ESSAYS ON FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH

A Ph.D. Dissertation

by

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July 2007

To My Father

ESSAYS ON FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH

The Institute of Economics and Social Sciences
of
Bilkent University

by

İLKAY ŞENDENİZ YÜNCÜ

In Partial Fulfillment of the Requirements for the Degree of

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July 2007

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Doctor of Philosophy in Management (Finance).

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ABSTRACT

ESSAYS ON FINANCIAL DEVELOPMENT

AND ECONOMIC GROWTH

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The relationship between financial development and economic growth is analyzed in this dissertation. The first essay investigates the roles of banking sector development and stock market development in economic growth and the role of economic growth in banking sector development and stock market development in 64 developed and emerging markets over the period 1994–2003 using dynamic panel data techniques. In emerging markets, a statistically significant and positive interdependence is observed both between banking sector development and economic growth and between stock market development and economic growth. The results show that in developed markets, although economic growth positively affects financial development, banking sector development and stock market development have no statistically significant effects on economic growth, supporting the demand-following view.

In the second essay, the role of futures markets in economic growth is investigated using both dynamic panel data and time-series techniques. Dynamic panel estimation results give evidence of a statistically significant and positive relationship between futures market development and economic growth. The results are consistent with models, which predict that well-functioning financial markets promote economic growth. Time-series analyses results indicate that this relationship is more robust for the countries that have medium-sized futures markets. It is concluded that risk management through futures markets improves economic growth mostly in countries with developing futures markets.

Keywords: Banking sector, stock market, futures market, economic growth, dynamic panel, time series.

ÖZET

FİNANSAL GELİŞME VE EKONOMİK BÜYÜME

ÜZERİNE MAKALELER

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Bu tezde finansal gelişme ile ekonomik büyüme arasındaki ilişki incelenmektedir. İlk bölümde, 64 gelişmiş ve gelişmekte olan ülkede 1994–2003 yılları arasında bankacılık sektörü ve hisse senedi piyasasındaki gelişmelerin ekonomik büyümede oynadıkları rol ile ekonomik büyümenin bankacılık sektörü ve hisse senedi piyasasındaki gelişmelerde oynadığı rol dinamik panel veri yöntemleri kullanılarak araştırılmaktadır. Gelişmekte olan ülkelerde hem bankacılık sektöründeki gelişmeler ile ekonomik büyüme arasında, hem de hisse senedi piyasalarındaki gelişmeler ile ekonomik büyüme arasında istatistiksel olarak anlamlı ve pozitif bir ilişki olduğu gözlenmiştir. Gelişmiş ülkelerde bulgular talep-öncelikli görüşü destekleyerek, ekonomik büyümenin finans piyasaları üzerinde pozitif etkisi olduğunu gösterirken, bankacılık sektörü ve hisse senedi piyasasındaki gelişmelerin ekonomik büyüme üzerinde istatistiksel olarak anlamlı bir etkisi olmadığını göstermiştir.

İkinci bölümde, vadeli işlem piyasalarındaki gelişmelerin ekonomik büyümedeki rolü dinamik panel veri ve zaman serileri yöntemleri kullanılarak araştırılmaktadır. Dinamik panel analiz bulguları vadeli işlem piyasalarındaki gelişmeler ile ekonomik büyüme arasında istatistiksel olarak anlamlı ve pozitif bir ilişki olduğunu göstermektedir. Bulgular, fonksiyonlarını iyi bir şekilde yerine getiren finansal piyasaların ekonomik büyümeyi desteklediği yönündeki modellerle tutarlılık göstermektedir. Zaman serileri bulguları bu ilişkinin orta büyüklükteki vadeli işlem piyasalarına sahip olan ülkelerde daha kuvvetli olduğunu göstermektedir. Vadeli işlem piyasaları aracılığı ile risk yönetiminin çoğunlukla gelişmekte olan vadeli işlem piyasalarına sahip olan ülkelerde ekonomik büyümeyi artırmakta olduğu sonucuna varılmaktadır.

Anahtar Kelimeler: Bankacılık sektörü, hisse senedi piyasası, vadeli işlem piyasası, ekonomik büyüme, dinamik panel, zaman serileri.

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CHAPTER 1

INTRODUCTION

The relationship between financial markets and economic growth has been an important topic of research debate for a long time. A function of a financial system is to intermediate between lenders and borrowers so that transaction and information costs for both parties can be reduced. Developed financial systems can influence economic growth by improving information on firms and economic conditions, providing capital to investors and minimizing investor risks. Financial intermediaries that produce better information on firms will fund more promising firms and, thus, encourage a more efficient allocation of capital. Because financial intermediaries provide profitable investments, they increase savings.

Beginning with the studies of Bagehot (1873) and Schumpeter (1911, 1934), which stress the critical role of the banking system in economic growth, there have been numerous studies investigating the relationship between finance and economic growth; however, so far, there is no consensus on the role of financial development in economic growth. The views about the role of financial development in economic growth are conflicting. While some researchers believe that financial development strongly affects economic growth, some do not. Four different views are summarized by Al-Yousif (2002). The first is the "supply-leading" view, according to which financial development has a positive effect on economic growth. Supporters of this view argue that financial intermediation contributes to economic growth by raising the efficiency of capital accumulation and, in turn, the marginal productivity of capital. Financial intermediation also raises the savings rate and, thus, the investment rate, which leads to economic growth. Some supporters of the "supply-leading" view are Hicks, (1969), Goldsmith (1969), McKinnon (1973), Shaw (1973), Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Arestis et al. (2001), Christopoulos and Tsionas (2004), and Rioja and Valev (2004).

The second view, advanced by Robinson (1952), is the "demand-following" view, according to which, as the real side of the economy expands its demand for financial arrangements increases, and, hence, financial services grow. Robinson (1952) argues that financial development follows economic growth. Patrick (1966) and Ireland (1994) give support for the "demand-following" view. Patrick (1966) shows financial development as a consequence of high growth that demands more and better financial services.

The third view of the relationship between financial development and economic growth states that the two variables have bi-directional causality. Demetriades and Hussein (1996) perform causality tests between financial development and real Gross Domestic Product (GDP) using a time-series approach.

They find bi-directional causality between the two variables. Luintel and Khan (1999) also find an evidence of bi-directional causality between finance and growth. Greenwood and Smith (1997) present two models with endogenous market formation to analyze this relationship. They argue that markets promote growth and that growth, in turn, encourages the formation of new markets. Their model stresses three points: (1) market formation is endogenous, and market formation costs will require that market development follows some period of real development; (2) market formation enhances growth by promoting the capital allocation; (3) competition among potential providers of market services leads markets to be efficient.

Finally, Lucas (1988) advanced a fourth view, which states that there is no causal relationship between financial development and economic growth. Lucas (1988: 6) discusses that the role of the financial system in economic growth is "over-stressed."

There are several empirical studies that test the validity of each of these conflicting views in order to clarify the finance-growth relationship. However there is no consensus on the role of financial development in growth yet. In the first essay, bi-directional relationship between financial development and economic growth, specifically, both the role of financial development in economic growth and the role of economic growth in financial development are investigated in 64 developed and emerging markets using dynamic panel data techniques over the period of 1994–2003. Existence of a long-run relationship both between the banking sector development and growth, and between the stock market development and growth are tested for a large sample of developed and emerging markets via panel cointegration tests.

Several studies provide evidence of a positive relationship between a country's economic growth and the development of its financial markets. With their functions of providing capital to investors and thus improving the real sector, developed financial systems influence economic growth. 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 are 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?

Capital markets, which are the major components of financial systems, provide capital to investors and minimize the risks that would be encountered in the real sector. One major function of financial markets is to reallocate risk between different economic agents. Reallocation of risk enables borrowers to tailor their risky portfolios and therefore, to achieve greater access to capital. In addition, savers become better able to diversify their risk and make more funds available for borrowing. As a result, an economy unquestionably gains from the efficient capital allocation generated from this improved risk sharing. The development of modern methods of risk allocation, especially through the growing sophistication of derivatives instruments improves the allocation of risk and increases the efficiency of financial intermediation.

Derivatives markets are viewed as mechanisms to allocate capital efficiently and to share risk. They allow markets to provide information about market clearing prices, 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. Derivatives markets also provide an opportunity for hedging risk and, thus, lead to economic growth. Levine (2005) discusses that financial systems may mitigate the risks associated with individual projects, firms, industries, regions and countries. Whereas savers generally do not like risk, high-return projects tend to be riskier than low-return projects. Thus, financial markets that make it easier for people to diversify risk tend to induce a portfolio shift toward projects with higher expected returns (see Gurley and Shaw, 1955; Patrick, 1966; Greenwood and Jovanovic, 1990; Devereux and Smith, 1994; and Obstfeld, 1994).

Second essay investigates whether derivative market development, specifically, futures market development causes economic growth in a sample of emerging and developed markets using both dynamic panel and time-series approaches. Analyzing this relationship is important because clarifying the role of futures markets in economic growth may lead to government policies that support developments in futures markets in order to promote economic growth. In the second essay the relationship between futures markets and economic growth is investigated for the first time by means of dynamic panel data and time-series techniques.

CHAPTER 2

BANKING SECTOR, STOCK MARKET AND ECONOMIC GROWTH

2.1 INTRODUCTION

In this essay the roles of banking sector development and stock market development in economic growth and the role of economic growth in the banking sector development and stock market development are investigated in 64 developed and emerging markets using dynamic panel data techniques considering the cointegration properties of the panel data over the period of 1994–2003.

Existing empirical studies, which are presented in the literature review section in detail, typically assign economic growth as the dependent variable, and, thus causality is expected to run from financial development to economic growth. Such an expectation may cause a model misspecification problem. In this essay, the interdependence of banking sector development and economic growth, and the interdependence of stock market development and economic growth, in other words the bi-directional relationship between financial development and economic growth is investigated.

Most of the empirical studies run cross-country regressions, which do not permit the investigation of causal links and ignore simultaneity bias and country-specific details that would be hidden in averaged-out results. The unobserved country specific effects become part of the error term and may bias the coefficient estimates. Demetriades and Hussein (1996) discuss that causality patterns vary across countries and point out the shortcomings of statistical inference in cross-country studies, which treat different economies as homogeneous entities. The time-series studies examining the causal relationship between financial development and economic growth mainly use banking sector development as a proxy for financial development and exclude the stock market, due to data limitations. Although there are studies including the stock market development indicator in their analyses, the need for long time-series data for the stock market has limited these studies to fewer countries, mostly the developed ones.

Beck and Levine (2004) discuss that panel-data studies overcome the limitations of cross-country and time-series studies; however, they criticize most of the existing panel-data studies that exclude stock market development measures, due to inadequacy of data. The authors state that it becomes difficult to assess whether a positive relationship between bank development and growth exists when controlling for stock market development. Beck and Levine (2004) investigate the impact of stock markets and banks on economic growth using dynamic panels that reduce statistical shortcomings of existing studies. They control for simultaneity bias, omitted variable bias, and the inclusion of lagged dependent variables in growth regressions. They find that stock markets and banks positively influence growth. However, they did not consider the stationarity and cointegration properties of the data. Christopoulos and Tsionas (2004) criticize previous studies that do not consider cointegration properties of data and state that it is not clear whether the estimated panel models in these studies represent a structural long-run equilibrium relationship or not. Christopoulos and Tsionas (2004)use panel unit root tests and panel cointegration analysis for 10 developing countries and conclude that there exists a uni-directional causality from financial depth to growth. They investigate the long-run relationship between the variables using fully modified OLS. However, their sample size was small and all the countries in the data set were developing ones. Therefore, the results may not be generalized for the developed countries. In addition, the authors ignore the possible causes of stock market, which may prevent them to reach a concrete conclusion.

This essay uses dynamic panel data techniques, which have many advantages over cross-country and time-series approaches. Generalized Method of Moments (GMM) dynamic panel estimators allow us to exploit the time-series nature of the relationship between the variables with pooled cross-section and time-series data, allow for the inclusion of lagged dependent variables as regressors, remove any bias created by unobserved country-specific effects, and control for the potential endogeneity of all explanatory variables by the use of instrumental variables. In addition, the existence of a long-run relationship between banking sector development and growth and between stock market development and growth is tested in 64 developed and emerging markets via panel cointegration tests. Therefore, this essay contributes to the existing literature and improves the studies of Beck and Levine (2004) and Christopoulos and Tsionas (2004) by using GMM dynamic panel estimators, considering the stationarity and cointegration properties of the data, and by showing the differences between emerging markets and developed markets in terms of the two relationships: that of banking sector development and economic growth and that of stock market development and economic growth for a large sample of countries.

The findings of this essay will help to clarify the role of economic growth in financial development and the role of finance in economic growth, which will have significant policy implications. Convincing evidence that the financial system influences long-run economic growth could lead to the implementation of policies that would support the well-functioning of financial system.

The essay is organized as follows. Section 2 reviews the existing literature. Section 3 describes the data, and the methodology is presented in Section 4. Section 5 presents the results and Section 6 summarizes the results, and concludes the essay.

2.2 LITERATURE REVIEW

Bagehot (1873), who was the leader of the finance-growth literature, discusses the relationship between the efficient capital markets and the Industrial Revolution. Another important contribution to the finance-growth literature was made by Schumpeter with his 1911 book, which was published in English in 1934. Schumpeter (1934) discusses that financial intermediaries improve economic development by shifting capital to entrepreneurs, mobilizing savings, managing risk, and facilitating transactions.

2.2.1 Theoretical Background

The endogenous growth theory tries to explain the link between financial development and economic growth. Levine (1997, 2005) reviews the theoretical literature on the finance-growth relationship. Levine (1997) argues that costs of information gathering and transactions are the incentives for the emergence of financial markets and institutions. Financial systems may affect economic growth by providing such functions as facilitating the trading, hedging, diversifying, and pooling of risk. These functions affect growth by influencing the rate of capital formation. Project holders use outside funding as a source for investments, and banks are the cheapest and fastest mobilization of savings for these project holders. Levine (2005: 86) argues that "...financial systems influence growth by easing information and transactions costs and thereby improving the acquisition of information about firms, corporate governance, risk management, resource mobilization, and financial exchanges." Levine (2005) discusses that banks improve the acquisition of information about firms and alter the allocation of credit. Similarly, financial contracts that make investors more confident will influence the allocation of their savings. Functions provided by financial systems are classified by Levine (2005) as follows. In particular, financial systems produce information about possible investments and allocate capital accordingly; monitor investments and exert corporate governance; facilitate the trading, diversification, and management of risk; mobilize and pool savings; and ease the exchange of goods and services. McKinnon (1973) and Shaw (1973) show that countries with high economic growth also have developed financial markets, and, in those countries, developed financial markets lead to higher economic growth by increasing the size of savings and improving the efficiency of investments.

On the theoretical side, Diamond and Dybvig (1983) stress an important role of financial markets as providers of liquidity to investors. In their model, agents face two investment opportunities: an illiquid, high-return project and a liquid, low-return project. Some of the agents receive shocks and want access to their savings before the illiquid project produces. The willing to invest in the liquid, low-return projects is due to this risk. In their model of liquidity, Diamond and Dybvig (1983) analyze an economy with a single bank. Their interpretation is that it represents the financial intermediary industry, and withdrawals represent net withdrawals from the system. Bencivenga and Smith (1991) develop an endogenous growth model that shows the shift of savings toward capital by financial intermediaries to promote growth. Their analysis is based on the model of Diamond and Dybvig (1983). In their model, Bencivenga and Smith (1991) show that banks affect resource allocations and real rates of growth.

As the banks eliminate the liquidity risk, investment in the high-return illiquid asset increases, which improves growth. Bencivenga and Smith (1991) argue that financial intermediaries reduce the amount of savings held in the form of unproductive liquid assets and prevent misallocations of capital due to liquid needs. In the endogenous growth model of Bencivenga and Smith (1991), economy consists of three-period-lived, overlapping generations, with multiple assets. Agents who face future liquidity needs accumulate capital. Time is indexed by $t = 0, 1 \ldots$. At $t = 0$, there is an initial old generation, endowed with an initial per firm capital stock of k_0, as well as an initial middle-aged generation, endowed with a per firm capital stock of k_1 units at $t = 1$. There are two goods in this economy: a single consumption good and a single capital good. The consumption good is produced from capital and labor. All capital is owned by old agents, called entrepreneurs. Entrepreneurs use only their own capital in production, and there are no rental markets for capital. Each young agent is endowed with a single unit of labor. There is no labor endowment at age 2 or 3. Financial intermediaries are also introduced in the model. These intermediaries accept deposits from young savers and invest in both a liquid asset and an illiquid capital investment. Investment in the liquid asset is a reserve holding by banks. The bank maximizes the expected utility of a representative depositor. Introduction of intermediaries shifts the savings toward capital, causing intermediation to be growth promoting. In addition, intermediaries reduce unnecessary capital liquidation and, hence, tend to promote growth.

Greenwood and Jovanovic (1990) show another theoretical model that links financial intermediaries and economic growth. In their model, the capital is assumed to be scarce. The authors show that financial intermediaries accelerate economic growth by improving information on firms and by providing efficient capital allocation. Similarly, Grossman and Stiglitz (1980) show that stock markets stimulate the production of information about firms, and, with the developing liquid financial markets, agents easily acquire information and make profit. Bencivenga and Smith (1993) show that financial intermediaries that improve corporate governance by reducing monitoring costs will reduce credit rationing and thereby improve capital accumulation and growth.

Levine (1997) states that financial development has positive effects on capital accumulation and economic growth. Similarly, King and Levine (1993b) and Acemoglu et al. (2006) argue that financial development may have positive effects on technological innovative activities and, thus, may improve economic growth.

Financial intermediaries may improve risk management with implications for resource allocation and growth. Levine (2005) divides the discussion of risk into three categories: cross-sectional risk diversification, intertemporal risk sharing, and liquidity risk. Levine (2005) explains that financial systems, such as banks, mutual funds, and securities markets may reduce the risks associated with individual projects, firms, industries, regions, and countries, which can affect long-run economic growth. Levine (2005) gives the following view: high-return projects are generally riskier than low-return projects, and savers do not like risk. Thus, financial markets that diversify risk tend to induce a portfolio shift toward projects with higher expected returns (see Gurley and Shaw, 1955; Patrick, 1966; Greenwood and Jovanovic, 1990; Devereux and Smith, 1994; and Obstfeld, 1994). Obstfeld (1994) and Devereux and Smith (1994) show that internationally integrated stock markets reduce international risk and make investors want to invest in high-return investments; and therefore, these markets may have positive effects on growth. Levine (1997) shows that stock markets may affect growth positively by increasing liquidity and reducing investment risk. Acemoglu and Zilibotti (1997) also develop a model that shows the link between cross-sectional risk sharing and economic growth.

As another type of risk discussion, Levine (2005) defines intertemporal risk sharing. Allen and Gale (1997) argue the role of intermediaries in intertemporal risk sharing and show that risks that cannot be diversified at a particular time can be diversified across generations.

Levine (2005) defines the liquidity risk as the risk arising due to the uncertainties associated with converting assets into a medium of exchange. Levine (2005: 17) states that "liquidity reflects the cost and speed with which agents can convert financial instruments into purchasing power at agreed prices." Savers do not like projects that require a long-run commitment of capital, and, therefore, there may be a reduction in such investment. Financial intermediaries increase the liquidity of these long-term investments. Levine (1991) and Bencivenga et al. (1995) derive models that show that liquid stock markets reduce disincentives to investing in long-duration projects facilitating investment in the long run, higher-return projects that boost productivity growth. They show that reductions in transactions costs encourage agents to seek the liquidity offered by organized markets. Levine (1991) develops an endogenous growth model and shows that stock markets allow savers to buy and sell quickly and cheaply and thereby, make financial assets less risky. Also, firms easily issue equity and access to capital. Therefore, allocation of capital and economic growth are improved. As stock market transaction costs are reduced, investments in the illiquid, high-return projects increase, and stock market liquidity induces faster steady-state growth. According to the model, in the absence of stock markets, risk-averse agents would be discouraged to invest. In addition, banks offer liquid deposits to savers and undertake a mixture of liquid, low-return investments (to satisfy demands on deposits) and illiquid, high-return investments. Thus, banks can provide insurance to savers against liquidity risk and facilitate long-run investments in high return projects by choosing an appropriate mixture of liquid and illiquid investments.

According to the endogenous growth model of Pagano (1993), growth rate depends positively on the percentage of savings diverted to investment. Pagano (1993) discusses that better screening of fund seekers and monitoring of recipients leads to more efficient resource allocations; financial services can encourage the mobilization of otherwise idle resources; and improvements in risk sharing and reductions in origination costs can enhance savings rates and promote the start of innovative, high-quality projects.

Besides the issue of the role of financial development in economic growth, researchers have studied the comparative importance of bank-based and market-based financial systems (Goldsmith, 1969; Boot and Thakor, 1997; Allen and Gale, 2000; Demirgüç-Kunt and Levine, 2001; Demirgüç-Kunt and Maksimovic, 2002; Beck and Levine, 2004). In some of these studies, the models show the advantages of bank-based financial systems, while others show the benefits of market-based financial systems.

A bank-based system may be superior to a market-based system, because there is a long-term relationship between banks and firms. Supporters of bank-based systems argue that market-based systems cannot gather perfect information about firms, which reduces economic performance. Boyd and Prescott (1986) model the critical role of banks in reducing information frictions and improving resource allocation. Both Stiglitz (1985) and Bhide (1993) argue that banks are superior to stock markets in improving resource allocation and corporate governance. Allen and Gale (2000) emphasize the role of markets in reducing the inefficiency due to the monopoly of banks and in encouraging economic growth. Supporters of market-based financial systems argue that a well-functioning stock market can aggregate information about firms and markets in a better way than can a single bank. Moreover, banks that issue loans may be biased against high-risk projects. Stock markets may also facilitate corporate control through compensation schemes, which are related to stock market performance. Stock markets may make high-risky projects more attractive for the individual investor by diversifying risk (Svaleryd and Vlachos, 2005). Supporters of market-based financial systems also state that markets provide better risk management tools and greater flexibility, while bank-based systems provide basic risk management services for standardized situations. As economies develop, they will need better risk management tools for raising capital, and they may benefit from an environment that supports the evolution of market-based activities (see Levine, 2005). Stock markets may stimulate information gathering about firms.

A huge theoretical literature exists on the link between stock markets and long-run growth suggesting that stock markets may promote long-run growth. Stock markets encourage information acquisition, reduce the cost of mobilizing savings, and facilitate investment (Diamond, 1984; Greenwood and Jovanovic, 1990; Williamson, 1986; Greenwood and Smith, 1997). Finally, some theories argue that markets and banks are complements rather than substitutes. Various components of both markets and banks improve economic growth (see Levine, 1997; Boyd and Smith, 1998; Huybens and Smith, 1999; Demirgüç-Kunt and Levine, 2001). Boyd and Smith (1998) argue that all external finance takes the form of either debt, such as bank loans (see Greenwood and Jovanovic, 1990; Bencivenga and Smith, 1991) or equity (see Levine, 1991; Bencivenga et al., 1995) but not both. Their objective is to present a framework in which capital formation is financed by issuing both debt and equity. They argue that debt and equity markets may be substitutes or complements for financing investments.

Whereas the existing theory ignores the effects of inflation, Hung (2003) developed an endogenous growth model to illustrate the importance of inflation in determining the role of financial development on economic growth. This theoretical model shows a negative correlation between inflation and economic growth for countries with high initial inflation rates and indicates that the possible underlying force is financial development. Hung (2003) suggests that financial development raises inflation and reduces economic growth for countries with relatively high initial inflation rates. In other words, financial development can reduce inflation and promote growth only when initial inflation rates are relatively low.

2.2.2 Empirical Literature

Most of the empirical studies give evidence of a positive relationship between financial development and economic growth; some of them show that the level of financial development is a good predictor of future rates of economic growth, capital accumulation, and technological change (see Levine, 1997). The empirical studies of Goldsmith (1969), one of the leaders of the view that financial intermediation contributes to economic growth, assume that there is a positive correlation between the sizes of financial systems and the supply and quality of financial services. Goldsmith (1969) shows a positive relationship between the level of financial institutions' assets to Gross National Product (GNP) ratio and the output per person, using data for 35 countries over the period 1860–1963. Goldsmith (1969) defined his three goals: (1) to document how financial structure changes with the developing economy; (2) to examine the effects of financial development on economic growth; and (3) to investigate whether financial structure influences the pace of economic growth. Goldsmith (1969) was successful in accomplishing his first goal. He documented that banks and non-bank financial institutions develop as the economy grows. To achieve his second goal, he examined the relationship between financial development and economic growth. Goldsmith (1969) graphically documented a positive correlation between financial development and economic growth; however, he was unwilling to draw causal interpretations from his graphical representations and did not make any statement on whether financial development causes growth. Moreover, due to data limitations, Goldsmith (1969) was unable to show cross-country evidence of the relationship between financial structure and economic growth .

Recently, there has been progress on studies that investigate the relationship between financial development and economic growth. Levine (2005) reviews and critiques theoretical and empirical research on the relationship between the operation of the financial system and economic growth. Several empirical research suggest that financial development positively affects economic growth. In their cross-country study, King and Levine (1993a) built on Goldsmith (1969) with data on 80 countries over the period 1960–1989 and showed that financial systems can promote economic growth. King and Levine (1993a,b) argue that the level of financial intermediation is a good predictor of long-run rates of economic growth, capital accumulation, and productivity improvements; however, none of the studies of King and Levine (1993a,b) show the direction of causality between financial development and economic growth. Deidda and Fattouh (2002) develop a model that establishes a non-linear and possibly non-monotonic relationship between financial development and economic growth. Applying a regression model to the data set of King and Levine (1993a), they found that in low-income countries there is no significant relationship between financial development and growth, whereas, in high-income countries, this relationship is positively significant.

Most of the empirical studies focus on only one segment of a financial system, namely banks. With the increasing intermediation role of the stock markets all over the world, researchers, beginning with Atje and Jovanovic (1993) and Levine and Zervos (1998) have investigated the relationship between stock market development and economic growth. These studies support the view that the stock market affects economic growth at least as much as does the banking sector. Theoretical literature on the role of equity markets in economic growth lead researchers to empirically investigate the relationship between long-run economic growth and equity markets. Because there are conflicting theories on the roles of banks and markets, the independent roles of these two financial agents needed to be investigated. Atje and Jovanovic (1993) present a cross-country study of stock markets and economic growth. They analyze a set of 40 countries over the period 1980–1988 and find a significant correlation between the value of stock market trading divided by GDP and growth, concluding that bank credit has no influence on growth. In his cross-sectional study Harris (1997) re-examined the relationship between stock markets and economic growth. Unlike Atje and Jovanovic (1993), Harris (1997) found no evidence showing an effect of the level of stock market activity on growth in per capita output. In their cross-country study, Levine and Zervos (1998) examine the individual role of stock markets, because banks provide different services than those of stock markets. They investigate whether measures of stock market liquidity, size, volatility, and integration with world capital markets are significantly correlated with current and future rates of economic growth, capital accumulation, productivity improvements, and savings rates. As a measure of bank development, they used bank credit to the private sector as a share of GDP and as measures of stock market development, they used market size (market capitalization relative to GDP), stock market activity (the value of trades relative to GDP), and market liquidity (the value of trades relative to market capitalization). Levine and Zervos (1998) made several contributions to the literature. First, they increased the sample size. They also built additional measures of stock market liquidity, a measure of stock volatility, and two measures of stock market integration in world capital markets. Their findings give evidence of an important empirical relationship between stock markets and economic growth. They showed that both stock market liquidity (measured by turnover ratio) and banking development positively and significantly correlated with current and future rates of economic growth, capital accumulation, and productivity growth when entered together in regressions, even after controlling for economic and political factors. Their results support the views that financial markets provide important services for growth and that stock markets provide different services from banks. Levine and Zervos (1998) show that stock market size, as measured by market capitalization divided by GDP, is not robustly correlated with economic growth; rather, the ability to trade (i.e., market activity) influences the economic growth. Levine and Zervos (1998) used the ordinary least squares (OLS) approach in their analyses. However, the OLS approach does not properly account for potential simultaneity bias and does not explicitly control for country-fixed effects. Demirgüç-Kunt and Levine (1996a,b) also give empirical evidence for the importance of stock market development for output growth. The extent of stock market development highly correlates with the development of banks, nonbank financial institutions, pension funds, and insurance companies in different countries. While Japan, the United States, and the United Kingdom have the most developed stock markets, Colombia, Venezuela, Nigeria, and Zimbabwe have the less developed stock markets. Demirgüç-Kunt and Levine (1996a,b) conclude that countries with well-developed stock markets have well-developed financial intermediaries, and vice versa, and there is no distinction between bank-based and market-based financial systems. Fink et al. (2003) argue that existing literature excludes the bond market capitalization, which may be larger than the stock market capitalization. They examine the relationship between bond market development and economic growth and conclude that bond market development influences economic growth in 13 developed countries.

There are studies that suggest that cross-country differences in legal systems influence the level of financial development and economic growth (La Porta et al., 1998; Demirgüç-Kunt and Maksimovic, 1999; Levine, 1998, 1999). Levine (1999) examines how the legal environment affects financial development, and how this effect, in turn, is linked to long-run economic growth. He states that the direction of causality runs in both directions, consistent with the views of Patrick (1966), and Greenwood and Smith (1997).

Although most of the recent theoretical and empirical literature agrees on the view that financial development positively affects growth, De Gregorio and Guidotti (1995) find that financial development significantly reduces economic growth for countries in Latin America during a time period with high inflation rates. This result has led the World Banks' operating directive on the financial sector to recommend to developing countries not to pursue financial reforms unless their inflation rates are sufficiently low (see Boyd et al., 1997). Boyd et al. (2001) argue that high inflation adversely affect the operations of financial markets. Their findings indicate that there is a significant negative relationship between inflation and both banking sector development and equity market activity.

Baier et al. (2004) examine the relationship between the creation of stock exchanges and economic growth and find an increase in economic growth after a stock exchange opens. They conclude that a new stock exchange can increase economic growth by aggregating information about firms' prospects, thereby directing capital to investment with higher returns. Utilizing time-series methods and quarterly data from five developed economies, Arestis et al. (2001) examine the relationship between stock market development and economic growth.

According to their results, although both banks and stock markets may be able to promote economic growth, the impact of the former is more powerful. They also suggest that the influence of stock markets on economic growth may have been exaggerated by studies that utilize cross-country growth regressions.

Cross-sectional regressions cannot give the country-specific details that are hidden in averaged-out results, even within a homogenous group of countries, in addition, findings are not clear on the causality issues. Recently, some researches investigated the causal relationship between financial development and economic growth; however, their sample sizes were small, in general. Arestis and Demetriades (1997) use time-series analysis and Johansen cointegration tests for the United States and Germany. Whereas for Germany they observed that banking development affects growth, for the United States they could not find strong evidence of such an effect; instead the results implied that GDP contributes to both banking system and stock market development. Rousseau and Wachtel (1998) examine the links between intensity of financial intermediation and economic performance in five countries with historical data from 1870–1929. Vector error correction models (VECMs) and Granger causality tests suggest a leading role for finance in real sector activity. From a time-series perspective for 13 OECD countries, Neusser and Kugler (1998) investigate the hypothesis that development of the financial sector is essential for economic growth. They state that the causal relationship varies widely across countries and point out the importance of historical and institutional factors. They also add that even within a homogenous group of countries, the variety of results suggests a more complex picture than is apparent from cross-sectional evidence. Luintel and Khan (1999) use a sample of ten less developed countries to conclude that the causality between financial development and output growth is bi-directional. Hansson and Jonung (1997) examine the long-run relationship between finance and economic growth in Sweden from the 1830s to the 1990s and identify a link between the volume of credit and the level of GDP, prior to World War II. The financial system had the largest impact on GDP in the period 1890–1939. These findings are consistent with studies, indicating that the role of the financial system in promoting growth was significant during the early stages of economic development. They suggest interdependence between finance and economic growth rather than any one-way causal relationship. Similarly, Fase (2001) investigates the relationship between financial development and long-term economic growth in the Netherlands between 1900 and 2000. The causality runs from financial intermediation to economic growth until World War II in the Netherlands, and vanishes afterwards. Fase (2001) argues that the development of the financial system has a greater impact on growth in a developing country than in developed economies. After the findings of Fase (2001), Fase and Abma (2003) examine the relationship between financial development and economic growth in nine emerging economies in South-East Asia. They found that financial development affects economic growth and that causality runs from financial structure to economic development, indicating that, in developing countries, a policy of financial reform is likely to improve economic growth. Andres et al. (2004) jointly estimate the effects of financial development and inflation on growth using both cross-section and time-series dimensions of the data on inflation, growth, and some banking and stock market indicators, over the period 1961–1993, for a sample of OECD countries. Andres et al. (2004) examine the role of the financial system in industrialized economies, which may differ in newly developing countries. In their paper, Andres et al. (2004) performed Granger-causality tests among inflation, growth, and banking system development and found that the link between finance development and growth is less reliable. Hondroyiannis et al. (2005) empirically investigates the relationship between the development of the banking system and the stock market and economic performance for the case of Greece over the period 1986–1999. The findings suggest the existence of bi-directional causality between finance and growth in the long run. The results show that both bank and stock market financing promote economic growth in the long run, and the contribution of stock market finance to economic growth appears to be substantially smaller, compared to bank finance. The evidence on causality states that for the majority of the countries, the causality is bi-directional, whereas in some cases, financial development follows economic growth. All these results show that a consensus on the role of financial development in the process of economic growth does not exist so far (see Christopoulos and Tsionas, 2004).

Although studies such as King and Levine (1993a,b), Levine and Zervos (1998), Neusser and Kugler (1998) and Rousseau and Wachtel (1998) give evidence that the level of financial development is a good predictor of future rates of economic growth, they do not agree on the issue of causality. Levine

(1998, 1999); Beck et al. (2000b) and Levine et al. (2000) extend the study of King and Levine (1993a,b). They used credit to private firms as a measure of bank development and an instrumental variable method to control for simultaneity bias. Levine et al. (2000) state that although their paper does not fully resolve all concerns about causality, either it uses more recent data and newer econometric procedures. They use GMM dynamic panel estimators and a cross-sectional instrumental variable estimator to directly confront the potential biases induced by simultaneity, omitted variables, and unobserved country-specific effects, which have plagued previous empirical studies on the finance-growth link. They also use legal origin as an instrumental variable to control for simultaneity bias and suggest that cross-country differences in legal systems influence the level of financial development and economic growth. Levine et al. (2000) find that the exogenous components of financial intermediary development are positively related to economic growth. Beck et al. (2000b) also use a panel GMM estimator that improves upon pure cross-country study. Using a panel approach gives researchers the advantage of being able to exploit the time-series and cross-sectional variation in the data and it avoids biases that come with the cross-country regressions. Beck et al. (2000b) evaluate the empirical relationship between the level of financial intermediary development and economic growth. They use a pure cross-country instrumental variable estimator to extract the exogenous component of financial intermediary development and a new panel technique that controls for biases associated with simultaneity and unobserved country-specific effects. They use both the pure cross-sectional instrumental variable estimator and the system dynamic-panel estimator methods and find that higher levels of financial intermediary development produce faster rates of economic growth and total factor productivity growth. They conclude that there is a positive link between the level of financial intermediaries and real per capita GDP growth.

Beck and Levine (2004) investigate the roles of stock markets and banks in economic growth using a panel data set for the period 1976–1998. They apply GMM techniques developed for dynamic panels that reduce statistical shortcomings of existing studies. They find that stock markets and banks positively influence growth; however, they did not consider the stationarity and cointegration properties of the data. Christopoulos and Tsionas (2004) criticize previous studies that do not consider cointegration properties of data and investigate the long-run relationship between financial depth and economic growth using fully modified OLS. They use panel unit root tests and panel cointegration analysis for 10 developing countries, which was a rather small sized sample. They conclude that there exists a uni-directional causality from financial depth to growth promoting the supply-leading view. However since the authors ignored the possible causes of stock market, it is difficult to assess whether their finding still holds when controlling for stock market development .

Rousseau and Wachtel (2000) use panel techniques with annual data to investigate the relationship between stock markets and growth. They stress the leading role of stock market liquidity and show that stock market development promotes economic performance. Rousseau and Wachtel (2000) list four reasons for the importance of a stock market. First, an equity market provides investors and entrepreneurs with a potential exit mechanism, because the option to exit through a liquid market mechanism makes venture capital investments more attractive and might increase entrepreneurial activity. Second, the existence of equity markets facilitates capital inflow and the ability to finance current account deficits. Third, the provision of liquidity through organized exchanges encourages both international and domestic investors to transfer their surpluses from short-term assets to the long-term capital market, where the funds can provide access to permanent capital for firms to finance large projects. Finally, the existence of a stock market provides important information that generally improves the efficiency of financial intermediation. Rioja and Valev (2004) suggest that the relationship between financial development and economic growth may vary according to the level of financial development of countries. They use dynamic panel data techniques in their study. They divide their sample into three regions. In the low region countries with very low levels of financial development, additional improvements in financial markets have an uncertain effect on growth. In the intermediate region, financial development has a large and positive effect on growth. Finally, in the high region, the effect is positive, but smaller. However, due to limited available stock market data, they did not use such data for all countries and periods in their original sample. Instead they constructed dummy variables for non-bank measures.

It is observed that while cross-country studies such as King and Levine (1993a,b), Levine and Zervos (1998) and panel data studies such as Levine et al. (2000) mainly agree on the view that financial development has positive effects on growth, existing time-series studies give contradictory results. Some of these studies conclude that the causality between financial development and economic growth is bi-directional, while others found uni-directional causality. In the light of existing evidence, it can be concluded that a consensus on the role of financial development in the process of economic growth does not exist so far.

Summarizing, most of the empirical studies examine the relationship between financial development and economic growth through cross-sectional data analysis, in which the results may vary considerably across countries due to differences in their institutional characteristics and in their legal, political, and financial systems. Moreover, cross-sectional data analysis does not permit the investigation of the direction and intensity of causal links and cannot settle the issue of causality. Time-series methods account for the individual country-specific effects and can clarify the causal relationship, which is important, because causality patterns may differ across countries (see Rousseau and Wachtel, 1998). Some studies investigate the causal patterns in the relationship between financial development and economic growth with time-series methods. However, they are either studies that consider single countries or a limited sample of countries with short time spans, which may lead to some limitations. In addition, the time-series studies can not deal with the issue of simultaneity.

Levine et al. (2000) and Beck et al. (2000b) use a panel GMM estimator that improves upon pure cross-country study. However, there are some weaknesses of the existing panel data studies, which are summarized by Beck and Levine (2004). The authors state a major weakness of these studies is the exclusion of the stock market development measures, due to inadequacy of data. Therefore, it is not easy to assess if (1) the positive relationship between bank development and economic growth holds when controlling for stock market development, (2) banks and markets each have an independent impact on economic growth, or (3) overall financial development is important for growth, but it is difficult to identify the separate impact of stock markets and banks on economic success. Another weakness stated by Christopoulos and Tsionas (2004) is that the existing panel data studies did not consider the cointegration properties of the data; thus, it is not clear if the estimated panel models represent a structural long-run equilibrium relationship or a spurious one.

Reviewing the existing empirical literature, a possible model misspecification problem is observed. Economic growth is assumed to be the dependent variable, and, therefore, causality is expected to generally run from financial development to economic growth. In this essay, the possibility of reverse causality, that of running from economic growth to financial development (the demand-following view) is taken into consideration. In this dissertation dynamic panel approach is used, which has many advantages over cross-country and time-series approaches. Moreover, the existence of a long-run relationship between the banking sector development and growth, and between the stock market development and growth are tested via panel cointegration tests. Therefore, this essay contributes to the existing literature by using GMM dynamic panel estimators, considering the stationarity and cointegration properties of the panel data, and by showing the differences between emerging markets and developed markets in terms of both the banking sector development and economic growth, and stock market development and economic growth relationships.

2.2.2.1 Literature on Financial Structure and Economic Growth

Allen and Gale (2000) extended the studies of Goldsmith (1969) on the relationship between financial structure and economic growth. The authors study the relationship between financial structure and growth in Germany, Japan, the United Kingdom, and the United States. Allen and Gale (2000) discuss that bank-based systems offer better risk sharing services than markets. Demirgüç-Kunt and Levine (2001) analyze the relationship between financial structure (the degree which a country has a bank-based or market-based financial system) and long-run economic growth using a broad cross-section of countries. Demirgüç-Kunt and Levine (2001) argue that countries with weak legal institutions tend to have bank-oriented financial systems rather than market-oriented ones. Demirgüç-Kunt and Levine (1999) construct indices of the organization of the financial structure for a large set of developing and developed countries. They measure the relative importance of bank vs. market finance by the relative size of stock aggregates, by relative trading or transaction volumes, and by indicators of relative efficiency. The authors show that developing countries have less developed banks and stock markets, whereas in developed countries, the financial sector becomes larger, more active, and more efficient. It is also argued that developing countries are more bank-based.

Demirgüç-Kunt and Huizinga (2000) show the impact of financial development and structure on bank performance. They argue that financial structure has important implications for long-run economic growth and discuss that countries differ widely in their relative reliance on bank vs. market finance. For example, whereas Germany and Japan are regarded as bank-based, because the volume of bank lending relative to the stock market is rather large in these countries, the United States and the United Kingdom are considered to be more market-based.

Tadesse (2002) examines the relationship between an economy's degree of market orientation and the real-sector performance. The research shows that although market-based systems outperform bank-based systems among countries with developed financial sectors, bank-based systems are superior to market-based systems among countries with underdeveloped financial sectors. Countries dominated by small firms grow faster in bank-based systems, and those dominated by larger firms, in market-based systems. However, in his cross-country study, Levine (2002) argues that classifying countries as bank- or market-based is not a very fruitful way to distinguish financial systems. Levine (2002) also states that the only financial development indicator that is not significantly related to growth is financial size, which is consistent with the finding of Levine and Zervos (1998) that market capitalization is not a robust predictor of economic growth. Beck et al. (2000a) also investigate the relationship between financial structure and economic growth. They investigate whether economies grow faster in market-based or bank-based systems, with a cross-country regression approach. Their findings show no evidence of the difference between the two financial systems in terms of influence on economic growth. Beck et al. (2000a) show that only the level of financial development influences economic growth and conclude that economies that heavily depend on external finance grow faster.

Another view comes from La Porta et al. (1998) who discuss the importance of the legal system in determining the enforceable contracts between firms and investors. According to the authors, the relevant differences between countries lie in the extent to which their financial systems protect investor rights, rather than in the distinction between bank-based and market-based systems. La Porta et al. (2000) also argue that the legal system is the key to the financial system. It is concluded that the legal system protects creditors and minority shareholders against expropriation by majority shareholders and managers, and effective corporate governance can be supported by legal investor protection.

2.2.2.2 Literature on Firm and Industry Level Studies

There is a vast amount of literature on firm- and industry-level studies. According to recent research (Demirgüç-Kunt and Maksimovic, 1998; Rajan and Zingales, 1998; Wurgler, 2000) industries and firms dependent on external financing grow faster in countries with well-developed financial systems. Demirgüç-Kunt and Maksimovic (1998) show that firms in countries with a developed stock market and large banking sector grow faster than predicted. Demirgüç-Kunt and Maksimovic (2002) extend the methodology of Demirgüç-Kunt and Maksimovic (1998) to address differences in bank-based and market-based systems in firm growth. They investigate whether firms' access to external financing differs in market-based and bank-based financial systems. Using firm-level data for 40 countries, they compute the proportion of firms in each country relying on external finance and examine the changes in the proportion across financial systems. Although they find that the development of a country's legal system predicts access to external finance and that stock markets and the banking system affect access to external finance differently, they find no evidence of firms' access to external financing is predicted by relative development of stock markets to the development of the banking system. Rajan and Zingales (1998) show that industries that rely mostly on external finance grow faster in countries with better-developed financial systems. The authors document that financial development reduces external financing costs and improves economic growth.

The summary of the literature on finance-growth relationship is presented in Table 2.1.

Table 2.1: Summary of related literature

Theory	Financial Development and Economic Growth Relationship	Gurley and Shaw (1955) Patrick (1966) McKinnon (1973) Shaw (1973) Diamond and Dybvig (1983) Greenwood and Jovanovic (1990) Levine (1991) Bencivenga and Smith (1991, 1993) King and Levine (1993b) Pagano (1993) Devereux and Smith (1994) Obstfeld (1994) Bencivenga et al. (1995) Acemoglu and Zilibotti (1997) Allen and Gale (1997) Acemoglu et al. (2006)
	Financial Structure and Economic Growth Relationship	Boyd and Prescott (1986) Boyd and Smith (1996) Boot and Thakor (1997) Allen and Gale (2000) Demirgüç-Kunt and Levine (2001)
Cross-country studies	Financial Development and Economic Growth Relationship	Goldsmith (1969) Atje and Jovanovic (1993) King and Levine (1993a,b) Demirgüç-Kunt and Levine (1996b) Harris (1997) Levine and Zervos (1998) Deidda and Fattouh (2002)
	Financial Structure and Economic Growth Relationship	Demirgüç-Kunt and Levine (1999, 2001) Demirgüç-Kunt and Huizinga (2000) Tadesse (2002)
	Firm and Industry Level Studies	Demirgüç-Kunt and Maksimovic (1998) Rajan and Zingales (1998) Wurgler (2000) Beck et al. (2000a) Beck et al. (2005)

Table 2.1: (cont'd)

Time-series studies	Financial Development and Economic Growth Relationship	Demetriades and Hussein (1996) Arestis and Demetriades (1997) Hansson and Jonung (1997) Neusser and Kugler (1998) Rousseau and Wachtel (1998) Luintel and Khan (1999) Arestis et al. (2001) Fase (2001) Fase and Abma (2003) Fink, Hais, and Hristoforova (2003) Jeong et al. (2003) Hondroyiannis et al. (2005) Şendeniz-Yüncü et al. (2007)
Panel data studies	Financial Development and Economic Growth Relationship	Beck et al. (2000b) Levine et al. (2000) Rousseau and Wachtel (2000) Beck and Levine (2004) Christopoulos and Tsionas (2004) Rioja and Valev (2004)

2.3 DATA

In this essay dynamic panel data techniques are used for the analyses of the banking sector-stock market-economic growth relationship[1]. Panel data sets that combine time-series and cross-sections containing annual observations on countries provide a rich resource of information compared to cross-country and time-series data. Using panel data instead of pure cross-sectional data allows us to exploit the time-series dimension of the data and deal with simultaneity. Typically, panel data sets are more oriented toward cross-section analyses (see Greene, 2000).

[1]EViews 5.1 software is used for the econometric analyses.

Table 2.2: Countries in the sample of Essay 1

Developed Markets		
Australia*	France*	Norway*
Austria*	Germany*	Spain*
Belgium*	Italy*	Sweden*
Canada*	Japan*	Switzerland*
Denmark*	Netherlands*	United Kingdom*
Finland	New Zealand*	United States*
Emerging Markets		
Argentina	Israel	Philippines
Botswana	Jamaica	Poland
Brazil*	Jordan	Portugal*
Chile	Kenya	Saudi Arabia
China	Korea, Rep.	Slovak Republic
Colombia	Kuwait	Slovenia
Cote d'Ivoire	Lithuania	South Africa*
Croatia	Malaysia	Sri Lanka
Czech Republic	Mauritius	Thailand
Ecuador	Mexico	Trinidad and Tobago
Egypt, Arab Rep.	Morocco	Tunisia
Greece	Nigeria	Turkey
Hong Kong*	Oman	Uruguay
Hungary*	Pakistan	Venezuela, RB
India	Panama	
Indonesia	Peru	

* These countries are also included in the sample of Essay 2.

The data set of 64 countries is divided into two parts: 18 developed markets and 46 emerging markets, according to the Standard and Poor's Emerging Markets Database and ISI Emerging Markets Database classifications. The panel data have a sample period of 1994–2003 with annual observations. The countries in the sample are shown in Table 2.2.

Following Levine and Zervos (1998) banking sector activity is used as a banking sector development indicator. Banking sector activity — hereafter

BAN — is measured by the value of deposit money bank credits to the private sector divided by GDP. This measure isolates bank credit to the private sector and excludes loans made to governments, government agencies, and the public sector by development banks. It also excludes credits issued by central banks. The source of this data is the World Bank Financial Structure Database, which takes the raw data from the electronic version of the International Monetary Fund's International Financial Statistics (IFS)[2].

Following Levine and Zervos (1998), as a stock market development indicator, value-traded ratio — hereafter STO — is used. The value-traded ratio is calculated by dividing the total value of domestic equities traded on domestic exchanges by GDP. The total value traded is the product of market price and the number of shares traded. The source of the value traded ratio data is the World Bank Financial Structure Database. The database takes raw stock market data from Standard and Poor's Emerging Markets Database (and Emerging Stock Markets Factbook).

The value-traded ratio is preferred to a market capitalization or turnover ratio, which are also used in the empirical literature. Levine and Zervos (1998) and Levine (2002) argue that market capitalization is not a good predictor of economic growth. Rousseau and Wachtel (2000) also state that total value traded is a better measure of stock market development than capitalization. The turnover ratio, the value of total shares traded divided by average real-market

[2] Data includes bank data from lines 22d and 42d, GDP data in local currency from lines 99B..ZF or, if not available, line 99B.CZF, end-of period CPI from line 64M..ZF or, if not available, line 64Q..ZF, and annual CPI from line 64..ZF of the electronic version of the IFS. Data is deflated to eliminate the potential mis-measurement caused by inflation.

capitalization, has been mainly used as a measure of stock market development in cross-sectional studies. Rousseau and Wachtel (2000) argue that changes in the degree of turnover will reflect short-term fluctuations and that this ratio is a less useful measure in dynamic specifications.

For an indicator of economic growth, the logarithm of annual real GDP per capita data — hereafter LNGDP — is used. This item is obtained from the World Bank World Development Indicators' (WDI) online database.

In order to assess the strength of the independent link between banking sector development and economic growth, control for other potential determinants of economic growth is needed in the analyses. Therefore, the following common control variables in the literature are used: a stock market development indicator, inflation — hereafter INF —, foreign direct investment as a percentage of GDP — hereafter FDI —, openness to trade — hereafter OPE — (i.e. total shares of exports and imports as a percentage of GDP) and the ratio of gross national expenditure to GDP — hereafter GNE —. The endogenous growth model of Hung (2003) illustrates the important role played by inflation in determining the effects of financial development on economic growth. Edison et al. (2002) suggest that, according to their OLS regression results, the flow of capital (foreign direct investment plus portfolio inflows and outflows divided by GDP) and inflow of capital (foreign direct investment plus portfolio inflows divided by GDP) measures are positively associated with economic growth.

A dummy variable is also used to control for the effect of a financial crisis. A significant number of countries in the sample are affected, especially by the

Asian crisis. The dummy variable — hereafter CRIS — takes a value of one during the years of crises and in the preceding and following year, and zero otherwise. The countries that experienced a financial crisis and the crisis periods are given in Table 2.3.

Table 2.3: Financial crisis periods

Country	Crisis Period
Argentina	1999–2002
Brazil	1997
Chile	1997
Hong Kong	1997–1998
Indonesia	1997–1998
Japan	1994–1998
Korea, Rep.	1996–1998
Malaysia	1997–1998
Mexico	1994–1995
Philippines	1997–1998
Thailand	1996–1998
Turkey	1994, 2000–2001

To see the independent link between stock market development and economic growth, again, control variables are needed, such as BAN, INF, FDI, OPE, GNE and CRIS.

2.4 METHODOLOGY

In the existing empirical literature, there are three main approaches to analyzing the relationship between financial development and economic growth. These are cross-country studies, time-series studies, and panel data studies. As discussed in Beck et al. (2000b), Levine et al. (2000), and Levine (2005), besides the cross-country variance, we would like to know if changes in financial development over time within a country affect economic growth through its various channels. Cross-sectional estimations of cross-country growth regressions have many shortcomings. In pure cross-country studies, the time-series dimension of the data is not exploited, and any unobserved country-specific effect is captured by the error term. Therefore, due to the potential endogeneity of most of the regressors, the estimates may be biased. An estimation based on panel data, which is pooled cross-section and time-series data, has advantages over a purely cross-sectional estimation. Panel data provide the chance to consider the effects of financial development on growth over time within a country in addition to the cross-country relationship between financial development and growth. Another advantage of a panel data approach is that; unobserved country-specific effects are controlled, and, thus, biases are reduced in the estimated coefficients.

In this essay, GMM dynamic-panel estimator developed by Holtz-Eakin et al. (1988), Arellano and Bond (1991) and Arellano and Bover (1995) is used. This method is designed to solve the econometric problems induced by unobserved country-specific effects and the joint endogeneity of the explanatory variables in lagged-dependent-variable models, such as growth regressions (see Levine et al., 2000). The data set of 64 countries is divided into two markets: developed and emerging. The first subsample consists of developed markets that have an annual panel data set of 18 countries for the period 1994–2003, and the second subsample consists of emerging markets with an annual panel data set of 46 countries for the period 1994–2003. To remove the omitted variable bias due to unobserved country-specific effects, the regression equation is differenced. Lagged values of the original regressors are used as instruments for the differenced values of the original regressors to eliminate potential parameter inconsistency arising from simultaneity bias.

First, the stationarity properties of the data are examined with panel unit root tests. Researchers such as Hadri (2000), Breitung (2000), Levin, Lin and Chu (2002), and Im, Pesaran and Shin (2003) have developed panel unit root tests that are similar to unit root tests carried out on a single series. Panel unit root tests have higher power than unit root tests based on individual time series since they combine the information in the time series with the information in the cross-section data. Im, Pesaran and Shin (2003) consider a sample of N cross sections observed over T time periods and suppose that the stochastic process, $y_{i,t}$, is generated by the first-order autoregressive process:

$$y_{it} = (1 - \phi_i)\mu_i + \phi_i y_{i,t-1} + \varepsilon_{it}, \quad i = 1, ..., N; \; t = 1, ..., T, \tag{2.1}$$

where initial values, y_{i0}, are given. The aim is to test the null hypothesis of unit roots $\phi_i = 1$ for all i. (2.1) can be expressed as

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \varepsilon_{it}, \tag{2.2}$$

where $\alpha_i = (1-\phi_i)\mu_i$, $\beta_i = -(1-\phi_i)$ and $\Delta y_{it} = y_{it} - y_{i,t-1}$. The null hypothesis of unit roots then becomes

$$H_0 : \beta_i = 0 \quad \text{for all } i, \tag{2.3}$$

The null hypothesis of the Fisher Chi-square Augmented Dickey-Fuller (ADF) unit root test is the same as for the as Im, Pesaran and Shin (IPS) unit root test. The panel unit root test results for emerging markets and developed markets are presented in Table 2.4 and Table 2.5, respectively. Unit root test results show that at least one of the tests indicate non-stationary in panel level series, whereas both tests indicate stationary in first-differenced panel series.

Table 2.4: Panel unit root tests for emerging markets

	BAN	STO	LNGDP
Level	Prob.	Prob.	Prob.
IPS	0.48	0.46	0.45
ADF	0.04**	0.03**	0.99
First Diff. (Δ)			
IPS	0.00***	0.00***	0.00***
ADF	0.00***	0.00***	0.00***

IPS : Im, Pesaran and Shin unit root test with null hypothesis of "unit root"
ADF : Fisher Chi-square ADF unit root test with null hypothesis of "unit root"
BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
LNGDP : Logarithm of real GDP per capita
, and * stand for the significance at 5%, and 1% level, respectively.

Pedroni, Kao, and Fisher/Johansen panel cointegration tests are performed to test the existence of a long-run relationship between banking sector development and economic growth and between stock market development and economic growth. Pedroni (1999, 2004) and Kao (1999) extend the Engle-Granger

Table 2.5: Panel unit root tests for developed markets

	BAN	STO	LNGDP
Level	Prob.	Prob.	Prob.
IPS	0.98	0.60	0.45
ADF	0.83	0.59	0.52
First Diff. (Δ)			
IPS	0.05**	0.00***	0.03**
ADF	0.03**	0.00***	0.02**

IPS : Im, Pesaran and Shin unit root test with null hypothesis of "unit root"
ADF : Fisher Chi-square ADF unit root test with null hypothesis of "unit root"
BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
LNGDP : Logarithm of real GDP per capita
, and * stand for the significance at 5% level, and 1% level, respectively.

(1987) cointegration test. Pedroni panel cointegration test allows for heterogeneous intercepts and trend coefficients across cross-sections. The Kao test follows the same basic approach as the Pedroni test, but specifies cross-section specific intercepts and homogeneous coefficients on the first-stage regressors. Both tests have the null hypothesis of no cointegration. Maddala and Wu (1999) propose an alternative approach to testing for cointegration in panel data by combining tests from individual cross-sections to obtain at test statistic for the full panel. The Pedroni, Kao, and Fisher/Johansen panel cointegration test results and the coefficients of the cointegration equations for emerging markets and developed markets are presented in Table 2.6 and Table 2.7, respectively. Results in emerging markets show that there is cointegration between banking sector development and economic growth and that there is cointegration between stock market development and economic growth, with 1 percent significance levels. Results in developed markets show that whereas there is coin-

Table 2.6: Panel cointegration tests for emerging markets

Variable	Cointegration Test			Prob.
BAN-LNGDP	Pedroni			
		ADF		0.00***
	Kao			
		ADF		0.00***
	Johansen Fisher	Hypothesized Number of CE(s)		
		None		0.00***
		At most 1		0.00***
	Cointegration Equation		Adjustment Parameter	
	BAN(-1)	1.000	ΔBAN	-0.001
	LNGDP(-1)	-0.048	ΔLNGDP	0.004
	Constant	2.519		

Variable	Cointegration Test			Prob.
STO-LNGDP	Pedroni			
		ADF		0.01***
	Kao			
		ADF		0.00***
	Johansen Fisher	Hypothesized Number of CE(s)		
		None		0.00***
		At most 1		0.00***
	Cointegration Equation		Adjustment Parameter	
	STO(-1)	1.000	ΔSTO	0.005
	LNGDP(-1)	-0.012	ΔLNGDP	0.003
	Constant	4.039		

BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
LNGDP : Logarithm of real GDP per capita
*** stands for the significance at 1% level.
EViews 6 software is used for the panel cointegration tests.

Table 2.7: Panel cointegration tests for developed markets

Variable	Cointegration Test			Prob.
BAN-LNGDP	Pedroni			
		ADF		0.02**
	Kao			
		ADF		0.06*
	Johansen Fisher	Hypothesized Number of CE(s)		
		None		0.00***
		At most 1		0.00***
	Cointegration Equation		Adjustment Parameter	
	BAN(-1)	1.000	ΔBAN	-0.013
	LNGDP(-1)	0.709	ΔLNGDP	-0.012
	Constant	-9.162		

Variable	Cointegration Test			Prob.
STO-LNGDP	Pedroni			
		ADF		0.00***
	Kao			
		ADF		0.00***
	Johansen Fisher	Hypothesized Number of CE(s)		
		None		0.00***
		At most 1		0.00***
	Cointegration Equation		Adjustment Parameter	
	STO(-1)	1.000	ΔSTO	-0.132
	LNGDP(-1)	0.527	ΔLNGDP	-0.005
	Constant	-6.045		

BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
LNGDP : Logarithm of real GDP per capita
***, **, and * stand for the significance at 1%, 5%, and 10% levels respectively.
EViews 6 software is used for the panel cointegration tests.

tegration between stock market development and economic growth, with a 1 percent significance level, there is cointegration between banking sector development and economic growth, with 1, 5, and 10 percent significance levels for different tests. These findings suggests the presence of co-movements among the variables, indicating long-run stationarity. Some of the existing time-series studies have examined stationarity and cointegration between financial development and economic growth. However most of them were carried out for individual countries. In this essay, with the help of panel unit root and panel cointegration tests, the information gathered from panel data is utilized more efficiently.

Following Levine et al. (2000) and Beck et al. (2000b) recently developed dynamic panel GMM technique is used to deal with the possible endogeneity problems of the data. The regression equation is as follows:

$$y_{i,t} - y_{i,t-1} = (\alpha_1 - 1)y_{i,t-1} + \beta_1' X_{i,t} + \eta_{1i} + \varepsilon_{1i,t} \tag{2.4}$$

where y is the logarithm of real per capita GDP, $y_{i,t} - y_{i,t-1}$ is the growth rate in real per capita GDP, X represents the set of explanatory variables including banking sector development and stock market development measures, η is an unobserved country-specific effect, ε is the error term, and the subscripts i and t represent country and time period, respectively.

Since the direction of causality is not clear the following models are also specified:

$$b_{i,t} - b_{i,t-1} = (\alpha_2 - 1)b_{i,t-1} + \beta_2' Y_{i,t} + \eta_{2i} + \varepsilon_{2i,t} \tag{2.5}$$

$$s_{i,t} - s_{i,t-1} = (\alpha_3 - 1)s_{i,t-1} + \beta_3' Z_{i,t} + \eta_{3i} + \varepsilon_{3i,t} \tag{2.6}$$

where b is the banking sector development measure, $b_{i,t} - b_{i,t-1}$ is the growth rate in banking sector development, s is the stock market development measure, $s_{i,t} - s_{i,t-1}$ is the growth rate in stock market development, Y represents the set of explanatory variables including economic growth and stock market development, Z represents the set of explanatory variables including economic growth and banking sector development.

The above equations can be rewritten as:

$$y_{i,t} = \alpha_1 y_{i,t-1} + \beta_1' X_{i,t} + \eta_{1i} + \varepsilon_{1i,t} \tag{2.7}$$

$$b_{i,t} = \alpha_2 b_{i,t-1} + \beta_2' Y_{i,t} + \eta_{2i} + \varepsilon_{2i,t} \tag{2.8}$$

$$s_{i,t} = \alpha_3 s_{i,t-1} + \beta_3' Z_{i,t} + \eta_{3i} + \varepsilon_{3i,t} \tag{2.9}$$

To eliminate the country-specific effect, first-differences are taken:

$$y_{i,t} - y_{i,t-1} = \alpha_1(y_{i,t-1} - y_{i,t-2}) + \beta_1'(X_{i,t} - X_{i,t-1}) + (\varepsilon_{1i,t} - \varepsilon_{1i,t-1}) \tag{2.10}$$

$$b_{i,t} - b_{i,t-1} = \alpha_2(b_{i,t-1} - b_{i,t-2}) + \beta_2'(Y_{i,t} - Y_{i,t-1}) + (\varepsilon_{2i,t} - \varepsilon_{2i,t-1}) \tag{2.11}$$

$$s_{i,t} - s_{i,t-1} = \alpha_3(s_{i,t-1} - s_{i,t-2}) + \beta_3'(Z_{i,t} - Z_{i,t-1}) + (\varepsilon_{3i,t} - \varepsilon_{3i,t-1}) \tag{2.12}$$

The use of instruments is required to deal with the endogeneity of the explanatory variables, and the problem that the error term $\varepsilon_{1i,t} - \varepsilon_{1i,t-1}$ is correlated with the lagged dependent variable; $y_{i,t-1} - y_{i,t-2}$, error term $\varepsilon_{2i,t} - \varepsilon_{2i,t-1}$ is correlated with the lagged dependent variable; $b_{i,t-1} - b_{i,t-2}$, and the error term $\varepsilon_{3i,t} - \varepsilon_{3i,t-1}$ is correlated with the lagged dependent variable; $s_{i,t-1} - s_{i,t-2}$. GMM difference estimator uses the lagged explanatory variables as instruments. By assuming that (1) the error term is not serially correlated, and (2) the explanatory variables are weakly exogenous (i.e., the explanatory variables are uncorrelated with future error terms), the following moment conditions are used:

$$E[y_{i,t-s}(\varepsilon_{1i,t} - \varepsilon_{1i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T, \tag{2.13}$$

$$E[b_{i,t-s}(\varepsilon_{2i,t} - \varepsilon_{2i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T, \tag{2.14}$$

$$E[s_{i,t-s}(\varepsilon_{3i,t} - \varepsilon_{3i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T, \tag{2.15}$$

$$E[X_{i,t-s}(\varepsilon_{1i,t} - \varepsilon_{1i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T, \tag{2.16}$$

$$E[Y_{i,t-s}(\varepsilon_{2i,t} - \varepsilon_{2i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T, \tag{2.17}$$

$$E[Z_{i,t-s}(\varepsilon_{3i,t} - \varepsilon_{3i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \dots, T. \tag{2.18}$$

Arellano and Bond (1991) suggest a two-step GMM estimator using the above moment conditions. In the first step the error terms are assumed to be independent and homoskedastic across countries and over time. In the second step, the residuals from the first step are used to construct a consistent estimate of the variance-covariance matrix. The consistency of the GMM estimator mainly depends on the assumptions that the error terms do not exhibit second order serial correlation and that the instruments are valid. To check whether or not these assumptions hold, the Sargan and serial correlation tests are performed. Sargan test of over-identifying restrictions test the overall validity of the instruments by analyzing the moment conditions. Serial correlation test examines whether the differenced error term is second-order serially correlated. Failure to reject the null hypothesis of these tests implies that the assumptions of the estimation hold.

2.5 RESULTS

The dynamic panel data analyses are performed for each of emerging markets and developed markets. It is oberved that the GMM estimation results for emerging markets and developed markets show differences.

2.5.1 GMM Estimation Results for Emerging Markets

GMM estimation results for emerging markets are presented in Table 2.8, Table 2.9 and Table 2.10. Results presented in Table 2.8 show that both banking sector development and stock market development have significant effects on economic growth, with 1 percent significance levels in emerging markets. The GMM estimations results for a reverse relationship, i.e., the role of economic growth in banking sector development and in stock market development in emerging

Table 2.8: GMM estimations for the banking sector development–stock market development–economic growth relationship in emerging markets (LNGDP as a dependent variable)

Dependent Variable: LNGDP
Method: Panel Generalized Method of Moments
Transformation: First Differences

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP(-1)	0.102267	0.026248	3.896158	0.0001
BAN	0.248204	0.035026	7.086201	0.0000
STO	0.088669	0.008546	10.37492	0.0000
INF	-7.21E-05	0.000147	-0.489614	0.6247
OPE	0.002410	0.000393	6.138469	0.0000
GNE	-0.001216	0.000162	-7.485185	0.0000
FDI	-0.005671	0.000822	-6.902371	0.0000
CRIS	-0.755899	0.038984	-19.39005	0.0000
J-statistic	37.10750			
Instrument rank	42.00000			
Sargan test[a] (p-val)	0.102			
Serial correlation[b] (p-val)	0.861			

LNGDP : Logarithm of real GDP per capita
BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
INF : Inflation
OPE : Openness to trade (total shares of exports and imports as a percentage of GDP)
GNE : Gross National Expenditure as a percentage of GDP
FDI : Foreign direct investment as a percentage of GDP
CRIS : Crisis periods dummy

[a] Sargan test has the null hypothesis that the over-identifying restrictions are valid.
[b] Serial correlation test has the null hypothesis that errors in the first-difference regression exhibit no second order serial correlation.

Table 2.9: GMM estimations for the banking sector development–stock market development–economic growth relationship in emerging markets (BAN as a dependent variable)

Dependent Variable: BAN
Method: Panel Generalized Method of Moments
Transformation: First Differences

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BAN(-1)	0.689383	0.008892	77.52598	0.0000
LNGDP	0.276021	0.028285	9.758448	0.0000
STO	-0.056421	0.002826	-19.96396	0.0000
INF	0.000430	0.000143	3.006309	0.0028
OPE	6.88E-05	0.000286	0.240634	0.8100
GNE	0.004100	5.42E-05	75.71236	0.0000
FDI	0.000401	0.000551	0.727559	0.4674
CRIS	0.060065	0.007978	7.528421	0.0000

J-statistic	38.72205
Instrument rank	43.00000
Sargan test[a] (p-val)	0.305
Serial correlation[b] (p-val)	0.148

LNGDP : Logarithm of real GDP per capita
BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
INF : Inflation
OPE : Openness to trade (total shares of exports and imports as a percentage of GDP)
GNE : Gross National Expenditure as a percentage of GDP
FDI : Foreign direct investment as a percentage of GDP
CRIS : Crisis periods dummy

[a] Sargan test has the null hypothesis that the over-identifying restrictions are valid.
[b] Serial correlation test has the null hypothesis that errors in the first-difference regression exhibit no second order serial correlation.

Table 2.10: GMM estimations for the banking sector development–stock market development–economic growth relationship in emerging markets (STO as a dependent variable)

Dependent Variable: STO
Method: Panel Generalized Method of Moments
Transformation: First Differences

Variable	Coefficient	Std. Error	t-Statistic	Prob.
STO(-1)	0.384708	0.017758	21.66358	0.0000
LNGDP	0.714416	0.069037	10.34830	0.0000
BAN	-1.600188	0.022036	-72.61544	0.0000
INF	-0.001739	0.000305	-5.705169	0.0000
OPE	-0.005352	0.000561	-9.543047	0.0000
GNE	0.007138	0.000118	60.35539	0.0000
FDI	-0.006767	0.001150	-5.882717	0.0000
CRIS	-0.072179	0.018126	-3.982143	0.0001

J-statistic	34.40388
Instrument rank	43.00000
Sargan test[a] (p-val)	0.497
Serial correlation[b] (p-val)	0.101

LNGDP : Logarithm of real GDP per capita
BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
INF : Inflation
OPE : Openness to trade (total shares of exports and imports as a percentage of GDP)
GNE : Gross National Expenditure as a percentage of GDP
FDI : Foreign direct investment as a percentage of GDP
CRIS : Crisis periods dummy

[a] Sargan test has the null hypothesis that the over-identifying restrictions are valid.
[b] Serial correlation test has the null hypothesis that errors in the first-difference regression exhibit no second order serial correlation.

markets are presented in Table 2.9 and Table 2.10 respectively. The results show that economic growth has a positive significant effect both on banking sector development and on stock market development, with 1 percent significance levels. These findings support the bi-directional relationship between financial development and economic growth in emerging markets.

In the literature different views exist on the role of inflation in growth. For instance, whereas Hung (2003) illustrates the important role of inflation in determining the effects of financial development on economic growth, Ireland (1994) states that the effects of inflation on growth are small, moreover, he adds that the effects of inflation on growth rates may disappear completely in the long run. In this essay, the GMM estimation results show that in emerging markets inflation has no significant effect on real growth. This result implies that although the inflation rates in emerging markets tend to be high relative to the inflation rates in developed markets, if an inflation rate is in the range of expected values, it does not affect the real growth rates significantly.

While OPE has a positive significant effect on growth, GNE, which includes the expenditure on imports but excludes the expenditure on exports, has a significant negative effect. The negative effect of GNE in emerging markets may be due to high expenditures on imports. The CRIS dummy variable has a negative significant effect on the growth rates of emerging markets, as expected.

The results show that in emerging markets FDI has a negative significant effect both on stock market development and growth. Especially in emerging markets, FDI mostly includes the investments by foreign banks. Recently, there has been an increase in foreign bank lending in emerging markets. In emerging markets, the bulk of production and investment takes place in privately-owned and small-sized businesses that may not benefit from big-sized foreign banks, which, in turn would negatively affect the growth in such countries. Boyd and Smith (1992) present the view that in countries with weak financial systems, financial integration causes a capital outflow from capital-scarce countries to capital-abundant countries with better institutions. Giannetti and Ongena (2007) investigated the growth effects of financial integration on small and young firms in Eastern European economies. These authors state that although foreign lending stimulates growth in firm sales, assets, and use of financial debt, the effect is dampened for small firms.

If there is an increase in the expected inflation, then there will be a demand for real goods, which, in turn, will increase the banking activities and banking sector development while decreasing the stock market development. The findings of this essay provide evidence to this view by showing that whereas inflation has a significant positive effect on banking sector development, it affects stock market development negatively.

Results also show that financial crises affect stock market development and economic growth negatively. Although banking sector development is also expected to be affected negatively by the financial crises, the reverse is observed. Increases in the banking activities in the years following the crises, which are also included as a dummy variable in the regressions, may explain this finding.

FDI mostly includes the investments by foreign banks, whereas big firms benefit from the entrance of foreign banks, there will be a decrease in the level of activities between the small firms and big foreign banks. Therefore, the two effects seem to cancel each other out, causing a neutral position of FDI in BAN.

2.5.2 GMM Estimation Results for Developed Markets

GMM estimation results for developed markets are presented in Table 2.11, Table 2.12 and Table 2.13. Results presented in Table 2.11 show that neither banking sector development, nor stock market development has a significant effect on economic growth in developed markets. The results also show that in developed markets almost all of the explanatory variables have no significant effects on growth. This result is intuitive since the effects of explanatory variables in economic growth is expected to be less robust in markets where the real economy is already well-developed and stable. It is seen that although INF has a negative effect on growth, this effect is only in 10 percent significance level. Similarly, FDI has a positive effect on growth, with 10 percent significance level. Moreover, the high value of the coefficient of the lagged dependent variable shows that there is inertia in growth rate for developed markets while it is not the case for emerging markets.

The GMM estimation results presenting the role of economic growth in banking sector development and stock market development are presented in Table 2.12 and Table 2.13 respectively. The findings show that economic growth

Table 2.11: GMM estimations for the banking sector development–stock market development–economic growth relationship in developed markets (LNGDP as a dependent variable)

Dependent Variable: LNGDP
Method: Panel Generalized Method of Moments
Transformation: First Differences

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP(-1)	0.805267	0.096848	8.314734	0.0000
STO	-0.002632	0.010303	-0.255496	0.7989
BAN	-0.008624	0.068728	-0.125475	0.9004
INF	-0.002497	0.001453	-1.718571	0.0889
OPE	0.001189	0.000419	2.837789	0.0055
GNE	-0.003912	0.003238	-1.208153	0.2299
FDI	0.001644	0.000964	1.704949	0.0914
CRIS	0.000338	0.025823	0.013081	0.9896

J-statistic	12.84788
Instrument rank	18.00000
Sargan test[a] (p-val)	0.232
Serial Correlation[b] (p-val)	0.143

LNGDP : Logarithm of real GDP per capita
BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
INF : Inflation
OPE : Openness to trade (total shares of exports and imports as a percentage of GDP)
GNE : Gross National Expenditure as a percentage of GDP
FDI : Foreign direct investment as a percentage of GDP
CRIS : Crisis periods dummy

[a] Sargan test has the null hypothesis that the over-identifying restrictions are valid.
[b] Serial correlation test has the null hypothesis that errors in the first-difference regression exhibit no second order serial correlation.

has positive significant effects both on banking sector development and on stock market development, with 1 percent significance levels, supporting the demand-following view.

Table 2.12: GMM estimations for the banking sector development–stock market development–economic growth relationship analysis in developed markets (BAN as a dependent variable)

Dependent Variable: BAN
Method: Panel Generalized Method of Moments
Transformation: First Differences

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BAN(-1)	0.635434	0.194782	3.262284	0.0015
LNGDP	0.923668	0.280194	3.296526	0.0014
STO	-0.002005	0.011566	-0.173380	0.8627
INF	-0.006171	0.002363	-2.611524	0.0105
OPE	-0.002162	0.001847	-1.170013	0.2450
GNE	-0.003359	0.003190	-1.053013	0.2950
FDI	-0.003681	0.001421	-2.591179	0.0111
CRIS	0.067113	0.038697	1.734348	0.0861

J-statistic	10.00401
Instrument rank	18.00000
Sargan test[a] (p-val)	0.440
Serial Correlation[b] (p-val)	0.692

LNGDP : Logarithm of real GDP per capita
BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
INF : Inflation
OPE : Openness to trade (total shares of exports and imports as a percentage of GDP)
GNE : Gross National Expenditure as a percentage of GDP
FDI : Foreign direct investment as a percentage of GDP
CRIS : Crisis periods dummy

[a] Sargan test has the null hypothesis that the over-identifying restrictions are valid.

[b] Serial correlation test has the null hypothesis that errors in the first-difference regression exhibit no second order serial correlation.

Table 2.13: GMM estimations for the banking sector development–stock market development–economic growth relationship analysis in developed markets (STO as a dependent variable)

Dependent Variable: STO
Method: Panel Generalized Method of Moments
Transformation: First Differences

Variable	Coefficient	Std. Error	t-Statistic	Prob.
STO(-1)	-0.269330	0.144076	-1.869362	0.0641
LNGDP	4.736445	1.727933	2.741105	0.0071
BAN	-0.853732	0.552496	-1.545229	0.1250
INF	0.035543	0.025207	1.410013	0.1612
OPE	0.018082	0.011863	1.524297	0.1302
GNE	0.052653	0.047916	1.098861	0.2741
FDI	-0.005361	0.016200	-0.330951	0.7413
CRIS	-0.868617	1.070836	-0.811158	0.4189
J-statistic	43.22861			
Instrument rank	43.00000			
Sargan test[a] (p-val)	0.160			
Serial Correlation[b] (p-val)	0.323			

LNGDP : Logarithm of real GDP per capita
BAN : Value of deposit money bank credits to the private sector divided by GDP
STO : Value of domestic equities traded on domestic exchanges divided by GDP
INF : Inflation
OPE : Openness to trade (total shares of exports and imports as a percentage of GDP)
GNE : Gross National Expenditure as a percentage of GDP
FDI : Foreign direct investment as a percentage of GDP
CRIS : Crisis periods dummy

[a] Sargan test has the null hypothesis that the over-identifying restrictions are valid.

[b] Serial correlation test has the null hypothesis that errors in the first-difference regression exhibit no second order serial correlation.

2.6 SUMMARY OF RESULTS

In this essay, the interdependence of financial development and economic growth is investigated. Specifically, the relationship between banking sector development and economic growth and the relationship between stock market development and economic growth are analyzed via dynamic panel data techniques considering the cointegration properties of the panel data.

Dynamic panel estimation results show differences between emerging markets and developed markets. In emerging markets, not only does economic growth positively affects financial markets development, but also, the developed financial markets have positive impacts on the economic growth. Therefore, results give evidence of a statistically significant and positive interdependence between banking sector development and economic growth in emerging markets. Similarly, stock market development and economic growth are interdependent in emerging markets. The results are consistent with the view that the relationship between financial development and economic growth is bi-directional, i.e., markets promote growth and growth, in turn encourages the formation of new markets.

However, the situation is different in developed markets. The dynamic panel estimation results show that in developed markets, although economic growth positively affects the financial market development, the reverse relationship is insignificant, i.e., banking sector development and stock market development have no significant effect on economic growth. Therefore, it is concluded that the relationship between financial markets and economic growth is in one direction, supporting the "demand-following" view. This view suggests that as the real side of the economy expands, its demand for financial services increases, which leads to the growth of these services. This result is intuitive, given that the effect of financial market development on economic growth is expected to be less robust in markets in which the real economy is already well-developed. Findings of this essay are consistent with Rioja and Valev (2004) who suggest that the relationship between financial development and economic growth may vary according to the level of financial development of countries. Rioja and Valev (2004) state that in the countries with intermediate level of financial development economic growth is positively affected by the developments in financial markets, whereas in the countries with developed financial markets this effect is smaller. However, due to limited available stock market data, Rioja and Valev (2004) did not use such data for all countries and periods in their original sample. Instead they constructed dummy variables for non-bank measures.

The dynamic panel estimator controls for the potential endogeneity of all explanatory variables and unobserved country-specific effects, therefore, the estimation results are not due to such possible biases.

As a future study, the financial development and economic growth relationship may be reinvestigated in the existence of other control variables such as short-term capital flow, and real exchange rate. When there is a short-term capital inflow, it may lead to an increase in GDP as well as it may also improve the financial system by increasing the volume of transactions and the number of instruments. In addition, high real exchange rate volatility may harm trade, investments, and economic growth, which, in turn, may cause negative effects on financial development.

CHAPTER 3

FUTURES MARKET AND ECONOMIC GROWTH

3.1 INTRODUCTION

There are several studies that provide evidence of a positive relationship between financial development and economic growth. 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?

An important function of financial markets is to reallocate risk between different economic agents. Reallocation of risk enables borrowers to tailor their risky portfolios and therefore, to achieve greater access to capital. In addition, savers become better able to diversify their risk and make more funds available for borrowing. The development of derivatives instruments improves the allocation of risk and increases the efficiency of financial intermediation. 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 many emerging and developed countries, derivatives markets are established in order to manage the risk that investors hold. This essay investigates whether or not futures market development causes economic growth in emerging and developed markets. Both dynamic panel and time-series approaches are used throughout the analyses. Clarifying the role of futures markets in economic growth may lead to government policies that support developments in futures markets in order to promote economic growth. Especially in emerging markets, most of the production takes place in privately held small firms where risk sharing is absent most of the time. Thus, promoting financial markets and services that ease risk sharing in these countries may result in welfare increase. This study is the first to investigate the relationship between futures markets and economic growth by means of dynamic panel data and time-series techniques. It is based on the view that reducing financial risks through derivatives markets enables borrowers to achieve greater access to capital, which, in turn, increases investment volume and hence, leads to a higher rate of economic growth.

The essay is organized as follows. Section 2 presents theoretical background of the study. Section 3 reviews the related literature and emphasizes the contribution of the essay to the literature. Section 4 describes the data. Methodology and the results are presented in Section 5. Section 6 summarizes the results and concludes the essay.

3.2 THEORETICAL BACKGROUND

Although there is no study in the literature that directly links futures market development to economic growth, there are both theoretical and empirical studies that demonstrate the link between financial risk and economic growth.

The theoretical background of the underlying argument in this essay can be reviewed as follows. In their model, Greenwood and Jovanovic (1990) show that financial intermediaries encourage high-yield investments and growth by pooling investment risks, improving information on firms, eliminating uncertainty about rates of return, and providing efficient capital allocation. They refer to the model of Diamond and Dybvig (1983) who assume that agents face two investment opportunities: an illiquid, high-return project and a liquid, low-return project. The authors argue that, in a world with idiosyncratic risks, agents may be reluctant to save considerable parts of their wealth in an illiquid asset, for fear that they may need to use these funds before the investment matures. Large financial intermediaries can accommodate this situation better than an individual saver can. The authors stress the role that intermediaries play in collecting and analyzing information and, thus, facilitating the migration of funds to the place in the economy that gives the highest social return. Similarly, Pagano (1993) develops an endogenous growth model and argues that improvements in risk hedging and diversification can enhance savings rates and promote the start of innovative, high-quality projects which, in turn, influence economic growth positively.

Acemoglu and Zilibotti (1997) discuss that the desire to avoid high-risky investments slows down capital accumulation and that the inability to diversify idiosyncratic risks introduces a large amount of uncertainty in the growth process. Hence, reducing financial risk through holding diversified portfolios allows agents to invest in high-return projects with a positive influence on growth. Acemoglu and Zilibotti (1997) assume that high-return, risky projects are frequently indivisible and require a large initial investment. If there were no financial arrangements that allow agents to hold diversified portfolios, agents would avoid high-return, risky projects. Krebs (2002) also shows that a reduction in the variation in firm-specific risk increases the total investment return and growth.

Angeletos and Calvet (2006) argue that idiosyncratic production shocks introduce a risk premium on private equity and reduce the demand for investment. Agents smooth consumption by reducing current investment, which results in low wealth, low savings, and high interest rates in later periods. Anticipating high interest rates in the near future, agents become less willing to engage in risky production activities and further reduce current investment, which amplifies the recession in later periods. Idiosyncratic risks thus influence a large class of investment decisions and potentially have substantial aggregate effects. Angeletos and Calvet (2006) derive the following model, which shows that demand for investment is negatively related to idiosyncratic risk. The demand for investment is given as:

$$r_t + \delta = f'(k_{t+1})[1 - \Gamma_t f(k_{t+1})\sigma_A^2] \tag{3.1}$$

where r_t is the interest rate in period t, f is a production function, k is the capital stock, Γ_t the absolute risk aversion in period t, σ_A is the magnitude of the production shock and capital depreciates at a fixed rate $\delta \in [0, 1]$. Angeletos and Calvet (2006) state that idiosyncratic production and capital-income shocks introduce a risk premium on private equity and reduce aggregate investment for any given risk-free rate. When $\sigma_A > 0$, this may lead to both a lower capital stock and a lower risk-free rate than in complete markets. Moreover, an anticipated increase in future rates raises the premium on private equity and thereby decreases the aggregate demand for investment. In an incomplete market, investment demand is negatively affected by the production risk σ_A. An increase in the standard deviation σ_A can reduce the precautionary savings and reduce an individual's willingness to invest. The authors 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 through the reduction in σ_A. If the idiosyncratic risk σ_A is reduced or becomes zero in the above model, the demand for investment will increase, and medium-run growth will be affected positively.

Saito (1998) constructs a model of incomplete insurance by introducing permanent idiosyncratic shocks into an endogenous growth model. Saito (1998) argues that both aggregate and idiosyncratic shocks have permanent effects on the individual wealth level. In his model Saito (1998) assumes many infinitely lived consumers are living in a continuous-time economy and agent i is endowed with the following technology:

$$y(t)dt = [Adt + \sigma_a dB_a(t) + \sigma_h dB_i(t)]K(t) \tag{3.2}$$

where $y(t)$ is output, A is the state of productivity, $K(t)$ is capital, $B_a(t)$ and $B_i(t)$ are the standard Brownian motions. $B_a(t)$ represents aggregate shocks and $B_i(t)$ represents idiosyncratic shocks for agent i. Moreover, $dB_i(t)$ is assumed to be uncorrelated among consumers, and uncorrelated with $dB_a(t)$. σ_a and σ_h are the standard deviations of $B_a(t)$ and $B_i(t)$, respectively, and they are assumed to be common across agents. There are no insurance markets in the model. Therefore, an idiosyncratic shock $\sigma_h dB_i(t)$ cannot be pooled among consumers and it remains uninsured. Each agent i maximizes life-time utility $(V(K_i(t)))$.

$$V(K_i(t)) = \max_{\{\mu_i(\tau), x_i(\tau)\}_{\tau=t}^{\infty}} E_t \int_t^{\infty} \left[\exp(-\rho(\tau - t)) \frac{c_i(\tau)^{1-\gamma}}{1-\gamma} \right] d\tau \tag{3.3}$$

$$\begin{aligned} dK_i(t) = {} & [(1 - x_i(t))r(t)dt + x_i(t)(Adt + \sigma_a dB_a(t) + \sigma_h dB_i(t)) \\ & - \mu_i(t)dt]K_i(t) \end{aligned} \tag{3.4}$$

where E_t is the conditional expectation operator, $c_i(t)$ is the consumption level, $x_i(t)$ is the share of risky assets, ρ is the time preference rate, $\gamma(> 0, \neq 1)$ is the degree of relative risk aversion, $r(t)$ is a risk-free rate of return, $\mu_i(t)$ is the marginal propensity to consume out of wealth, and A is the average return on both types of capital.

Saito (1998) shows that equilibrium without any bond trading emerges under constant risk-free rates, $(r(t) = r)$ and refers to Merton (1971) to show the optimal consumption and portfolio rules as:

$$\mu_i(t) = x_i(t)A + (1 - x_i(t))r + \frac{1}{\gamma}(\rho - r) - \frac{\gamma + 1}{2}(\sigma_a^2 + \sigma_h^2) \tag{3.5}$$

and

$$x_i(t) = \frac{A - r}{\gamma(\sigma_a^2 + \sigma_h^2)} \tag{3.6}$$

For an equilibrium,

$$\mu_i(t) > 0 \tag{3.7}$$

No bond trading takes place among consumers since the optimal portfolio is identical among consumers. Then, market equilibrium condition is

$$x_i(t) = 1 \quad \text{for all } i \text{ and } t. \tag{3.8}$$

Substituting Eq. (3.8) into Eq. (3.6), the constant equilibrium risk-free rate becomes

$$r(t) = r = A - \gamma(\sigma_a^2 + \sigma_h^2) \tag{3.9}$$

Given the optimal rules (3.5) and (3.6), and the equilibrium condition (3.9), Eq. (3.4) implies that both aggregate and idiosyncratic shocks have permanent effects on the individual wealth level.

Moreover, Storesletten et al. (2004) and Turnovsky and Bianconi (2005) show that idiosyncratic risks play an important role in aggregate risk; thus, reducing the idiosyncratic risks of economic agents leads to economic growth. Turnovsky and Bianconi (2005) develop a model of an economy with only one good and that is populated by a large number, I, of individuals indexed by i. Each individual is endowed with one unit of time that he allocates between leisure, l, and labor, $(1-l)$, produces output dQ_i, in firm i, in accordance with the Cobb-Douglas production function. In equilibrium, individual output follows the process

$$dQ_i = A(1-l)^{\beta} K_i (dt + dy + dz_i) \equiv Z_i (dt + dy + dz_i) \tag{3.10}$$

where K_i is the individual instantaneous stock of capital, dy is the economy-wide productivity shock and dz_i is the individual-specific productivity shock. The individual-specific shocks average out in the aggregate and equilibrium aggregate output becomes:

$$dQ = A(1-l)^{\beta} K (dt + dy) \equiv Z (dt + dy) \tag{3.11}$$

The authors state that the presence of idiosyncratic risk causes the productivity of capital to decline with time. For a sufficiently large number of agents the individual risk vanishes upon aggregation. Turnovsky and Bianconi (2005) argue that, in reality, idiosyncratic shocks exist and are important, and empirical evidence suggests that the volatility of such shocks is several times that of aggregate shocks. In the process of eliminating aggregate risk, if the policymaker can reduce idiosyncratic risk by a modest amount, the welfare gains from aggregate stabilization can become significant.

Recently, Angeletos (2007) augmented the neoclassical growth model to study the macroeconomic effects of uninsured idiosyncratic investment risk. He states that uninsured idiosyncratic investment risks are dominant in less developed economies, where the bulk of production and investment takes place in privately-owned businesses and where risk-sharing opportunities are rather limited.

3.3 LITERATURE REVIEW AND CONTRIBUTION TO THE LITERATURE

In this essay, the effectiveness of the risk-hedging function of futures markets on economic growth is investigated. The findings help to answer the questions: whether or not futures markets and economic growth are cointegrated and co-move together in time and whether or not developments in futures market Granger-cause economic growth. If futures markets development has a significant role in economic growth and, further, the variables are observed to have a causal relationship, policy makers can make clear decisions that will support developments in the futures markets for the sake of their real economies.

In the existing literature on the finance-growth nexus, there are various empirical studies that investigate the relationship between financial development and economic growth. Among many others, Goldsmith, (1969), King and Levine (1993a), Beck et al. (2000b), Levine et al. (2000), Jeong et al. (2003), and Şendeniz-Yüncü et al. (2007) examine the relationship between financial intermediary development, namely banking sector development, and economic growth. Similarly, Atje and Jovanovic (1993), Demirgüç-Kunt and Levine (1996a,b), Harris (1997), Levine and Zervos (1998), Rousseau and Wachtel (1998), and Arestis et al. (2001) study the relationship between stock market development and economic growth. Moreover, Beck and Levine (2004) investigate the role of the development of the banking sector and the stock market in economic growth. In the consensus of these studies, it is now a common belief that well-functioning financial intermediaries ameliorate market information, reduce transaction costs and, hence, promote efficient resource allocation and economic growth. However, researchers have not thoroughly examined the underlying mechanisms that lead to the positive relationship between the degree of the development of the financial system and economic growth. Although the relationship among the banking sector, the stock market, and economic growth is extensively examined in the literature, there is no study that focuses on the effect of the development of derivative markets on economic growth. 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 derivative contracts contribute to economic growth as well?

This study is the first to investigate the relationship between economic growth and derivatives markets, which is a rather new and major component of the financial sector, via dynamic panel data and time-series techniques. Futures markets are chosen to represent derivatives markets in the essay. Convincing evidence of the existence of causality between the futures markets and economic growth will be the first empirical support for the theoretical view that hedging risk through financial markets influences economic growth positively.

3.4 DATA

The data set consists of both emerging and developed markets. The countries in the sample are the ones in which futures markets have been operating for at least six years. This period is needed to make healthy econometric analyses. Because the number of countries having derivatives markets is relatively less than the number of countries that have stocks market, and the history of derivatives markets in most of these countries is not long, the sample that is used in this essay is smaller than that of the previous essay.

In the first part of the analysis of the relationship between futures market development and economic growth, dynamic panel data techniques are used. Panel data sets that combine time-series and cross-sections containing annual observations on countries provide a rich resource of information compared to cross-country and time-series data. A panel data set is more oriented toward cross-section analyses; in other words, it is larger in cross-section relative to period, as Greene (2000) suggests. In the dynamic panel data analyses, data for 15 countries with annual observations in the period 1994–2003 are used.

Table 3.1: Countries in the sample of Essay 2

Country	Futures Exchange	Index Name	Period
Developed Markets			
Australia*	Sydney Futures Exchange (SFE)	SPI 200	2000:III–2005:III
Austria	Wiener Börse (OTOB)	ATX	1992:IV–2005:III
Belgium	Belgian Futures & Options Exchange (BELFOX)	BEL20	1994:I–2005:III
Canada*	Toronto Futures Exchange (TFE)	TORONTO 35	1991:II–2000:I
Denmark	Guarantee Fund for Danish Options and Futures (FUTOP)	OMXC20	1992:III–2005:III
France*	Marche a Terme International de France (MATIF)	MONEP–CAC 40	1999:II–2005:III
Germany	Deutsche Terminboerse Gmbh (DTB)	EUREX–DAX	1991:I–2005:III
Italy*	Mercato Italiano Futures (MIF)	MIB 30	1995:I–2004:IV
Japan	Osaka Stock Exchange (OSE)	OSX–NIKKEI 225	1988:IV–2005:III
Netherlands	AEX–Optiebeurs (AEX)	AEX	1989:I–2005:III
New Zealand*	The NZ Futures & Options Exchange (NZFOE)	NZFE–NZSE 10	1995:IV–2003:III
Norway	Oslo Stock Exchange (OSLO)	OBX	1992:IV–2005:III
Spain	Mercado De Futuros Financieros (MEFF)	IBEX 35 PLUS	1992:III–2005:III
Sweden	The OMLX Exchange (OMLX)	OMXS30	1990:II–2005:III
Switzerland	Swiss Options & Financial Futures Exchange (SOFFEX)	EUREX–SMI	1991:I–2005:III
UK	London International Financial Futures & Options Exchange (LIFFE)	FTSE 100	1984:III–2005:III
US	Chicago Mercantile Exchange (CME)	S&P 500	1982:III–2005:III
Emerging Markets			
Brazil	Bolsa de Mercadorias & Futuros (BM&F)	BOVESPA	1994:I–2005:III
Hong Kong	Hong Kong Futures Exchange (HKFE)	HANG SENG	1988:II–2005:III
Hungary*	Budapest Stock Exchange (BSE)	BUX	1995:II–2005:III
Portugal*	Bolsa de Derivados de Porto (BDP)	PSI 20	1996:III–2005:III
South Africa	South African Futures Exchange (SAFEX)	ALL SHARE 40	1990:III–2005:III

* Countries not included in the panel data analysis.

The second part of the essay consists of the time-series analysis. In order to see the relationship in each country separately, time-series analyses are conducted. In time-series analyses, quarterly data that belongs to 22 countries, 17 of which are developed markets and 5 of which are emerging markets are used. The data period varies between countries, and the widest data period belongs to the United States, which is 1982:Q3–2005:Q3. The countries in the sample, names of the futures exchanges, and the observation periods are shown in Table 3.1.

As a futures market development indicator of a country, a ratio of the value of stock index futures contracts to GDP — hereafter FUTURES — is used. Kenourgios et al. (2007), by using the S&P 500 stock index futures data show that a stock index futures contract is an effective tool for hedging risk. The total value of stock index futures contracts is calculated by multiplying the volume of contracts traded by average contract prices in each period. The futures data is obtained from the Datastream Advance 3.5.

As for the economic growth indicator, logarithm of seasonally adjusted quarterly real GDP data — hereafter LNGDP — is used. LNGDP is obtained from the International Monetary Fund's (IMF) International Financial Statistics (IFS). All observations are in the countries' national currencies.

The annual values of stock index futures contracts to GDP ratios for each country are presented in Table 3.2.

In order to assess the strength of the independent link between futures market development and economic growth, control for other potential determinants

Table 3.2: Ratios of annual values of stock index futures contracts to GDP

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Avg.
Australia																			0.085	0.096	0.095	0.110	0.097
Austria											0.001	0.001	0.002	0.002	0.003	0.003	0.003	0.002	0.001	0.001	0.000	0.000	0.002
Belgium												0.000	0.000	0.001	0.001	0.002	0.003	0.002	0.002	0.001	0.001	0.001	0.001
Brazil												0.090	0.096	0.113	0.188	0.111	0.062	0.094	0.065	0.047	0.054	0.098	0.092
Canada										0.002	0.002	0.004	0.004	0.005	0.013	0.019	0.023						0.009
Denmark											0.027	0.042	0.020	0.018	0.032	0.052	0.227	0.214	0.083	0.071	0.083	0.094	0.080
France																		0.124	0.109	0.099	0.083	0.081	0.099
Germany									0.048	0.145	0.193	0.322	0.265	0.360	0.631	0.857	0.377	0.519	0.460	0.460	0.455	0.663	0.411
Hong Kong							0.053	0.052	0.124	0.251	0.680	1.873	1.829	2.029	2.911	2.780	2.582	2.468	2.070	1.938	2.456	4.094	1.762
Hungary														0.004	0.058	0.159	0.094	0.079	0.023	0.013	0.014	0.021	0.052
Italy													0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Japan							0.113	0.184	0.278	0.145	0.091	0.062	0.064	0.073	0.059	0.042	0.063	0.056	0.047	0.046	0.048	0.069	0.090
Netherlands							0.008	0.016	0.022	0.021	0.033	0.062	0.054	0.094	0.220	0.414	0.456	0.429	0.342	0.312	0.257	0.325	0.192
New Zealand														0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Norway											0.001	0.000	0.000	0.001	0.005	0.016	0.026	0.038	0.029	0.030	0.022	0.031	0.017
Portugal															0.030	0.107	0.053	0.039	0.021	0.010	0.005	0.004	0.034
South Africa									0.007	0.015	0.021	0.062	0.050	0.043	0.055	0.084	0.107	0.113	0.137	0.179	0.128	0.174	0.084
Spain											0.003	0.012	0.011	0.014	0.008	0.008	0.006	0.005	0.003	0.002	0.002	0.002	0.006
Sweden									0.001	0.003	0.008	0.019	0.029	0.027	0.054	0.170	0.366	0.682	0.502	0.310	0.271	0.411	0.204
Switzerland									0.021	0.044	0.054	0.116	0.110	0.166	0.232	0.384	1.266	0.916	0.778	0.878	0.934	0.999	0.493
UK			0.003	0.005	0.018	0.018	0.036	0.058	0.066	0.107	0.128	0.192	0.161	0.170	0.223	0.364	0.593	0.679	0.639	0.704	0.723	0.794	0.284
US	0.021	0.037	0.049	0.063	0.077	0.040	0.038	0.043	0.047	0.051	0.054	0.067	0.085	0.105	0.126	0.234	0.245	0.218	0.165	0.143	0.114	0.097	0.096

of economic growth is needed in the regressions. For this purpose banking sector development (BAN), stock market development (STO), inflation rate (INF), and foreign direct investment as a percentage of GDP (FDI) are used as control variables. Consistent with the literature, the banking sector development is measured as the volume of credit extended to the private sector by deposit money banks divided by GDP. As a stock market development indicator, value traded ratio is used, which is calculated by dividing the total value of domestic equities traded on domestic exchanges by GDP. The source of the banking sector development and stock market development data is the World Bank Financial Structure Database. Inflation and FDI data are obtained from the World Bank World Development Indicators (WDI) database. These are commonly used control variables in literature (see Edison et al., 2002; Beck and Levine, 2004). The endogenous growth model of Hung (2003) illustrates the important role played by inflation in determining the effects of financial development on economic growth. Edison et al. (2002) states that according to their OLS regression results, the Flow of Capital (foreign direct investment plus portfolio inflows and outflows divided by GDP) and Inflow of Capital (foreign direct investment plus portfolio inflows divided by GDP) measures are positively associated with economic growth.

Dummy variable is also used to control for the effect of financial crisis. Brazil has a crisis in 1997, Hong Kong has a crisis period of 1997–1998 and Japan has a crisis period of 1994–1998. The dummy variable takes a value of one during the years of crises and in the preceding and following years, and zero in the other years.

3.5 METHODOLOGY AND RESULTS

In this essay both dynamic panel and time-series analyses are used to examine the relationship between futures market development and economic growth[1]. First, dynamic panel analyses are performed for a data set consisting of both emerging and developed countries. Afterwards in order to investigate the relationship in each individual country, time-series analyses are performed.

3.5.1 Dynamic Panel Model

To review the relationship between futures market development and the economic growth, Generalized Method of Moments (GMM) estimators developed for dynamic panel models by Holtz-Eakin et al. (1988), Arellano and Bond (1991) and Arellano and Bover (1995) are employed. As Edison et al. (2002) argue, the dynamic panel approach offers many advantages for researchers. First, dynamic panel econometric technique allows us to exploit the time-series nature of the relationship between the variables with pooled cross-section and time-series data. Second, by using this technique we are able to remove any

[1] EViews 5.1 software is used for the econometric analyses.

Table 3.3: Summary statistics (1994–2003)

	Economic Growth (%)	Futures Market (%)	Bank Credit (%)	Stock Market (%)
Mean	2.50	32.00	91.51	74.46
Median	2.63	8.78	92.21	48.81
Maximum	10.17	291.00	178.49	326.78
Minimum	-5.45	0.02	26.77	2.85
Std. Dev.	1.84	58.62	41.24	70.71

Economic Growth : Real GDP growth.
Futures Market : Value of futures contracts as a percentage of GDP.
Stock Market : Value of domestic equities traded on domestic exchanges as a percentage of GDP.
Bank Credit : Value of deposit money bank credits to the private sector as a percentage of GDP.

bias created by unobserved country-specific effects. Third, it controls for the potential endogeneity of all explanatory variables. Thus, the dynamic panel estimator is viewed as a better technique to examine the relationship mentioned above.

The data used in dynamic panel estimation covers the period 1994–2003. Table 3.3 presents summary statistics. Belgium had the highest growth rate of 10.17% in 1999, while Hong Kong had the lowest growth rate of -5.45% in 1998. In terms of the value of futures contracts as a percentage of GDP, Hong Kong had the highest value of 291% in 1997. Belgium, with only 2% had the lowest value of futures contracts as a percentage of GDP in 1994.

The stationarity properties of the data are examined along with Im, Pesaran and Shin (IPS) and Fisher Chi-square Augmented Dickey-Fuller (ADF) panel unit root tests. Both tests have the null hypothesis of existence of unit root. The panel unit root test results that are presented in Table 3.4 show that both

Table 3.4: Panel unit root tests

	FUTURES	BAN	STO	LNGDP
Level	Prob.	Prob.	Prob.	Prob.
IPS	0.28	0.92	0.27	0.30
ADF	0.34	0.68	0.43	0.19
First Diff. (Δ)				
IPS	0.00***	0.00***	0.00***	0.03**
ADF	0.00***	0.01***	0.00***	0.02**

IPS : Im, Pesaran and Shin unit root test with null hypothesis of "unit root"
ADF : Fisher Chi-square ADF unit root test with null hypothesis of "unit root"
FUTURES : Value of futures contracts divided by GDP.
BAN : Value of deposit money bank credits to the private sector divided by GDP.
LNGDP : Logarithm of Real GDP.
, and * stand for the significance at 5%, and 1% level, respectively.

tests indicate non-stationary in level panel series and indicate stationary in first-differenced panel series.

Pedroni, Kao, and Fisher/Johansen panel cointegration tests are done to test the existence of a long-run relationship between futures market development and economic growth. The panel cointegration test results, and the coefficients of cointegration equation are presented in Table 3.5. The results show that there is cointegration between futures market development and economic growth, with 1 percent significance level. This finding suggests the presence of co-movement among the variables, indicating long-run stationarity.

This essay investigates the relationship between futures market development and economic growth employing Generalized Method of Moments (GMM) estimators developed for dynamic panel models by Holtz-Eakin et al. (1988), Arellano and Bond (1991) and Arellano and Bover (1995). Recently, dynamic panel models are preferred by the researchers investigating the relationship between

Table 3.5: Panel cointegration tests

Variable	Cointegration Test				Prob.
FUTURES-LNGDP	Pedroni				
			ADF		0.00***
	Kao				
			ADF		0.00***
	Johansen Fisher		Hypothesized Number of CE(s)		
			None		0.00***
			At most 1		0.00***
	Cointegration Equation		Adjustment Parameter		
	FUTURES(-1)	1.000	ΔFUTURES		-0.018
	LNGDP(-1)	0.602	ΔLNGDP		-0.001
	Constant	-17.864			

FUTURES : Value of futures contracts divided by GDP
LNGDP : Logarithm of real GDP
*** stands for the significance at 1% level.
EViews 6 software is used for the panel cointegration tests.

financial intermediation and economic growth (see Beck et al., 2000; Levine et al., 2000 and Beck and Levine, 2004).

The regression equation is as follows:

$$y_{i,t} - y_{i,t-1} = (\alpha - 1)y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t} \tag{3.12}$$

where y is the logarithm of real GDP, X represents the set of explanatory variables including the futures market development measure, η is an unobserved country-specific effect, ε is the error term, and the subscripts i and t represent country and time period, respectively.

The above equation can be rewritten as

$$y_{i,t} = \alpha y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t} \tag{3.13}$$

Arellano and Bond (1991) propose to difference the above equation in order to eliminate the country-specific effect:

$$y_{i,t} - y_{i,t-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \tag{3.14}$$

Differencing eliminates the country-specific effect, however, it introduces a new econometric problem. The new error term in the difference equation $(\varepsilon_{i,t} - \varepsilon_{i,t-1})$ is now correlated with the lagged dependent variable $(y_{i,t-1} - y_{i,t-2})$. Lagged values of the original regressors are used as instruments for the differenced values of the original to eliminate potential parameter inconsistency arising from simultaneity bias. By assuming that (1) the error term is not serially correlated, and (2) the explanatory variables are weakly exogenous (i.e., the explanatory variables are uncorrelated with future error terms), the GMM dynamic panel estimator uses the following moment conditions:

$$E[y_{i,t-s}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \ldots T, \tag{3.15}$$

$$E[X_{i,t-s}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2; t = 3, \ldots T. \tag{3.16}$$

The consistency of the GMM estimator, which mainly depends on the assumptions that the error terms do not exhibit second order serial correlation and that the instruments are valid, is checked by the Sargan and serial correlation tests. Sargan test of over-identifying restrictions test the overall validity of the instruments by analyzing the moment conditions. Serial correlation test examines whether the differenced error term is second-order serially correlated. The test results show that the assumptions of the estimation hold.

3.5.1.1 Results of Dynamic Panel Data Analyses

GMM dynamic panel estimation results for a data set of emerging and developed markets are presented in Table 3.6. Banking sector development and stock market development measures are included in the regressions as control variables. It is observed that the development of futures markets has a positive significant effect on economic growth with 5% significance level.

The results in Table 3.6 are intuitive. One 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, amelioration of information and transaction costs fosters efficient resource allocation, thus leading to economic growth.

Moreover, panel study results further show that while stock market development and foreign direct investment have statistically significant positive effect

Table 3.6: GMM estimations for the futures market development–economic growth relationship analysis

Dependent Variable: LNGDP
Method: Panel Generalized Method of Moments
Transformation: First Differences

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP(-1)	0.690211	0.038203	18.06714	0.0000
INF	-0.000794	0.000316	-2.515026	0.0133
STO	0.010309	0.003777	2.729563	0.0074
FUTURES	0.042585	0.019181	2.220182	0.0284
FDI	0.000568	0.000308	1.844551	0.0677
BAN	0.021889	0.016986	1.288639	0.2002
CRIS	-0.055554	0.010914	-5.090412	0.0000

J-statistic	42.73507
Instrument rank	41.00000
Sargan test[a] (p-val)	0.145
Serial Correlation[b] (p-val)	0.230

LNGDP : Logarithm of real GDP.
INF : Inflation.
STO : Value of domestic equities traded on domestic exchanges divided by GDP.
FUTURES : Value of futures contracts divided by GDP.
FDI : Foreign direct investment divided by GDP.
BAN : Value of deposit money bank credits to the private sector divided by GDP.
CRIS : Crisis periods dummy.
[a] Sargan test has the null hypothesis that the over-identifying restrictions are valid.
[b] Serial correlation test has the null hypothesis that errors in the first-difference regression exhibit no second order serial correlation.

on economic growth, inflation and economic crises have statistically significant negative effects on economic growth, as expected. The findings of the previous essay also suggest that foreign direct investment has a significant positive effect on economic growth in developed markets, being consistent with the above finding.

In the regression banking sector development variable (as it is commonly measured in the literature as the volume of credit extended to the private sector by deposit money banks, divided by GDP) enters statistically insignificantly with a positive sign. This result is not surprising, because Beck and Levine (2004) also report that the effect of banking sector development becomes statistically insignificant when the regression is controlled for inflation and trade openness, which was the case in developed markets in the previous essay. In addition, in the regression, stock market development indicator enters statistically insignificantly. Furthermore, there is no second order serial correlation in the differenced error terms and instruments are adequate.

3.5.2 Time-series Approach

Exploring the time-series properties of the futures market development and the economic growth relationship for individual countries can be further informative. Time-series techniques allow us to investigate this relationship in further detail for individual countries, over time. In order to examine the relationship between futures market development and economic growth over time for an individual country, the following time-series tests are performed for each country using quarterly data: (i) cointegration tests to see the comovement of variables in the long run and to select a Vector Error Correction Model (VECM), (ii) causality tests to analyze the direction of causalities, (iii) variance decompositions to break down the variance of the forecast error for each variable into components, and (iv) the impulse-response function to trace the effect of a one-time shock to one of the endogenous variables on current and future values of itself and the other endogenous variables.

3.5.2.1 Unit Root Tests

If there is a stationary linear combination between non-stationary series, then, a cointegrating relationship exists between them. This suggests a need to test the stationarity of the series. Existence of a long-run relationship between the futures markets development and GDP are tested by cointegration analysis. However, prior to cointegration analysis, Augmented-Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are done to determine whether or not the series, namely FUTURES and GDP, are stationary. The ADF and PP tests have the null hypothesis of the existence of a unit root, rejection of which indicates stationarity. ADF and PP unit root tests are used to determine the stationarity of the futures markets development indicator and logarithmic data series of seasonally adjusted real GDP.

Table A.1 in the Appendix presents the results of the ADF and PP unit root tests for 22 countries in levels and first differences. At least one test failed to reject the null hypothesis at the 5 percent significance level for 20 series in levels, indicating non-stationarity. For the other 2 countries, Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test results confirmed non-stationarity of the series in levels. At least one test rejected the null hypothesis at the 5 percent significance level for 19 series in first differences in the sample[2]. For the other 3 countries, KPSS test results confirmed stationarity of the first differenced series. KPSS test was also performed for the series that showed inconsistency between the ADF and PP tests. KPSS test results confirmed stationarity of the first differenced series.

3.5.2.2 Cointegration Tests

The finding that many time series contain a unit root has spurred the development of the theory of non-stationary time-series analysis. Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists, the non-stationary time series are said to be cointegrated. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship among the variables. A common trend in the variables is examined after failing to reject the unit root hypothesis for all series in levels. As the unit root tests show, differencing eliminates time trends in variables and therefore yields stationarity. This stationarity allows us to analyze the short-run dynamics of these variables. Although individual series are non-stationary, a linear combination of these series may be stationary. The theory of cointegration addresses the issue of integrating the short-run dynamics with

[2] Lags between 1 and 10 were checked, and the lag that minimized the AIC was chosen when performing the ADF test. The Newey-West bandwidth automatic selection was used when performing the PP unit root test.

the long-run equilibrium. Therefore, such a stationary linear combination, i.e., the cointegrating equation is searched. Johansen's cointegration tests are performed to see if the non-stationary series, FUTURES and GDP move together over time and if cointegration exists between them. However, by differencing, potential valuable information about the long-run relationship among the variables is ignored. If the variables move together over time, an Error Correction Model (ECM) should be used to correct the deviation from long-run equilibrium by the short-run adjustments in ECM.

Although individual series are non-stationary, a linear combination of those series may be stationary. Therefore, the cointegrating equation, i.e., a stationary linear combination of the series is investigated. Existence of a cointegrating equation between FUTURES and LNGDP is tested by Johansen's cointegration test, which has a null hypothesis of "no cointegration." Table 3.7 presents the results of the Johansen cointegration tests. Rejection of the null hypothesis indicates the existence of at least one cointegrating equation in all countries. The finding of cointegration between the series FUTURES and LNGDP for all countries suggests the presence of co-movements among the variables, indicating long-run stationarity.

3.5.2.3 Causality Tests

Granger-causality establishes the leading role of one variable in the fluctuations of another. It helps us to make better forecasting. Granger-causality tests are

Table 3.7: Johansen cointegration tests

Country	Hypothesized Number of CE(s)	Probability
Australia	None	0.04**
	At most 1	0.22
Austria	None	0.01***
	At most 1	0.02**
Belgium	None	0.01***
	At most 1	0.02**
Brazil	None	0.05**
	At most 1	0.99
Canada	None	0.00***
	At most 1	0.47
Denmark	None	0.00***
	At most 1	0.01***
France	None	0.00***
	At most 1	0.04
Germany	None	0.00***
	At most 1	0.13
Hong Kong	None	0.02**
	At most 1	0.18
Hungary	None	0.00***
	At most 1	0.37
Italy	None	0.00***
	At most 1	0.73
Japan	None	0.01***
	At most 1	0.41
Netherlands	None	0.03**
	At most 1	0.20
New Zealand	None	0.00***
	At most 1	0.37
Norway	None	0.04**
	At most 1	0.01***
Portugal	None	0.00***
	At most 1	0.00***
South Africa	None	0.03**
	At most 1	0.35
Spain	None	0.01***
	At most 1	0.80
Sweden	None	0.09*
	At most 1	0.45
Switzerland	None	0.02**
	At most 1	0.49
United Kingdom	None	0.05**
	At most 1	0.68
United States	None	0.04**
	At most 1	0.61

Series : FUTURES (value of futures contracts divided by GDP), LNGDP (logarithm of seasonalized real GDP).
Data : Quarterly Level data.
CE : Cointegrating Equation.
*, **, and *** stand for the significance at 10%, 5%, and 1% level, respectively.

performed to investigate the strength and the direction of the Granger-causality between FUTURES and LNGDP. The basic rationale of Granger-causality is that the change in FUTURES Granger-causes the change in LNGDP, if past values of the change in FUTURES improve unbiased least-squares predictions about the change in LNGDP. Granger-causality regressions of the following form are run:

$$\Delta LNGDP_t = \sum_{i=1}^{n} \pi_{11} \Delta LNGDP_{t-i} + \sum_{i=1}^{n} \pi_{12} \Delta FUTURES_{t-i} + u_t \quad (3.17)$$

$$\Delta FUTURES_t = \sum_{i=1}^{n} \pi_{22} \Delta FUTURES_{t-i} + \sum_{i=1}^{n} \pi_{21} \Delta LNGDP_{t-i} + v_t \quad (3.18)$$

where Δ is the change operator and u, and v are the error terms.

In the first regression, Granger-causality test shows us how much of the current economic growth can be explained by past values of futures market development and then to see whether adding lagged values of futures market development can improve the explanation. Change in LNGDP is said to be Granger-caused by change in FUTURES if change in FUTURES helps in the prediction of change in LNGDP, or equivalently if the coefficients on the lagged change in FUTURES's are statistically significant. However, the statement that change in FUTURES Granger causes change in LNGDP does not imply that change in LNGDP is the effect or the result of change in FUTURES. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term.

The lag length shows the reasonable longest time over which one of the variables could help predict the other. For the right-hand side of the above equations, lags between 1 and 10 are tried and the lags that yielded the smallest Akaike Information Criteria (AIC) are chosen[3]. In the above Granger-causality regressions, if π_{12} parameters are jointly zero, it is indicated that change in FUTURES does not Granger cause change in LNGDP; whereas, if π_{21} parameters are jointly zero, it is indicated that change in LNGDP does not Granger cause change in FUTURES. The null hypotheses are: change in FUTURES does not Granger cause change in LNGDP in the first regression, and change in LNGDP does not Granger cause change in FUTURES in the second regression. If none of the null hypotheses are rejected, it can be concluded that economic growth and futures market development are Granger-independent. If both are rejected, it implies a Granger-feedback between economic growth and futures market development.

Table 3.8 presents the results of Granger-causality tests. It is observed that in Brazil, France, Japan and Portugal the change in FUTURES Granger causes the change in LNGDP (ΔFUTURES $\Rightarrow$ ΔLNGDP) with 5 percent significance levels. Brazil, France, Japan and Portugal are the countries that have medium-sized annual values of futures contracts relative to their GDPs. However, we do not observe a significant impact of futures market development on economic

[3]The Schwarz Criterion (SC) is also used in conjunction with AIC for the sake of confirmation. No contradiction is observed between AIC and SC; both point to the same lag choices.

Table 3.8: Granger-causality tests

Country	Variable and Direction	Probability	Lag
Australia	ΔFUTURES ⇒ ΔLNGDP	0.60	4
	ΔLNGDP ⇒ ΔFUTURES	0.76	4
Austria	ΔFUTURES ⇒ ΔLNGDP	0.49	8
	ΔLNGDP ⇒ ΔFUTURES	0.29	8
Belgium	ΔFUTURES ⇒ ΔLNGDP	0.11	10
	ΔLNGDP ⇒ ΔFUTURES	0.33	10
Brazil	ΔFUTURES ⇒ ΔLNGDP	0.02**	8
	ΔLNGDP ⇒ ΔFUTURES	0.39	8
Canada	ΔFUTURES ⇒ ΔLNGDP	0.71	9
	ΔLNGDP ⇒ ΔFUTURES	0.76	9
Denmark	ΔFUTURES ⇒ ΔLNGDP	0.33	7
	ΔLNGDP ⇒ ΔFUTURES	0.83	7
France	ΔFUTURES ⇒ ΔLNGDP	0.02**	3
	ΔLNGDP ⇒ ΔFUTURES	0.16	3
Germany	ΔFUTURES ⇒ ΔLNGDP	0.55	9
	ΔLNGDP ⇒ ΔFUTURES	0.47	9
Hong Kong	ΔFUTURES ⇒ ΔLNGDP	0.82	1
	ΔLNGDP ⇒ ΔFUTURES	0.02**	1
Hungary	ΔFUTURES ⇒ ΔLNGDP	0.52	10
	ΔLNGDP ⇒ ΔFUTURES	0.28	10
Italy	ΔFUTURES ⇒ ΔLNGDP	0.70	10
	ΔLNGDP ⇒ ΔFUTURES	0.12	10
Japan	ΔFUTURES ⇒ ΔLNGDP	0.05**	8
	ΔLNGDP ⇒ ΔFUTURES	0.67	8
Netherlands	ΔFUTURES ⇒ ΔLNGDP	0.52	1
	ΔLNGDP ⇒ ΔFUTURES	0.08*	1
New Zealand	ΔFUTURES ⇒ ΔLNGDP	0.49	4
	ΔLNGDP ⇒ ΔFUTURES	0.59	4
Norway	ΔFUTURES ⇒ ΔLNGDP	0.64	1
	ΔLNGDP ⇒ ΔFUTURES	0.02**	1
Portugal	ΔFUTURES ⇒ ΔLNGDP	0.03**	8
	ΔLNGDP ⇒ ΔFUTURES	0.02**	8
South Africa	ΔFUTURES ⇒ ΔLNGDP	0.60	1
	ΔLNGDP ⇒ ΔFUTURES	0.77	1
Spain	ΔFUTURES ⇒ ΔLNGDP	0.39	2
	ΔLNGDP ⇒ ΔFUTURES	0.88	2
Sweden	ΔFUTURES ⇒ ΔLNGDP	0.57	3
	ΔLNGDP ⇒ ΔFUTURES	0.59	3
Switzerland	ΔFUTURES ⇒ ΔLNGDP	0.95	1
	ΔLNGDP ⇒ ΔFUTURES	0.12	1
United Kingdom	ΔFUTURES ⇒ ΔLNGDP	0.34	9
	ΔLNGDP ⇒ ΔFUTURES	0.16	9
United States	ΔFUTURES ⇒ ΔLNGDP	0.60	3
	ΔLNGDP ⇒ ΔFUTURES	0.62	3

Data : First differenced quarterly data.
Lags : 1-10 lags are tried, lag minimizing AIC is chosen.
First Diff. (Δ) : First difference operator or the change in the variable.
Null hypothesis : i) change in FUTURES does not Granger-cause change in LNGDP,
ii) change in LNGDP does not Granger-cause change in FUTURES.
*, **, and *** stand for the significance at 10%, 5%, and 1% level, respectively.

growth for countries that have large futures markets relative to their GDPs or for countries that have small futures markets relative to their GDPs.

The reverse causality is observed in Hong Kong, the Netherlands, Norway and Portugal; that is, the change in LNGDP Granger causes the change in FUTURES (ΔLNGDP $\Rightarrow$ ΔFUTURES). There is bi-directional Granger-causality between the futures market development and economic growth in Portugal.

3.5.2.4 Vector Error Correction Models

The existence of cointegration between FUTURES and LNGDP suggests the usage of VECM. A cointegration in variables indicates long-run stationarity but gives no information about the speed of adjustments of the variables to deviations from their common stochastic trend. To see the speed of adjustments of the variables to deviations from their common stochastic trend, the ECM should be used. Here, ECM should be used to correct the deviation from the long-run equilibrium, by short-run adjustments. As Engle and Granger (1987) show, in the presence of cointegration, there will be a corresponding error-correction representation.

The VECM is constructed by adding an adjustment parameter to the cointegration equation. Consequently, short-run adjustments correct deviations from the long-run equilibrium. VECM will be used in the calculation of variance decomposition and impulse-response function among FUTURES and GDP.

The following VECM is constructed. The fourth component of each equation is the error correction term (ECT) that is formed with the cointegrating vector. The sign and the size of the coefficient of the ECT in each equation reflect the direction and speed of adjustments of the dependent variable to deviations from the linear long-run relationship. The VECM has the following form:

$$\begin{aligned} \Delta FUTURES_t = d_1 + a_{11}(L)\Delta FUTURES_{t-1} + a_{12}(L)\Delta LNGDP_{t-1} \\ + g_1(FUTURES_{t-1} + b_{12}LNGDP_{t-1} + c_0) + \varepsilon_{1t} \end{aligned} \tag{3.19}$$

$$\begin{aligned} \Delta LNGDP_t = d_2 + a_{21}(L)\Delta FUTURES_{t-1} + a_{22}(L)\Delta LNGDP_{t-1} \\ + g_2(FUTURES_{t-1} + b_{12}LNGDP_{t-1} + c_0) + \varepsilon_{2t} \end{aligned} \tag{3.20}$$

where Δ is the change operator; d_1, d_2 and c_0 are constants; L is the lag operator $[a_{11}(L) : a_{11.0}L^0 + a_{11.1}L^1 + \ldots$ (a polynomial in L)]; g_1 and g_2 are the adjustment parameters; and b_{12} is the cointegration coefficient.

VECM corrects the deviation from the long-run equilibrium by short-run adjustments. The estimates of speed of adjustment, g_1 and g_2, should be different from zero, otherwise the cointegration finding would not be reliable. The cointegration equations and adjustment parameters for each country are given in Table A.2 in the Appendix. For both FUTURES and LNGDP, there is inter-country variation in the speed of adjustments. In some countries speed of adjustment to equilibrium is fast, whereas in the others we observe slow adjustments. However, the results show that the cointegration findings are reliable for all countries.

VECM are needed in the calculation of the variance decomposition and impulse-response function between FUTURES and LNGDP series. While 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, the impulse-response function traces the effect of a one-time shock to one of the endogenous variables on current and future values of itself and the other endogenous variable. One standard deviation of one variable's innovation may affect the other variable negatively, positively, or both, throughout the period.

3.5.2.5 Variance Decomposition and Impulse-Response Function

Variance decomposition analysis and impulse-response function analysis are performed to see the relationship between futures market development and economic growth. They are used to find evidence that the futures markets development affects the economic growth, the economic growth affects the futures markets development, or both. VECM is used in calculating the variance decomposition and impulse-response function among FUTURES and LNGDP. 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. Thus, it provides information about the relative importance of the effect of each random innovation on the variables.

An impulse-response function traces the effect of a one-time shock to an endogenous variable on current and future values of itself and of the other endogenous variables. One standard deviation of a variable's innovation may affect the other variable negatively, positively, or both, during the period. Impulse-response function analysis shows the response of an endogenous variable i at time $t+s$ to the changes in errors of the other variable j at time t. More specifically,

$$\psi_s = \frac{\partial y_{i,t+s}}{\partial \varepsilon_{jt}} \tag{3.21}$$

where y is the vector of endogenous variables, and ε is the vector of the error term.

Table A.3 in the Appendix shows the variance decompositions of FUTURES and LNGDP for 22 countries. To illustrate the interpretation of Table A.3, for Belgium, FUTURES innovations cause 100% of the variation in its forecast error in the first period, while LNGDP innovations cause zero percent of the same variation. In the variance decomposition of LNGDP, LNGDP innovations cause 81.26% of the variation in their forecast error in the first period, while FUTURES innovations cause 18.74% percent of the same variation. Looking at the whole 10 periods, FUTURES innovation yields much greater variation in LNGDP forecast error (18.74% – 30.65%) relative to the variation that LNGDP innovation yields in FUTURES (0% – 2.21%). In other words, FUTURES plays a much more important role in explaining the variation in LNGDP. The other countries in which the variance-decomposition analysis results support the view that futures markets affect the economy are: Brazil, France, Hungary, Italy and Portugal. FUTURES innovation yields high variation in LNGDP forecast error for Brazil (19.12% – 44.70%), France (44.17% – 75.67%), Hungary (38.50% – 63.56%), Italy (32.21% – 42.35%) and Portugal (18.61% – 32.67%). The reverse relationship, that is, the economic growth affecting the futures markets, holds with a lag in Hong Kong, Portugal and the United Kingdom.

Estimates of the impulse-response function analysis are shown in Table A.4 in the Appendix. It is observed that, in general, one standard deviation FUTURES innovation affects LNGDP in the long term.

The above variance decomposition and impulse-response function analyses are factorized by Cholesky Decomposition and ordering for Cholesky is FUTURES to LNGDP. If the residuals of FUTURES and LNGDP are uncorrelated, i.e., less than 0.2, the ordering does not affect the results. However if the correlation coefficients of the residuals are greater than 0.2, ordering is important. After checking for the residual correlation matrices, it is seen that for Australia, Austria, Belgium, France, Hungary, Italy, New Zealand and Portugal the residuals of FUTURES and LNGDP are correlated, i.e., correlation coefficients are greater than 0.2. This makes the ordering important for these countries. Therefore for these eight countries the variance decomposition and impulse-response function analyses are repeated for the reverse Cholesky ordering, i.e., LNGDP to FUTURES. The results are given in Table A.5 in the Appendix for variance decomposition analysis for reverse Cholesky ordering. It is seen that, FUTURES innovation yields high variation in LNGDP forecast error for France (18.32% – 25.75%), Hungary (14.42% – 27.14%), New Zealand (19.77% – 29.05%) and Portugal (17.10% – 32.94%) with one period lag. To summarize, taking Cholesky ordering into consideration, variance decomposition analyses results support the role of futures market development in economic growth in Brazil, France, Hungary and Portugal, which are the countries with medium-sized futures markets.

The results are given in Table A.6 in the Appendix for the impulse-response function analysis for reverse Cholesky ordering. Again it is observed that, in general, one standard deviation FUTURES innovation affects LNGDP in the long term.

3.6 SUMMARY OF RESULTS

In this essay, the role of futures markets in economic growth is investigated using dynamic panel and time-series techniques. Dynamic panel study results give evidence of a statistically significant positive relationship between futures market development and economic growth. Because the dynamic panel estimator controls for the potential endogeneity of all explanatory variables and unobserved country specific effects, results are not due to such possible biases. Panel study results are consistent with models that predict that well-functioning financial markets provide opportunities for firms to have more efficient and greater risk sharing along with amelioration of information and transaction costs and thereby promote economic growth.

Moreover, it is appealing to know if futures market development over time, within a country has an effect on economic growth. Time-series properties of the relationship between futures market development and economic growth yield mixed results. Granger-causality test results show that in Brazil, France, Japan and Portugal, futures market development Granger-causes economic growth. Variance decomposition analyses results also support the existence of a relationship between futures market development and economic growth in Brazil, France, Hungary and Portugal. In general, these are the countries that have medium-sized futures markets relative to their GDPs in the data set. However, notably, a significant impact of futures market development on economic growth is not observed for countries like Australia, Germany, Hong Kong, the Netherlands, Sweden, Switzerland, the United Kingdom and the United States that have large values of futures market contracts relative to their GDPs, or for countries like Austria, Belgium, Canada, Italy, New Zealand and Spain that have small values of futures market contracts relative to their GDPs. The results of the impulse-response function analyses suggest that one-time shock to futures markets affects GDP in the long term.

To summarize, panel data estimations suggest that futures market development has a significant impact on economic growth whereas time-series estimations in general indicate that this relationship is more robust for the countries that have medium-sized futures markets relative to their real economies.

CHAPTER 4

CONCLUSION

The interdependence of financial markets and economic growth is being investigated by several researchers. However, researchers have not yet reached a consensus on the role of financial development in economic growth or on the role of economic growth in financial market development.

In the first essay, the relationship between banking sector development and economic growth, and the relationship between stock market development and economic growth are analyzed via dynamic panel data techniques, which has many advantages over cross-country and time-series approaches. Moreover, the stationarity and cointegration properties of the panel data are examined and the existence of a long-run relationship between banking sector development and growth, and between stock market development and growth are shown using panel cointegration analyses.

In the existing empirical literature a possible model misspecification problem is observed. Economic growth is mostly assumed to be the dependent variable and therefore causality is expected to run from the financial development to economic growth. In this essay, the possibility of reverse causality running from economic growth to financial development, i.e., demand-following view, is also taken into consideration.

The first essay also shows the differences between developed and emerging markets in terms of a finance-growth relationship. Results provide evidence of a statistically significant and positive interdependence both between banking sector development and economic growth and between stock market development and economic growth, in emerging markets. However, the situation is different in developed markets. The dynamic panel estimation results show that in developed markets, although economic growth positively affects the financial market development, the banking sector development and stock market development have no significant effects on economic growth, supporting the demand-following view. To sommarize, this essay contributes to the existing literature by using GMM dynamic panel estimators, considering the stationarity and cointegration properties of the data, and by showing the differences between emerging markets and developed markets in terms of both the banking sector development and economic growth, and stock market development and economic growth relationships for a large sample of countries.

In the second essay, the role of futures markets in economic growth is investigated using dynamic panel and time-series techniques. This study is the first to investigate the relationship between futures markets and economic growth. Dynamic panel study results give evidence of a statistically significant positive relationship between futures market development and economic growth. The results are consistent with models that predict that well-functioning financial markets provide opportunities for firms to have more efficient and greater risk sharing and to ameliorate information and transaction costs, thereby, promoting economic growth. The dynamic panel estimator controls for the potential endogeneity of all explanatory variables and unobserved country-specific effects, thus, the results are not due to such possible biases.

Moreover, it is appealing to know that over time, within a country, futures market development has an effect on economic growth. Time-series properties of the relationship between futures market development and economic growth yield mixed results. Time-series estimations indicate that this relationship is more robust for countries that have medium-sized values of futures market contracts relative to their GDPs. It is concluded that reducing financial risks through futures markets increases economic growth mostly in countries with developing futures markets.

In light of the above conclusions, the role of derivatives markets in investment could be tested as future research. It can be expected that reducing financial risks through derivatives markets enables borrowers to achieve greater access to capital, which, in turn, increases investment volume.

The growth effects of derivatives markets development on firms with different sizes and ownership structures may be a motivating research topic. Financial markets tend to promote economic growth through improving investments by firms. Beck et al. (2005) suggest that developed financial systems tend to boost the growth of small-firm industries more than large-firm industries. It would be interesting to find out if firms with different sizes and ownership structures are affected differently by derivatives markets development.

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APPENDIX A

TABLES

Table A.1: Unit root tests

Country		FUTURES			LNGDP		
		Statistic	Critical Value (5%)	Lag	Statistic	Critical Value (5%)	Lag
Australia	Level						
	ADF	1.92	-3.83	7	-2.42	-3.73	3
	PP	-2.16	-3.66	7	-2.76	-3.67	1
	First Diff. (Δ)						
	ADF	0.01	-3.79	5	-1.76	-3.93	7
	PP	-3.39	-3.67	0	-6.43	-3.69	5
Austria	Level						
	ADF	-1.76	-3.52	7	-1.22	-3.51	1
	PP	-2.02	-3.50	4	-1.09	-3.50	4
	First Diff. (Δ)						
	ADF	-1.77	-3.52	6	-8.17	-3.51	0
	PP	-7.66	-3.50	4	-8.74	-3.51	7
Belgium	Level						
	ADF	-3.39	-3.53	7	-1.44	-3.51	0
	PP	-1.40	-3.51	3	-1.47	-3.51	2
	First Diff. (Δ)						
	ADF	-1.67	-3.52	3	-7.11	-3.52	0
	PP	-7.53	-3.51	3	-7.11	-3.52	1
Brazil	Level						
	ADF	-1.98	-3.53	8	-1.87	-3.50	3
	PP	-2.84	-3.51	1	-7.51	-3.49	12
	First Diff. (Δ)						
	ADF	-3.45	-3.53	7	-16.38	-3.50	2
	PP	-7.41	-3.51	7	-23.82	-3.50	12

Table A.1: (cont'd)

Country		FUTURES Statistic	FUTURES Critical Value (5%)	FUTURES Lag	LNGDP Statistic	LNGDP Critical Value (5%)	LNGDP Lag
Canada	Level						
	ADF	-0.28	-3.61	10	-1.55	-3.55	1
	PP	-1.80	-3.55	1	-1.07	-3.54	3
	First Diff. (Δ)						
	ADF	-2.96	-3.61	9	-3.14	-3.55	0
	PP	-2.98	-3.55	1	-3.16	-3.55	2
Denmark	Level						
	ADF	-2.55	-3.50	0	-1.09	-3.51	3
	PP	-2.61	-3.50	4	-1.68	-3.50	4
	First Diff. (Δ)						
	ADF	-6.57	-3.50	1	-6.41	-3.51	2
	PP	-8.72	-3.50	3	-18.65	-3.50	23
France	Level						
	ADF	-1.03	-3.71	8	-0.21	-3.79	9
	PP	-2.37	-3.60	1	-10.35	-3.62	12
	First Diff. (Δ)						
	ADF	-1.00	-3.76	9	-0.45	-3.83	9
	PP	-4.49	-3.61	0	-20.57	-3.63	11
Germany	Level						
	ADF	-2.23	-3.50	6	-2.10	-3.49	0
	PP	-3.22	-3.49	3	-2.23	-3.49	1
	First Diff. (Δ)						
	ADF	-4.69	-3.50	4	-6.93	-3.49	0
	PP	-11.19	-3.49	11	-6.93	-3.49	0
Hong Kong	Level						
	ADF	-2.05	-3.48	0	-2.38	-3.48	1
	PP	-2.16	-3.48	3	-2.20	-3.48	3
	First Diff. (Δ)						
	ADF	-8.42	-3.48	0	-6.22	-3.48	0
	PP	-8.42	-3.48	2	-6.25	-3.48	1
Hungary	Level						
	ADF	-4.08	-3.56	10	-1.78	-3.54	4
	PP	-1.96	-3.52	1	-3.57	-3.53	1
	First Diff. (Δ)						
	ADF	-1.59	-3.55	7	-3.90	-3.54	3
	PP	-6.69	-3.53	2	-12.52	-3.53	38
Italy	Level						
	ADF	-0.81	-3.54	2	-0.91	-3.53	0
	PP	-1.10	-3.53	3	-0.98	-3.53	2
	First Diff. (Δ)						
	ADF	-7.15	-3.54	1	-6.10	-3.53	0
	PP	-6.81	-3.54	7	-6.10	-3.53	1
Japan	Level						
	ADF	-2.80	-3.49	6	-3.21	-3.49	6
	PP	-3.17	-3.48	5	-3.26	-3.48	4
	First Diff. (Δ)						
	ADF	-2.79	-3.49	7	-7.69	-3.48	0
	PP	-8.62	-3.48	4	-7.74	-3.48	4

Table A.1: (cont'd)

Country		FUTURES			LNGDP		
		Statistic	Critical Value (5%)	Lag	Statistic	Critical Value (5%)	Lag
Netherlands	Level						
	ADF	-3.18	-3.49	5	-2.36	-3.49	7
	PP	-1.88	-3.48	5	-0.36	-3.48	5
	First Diff. (Δ)						
	ADF	-2.44	-3.48	2	-2.50	-3.49	2
	PP	-7.83	-3.48	5	-5.07	-3.48	4
New Zealand	Level						
	ADF	-2.32	-3.59	1	-1.47	-3.64	10
	PP	-1.71	-3.57	8	-2.40	-3.56	1
	First Diff. (Δ)						
	ADF	-1.65	-3.67	7	-2.82	-3.66	10
	PP	-12.00	-3.59	26	-8.57	-3.57	8
Norway	Level						
	ADF	-3.58	-3.50	0	-1.59	-3.51	1
	PP	-3.54	-3.50	2	-2.05	-3.51	1
	First Diff. (Δ)						
	ADF	-6.14	-3.51	2	-5.53	-3.52	3
	PP	-20.85	-3.50	49	-25.62	-3.51	16
Portugal	Level						
	ADF	-1.49	-3.59	9	-0.59	-3.56	1
	PP	-2.39	-3.54	1	-0.91	-3.55	7
	First Diff. (Δ)						
	ADF	-7.46	-3.60	9	-6.82	-3.56	0
	PP	-4.40	-3.54	2	-6.91	-3.56	5
South Africa	Level						
	ADF	-4.90	-3.49	0	-3.85	-3.49	1
	PP	-4.92	-3.49	1	-3.03	-3.49	2
	First Diff. (Δ)						
	ADF	-5.20	-3.50	6	-3.82	-3.50	2
	PP	-17.45	-3.49	17	-3.36	-3.49	5
Spain	Level						
	ADF	-3.20	-3.50	0	-2.08	-3.51	4
	PP	-3.14	-3.50	1	-8.45	-3.50	0
	First Diff. (Δ)						
	ADF	-3.97	-3.51	4	-4.55	-3.51	3
	PP	-8.52	-3.50	0	-26.07	-3.50	15
Sweden	Level						
	ADF	-1.80	-3.49	3	-3.26	-3.49	4
	PP	-1.86	-3.49	5	-2.84	-3.49	9
	First Diff. (Δ)						
	ADF	-2.18	-3.49	2	-2.49	-3.49	3
	PP	-9.70	-3.49	5	-9.41	-3.49	7
Switzerland	Level						
	ADF	-2.61	-3.49	0	-2.08	-3.49	1
	PP	-2.69	-3.49	1	-2.40	-3.49	2
	First Diff. (Δ)						
	ADF	-7.52	-3.49	0	-5.64	-3.49	0
	PP	-7.54	-3.49	3	-5.69	-3.49	1

Table A.1: (cont'd)

Country		FUTURES			LNGDP		
		Statistic	Critical Value (5%)	Lag	Statistic	Critical Value (5%)	Lag
United Kingdom	Level						
	ADF	-1.62	-3.47	9	-1.65	-3.47	7
	PP	-2.92	-3.46	7	-6.42	-3.47	9
	First Diff. (Δ)						
	ADF	-3.63	-3.47	8	-2.51	-3.47	6
	PP	-17.16	-3.46	14	-12.85	-3.47	13
United States	Level						
	ADF	-1.23	-3.46	0	-3.23	-3.47	9
	PP	-1.24	-3.46	2	-2.81	-3.46	5
	First Diff. (Δ)						
	ADF	-9.55	-3.46	0	-3.33	-3.47	10
	PP	-9.55	-3.46	1	-6.65	-3.46	3

Data : Quarterly data are used.
FUTURES : Value of futures contracts divided by GDP.
LNGDP : Logarithm of real GDP (seasonalized).
ADF : Augmented Dickey-Fuller Test (H_0: There is unit root).
PP : Phillips-Perron Test (H_0: There is unit root).
First Diff. (Δ) : First difference operator or the change in the variable.
If test statistic $>$ critical value, then H_0 is rejected.

Table A.2: VECM regression results

Country	Cointegration Equation		Adjustment Parameter	
Australia	FUTURES(-1)	1.000	ΔFUTURES	0.362
	LNGDP(-1)	0.254	ΔLNGDP	-0.202
	Constant	-7.041		
Austria	FUTURES(-1)	1.000	ΔFUTURES	-0.024
	LNGDP(-1)	0.129	ΔLNGDP	-0.780
	Constant	-3.532		
Belgium	FUTURES(-1)	1.000	ΔFUTURES	-0.054
	LNGDP(-1)	-0.004	ΔLNGDP	4.678
	Constant	0.110		
Brazil	FUTURES(-1)	1.000	ΔFUTURES	-0.716
	LNGDP(-1)	0.642	ΔLNGDP	0.460
	Constant	-16.726		
Canada	FUTURES(-1)	1.000	ΔFUTURES	-1.093
	LNGDP(-1)	-0.074	ΔLNGDP	1.801
	Constant	2.014		
Denmark	FUTURES(-1)	1.000	ΔFUTURES	-0.022
	LNGDP(-1)	12.691	ΔLNGDP	-0.008
	Constant	-335.796		
France	FUTURES(-1)	1.000	ΔFUTURES	-0.282
	LNGDP(-1)	0.729	ΔLNGDP	-0.644
	Constant	-20.902		
Germany	FUTURES(-1)	1.000	ΔFUTURES	-0.427
	LNGDP(-1)	-3.199	ΔLNGDP	0.032
	Constant	87.824		
Hong Kong	FUTURES(-1)	1.000	ΔFUTURES	-0.166
	LNGDP(-1)	-6.788	ΔLNGDP	-0.002
	Constant	177.167		
Hungary	FUTURES(-1)	1.000	ΔFUTURES	-1.950
	LNGDP(-1)	0.298	ΔLNGDP	0.263
	Constant	-8.642		
Italy	FUTURES(-1)	1.000	ΔFUTURES	-0.347
	LNGDP(-1)	0.004	ΔLNGDP	-6.228
	Constant	-0.128		
Japan	FUTURES(-1)	1.000	ΔFUTURES	-0.197
	LNGDP(-1)	0.178	ΔLNGDP	0.026
	Constant	-6.090		
Netherlands	FUTURES(-1)	1.000	ΔFUTURES	-0.106
	LNGDP(-1)	-1.612	ΔLNGDP	0.020
	Constant	41.705		
New Zealand	FUTURES(-1)	1.000	ΔFUTURES	-1.270
	LNGDP(-1)	0.003	ΔLNGDP	-54.787
	Constant	-0.069		
Norway	FUTURES(-1)	1.000	ΔFUTURES	-0.418
	LNGDP(-1)	-0.104	ΔLNGDP	-0.295
	Constant	2.735		
Portugal	FUTURES(-1)	1.000	ΔFUTURES	-0.028
	LNGDP(-1)	1.615	ΔLNGDP	-0.212
	Constant	-47.480		
South Africa	FUTURES(-1)	1.000	ΔFUTURES	-0.529
	LNGDP(-1)	-0.454	ΔLNGDP	0.042
	Constant	12.388		

Table A.2: (cont'd)

Country	Cointegration Equation		Adjustment Parameter	
Spain	FUTURES(-1)	1.000	ΔFUTURES	-0.507
	LNGDP(-1)	0.032	ΔLNGDP	0.818
	Constant	-0.994		
Sweden	FUTURES(-1)	1.000	ΔFUTURES	-0.242
	LNGDP(-1)	-1.407	ΔLNGDP	-0.003
	Constant	37.693		
Switzerland	FUTURES(-1)	1.000	ΔFUTURES	-0.226
	LNGDP(-1)	-6.941	ΔLNGDP	0.010
	Constant	175.208		
United Kingdom	FUTURES(-1)	1.000	ΔFUTURES	-0.226
	LNGDP(-1)	-2.246	ΔLNGDP	0.001
	Constant	58.245		
United States	FUTURES(-1)	1.000	ΔFUTURES	-0.063
	LNGDP(-1)	-0.146	ΔLNGDP	-0.003
	Constant	4.229		

VECM is constructed by adding an adjustment parameter to the cointegration equation, consequently short-run adjustments correct deviations from the long-run equilibrium. Two important results of the VECM regression are the coefficients of cointegration equations and adjustment parameters.

First Diff. (Δ) : First difference operator or the change in the variable.

Table A.3: Variance decomposition

Country	Period	FUTURES			LNGDP		
		S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Australia	1	0.00	100.00	0.00	0.00	4.50	95.50
	2	0.01	98.57	1.43	0.01	3.13	96.87
	3	0.01	98.85	1.15	0.01	3.49	96.51
	4	0.01	96.48	3.52	0.01	6.60	93.40
	5	0.01	91.10	8.90	0.01	7.96	92.04
	6	0.02	92.20	7.80	0.01	14.65	85.35
	7	0.02	94.10	5.90	0.01	18.78	81.22
	8	0.02	95.43	4.57	0.01	19.98	80.02
	9	0.03	96.43	3.57	0.01	27.33	72.67
	10	0.04	96.49	3.51	0.01	37.71	62.29
Austria	1	0.00	100.00	0.00	0.01	8.06	91.94
	2	0.00	99.83	0.17	0.01	6.55	93.45
	3	0.00	96.53	3.47	0.01	5.00	95.00
	4	0.00	87.59	12.41	0.01	4.84	95.16
	5	0.00	76.82	23.18	0.01	4.56	95.44
	6	0.00	70.47	29.53	0.01	5.01	94.99
	7	0.00	61.21	38.79	0.02	4.95	95.05
	8	0.00	58.35	41.65	0.02	4.86	95.14
	9	0.00	60.17	39.83	0.02	4.88	95.12
	10	0.00	61.00	39.00	0.02	4.93	95.07
Belgium	1	0.00	100.00	0.00	0.01	18.74	81.26
	2	0.00	98.77	1.23	0.02	11.07	88.93
	3	0.00	98.49	1.51	0.02	10.56	89.44
	4	0.00	98.36	1.64	0.02	12.16	87.84
	5	0.00	98.23	1.77	0.03	14.52	85.48
	6	0.00	98.13	1.87	0.03	17.44	82.56
	7	0.00	98.04	1.96	0.03	20.66	79.34
	8	0.00	97.95	2.05	0.03	24.00	76.00
	9	0.00	97.87	2.13	0.04	27.36	72.64
	10	0.00	97.79	2.21	0.04	30.65	69.35
Brazil	1	0.02	100.00	0.00	0.02	19.12	80.88
	2	0.03	100.00	0.00	0.03	18.82	81.18
	3	0.04	92.78	7.22	0.03	26.07	73.93
	4	0.04	86.06	13.94	0.03	44.91	55.09
	5	0.04	81.50	18.50	0.03	42.58	57.42
	6	0.04	80.76	19.24	0.04	47.30	52.70
	7	0.04	83.04	16.96	0.04	46.96	53.04
	8	0.05	85.95	14.05	0.04	48.20	51.80
	9	0.05	85.94	14.06	0.04	41.39	58.61
	10	0.05	85.28	14.72	0.05	44.70	55.30

Table A.3: (cont'd)

Country	Period	FUTURES			LNGDP		
		S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Canada	1	0.00	100.00	0.00	0.00	3.90	96.10
	2	0.00	92.57	7.43	0.01	12.89	87.11
	3	0.00	95.67	4.33	0.01	10.67	89.33
	4	0.00	97.13	2.87	0.01	13.93	86.07
	5	0.00	72.67	27.33	0.01	11.90	88.10
	6	0.00	65.40	34.60	0.01	14.18	85.82
	7	0.00	47.31	52.69	0.01	14.47	85.53
	8	0.00	39.89	60.11	0.01	14.91	85.09
	9	0.00	27.09	72.91	0.01	14.77	85.23
	10	0.00	24.13	75.87	0.01	13.86	86.14
Denmark	1	0.05	100.00	0.00	0.01	3.43	96.57
	2	0.06	97.83	2.17	0.01	4.05	95.95
	3	0.07	96.70	3.30	0.01	7.45	92.55
	4	0.08	92.00	8.00	0.01	7.90	92.10
	5	0.09	91.57	8.43	0.01	8.75	91.25
	6	0.10	90.86	9.14	0.01	10.34	89.66
	7	0.11	90.27	9.73	0.01	29.22	70.78
	8	0.12	90.01	9.99	0.01	38.63	61.37
	9	0.13	90.16	9.84	0.01	36.86	63.14
	10	0.13	89.74	10.26	0.01	38.52	61.48
France	1	0.01	100.00	0.00	0.00	44.17	55.83
	2	0.01	99.88	0.12	0.01	40.11	59.89
	3	0.01	99.87	0.13	0.01	43.80	56.20
	4	0.01	99.20	0.80	0.01	46.74	53.26
	5	0.01	99.15	0.85	0.01	66.66	33.34
	6	0.01	98.95	1.05	0.01	70.84	29.16
	7	0.01	98.76	1.24	0.01	70.18	29.82
	8	0.01	97.87	2.13	0.01	66.92	33.08
	9	0.01	96.70	3.30	0.01	76.41	23.59
	10	0.01	96.36	3.64	0.01	75.67	24.33
Germany	1	0.13	100.00	0.00	0.00	0.01	99.99
	2	0.19	95.54	4.46	0.01	10.54	89.46
	3	0.21	90.19	9.81	0.01	10.00	90.00
	4	0.22	89.31	10.69	0.01	9.33	90.67
	5	0.24	88.80	11.20	0.01	8.89	91.11
	6	0.25	89.11	10.89	0.01	8.96	91.04
	7	0.25	89.38	10.62	0.01	12.49	87.51
	8	0.25	89.56	10.44	0.01	22.88	77.12
	9	0.26	88.08	11.92	0.01	31.42	68.58
	10	0.26	88.17	11.83	0.01	39.69	60.31

Table A.3: (cont'd)

Country	Period	FUTURES			LNGDP		
		S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Hong Kong	1	0.33	100.00	0.00	0.02	0.95	99.05
	2	0.45	95.35	4.65	0.03	0.60	99.40
	3	0.52	91.11	8.89	0.03	0.41	99.59
	4	0.57	87.48	12.52	0.04	0.29	99.71
	5	0.61	84.20	15.80	0.04	0.23	99.77
	6	0.63	81.12	18.88	0.05	0.20	99.80
	7	0.66	78.17	21.83	0.05	0.19	99.81
	8	0.68	75.34	24.66	0.06	0.20	99.80
	9	0.70	72.63	27.37	0.06	0.22	99.78
	10	0.71	70.03	29.97	0.06	0.25	99.75
Hungary	1	0.02	100.00	0.00	0.01	38.50	61.50
	2	0.02	96.41	3.59	0.01	63.90	36.10
	3	0.03	87.80	12.20	0.01	65.34	34.66
	4	0.03	86.33	13.67	0.01	65.04	34.96
	5	0.03	87.32	12.68	0.01	51.08	48.92
	6	0.03	86.91	13.09	0.01	64.40	35.60
	7	0.03	78.14	21.86	0.01	66.08	33.92
	8	0.03	76.04	23.96	0.01	65.23	34.77
	9	0.03	70.61	29.39	0.02	57.53	42.47
	10	0.04	72.96	27.04	0.02	63.56	36.44
Italy	1	0.00	100.00	0.00	0.00	32.21	67.79
	2	0.00	99.60	0.40	0.01	37.84	62.16
	3	0.00	97.77	2.23	0.01	46.67	53.33
	4	0.00	97.77	2.23	0.01	48.82	51.18
	5	0.00	79.81	20.19	0.01	47.94	52.06
	6	0.00	76.64	23.36	0.01	46.21	53.79
	7	0.00	71.22	28.78	0.01	45.05	54.95
	8	0.00	70.65	29.35	0.01	43.82	56.18
	9	0.00	69.87	30.13	0.01	42.78	57.22
	10	0.00	58.92	41.08	0.01	42.35	57.65
Japan	1	0.01	100.00	0.00	0.01	1.65	98.35
	2	0.02	98.25	1.75	0.01	2.35	97.65
	3	0.02	97.82	2.18	0.01	5.14	94.86
	4	0.02	97.77	2.23	0.02	6.21	93.79
	5	0.02	97.52	2.48	0.02	7.38	92.62
	6	0.02	96.81	3.19	0.02	9.89	90.11
	7	0.02	95.39	4.61	0.02	11.58	88.42
	8	0.02	95.00	5.00	0.02	13.82	86.18
	9	0.02	94.75	5.25	0.02	14.93	85.07
	10	0.03	94.59	5.41	0.02	15.23	84.77

Table A.3: (cont'd)

Country	Period	FUTURES			LNGDP		
		S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Netherlands	1	0.03	100.00	0.00	0.00	1.94	98.06
	2	0.05	93.79	6.21	0.01	5.02	94.98
	3	0.06	89.85	10.15	0.01	8.51	91.49
	4	0.07	87.45	12.55	0.01	12.23	87.77
	5	0.08	85.87	14.13	0.01	15.98	84.02
	6	0.08	84.74	15.26	0.02	19.62	80.38
	7	0.09	83.87	16.13	0.02	23.06	76.94
	8	0.09	83.16	16.84	0.02	26.27	73.73
	9	0.10	82.57	17.43	0.02	29.24	70.76
	10	0.10	82.06	17.94	0.02	31.96	68.04
New Zealand	1	0.00	100.00	0.00	0.01	13.53	86.47
	2	0.00	99.99	0.01	0.01	9.39	90.61
	3	0.00	99.98	0.02	0.02	6.04	93.96
	4	0.00	99.81	0.19	0.02	10.13	89.87
	5	0.00	97.23	2.77	0.02	9.17	90.83
	6	0.00	95.08	4.92	0.02	8.76	91.24
	7	0.00	94.44	5.56	0.02	12.92	87.08
	8	0.00	93.29	6.71	0.02	12.59	87.41
	9	0.00	92.65	7.35	0.02	12.82	87.18
	10	0.00	91.97	8.03	0.02	12.41	87.59
Norway	1	0.01	100.00	0.00	0.02	0.53	99.47
	2	0.01	92.29	7.71	0.02	0.46	99.54
	3	0.01	92.31	7.69	0.02	0.69	99.31
	4	0.01	89.96	10.04	0.02	1.07	98.93
	5	0.01	89.14	10.86	0.03	1.60	98.40
	6	0.01	87.68	12.32	0.03	2.08	97.92
	7	0.01	86.70	13.30	0.03	2.53	97.47
	8	0.01	85.54	14.46	0.03	2.91	97.09
	9	0.01	84.56	15.44	0.03	3.24	96.76
	10	0.01	83.55	16.45	0.04	3.52	96.48
Portugal	1	0.00	100.00	0.00	0.01	18.61	81.39
	2	0.01	89.60	10.40	0.01	14.44	85.56
	3	0.01	81.81	18.19	0.01	12.40	87.60
	4	0.01	78.02	21.98	0.01	15.81	84.19
	5	0.01	77.12	22.88	0.01	15.92	84.08
	6	0.01	78.24	21.76	0.01	20.89	79.11
	7	0.01	78.29	21.71	0.01	26.32	73.68
	8	0.01	76.21	23.79	0.01	28.48	71.52
	9	0.01	75.64	24.36	0.01	29.48	70.52
	10	0.02	76.20	23.80	0.02	32.67	67.33

Table A.3: (cont'd)

Country	Period	FUTURES			LNGDP		
		S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
South Africa	1	0.03	100.00	0.00	0.00	3.22	96.78
	2	0.03	99.33	0.67	0.01	6.51	93.49
	3	0.03	97.75	2.25	0.01	10.22	89.78
	4	0.03	95.56	4.44	0.02	13.43	86.57
	5	0.03	93.06	6.94	0.02	15.99	84.01
	6	0.03	90.48	9.52	0.03	17.97	82.03
	7	0.03	87.93	12.07	0.03	19.48	80.52
	8	0.03	85.49	14.51	0.03	20.64	79.36
	9	0.03	83.18	16.82	0.04	21.55	78.45
	10	0.03	81.02	18.98	0.04	22.27	77.73
Spain	1	0.00	100.00	0.00	0.01	0.03	99.97
	2	0.00	99.66	0.34	0.01	1.55	98.45
	3	0.00	99.20	0.80	0.01	5.78	94.22
	4	0.00	99.26	0.74	0.01	6.12	93.88
	5	0.00	98.41	1.59	0.02	6.38	93.62
	6	0.00	98.36	1.64	0.02	6.52	93.48
	7	0.00	98.35	1.65	0.02	6.10	93.90
	8	0.00	98.24	1.76	0.02	6.89	93.11
	9	0.00	97.52	2.48	0.02	7.04	92.96
	10	0.00	97.39	2.61	0.02	7.48	92.52
Sweden	1	0.08	100.00	0.00	0.01	1.67	98.33
	2	0.09	97.25	2.75	0.02	5.03	94.97
	3	0.11	95.63	4.37	0.02	4.78	95.22
	4	0.14	95.17	4.83	0.02	4.28	95.72
	5	0.14	91.42	8.58	0.03	3.80	96.20
	6	0.15	88.88	11.12	0.03	3.55	96.45
	7	0.16	85.83	14.17	0.04	3.19	96.81
	8	0.17	82.54	17.46	0.04	2.88	97.12
	9	0.17	79.81	20.19	0.04	2.51	97.49
	10	0.17	76.88	23.12	0.05	2.29	97.71
Switzerland	1	0.14	100.00	0.00	0.00	0.59	99.41
	2	0.19	99.49	0.51	0.01	1.87	98.13
	3	0.21	99.49	0.51	0.01	7.69	92.31
	4	0.22	99.50	0.50	0.01	16.54	83.46
	5	0.23	99.14	0.86	0.01	25.51	74.49
	6	0.23	98.41	1.59	0.01	33.02	66.98
	7	0.24	97.45	2.55	0.02	38.79	61.21
	8	0.24	96.43	3.57	0.02	43.10	56.90
	9	0.25	95.44	4.56	0.02	46.33	53.67
	10	0.25	94.52	5.48	0.02	48.79	51.21

Table A.3: (cont'd)

Country	Period	FUTURES			LNGDP		
		S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
United Kingdom	1	0.06	100.00	0.00	0.01	0.03	99.97
	2	0.06	90.36	9.64	0.01	0.80	99.20
	3	0.07	85.52	14.48	0.02	0.88	99.12
	4	0.08	84.84	15.16	0.02	2.21	97.79
	5	0.09	82.92	17.08	0.02	1.27	98.73
	6	0.09	82.86	17.14	0.03	0.96	99.04
	7	0.10	81.74	18.26	0.03	0.82	99.18
	8	0.10	78.75	21.25	0.03	1.14	98.86
	9	0.11	75.39	24.61	0.04	0.89	99.11
	10	0.11	73.34	26.66	0.04	0.89	99.11
United States	1	0.02	100.00	0.00	0.00	1.81	98.19
	2	0.02	99.86	0.14	0.01	3.13	96.87
	3	0.03	99.86	0.14	0.01	4.33	95.67
	4	0.03	99.71	0.29	0.01	6.10	93.90
	5	0.04	99.41	0.59	0.02	7.16	92.84
	6	0.04	98.88	1.12	0.02	7.97	92.03
	7	0.04	98.35	1.65	0.02	8.37	91.63
	8	0.04	97.82	2.18	0.02	8.55	91.45
	9	0.05	97.35	2.65	0.03	8.54	91.46
	10	0.05	96.92	3.08	0.03	8.43	91.57

Variance decompositions of FUTURES and LNGDP are presented for 22 countries. 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.

FUTURES : Value of futures contracts divided by GDP.
LNGDP : Logarithm of real GDP (seasonalized).
S.E. : Forecast error.

Table A.4: Impulse-response function

Country	Period	FUTURES, $y_{1,t+s}$		LNGDP, $y_{2,t+s}$	
		ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Australia	1	0.005	0.000	-0.001	0.004
	2	0.004	-0.001	0.001	0.005
	3	0.005	0.000	-0.001	0.002
	4	0.006	-0.002	-0.001	0.001
	5	0.007	-0.003	-0.001	0.000
	6	0.009	-0.002	-0.002	0.001
	7	0.012	-0.002	-0.002	0.004
	8	0.014	-0.002	-0.002	0.004
	9	0.017	-0.002	-0.004	0.003
	10	0.022	-0.004	-0.005	0.002
Austria	1	0.000	0.000	0.003	0.009
	2	0.000	0.000	-0.001	0.007
	3	0.000	0.000	0.000	0.006
	4	0.000	0.000	-0.001	0.004
	5	0.000	0.000	0.000	0.004
	6	0.000	0.000	-0.001	0.003
	7	0.000	0.000	-0.001	0.003
	8	0.000	0.000	0.000	0.002
	9	0.000	0.000	0.000	0.001
	10	0.000	0.000	0.000	0.001
Belgium	1	0.000	0.000	0.005	0.011
	2	0.000	0.000	0.001	0.011
	3	0.000	0.000	0.003	0.010
	4	0.000	0.000	0.005	0.011
	5	0.000	0.000	0.006	0.011
	6	0.000	0.000	0.007	0.010
	7	0.000	0.000	0.008	0.010
	8	0.000	0.000	0.009	0.010
	9	0.000	0.000	0.010	0.010
	10	0.000	0.000	0.011	0.010
Brazil	1	0.022	0.000	-0.011	0.022
	2	0.021	0.000	0.004	-0.008
	3	0.019	-0.010	0.009	-0.005
	4	0.003	-0.011	0.016	0.002
	5	0.008	-0.010	0.000	0.008
	6	-0.006	-0.005	-0.013	-0.008
	7	-0.015	0.000	-0.001	-0.003
	8	-0.022	0.003	0.006	0.000
	9	-0.015	0.006	-0.011	0.020
	10	-0.012	0.007	-0.011	-0.003

Table A.4: (cont'd)

Country	Period	FUTURES, $y_{1,t+s}$		LNGDP, $y_{2,t+s}$	
		ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Canada	1	0.000	0.000	0.001	0.004
	2	0.000	0.000	0.003	0.006
	3	0.001	0.000	0.001	0.005
	4	-0.001	0.000	0.003	0.005
	5	0.001	-0.001	0.001	0.005
	6	-0.001	0.001	0.002	-0.001
	7	0.001	-0.001	-0.001	0.001
	8	-0.001	0.001	0.002	-0.003
	9	0.000	-0.002	0.000	0.001
	10	0.000	0.001	0.000	-0.003
Denmark	1	0.046	0.000	-0.002	0.008
	2	0.035	-0.009	-0.001	0.000
	3	0.031	-0.009	0.002	0.002
	4	0.044	-0.020	0.001	0.001
	5	0.040	-0.013	0.001	0.003
	6	0.035	-0.014	0.001	0.000
	7	0.046	-0.017	0.005	0.000
	8	0.046	-0.016	0.004	-0.001
	9	0.032	-0.010	0.000	0.002
	10	0.034	-0.014	0.002	-0.001
France	1	0.006	0.000	-0.003	0.004
	2	0.007	0.000	0.001	0.002
	3	0.004	0.000	0.002	-0.001
	4	0.002	0.001	0.002	-0.001
	5	0.000	0.000	-0.006	0.003
	6	-0.002	0.000	-0.005	0.002
	7	0.000	0.000	-0.001	-0.001
	8	0.000	-0.001	-0.002	-0.003
	9	0.002	-0.001	-0.008	0.002
	10	0.002	-0.001	-0.002	0.002
Germany	1	0.128	0.000	0.000	0.005
	2	0.128	0.039	0.002	0.003
	3	0.086	0.053	0.001	0.003
	4	0.063	0.030	0.000	0.002
	5	0.088	0.035	0.000	0.002
	6	0.042	0.003	0.001	0.002
	7	0.044	0.007	0.002	0.001
	8	0.045	-0.010	0.003	0.001
	9	0.044	0.037	0.003	0.001
	10	0.037	0.011	0.004	0.002

Table A.4: (cont'd)

Country	Period	FUTURES, $y_{1,t+s}$		LNGDP, $y_{2,t+s}$	
		ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Hong Kong	1	0.332	0.000	0.002	0.016
	2	0.282	0.096	0.001	0.020
	3	0.236	0.121	0.001	0.021
	4	0.195	0.129	0.000	0.021
	5	0.161	0.132	0.000	0.021
	6	0.133	0.134	-0.001	0.021
	7	0.108	0.136	-0.001	0.021
	8	0.088	0.137	-0.001	0.021
	9	0.071	0.138	-0.001	0.021
	10	0.057	0.139	-0.001	0.021
Hungary	1	0.023	0.000	0.004	0.005
	2	0.001	0.005	0.006	0.002
	3	0.006	0.008	0.002	0.000
	4	0.001	0.003	-0.001	0.001
	5	0.010	-0.002	0.003	0.006
	6	-0.010	-0.004	0.007	0.001
	7	-0.005	0.010	0.003	0.001
	8	0.006	-0.006	0.000	0.002
	9	0.000	-0.009	0.005	0.006
	10	-0.013	-0.005	0.007	-0.001
Italy	1	0.000	0.000	-0.003	0.004
	2	0.000	0.000	-0.003	0.004
	3	0.000	0.000	-0.005	0.004
	4	0.000	0.000	-0.004	0.003
	5	0.000	0.000	-0.003	0.004
	6	0.000	0.000	-0.002	0.003
	7	0.000	0.000	-0.001	0.003
	8	0.000	0.000	-0.001	0.003
	9	0.000	0.000	-0.001	0.002
	10	0.000	0.000	0.000	0.001
Japan	1	0.014	0.000	0.001	0.007
	2	0.011	-0.002	0.001	0.008
	3	0.013	-0.002	0.003	0.009
	4	0.009	-0.001	0.003	0.008
	5	0.004	-0.001	0.003	0.008
	6	0.001	-0.002	0.004	0.006
	7	0.003	-0.003	0.004	0.007
	8	0.002	-0.002	0.004	0.006
	9	0.003	-0.001	0.003	0.003
	10	0.003	-0.001	0.002	0.002

Table A.4: (cont'd)

Country	Period	FUTURES, $y_{1,t+s}$		LNGDP, $y_{2,t+s}$	
		ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Netherlands	1	0.034	0.000	0.001	0.005
	2	0.032	0.012	0.002	0.006
	3	0.031	0.014	0.002	0.006
	4	0.030	0.015	0.003	0.006
	5	0.029	0.015	0.004	0.007
	6	0.029	0.015	0.005	0.007
	7	0.028	0.015	0.005	0.007
	8	0.027	0.015	0.006	0.007
	9	0.027	0.015	0.006	0.007
	10	0.026	0.014	0.007	0.007
New Zealand	1	0.000	0.000	0.003	0.007
	2	0.000	0.000	-0.002	0.008
	3	0.000	0.000	0.001	0.010
	4	0.000	0.000	-0.004	0.008
	5	0.000	0.000	0.000	0.006
	6	0.000	0.000	-0.001	0.005
	7	0.000	0.000	-0.004	0.003
	8	0.000	0.000	0.000	0.003
	9	0.000	0.000	-0.002	0.003
	10	0.000	0.000	0.000	0.004
Norway	1	0.008	0.000	0.001	0.016
	2	0.004	0.003	0.000	0.008
	3	0.003	0.001	-0.001	0.013
	4	0.001	0.002	-0.002	0.010
	5	0.001	0.001	-0.002	0.011
	6	0.000	0.001	-0.002	0.010
	7	0.000	0.001	-0.003	0.011
	8	0.000	0.001	-0.003	0.011
	9	0.000	0.001	-0.003	0.011
	10	0.000	0.001	-0.003	0.011
Portugal	1	0.005	0.000	-0.004	0.008
	2	0.007	-0.003	0.002	0.006
	3	0.005	-0.004	0.002	0.006
	4	0.004	-0.003	0.003	0.003
	5	0.002	-0.002	-0.001	0.001
	6	0.003	0.000	-0.003	0.000
	7	0.005	-0.002	-0.004	0.002
	8	0.004	-0.003	-0.003	0.003
	9	0.004	-0.002	-0.002	0.000
	10	0.003	-0.001	-0.003	0.001

Table A.4: (cont'd)

Country	Period	FUTURES, $y_{1,t+s}$		LNGDP, $y_{2,t+s}$	
		ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
South Africa	1	0.025	0.000	0.001	0.005
	2	0.013	0.002	0.002	0.008
	3	0.007	0.004	0.004	0.009
	4	0.004	0.005	0.005	0.011
	5	0.003	0.005	0.006	0.011
	6	0.003	0.005	0.007	0.012
	7	0.003	0.006	0.007	0.012
	8	0.003	0.006	0.007	0.012
	9	0.003	0.006	0.007	0.013
	10	0.003	0.006	0.008	0.013
Spain	1	0.002	0.000	0.000	0.011
	2	0.001	0.000	-0.001	0.001
	3	0.001	0.000	-0.003	0.002
	4	0.001	0.000	0.001	0.000
	5	0.000	0.000	0.003	0.010
	6	0.000	0.000	0.001	0.002
	7	0.000	0.000	0.000	0.004
	8	0.000	0.000	0.001	0.000
	9	0.000	0.000	0.002	0.008
	10	0.000	0.000	0.001	0.002
Sweden	1	0.083	0.000	0.002	0.013
	2	0.041	0.016	0.004	0.011
	3	0.061	0.018	0.002	0.011
	4	0.072	0.018	0.002	0.011
	5	0.037	0.030	0.003	0.017
	6	0.051	0.030	0.003	0.015
	7	0.035	0.033	0.002	0.015
	8	0.017	0.033	0.001	0.014
	9	0.021	0.033	0.001	0.017
	10	0.005	0.033	0.001	0.016
Switzerland	1	0.145	0.000	0.000	0.005
	2	0.125	-0.014	0.001	0.005
	3	0.094	-0.007	0.002	0.005
	4	0.067	0.005	0.004	0.005
	5	0.049	0.014	0.004	0.004
	6	0.039	0.020	0.005	0.004
	7	0.035	0.024	0.005	0.004
	8	0.034	0.025	0.005	0.004
	9	0.034	0.026	0.005	0.004
	10	0.035	0.026	0.005	0.004

Table A.4: (cont'd)

Country	Period	FUTURES, $y_{1,t+s}$		LNGDP, $y_{2,t+s}$	
		ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
United Kingdom	1	0.057	0.000	0.000	0.010
	2	0.024	0.020	-0.001	0.007
	3	0.028	0.019	-0.001	0.009
	4	0.019	0.010	0.002	0.011
	5	0.034	0.019	0.000	0.016
	6	0.023	0.011	0.000	0.014
	7	0.034	0.019	0.001	0.013
	8	0.022	0.022	0.002	0.013
	9	0.011	0.023	0.000	0.018
	10	-0.007	0.018	0.001	0.015
United States	1	0.017	0.000	0.001	0.004
	2	0.016	-0.001	0.001	0.006
	3	0.016	-0.001	0.002	0.008
	4	0.016	0.001	0.003	0.008
	5	0.015	0.002	0.003	0.009
	6	0.015	0.003	0.003	0.009
	7	0.014	0.003	0.003	0.009
	8	0.013	0.004	0.003	0.010
	9	0.013	0.004	0.003	0.010
	10	0.012	0.004	0.003	0.010

Estimates of the impulse-response function analysis are shown. The impulse-response function traces the effect of a one-time shock to one of the endogenous variables on current and future values of itself and the other endogenous variables. One standard deviation of one variable's innovation may affect the other variable negatively, positively, or both, throughout the period. Impulse-response function analysis shows the response of an endogenous variable to the changes in errors of the other variables.

FUTURES : Value of futures contracts divided by GDP.
LNGDP : Logarithm of real GDP (seasonalized).
ε : Innovation.

Table A.5: Variance decomposition for reverse Cholesky ordering

Country	Period	FUTURES			LNGDP		
		S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Australia	1	0.00	95.50	4.50	0.00	0.00	100.00
	2	0.01	91.27	8.73	0.01	6.01	93.99
	3	0.01	91.25	8.75	0.01	5.43	94.57
	4	0.01	86.11	13.89	0.01	7.31	92.69
	5	0.01	77.59	22.41	0.01	8.65	91.35
	6	0.02	78.70	21.30	0.01	14.04	85.96
	7	0.02	81.61	18.39	0.01	13.87	86.13
	8	0.02	83.76	16.24	0.01	12.52	87.48
	9	0.03	85.48	14.52	0.01	17.24	82.76
	10	0.04	85.27	14.73	0.01	26.11	73.89
Austria	1	0.00	91.94	8.06	0.01	0.00	100.00
	2	0.00	93.18	6.82	0.01	8.58	91.42
	3	0.00	95.00	5.00	0.01	8.40	91.60
	4	0.00	93.94	6.06	0.01	9.51	90.49
	5	0.00	89.02	10.98	0.01	9.95	90.05
	6	0.00	84.92	15.08	0.01	11.34	88.66
	7	0.00	78.40	21.60	0.02	11.90	88.10
	8	0.00	77.80	22.20	0.02	11.95	88.05
	9	0.00	79.68	20.32	0.02	11.87	88.13
	10	0.00	80.75	19.25	0.02	11.86	88.14
Belgium	1	0.00	81.26	18.74	0.01	0.00	100.00
	2	0.00	74.91	25.09	0.02	4.59	95.41
	3	0.00	73.13	26.87	0.02	3.80	96.20
	4	0.00	72.19	27.81	0.02	2.87	97.13
	5	0.00	71.47	28.53	0.03	2.33	97.67
	6	0.00	70.92	29.08	0.03	2.23	97.77
	7	0.00	70.47	29.53	0.03	2.52	97.48
	8	0.00	70.09	29.91	0.03	3.14	96.86
	9	0.00	69.75	30.25	0.04	4.02	95.98
	10	0.00	69.44	30.56	0.04	5.10	94.90
France	1	0.01	55.83	44.17	0.00	0.00	100.00
	2	0.01	53.19	46.81	0.01	18.32	81.68
	3	0.01	54.26	45.74	0.01	17.27	82.73
	4	0.01	55.98	44.02	0.01	15.58	84.42
	5	0.01	55.99	44.01	0.01	16.88	83.12
	6	0.01	56.69	43.31	0.01	17.41	82.59
	7	0.01	56.63	43.37	0.01	19.87	80.13
	8	0.01	56.37	43.63	0.01	25.20	74.80
	9	0.01	54.35	45.65	0.01	26.89	73.11
	10	0.01	53.27	46.73	0.01	25.75	74.25

Table A.5: (cont'd)

Country	Period	FUTURES			LNGDP		
		S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	S.E.	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Hungary	1	0.02	61.50	38.50	0.01	0.00	100.00
	2	0.02	59.61	40.39	0.01	14.42	85.58
	3	0.03	50.53	49.47	0.01	16.74	83.26
	4	0.03	49.66	50.34	0.01	20.28	79.72
	5	0.03	53.81	46.19	0.01	14.46	85.54
	6	0.03	49.91	50.09	0.01	24.31	75.69
	7	0.03	53.91	46.09	0.01	25.26	74.74
	8	0.03	57.18	42.82	0.01	25.55	74.45
	9	0.03	55.60	44.40	0.02	19.55	80.45
	10	0.04	51.89	48.11	0.02	27.14	72.86
Italy	1	0.00	67.79	32.21	0.00	0.00	100.00
	2	0.00	63.86	36.14	0.01	0.60	99.40
	3	0.00	59.69	40.31	0.01	3.17	96.83
	4	0.00	59.65	40.35	0.01	3.83	96.17
	5	0.00	48.78	51.22	0.01	3.43	96.57
	6	0.00	46.26	53.74	0.01	3.19	96.81
	7	0.00	40.92	59.08	0.01	3.06	96.94
	8	0.00	41.88	58.12	0.01	3.00	97.00
	9	0.00	44.10	55.90	0.01	3.00	97.00
	10	0.00	31.10	68.90	0.01	3.31	96.69
New Zealand	1	0.00	86.47	13.53	0.01	0.00	100.00
	2	0.00	86.68	13.32	0.01	19.77	80.23
	3	0.00	86.50	13.50	0.02	13.16	86.84
	4	0.00	87.15	12.85	0.02	25.04	74.96
	5	0.00	86.13	13.87	0.02	24.46	75.54
	6	0.00	82.76	17.24	0.02	24.71	75.29
	7	0.00	83.93	16.07	0.02	29.50	70.50
	8	0.00	83.25	16.75	0.02	28.96	71.04
	9	0.00	81.88	18.12	0.02	29.68	70.32
	10	0.00	81.97	18.03	0.02	29.05	70.95
Portugal	1	0.00	81.39	18.61	0.01	0.00	100.00
	2	0.01	55.05	44.95	0.01	17.10	82.90
	3	0.01	45.01	54.99	0.01	23.03	76.97
	4	0.01	40.45	59.55	0.01	29.98	70.02
	5	0.01	39.34	60.66	0.01	29.67	70.33
	6	0.01	41.17	58.83	0.01	32.36	67.64
	7	0.01	40.42	59.58	0.01	33.19	66.81
	8	0.01	37.92	62.08	0.01	31.72	68.28
	9	0.01	36.94	63.06	0.01	32.15	67.85
	10	0.02	37.38	62.62	0.02	32.94	67.06

Table A.6: Impulse-response function for reverse Cholsesky ordering

Country	Period	FUTURES, $y_{1,t+s}$		LNGDP, $y_{2,t+s}$	
		ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Australia	1	0.005	-0.001	0.000	0.005
	2	0.003	-0.002	0.002	0.004
	3	0.005	-0.002	0.000	0.002
	4	0.006	-0.003	-0.001	0.001
	5	0.006	-0.005	-0.001	0.000
	6	0.008	-0.004	-0.002	0.001
	7	0.011	-0.004	-0.002	0.004
	8	0.013	-0.005	-0.001	0.005
	9	0.017	-0.006	-0.003	0.004
	10	0.021	-0.009	-0.004	0.003
Austria	1	0.000	0.000	0.000	0.009
	2	0.000	0.000	-0.003	0.006
	3	0.000	0.000	-0.002	0.006
	4	0.000	0.000	-0.002	0.004
	5	0.000	0.000	-0.002	0.004
	6	0.000	0.000	-0.002	0.003
	7	0.000	0.000	-0.002	0.003
	8	0.000	0.000	-0.001	0.002
	9	0.000	0.000	0.000	0.001
	10	0.000	0.000	0.000	0.001
Belgium	1	0.000	0.000	0.000	0.013
	2	0.000	0.000	-0.004	0.011
	3	0.000	0.000	-0.001	0.011
	4	0.000	0.000	0.000	0.012
	5	0.000	0.000	0.001	0.012
	6	0.000	0.000	0.002	0.012
	7	0.000	0.000	0.003	0.013
	8	0.000	0.000	0.003	0.013
	9	0.000	0.000	0.004	0.014
	10	0.000	0.000	0.005	0.014
France	1	0.004	-0.004	0.000	0.005
	2	0.005	-0.005	0.002	0.001
	3	0.003	-0.002	0.001	-0.002
	4	0.002	-0.001	0.001	-0.002
	5	0.000	0.000	-0.003	0.006
	6	-0.002	0.001	-0.002	0.004
	7	0.000	0.000	-0.002	0.000
	8	-0.001	-0.001	-0.003	-0.001
	9	0.001	-0.002	-0.005	0.007
	10	0.001	-0.002	-0.001	0.003

Table A.6: (cont'd)

Country	Period	FUTURES, $y_{1,t+s}$		LNGDP, $y_{2,t+s}$	
		ε_{1t} (FUTURES)	ε_{2t} (LNGDP)	ε_{1t} (FUTURES)	ε_{2t} (LNGDP)
Hungary	1	0.018	0.015	0.000	0.006
	2	-0.002	0.004	0.003	0.005
	3	0.000	0.010	0.002	0.001
	4	-0.001	0.004	-0.002	0.000
	5	0.009	0.004	-0.001	0.007
	6	-0.005	-0.009	0.005	0.005
	7	-0.010	0.005	0.002	0.002
	8	0.009	-0.001	-0.001	0.001
	9	0.005	-0.007	0.000	0.008
	10	-0.007	-0.011	0.006	0.004
Italy	1	0.000	0.000	0.000	0.005
	2	0.000	0.000	-0.001	0.005
	3	0.000	0.000	-0.002	0.006
	4	0.000	0.000	-0.001	0.005
	5	0.000	0.000	-0.001	0.005
	6	0.000	0.000	0.000	0.003
	7	0.000	0.000	0.000	0.003
	8	0.000	0.000	0.000	0.003
	9	0.000	0.000	0.000	0.003
	10	0.000	0.000	0.001	0.001
New Zealand	1	0.000	0.000	0.000	0.007
	2	0.000	0.000	-0.005	0.007
	3	0.000	0.000	-0.002	0.010
	4	0.000	0.000	-0.007	0.006
	5	0.000	0.000	-0.003	0.005
	6	0.000	0.000	-0.003	0.004
	7	0.000	0.000	-0.005	0.001
	8	0.000	0.000	-0.001	0.003
	9	0.000	0.000	-0.002	0.002
	10	0.000	0.000	-0.001	0.004
Portugal	1	0.004	-0.002	0.000	0.008
	2	0.005	-0.006	0.004	0.005
	3	0.003	-0.005	0.004	0.005
	4	0.002	-0.004	0.004	0.002
	5	0.001	-0.002	0.000	0.001
	6	0.002	-0.001	-0.003	0.002
	7	0.003	-0.004	-0.003	0.003
	8	0.002	-0.004	-0.002	0.004
	9	0.002	-0.004	-0.001	0.001
	10	0.002	-0.003	-0.002	0.003