels among the countries in our sample. We observe unidirectional Granger-causality in the reverse direction, i.e. from economic growth to futures markets development, in Austria, France, Germany, Greece, Hong Kong-China, Italy, Japan, the Netherlands, Poland, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom, which have high real per capita GDP levels. Variance decomposition and IRF analyses results also support the existence of a relationship between stock index futures markets and real per capita GDP.

Our results are intuitive. On the one hand, well-functioning futures markets allow for greater and more efficient risk sharing, thereby making it possible for firms to undertake relatively riskier projects and, hence, promote growth. On the other hand, futures markets widely distribute equilibrium prices that reflect demand and supply conditions, and knowledge of those prices allows investors, consumers, and producers to make informed decisions. Consequently, the amelioration of information and transaction costs fosters efficient resource allocation, thus leading to economic growth. Middle-income economies benefit more from the increase in the efficiency of resource allocation. Our findings have important policy implications. Government policies to promote derivative markets may help lead to a higher economic growth, especially for middle-income countries.

Notes

1. See Levine (2005) for a survey. See Wachtel (2001) for a summary of consensus and discussion of the techniques that have been used in the related literature.
2. See also Cyree, Huang, and Lindley (2011) for a discussion of function of banks' derivatives use.
3. See Jeong, Kymn, and Kymn (2003), Berger, Hasan, and Klapper (2004), Şendeniz-Yüncü, Akdeniz, and Aydoğan (2008), and Cheng and Degryse (2010) for further analysis of the impact of banking sector on economic growth.
4. See also Saci, Giorgioni, and Holden (2009) for a discussion of the impact of both stock market and banking sector developments on growth using GMM panel techniques.
5. See also Baluch and Ariff (2007) and Bekale, Botha, and Vermeulen (2015) for discussions of derivative markets and economic growth relationships.
6. Smith and Stulz (1985) argue that by reducing the variability of the future value of the firm, hedging lowers the probability of incurring bankruptcy costs, and benefits shareholder.
7. EViews 7 is used for all the analyses.
8. KPSS test results are available upon request.
9. Source for GDP growth (annual %) and gross fixed capital formation (annual % growth) data for Hungary is the World Bank.
10. See also Wachtel (2003) for the discussions of different levels of effects of finance on economic growth in countries with different income levels.
11. IRF analyses results are available upon request.

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APPENDIX

Table A1. Variance decompositions.

		FUTURES			RGDPC		
Country	**Period**	**S.E.**	**ε_{1t} (FUTURES)**	**ε_{2t} (RGDPC)**	**S.E.**	**ε_{1t} (FUTURES)**	**ε_{2t} (RGDPC)**
Australia	1	0.095	100.000	0.000	0.003	5.962	94.038
	2	0.134	98.123	1.877	0.005	13.044	86.956
	11	0.233	94.820	5.180	0.007	26.959	73.041
	12	0.234	94.863	5.137	0.007	29.314	70.686
Austria	1	0.004	100.000	0.000	0.008	6.227	93.773
	2	0.004	98.420	1.580	0.013	20.813	79.187
	11	0.006	81.447	18.553	0.032	35.104	64.896
	12	0.007	82.435	17.565	0.032	35.358	64.642
Belgium	1	0.008	100.000	0.000	0.004	0.013	99.987
	2	0.010	99.282	0.718	0.009	0.082	99.918
	11	0.024	96.791	3.209	0.023	2.376	97.624
	12	0.024	96.047	3.953	0.024	2.296	97.704
Brazil	1	0.038	100.000	0.000	0.011	8.193	91.807
	2	0.066	98.183	1.817	0.017	10.778	89.222
	11	0.121	96.342	3.658	0.041	26.411	73.589
	12	0.121	96.120	3.880	0.043	25.714	74.286
Canada	1	0.026	100.000	0.000	0.005	9.560	90.440
	2	0.031	96.529	3.471	0.010	20.562	79.438
	11	0.055	84.632	15.368	0.026	9.538	90.462
	12	0.057	79.461	20.539	0.027	8.498	91.502
China	1	0.032	100.000	0.000	0.103	6.856	93.144
	2	0.047	83.992	16.008	0.106	11.408	88.592
	11	0.088	57.228	42.772	0.152	35.838	64.162
	12	0.092	56.699	43.301	0.155	36.692	63.308
Denmark	1	0.003	100.000	0.000	0.004	65.503	34.497
	2	0.003	99.336	0.664	0.005	51.932	48.068
	11	0.003	99.267	0.733	0.011	17.827	82.173
	12	0.003	99.267	0.733	0.011	17.189	82.811
France	1	0.115	100.000	0.000	0.004	0.377	99.623
	2	0.152	95.190	4.810	0.008	4.630	95.370
	11	0.381	88.611	11.389	0.018	13.272	86.728
	12	0.398	88.854	11.146	0.018	13.944	86.056
Germany	1	0.273	100.000	0.000	0.008	0.836	99.164
	2	0.366	92.391	7.609	0.014	1.871	98.129
	11	0.700	72.965	27.035	0.038	4.544	95.456
	12	0.716	71.854	28.146	0.040	4.743	95.257
Greece	1	0.016	100.000	0.000	0.013	29.111	70.889
	2	0.023	79.133	20.867	0.018	28.632	71.368
	11	0.064	49.984	50.016	0.102	50.824	49.176
	12	0.067	50.555	49.445	0.115	50.035	49.965
Hong Kong, China	1	0.001	100.000	0.000	0.017	0.865	99.135
	2	0.001	91.708	8.292	0.026	0.480	99.520
	11	0.002	71.494	28.506	0.069	1.681	98.319
	12	0.002	69.813	30.187	0.070	1.641	98.359
Hungary	1	0.006	100.000	0.000	0.006	11.074	88.926

(*Continued*)

Table A1. Variance decompositions. (Continued)

		FUTURES			RGDPC		
Country	Period	S.E.	ε_{1t} (FUTURES)	ε_{2t} (RGDPC)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (RGDPC)
	2	0.007	99.980	0.020	0.011	15.079	84.921
	11	0.014	95.324	4.676	0.039	71.593	28.407
	12	0.014	95.335	4.665	0.044	75.324	24.676
India	1	0.121	100.000	0.000	0.011	15.457	84.543
	2	0.174	96.759	3.241	0.016	8.411	91.589
	11	0.311	87.423	12.577	0.041	13.530	86.470
	12	0.317	87.468	12.532	0.043	13.448	86.552
Italy	1	0.039	100.000	0.000	0.004	0.265	99.735
	2	0.060	63.172	36.828	0.007	15.405	84.595
	11	0.112	55.651	44.349	0.020	20.968	79.033
	12	0.126	54.754	45.246	0.020	21.676	78.324
Japan	1	0.0959	100.000	0.000	0.011	0.001	99.999
	2	0.122	96.223	3.777	0.017	0.103	99.897
	11	0.201	59.954	40.046	0.036	0.042	0.402
	12	0.207	56.836	43.164	0.036	0.044	0.418
Korea, Rep.	1	0.633	100.000	0.000	0.009	4.942	95.058
	2	0.857	99.960	0.040	0.014	3.173	96.827
	11	2.254	99.206	0.794	0.028	3.773	96.227
	12	2.379	99.161	0.839	0.029	3.968	96.032
Malaysia	1	0.000	100.000	0.000	0.006	3.035	96.965
	2	0.000	99.995	0.005	0.007	21.657	78.343
	11	0.000	99.949	0.051	0.018	44.788	55.212
	12	0.000	99.944	0.056	0.018	45.121	54.879
Mexico	1	0.002	100.000	0.000	0.008	0.006	99.994
	2	0.003	95.403	4.597	0.015	0.452	99.548
	11	0.008	92.447	7.553	0.038	19.922	80.078
	12	0.009	91.975	8.025	0.039	21.197	78.803
The Netherlands	1	0.173	100.000	0.000	0.005	2.568	97.432
	2	0.234	95.477	4.523	0.008	32.213	67.787
	11	0.729	98.397	1.603	0.040	94.218	5.782
	12	0.744	98.460	1.540	0.042	94.622	5.378
Norway	1	0.012	100.000	0.000	0.009	0.008	99.992
	2	0.015	99.272	0.728	0.011	0.404	99.596
	11	0.027	91.927	8.073	0.026	47.525	52.475
	12	0.028	92.008	7.992	0.029	54.185	45.815
Poland	1	0.000	100.000	0.000	0.004	66.742	33.258
	2	0.000	93.597	6.403	0.007	76.499	23.501
	11	0.004	75.054	24.946	0.028	78.563	21.437
	12	0.006	76.605	23.395	0.028	78.062	21.938
Portugal	1	0.003	100.000	0.000	0.008	2.444	97.556
	2	0.004	93.239	6.761	0.013	3.786	96.214
	11	0.005	69.871	30.129	0.035	8.208	91.792
	12	0.005	69.309	30.691	0.036	8.347	91.653
Russian Federation	1	2.446	100.000	0.000	0.005	32.291	67.709
	2	3.307	99.349	0.651	0.011	43.196	56.804
	11	6.362	90.948	9.052	0.032	73.969	26.031
	12	6.403	89.912	10.088	0.033	75.991	24.009
Singapore	1	0.000	100.000	0.000	0.020	1.932	98.068

(*Continued*)

Table A1. Variance decompositions. (Continued)

		FUTURES			RGDPC		
Country	Period	S.E.	ε_{1t} (FUTURES)	ε_{2t} (RGDPC)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (RGDPC)
	2	0.000	92.395	7.605	0.030	0.971	99.029
	11	0.000	86.113	13.887	0.077	35.111	64.889
	12	0.000	85.598	14.402	0.080	35.670	64.330
South Africa	1	0.158	100.000	0.000	0.005	6.918	93.082
	2	0.201	99.880	0.120	0.010	9.657	90.343
	11	0.374	63.644	36.356	0.044	10.897	89.103
	12	0.383	60.750	39.250	0.047	10.163	89.837
Spain	1	0.118	100.000	0.000	0.002	13.332	86.668
	2	0.163	99.018	0.982	0.005	15.035	84.965
	11	0.407	80.451	19.549	0.031	26.398	73.602
	12	0.421	81.083	18.917	0.032	26.549	73.451
Sweden	1	0.040	100.000	0.000	0.010	39.491	60.509
	2	0.055	87.570	12.430	0.016	58.341	41.659
	11	0.206	56.809	43.191	0.041	58.383	41.617
	12	0.207	56.867	43.133	0.041	58.379	41.621
Switzerland	1	0.213	100.000	0.000	0.005	1.085	98.915
	2	0.246	98.292	1.708	0.010	3.032	96.968
	11	0.420	89.094	10.906	0.033	7.962	92.038
	12	0.429	88.396	11.604	0.035	8.384	91.616
Thailand	1	0.000	100.000	0.000	0.039	24.965	75.035
	2	0.000	73.448	26.553	0.043	21.983	78.017
	11	0.001	55.369	44.631	0.110	61.328	38.672
	12	0.001	85.438	14.562	0.193	83.204	16.796
Turkey	1	0.030	100.000	0.000	0.027	2.930	97.070
	2	0.047	55.884	44.116	0.047	9.787	90.213
	11	0.109	33.473	66.527	0.067	20.155	79.845
	12	0.109	32.977	67.023	0.067	20.103	79.897
United Kingdom	1	0.102	100.000	0.000	0.004	2.038	97.962
	2	0.111	99.732	0.268	0.008	0.976	99.024
	11	0.151	86.371	13.629	0.040	32.585	67.415
	12	0.152	86.495	13.505	0.043	34.632	65.368
United States	1	0.057	100.000	0.000	0.006	2.682	97.317
	2	0.079	99.992	0.008	0.010	5.158	94.842
	11	0.165	99.974	0.027	0.027	8.284	91.716
	12	0.170	99.964	0.036	0.028	8.340	91.600

Notes: First 2 and last 2 periods are reported to save space. Variance decomposition breaks down the variance of the forecast error for each variable into components that can be attributed to each of the endogenous variables. S.E. is the forecast error.

Table A2. Residual serial correlation LM tests.

Country	Lags	LM statistics	*p*-value	Country	Lags	LM statistics	*p*-Value
Australia	1	1.795	0.773	Malaysia	1	3.733	0.443
	2	5.395	0.249		2	3.954	0.412
	7	2.189	0.701		7	1.853	0.763
	8	1.327	0.857		8	3.684	0.451
Austria	1	1.116	0.892	Mexico	1	5.784	0.216
	2	1.506	0.826		2	4.936	0.294
	7	2.590	0.629		7	5.250	0.263
	8	1.041	0.904		8	0.630	0.960
Belgium	1	5.542	0.236	The Netherlands	1	0.721	0.949
	2	2.881	0.578		2	3.716	0.446
	7	5.429	0.246		7	5.185	0.269
	8	4.636	0.327		8	1.438	0.838
Brazil	1	2.692	0.611	Norway	1	5.590	0.232
	2	3.585	0.465		2	5.842	0.211
	7	2.333	0.675		7	4.912	0.297
	8	1.165	0.884		8	2.978	0.562
Canada	1	1.276	0.865	Poland	1	1.857	0.762
	2	0.116	0.998		2	4.726	0.317
	7	2.663	0.616		7	5.057	0.282
	8	1.293	0.863		8	1.555	0.817
China	1	1.397	0.845	Portugal	1	5.994	0.200
	2	4.963	0.291		2	1.241	0.871
	7	7.012	0.135		7	5.350	0.253
	8	6.703	0.152		8	4.804	0.308
Denmark	1	5.048	0.282	Russian Federation	1	0.907	0.924
	2	5.571	0.234		2	3.518	0.475
	7	1.246	0.871		7	1.118	0.891
	8	1.651	0.800		8	3.129	0.537
France	1	2.592	0.628	Singapore	1	3.232	0.520
	2	5.027	0.285		2	3.572	0.467
	7	5.140	0.273		7	3.971	0.410
	8	0.529	0.971		8	1.614	0.806
Germany	1	3.395	0.494	South Africa	1	5.359	0.252
	2	2.723	0.605		2	6.636	0.156
	7	0.425	0.980		7	4.067	0.397
	8	0.809	0.937		8	1.121	0.891
Greece	1	1.910	0.752	Spain	1	6.333	0.176
	2	1.816	0.770		2	6.328	0.176
	7	4.375	0.358		7	1.478	0.831
	8	2.145	0.709		8	3.663	0.454
Hong Kong, China	1	1.612	0.807	Sweden	1	4.357	0.360
	2	0.553	0.968		2	2.477	0.649
	7	4.248	0.373		7	6.148	0.188
	8	6.196	0.185		8	5.057	0.282
Hungary	1	5.831	0.212	Switzerland	1	7.441	0.114
	2	1.621	0.805		2	1.979	0.740
	7	2.201	0.699		7	4.922	0.295
	8	6.498	0.165		8	4.664	0.324
India	1	1.655	0.799	Thailand	1	4.154	0.386
	2	7.412	0.116		2	2.985	0.560

(*Continued*)

Table A2. Residual serial correlation LM tests. (Continued)

Country	Lags	LM statistics	*p*-value	Country	Lags	LM statistics	*p*-Value
	7	2.059	0.725		7	3.823	0.431
	8	2.122	0.713		8	2.397	0.663
Italy	1	3.000	0.558	Turkey	1	5.475	0.242
	2	5.918	0.205		2	4.079	0.395
	7	0.603	0.963		7	1.769	0.778
	8	2.696	0.610		8	5.069	0.280
Japan	1	1.117	0.892	United Kingdom	1	6.017	0.198
	2	4.256	0.373		2	2.400	0.663
	7	1.378	0.848		7	3.614	0.461
	8	7.030	0.134		8	3.621	0.460
Korea, Rep.	1	1.379	0.848	United States	1	2.980	0.561
	2	2.487	0.647		2	4.773	0.311
	7	1.234	0.873		7	1.683	0.794
	8	0.647	0.958		8	4.246	0.374

Notes: First 2 and last 2 lags are reported to save space. *p*-values from chi-square with 4 df.