UNIVERSITY OF TWENTE.

Capital Market Development and Economic Growth in Bolivia

Master of Science Thesis

Santiago Zegada

Photograph in the cover:

Small, strong and a hardened smoker, showing off an elegant thin mustache and always carrying countless goods, fortune and prosperity, the Ekeko, is the representation of the pagan god of abundance in the Andean cultures. It is the central figure in the yearly fair of "Alasitas" in La Paz, in which people buy miniature goods with the hope that this mythical character will make them come true and bring them wealth in the course of the year.

Capital Market Development and Economic Growth in Bolivia

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Executive Summary

The issue of whether or not the financial sector contributes to the economy has been object of much discussion in the past few decades. While some argue that financial development has a great potential in generating economic growth, others maintain that it is economic growth that precedes financial development, that they are both mutually causal or, that there is no relationship between them at all. These contradictory viewpoints have been based on several empirical studies which have brought to light the large heterogeneity on the nature of this relationship among countries and have highlighted the importance of carrying out in-depth country-specific studies to assess this relationship in order to include country-specific characteristics in the analysis.

Bolivia is one of the poorest countries in Latin America. It has experimented with many different economic policies in different moments of its history, going from nationalization to privatization, capitalization and, more recently, nationalization again. In spite of this, its economic growth rates have remained persistently low and have been largely determined by population growth. It is in this context that this thesis analyzes the relationship between the capital market and economic growth in Bolivia.

The Bolivian capital market is of recent creation. The legal basis for its functioning was established in the late 1970's, while the Bolivian Stock Exchange (*Bolsa Boliviana de Valores*) started operating just in 1989 and the trading of stocks was introduced in 1994. Currently, the most traded instruments are fixed-income securities, in particular, fixed-term deposits. Since their introduction in the Bolivian Stock Exchange in 1994 the trading of stocks has represented only a minor proportion of total trades and has never exceeded 3,7% of the total amount traded. The base of issuers is characterized by a large presence of financial institutions and a very modest participation of small and medium-sized enterprises which compose the largest group of firms in the country and are an important source of employment.

The relationship between capital market development and economic growth is assessed by estimating bivariate and trivariate Vector Autoregressive models and performing Granger causality tests using quarterly time-series data from the period between 1994 and 2010. Measures of size and liquidity for both the stock market and the fixed-income security market are used and economic growth is measured with real GDP per capita.

The main conclusion of the thesis is that the Bolivian capital market has not significantly contributed to the growth of the economy during the time period analyzed. This suggests that the stock market is too small and illiquid to contribute to economic growth; and that the fixed-income security market, although larger and more liquid, has also a limited impact on the economy. This does not imply, however, that the Bolivian capital market is unimportant or that it should not be considered as a means for promoting economic growth. It rather seems to suggest that there might be a threshold in terms of size and liquidity that must be reached before the capital market is able to influence the economic dynamics of the country.

In addition, it may be presumed that the current configuration of issuers and investors participating in the Bolivian capital market, characterized by a predominant presence of firms coming from the financial sector and a very modest presence of enterprises from the productive sector, limits the possibility for this mechanism to boost economic growth.

Resumen Ejecutivo

El tema de si el sector financiero contribuye a la economía ha sido ampliamente discutido en las últimas décadas. Mientras algunos consideran que el desarrollo del sector financiero tiene un gran potencial para generar crecimiento económico, otros sostienen que el crecimiento económico precede al desarrollo financiero, que tienen una relación de causalidad mutua o que no existe ninguna relación entre ellos. Estos puntos de vista contradictorios han surgido a partir de varios estudios empíricos que han puesto de manifiesto la amplia heterogeneidad de esta relación en diversos países y han resaltado la importancia de llevar a cabo estudios a profundidad enfocados en países específicos con el objeto de incluir las características específicas de cada país en el análisis

Bolivia es uno de los países más pobres de América Latina. Diferentes políticas económicas han sido implementadas en diferentes momentos de su historia, desde nacionalización a privatización, capitalización y, más recientemente, nacionalización una vez más. A pesar de esto, las tasas de crecimiento económico se han mantenido bajas y han sido en gran parte determinadas por el crecimiento poblacional. En este contexto económico, ésta tesis analiza la relación entre el mercado de valores y el crecimiento económico en Bolivia.

El mercado de valores boliviano es de creación reciente. La base legal para su funcionamiento fue establecida a fines de la década de 1970, la Bolsa Boliviana de Valores inició sus operaciones en 1989 y la negociación de acciones de empresas fue introducida recién en 1994. Actualmente, los instrumentos más negociados son instrumentos de renta fija y, en particular, los depósitos a plazo fijo. Desde su introducción a la Bolsa Boliviana de Valores, la negociación de acciones ha representado una porción mínima de los montos negociados y en ningún momento ha logrado superar el 3,7% del monto total negociado. La base de emisores se caracteriza por la amplia presencia de instituciones del sector financiero y una modesta participación de pequeñas y medianas empresas, que componen el grupo más grande de empresas en el país y son una importante fuente de empleo.

La relación entre el mercado de valores y el crecimiento económico es evaluada estimando modelos de vectores autorregresivos y realizando pruebas de causalidad de Granger utilizando datos trimestrales de series de tiempo del periodo comprendido entre 1994 y 2010. Se utilizan indicadores para el tamaño y la liquidez tanto para el mercado de acciones como para el mercado de instrumentos de renta fija y como indicador de crecimiento económico se utiliza el PIB per cápita trimestral.

La conclusión central de la tesis es que el mercado de valores boliviano no ha contribuido significativamente al crecimiento económico durante el período analizado. Esto sugiere, por un lado, que el mercado de acciones de empresas es demasiado pequeño y su liquidez muy reducida para contribuir al crecimiento económico y, por el otro, que el mercado de instrumentos de renta fija, más desarrollado en términos de tamaño y liquidez, tiene un impacto limitado en la economía del país. Sin embargo, esto no implica que el mercado de valores no debiera ser considerado como un medio para promover crecimiento económico. Sino más bien sugiere la presencia de un umbral en términos de tamaño y liquidez que debe ser alcanzado antes de que pueda influir significativamente en la economía del país.

Finalmente, la actual configuración de emisores e inversores que participan en el mercado de valores, caracterizada por la predominancia de empresas del sector financiero y una modesta

presencia de empresas del sector productivo, parece limitar sus posibilidades de contribuir al crecimiento económico.

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The completion of this thesis also marks the end of my student life in Enschede. During the last couple of years I have been able to meet people from different countries and cultures who have contributed, in one way or another, to my academic and personal development.

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Finally, I want to thank Patricia and Oscar for their *words*.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

ADF	Augmented Dickey-Fuller
AFP	Administradora de Fondo de Pensiones (Pension Fund Administrator)
AIC	Akaike Information Criterion
APEC	Asia-Pacific Economic Cooperation
BCB	Banco Central de Bolivia (Bolivian Central Bank)
BSE	Bolivian Stock Exchange (Bolsa Boliviana de Valores)
CEDEIM	Certificados de devolución impositiva (Tax refund certificates)
COMIBOL	Corporación Minera de Bolivia (State-Owned mining company)
ECLAC	United Nation's Economic Commission for Latin America and the Caribbean
ENDE	Empresa Nacional de Electricidad (State-owned electricity company)
ENFE	Empresa Nacional de Ferrocarriles (State-owned railway company)
ENTEL	Empresa Nacional de Telecomunicaciones (State-owned telecommunications company)
GDP	Gross Domestic Product
GDPpc	Real GDP per capita
GDPpc4	Real GDP per capita in 4^{th} differences
HQ	Hannan-Quinn Criterion
IFAS	Investment Fund Administrating Societies
INE	Instituto Nacional de Estadística (National Institute of Statistics)
LAB	Lloyd Aéreo Boliviano (State-owned airline)
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
PP	Philips-Perron
PSR	Public fixed-income securities registered to GDP ratio
PST	Public fixed-income securities traded to GDP ratio
PvSR	Private fixed-income securities registered to GDP ratio
PvST	Private fixed-income securities traded to GDP ratio
SIC	Schwarz Bayesian Information Criterion
SMC	Stock market capitalization to GDP ratio
SME	Small and Medium-sized Enterprise
TFP	Total Factor Productivity
UDAPE	Unidad de Análisis de Políticas Sociales y Económicas (Unit of Analysis of Social and Economic Policies)
USAID	United States Agency for International Development
VAR	Vector Autoregression
VEC	Vector Error Correction
VST	Value of stocks traded to GDP ratio
YPFB	Yacimientos Petrolíferos Fiscales Bolivianos (State-owned oil company)

CHAPTER 1. Introduction

The Bolivian economy has been historically dependent on the exploitation and export of natural resources with few or none added value. In addition to this, it has been described as a narrow-based economy characterized by the concentration of the largest proportion of income in sectors that generate limited amounts of employment; most of the population is self-employed and the informal sector is estimated to generate over 55% of the urban employment (Gray, Araníbar, Archondo, & Wanderley, 2005; Evia, Pacheco, & Quispe, 2010). In spite of the implementation of different economic policies, the growth of the Bolivian economy has been very low and it has remained one of the poorest countries in Latin America. It is in this context that this thesis will analyze the relationship between capital market development and growth of the Bolivian economy.

The Bolivian capital market started gaining shape at the end of the 1970's when the legal basis required for its functioning was established. The Bolivian Stock Exchange (BSE), which is at the moment the only stock exchange in the country, was created as a non-profit company in 1979; however, it started its operations 10 years later, in 1989 with securities issued by the Bolivian Central Bank. The private sector started participating in the BSE in 1991 with issues of convertible and short-term bonds. Currently, trading activities are mainly organized around the Bolivian Stock Exchange. The securities traded are organized in fixed- and variable-income securities; while the former type of securities include bonds, fixed-term deposits and promissory notes, among others, the latter type is composed by ordinary and preferred stocks and participation quotas in investment funds. Up to 2010 there were 82 issuing institutions registered in the Bolivian Stock Exchange of which 37 had issued stocks; of the $us. 3,9 billion traded from January to December 2010, 68% corresponded to fixed-term deposits, 23% to bonds and only 0,27% to stocks.

In the Latin American context, at year end 2009, the Bolivian stock market capitalization was one of the smallest in the region, around $us 2,8 billion, followed only by Costa Rica and Uruguay, while the largest ones were Brazil, Mexico and Argentina with stock market capitalizations of $us 1.339 billion, 665 billion and 574 billion respectively. In terms of the value of fixed-income security trading, however, the performance of the Bolivian Stock Exchange was quite different; during 2009 it was one of the largest in the region with a value of fixed-income securities traded of $us 2.166 billion, only exceeded by those in Buenos Aires, Santiago and Colombia (Federación Iberoamericana de Bolsas, 2010).

Extensive research on the relationship between financial development and economic growth has been carried out in the past decades. While theoretical studies have focused on the functions of financial systems and how these can contribute to technological innovation and capital accumulation and generate economic growth, empirical studies have analyzed the impact of financial development on economic growth using different econometric techniques. Whereas the initial empirical studies carried out were based on cross-country data and focused only on the correlation between financial development and economic growth concluding that they are closely related, more recent studies have focused on the causality issue using country-specific time series data showing that the finance-growth relationship is not homogeneous across countries. This has highlighted the importance of focusing on assessing country-specific relationships between financial development and economic growth.

In the case of Bolivia, some studies have assessed the relationship between the development of the financial sector in general and economic growth focusing mainly on the depth of the financial system (see for example Morales (2007) and Gutiérrez, Yujra & Quelca (2009)); however, the relationship between the development of the Bolivian capital market and economic growth is still unexplored. This study has been conceived precisely with the purpose of enhancing the empirical evidence about the nature and direction of this relationship contributing to the academic debate around this issue.

The main research objective of this study is to empirically investigate the relationship between capital market development and economic growth and its causal direction in Bolivia. The specific objectives are the following:

- To make an overview of the historical development and current situation of capital markets in Bolivia.
- To estimate Vector auto-regressive models of the relationship between capital market development proxies and economic growth in Bolivia.
- To determine the causal relationship between capital market development and economic growth in Bolivia.

Chapter 2 presents a description of the historical development of the Bolivian capital market and its current state with an emphasis on the Bolivian Stock Exchange. Chapter 3 makes an overview of the Bolivian economy, the most relevant economic policies implemented and its evolution during the last 30 years. Chapter 4 presents a literature review of the studies on financial development and economic growth and it is organized in two parts. While the first one presents the theoretical studies on the finance-growth nexus, the second one presents the numerous empirical studies carried out in this field. Chapter 5 develops the econometric analysis of the relationship between capital market development and economic growth for the Bolivian case. Finally, the conclusions are presented in Chapter 6.

Given that the aim of this thesis is to give an initial insight on the relationship between capital market development and economic growth focusing mainly on its empirical nexus, it does not present an in depth discussion of the Bolivian economy, its characteristics and its problems, nor does it intend to criticize studies carried out in this direction.

In this study the term *financial system* will be understood as the system which allows the transfer of money between lenders and borrowers and which comprises a wide range of institutions, markets, transactions, regulations and practices. The term c*apital market,* on the other hand, refers to the sector of the financial system which is concerned with raising capital by dealing with both fixed- and variable-income securities. The Bolivian Stock Exchange, which is part of the capital market, is the only stock exchange established in Bolivia. The market of company stocks traded in the Bolivian Stock Exchange will be referred to as the *stock market* and the market of fixed-income securities traded in the Bolivian Stock Exchange (bonds, promissory notes, etc.) will be referred to as the *fixed-income security market.*

CHAPTER 2. The Bolivian capital market

The Bolivian capital market operates within the framework of the Law of Capital Markets (Law No. 1834) under the regulation and supervision of the Financial System Supervision Authority and is constituted by the Bolivian Stock Exchange, stock brokerage firms, the Central Securities Depository, issuing firms and investors. Trading activities are mainly organized around the Bolivian Stock Exchange which is the only stock exchange in the country. This chapter will focus on the historical development and current state of the Bolivian capital market and, given its central role, the Bolivian Stock Exchange will play an important part in the development of the chapter.

2.1 Historical development

The Bolivian capital market started to take form during the last years of the 1970s. The commercial code approved by the executive order with force of law No. 14379 prevailing since January 1st, 1978 made reference to capital markets, issuers, intermediaries, and the National Securities Commission, among others (Gaceta Oficial de Bolivia, 1977). Even though the capital market entered into legal existence with this law, it had its starts with the creation of the Bolivian Stock Exchange (BSE, Bolsa Boliviana de Valores) in April, 1979 which was established as a non-profit corporation. The National Securities Commission was created in August 2nd, 1979, by executive order with force of law No. 16995 (Gaceta Oficial de Bolivia, 1979). Due to unstable political and economic conditions from the late 1970's until the second half of the 1980's the Bolivian Stock Exchange did not start its operations until 1989. This situation will be briefly described in the following paragraph.

In 1978 after the fall of the right-winged military dictatorship of Hugo Bánzer, Bolivia entered into a very unstable political situation. The political stage was divided between groups that wanted to return to democracy and groups that wanted to deepen dictatorship continuing with the line of Bánzer and that of the dictatorships in Argentina, Chile, Brazil and other countries in the region. This situation was reflected with successive coups between democratic elections and the appointment of eight different presidents in the four-year period from 1978 to 1982, year in which there was a definite return to democracy. The Bolivian economy was submerged in a deep crisis generated not only by external shocks that affected South America in general, but also as a reflection of the internal political and economic conflicts during the entire 20th century (Morales & Sachs, Bolivia's Economic Crisis, 1989). The economic situation was stabilized with economic reforms carried out by the government of Víctor Paz Estenssoro in 1985 that basically dismantled the state capitalism that prevailed during the previous decades. In 1989, in a much more stable economic and political situation, the Bolivian Stock Exchange would officially start its operations.

In March 1989 a cooperation agreement between the governments of Bolivia and the United States of America was signed with the aim of developing Bolivian capital markets. Within the framework of this agreement the BSE obtained economic and technical assistance from the United States Agency for International Development (USAID) (Bolsa Boliviana de Valores, 2006b).

On October 17th, 1989, the National Securities Commission authorized the functioning of the BSE and the first transactions were carried out in October 20th, 1989. These were buying and selling transactions of Negotiable Deposit Certificates issued by the Bolivian Central Bank

(BCB). During the rest of that year the BCB had authorized an amount equivalent to $us 1,3 billion to be negotiated in Negotiable Deposit Certificates (Bolsa Boliviana de Valores, 2006b).

In 1990 two new instruments were introduced in the BSE: Negotiable Credit Note Certificates issued by the national tax collecting agency (Dirección General de la Renta Interna) and Convertible Bank Bonds. In 1991 the first short-term bonds and short-term promissory notes were issued by private firms. The number of authorized stock brokerage firms in that year was fifteen. During 1992, fixed term deposits issued by banks were allowed to be registered and traded in the BSE and the first banking bonds were issued. The first long-term bonds were issued in 1993.

In 1994 two financial institutions, the Banco Boliviano Americano and BISA Leasing, were the first firms to register and trade stocks in the BSE. The total amount traded during that year in the BSE was above $us. 1.000 million, almost doubling the amount traded the year before. By 1996 the total amount of stocks traded was $us. 3,4 million (including the auction of stocks not registered in the BSE) five times larger than that in 1995 and the total amount of stocks registered was $us. 111,3 million (Bolsa Boliviana de Valores, 2006b).

The capitalization of state owned companies and the pension system reform carried out between 1994 and 1997 led to the creation of individual capitalization pension funds that were to be managed by pension fund administrators (Gaceta Oficial de Bolivia, 1994). These pension funds that were to contribute to the development of the BSE, started their participation as institutional investors in 1997. During this year the Superintendence of Securities (*Superintendencia de Valores*), in charge of the supervision of capital markets, was created in order to replace the National Securities Commission (Bolsa Boliviana de Valores, 2006b).

During 1998 the Law of Capital Markets No. 1834 was passed. The aim of this law was to regulate and promote an organized, efficient and transparent capital market, as well as to regulate the functioning and activities of the Superintendence of Securities (Gaceta Oficial de Bolivia, 1998). This law contributed to the development of the capital market by establishing tax incentives for issuers and investors, by broadening the type of companies that could issue securities and by authorizing the participation of foreign investors and foreign securities in Bolivian capital markets (Bolsa Boliviana de Valores, 2006b).

In 1999 the first risk rating agencies were registered in the Capital Market Registry and at the BSE and integration agreements were signed with the stock exchanges of Lima and Quito. During 1999 an economic crisis, signaled by the collapse of domestic investment, hit Bolivia along with other countries in the Latin American region (Marconi & Mosley, 2005). Even though the total amount traded at the BSE increased from $us. 1.670 million in 1998 to $us. 1.700 million in 1999, the total amount traded in the capital market considering trades done inside and outside the BSE dropped from $us. 4.300 million in 1998 to $us. 3.800 million in 1999[1] (Bolsa Boliviana de Valores, 2006c).

The Economic Reactivation Law No. 2064 was passed in the year 2000. This law modified some aspects of the Law of Capital Markets No. 1834. The most relevant modification was that the type of firms allowed to issue securities was broadened to include limited liability companies, mutual companies and cooperatives (Gaceta Oficial de Bolivia, 2000). In 2001 the total amount

[1] The trades done outside the BSE are computed based on the information provided by broker agencies to the BSE. This does not necessarily mean that it considers all transactions done outside the BSE.

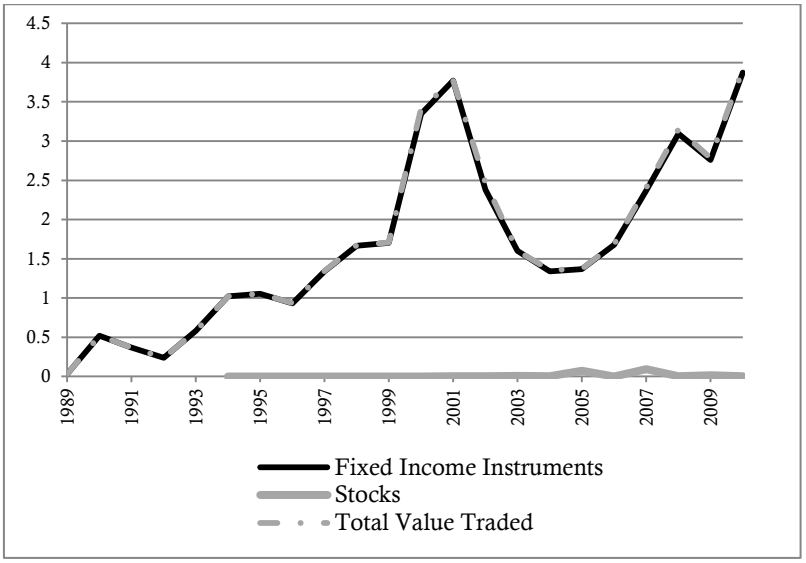
traded at the BSE reached a historical peak with $us. 3.772 million of which only $us. 1,3 million (0,03%) represented the trade of stocks (Bolsa Boliviana de Valores, 2006c).

In the following years the BSE would suffer a market contraction. The total amount traded was reduced by 35% in 2002 with respect to the previous year and again by 35% in 2003 with respect to 2002. The total amount traded during 2002 and 2003 was $us. 2.470 million and $us. 1.601 million respectively. The lowest trading level was reached in 2004 when the total amount traded was reduced to $us. 1.355 million (Bolsa Boliviana de Valores, 2006c).

In 2003, in an effort to integrate to the stock exchanges of the region, the BSE joined the Federation of Ibero-American Stock Exchanges (Bolsa Boliviana de Valores, 2006b). In April that year the Bolivian Central Securities Depository was created however it would not start fully working until 2005. From 2005 to 2010 the total amount traded in the BSE increased almost continuously from $us. 1.374 million to $us. 3.915 million.

The values traded from 1989 to 2010 are presented in Figure 1. It can be noted that since the first listing and trading of stocks in 1994 they have contributed with a very small proportion to the total value traded at the BSE. The highest proportion reached by stocks was 3.69% of total trades in 2002 with a total amount of $us. 72 million (Bolsa Boliviana de Valores, 2006c). Even though stock market capitalization as a percentage of GDP has grown from 0,4% in 1994 to 16,1% in 2009, it has always remained below the average levels in Latin America and the Caribbean which were 30% and 58% during the same period (The World Bank, 2010). These low values of stocks traded at the BSE may be caused by three factors. First, stock trades in BSE are quite recent and they have not yet been consolidated as regular investment instruments. Second, most Bolivian companies are small, family-owned and are not listed in the Stock Exchange. This makes the number of stock-issuing firms very small. Finally, it is common for firms to sell stocks directly to interested parties and not through the BSE.

Figure 1. Amounts traded at the BSE by year in billions of $us.



Source: Own elaboration based on Bolsa Boliviana de Valores (2006c), Bolsa Boliviana de Valores (2006a), Bolsa Boliviana de Valores (2007), Bolsa Boliviana de Valores (2008), Bolsa Boliviana de Valores (2009), Bolsa Boliviana de Valores (2010a).

Since their incorporation as trading instruments in the BSE in 1993, fixed-term deposits have constituted an important percentage of the total amount of trades. In 1993 they represented 54% of total trades, reaching their lowest level in 2008 with 21% and increasing to 68% of the total amount traded at the BSE in 2010 (Bolsa Boliviana de Valores, 2010a). The issuers of these instruments are uniquely banks and other financial institutions such as financial cooperatives and funds.

With respect to the number of issuing institutions, it has increased during the lifespan of the BSE. In 1989 the only issuing institution was the Bolivian Central Bank and in 2010 there were 82 issuing firms registered at the BSE. The number of listed companies that registered stocks increased from 2 in 1994 to 37 in 2010.

2.2 Securities traded at the Bolivian Stock Exchange and types of operations

2.2.1 Securities traded at the BSE

The securities traded at the Bolivian Stock Exchange are organized in two main groups (Bolsa Boliviana de Valores, 2011b):

a) *Fixed income securities:* These are securities in which the perceived interest is fixed beforehand. The securities that compose this group are the following:
   - *Bonds.* Obligations of the issuer to pay money to the holder according to conditions determined at the time of issue. At maturity the issuer must pay a face value and, depending on the type of bond, the issuer may need to pay periodical coupons at a fixed or variable rate. In the BSE the bonds traded are classified into: bank bonds, convertible bonds, central bank bonds, short-term bonds, long-term bonds, municipal bonds and treasury bonds.
   - *Fixed-term deposits*. Issued by banks and other financial institutions at different rates and terms.
   - *Treasury notes.* These are sold in public auctions organized by the Bolivian Central Bank as the state's financial agent.
   - *Deposit certificates of the Bolivian Central Bank.* Securities issued at discount by the Bolivian Central Bank and sold in public auction to the bidder offering the lowest discount rate.
   - *Tax refund certificates (CEDEIM).* Securities issued by the national tax collecting institution (Servicio de Impuestos Nacionales) given to exporters to refund the Value Added Tax. It was created as stimuli of exporting activities.
   - *Promissory notes.* Document through which the issuer makes the unconditional promise of paying the holder a certain amount of money at a certain date. These can be of two types: (1) promissory notes with maturity up to 360 days and (2) short-term promissory notes with maturity up to 270 days which are traded in negotiation rounds and exclusively for Small and Medium-sized Enterprises.
   - *Bond Coupons.*
   - *Securities issued through a securitization process.* These can be of three types: (1) credit securities, when they represent a debt that the issuer must pay to the holder, (2) participation securities, when the holder has property rights in the established equity and (3) mixed, which are a combination of the first two.

b) *Variable income securities:* These are company stocks and, which can be of two types, and participation quotas in investment funds:
   - *Ordinary Stocks*, which entitle the holder the right to vote in ordinary and extra-ordinary meetings.
   - *Preference Stocks,* these are issued with certain special features, generally paying the holders a fixed interest rate when the company earns profit. They do not entitle the holder the right to vote but they rank before ordinary stocks when paying dividends.
   - *Participation quotas in investment funds.* Which are issued by investment funds participating in the BSE.

Fixed income securities represent the largest part of the total value traded at the BSE. Table 1 presents the amounts traded in 2010 based on the type of security. Fixed-term deposits composed over 68% of trades that year. This difference with respect to other securities may be explained by two factors. First, fixed-term deposits are issued only by banks and other financial institutions which represent the largest group of firms listed at the BSE (in fact, they represent almost 40% of the firms listed) and second, fixed-term deposits have been widely available as investment instruments even before the creation of the BSE and are those which common investors are more familiar with.

Table 1. Amount traded in 2010 by security type.

	Total Amount	
	in $us	**% of the total**
Fixed Income		
Bank Bonds	39.124.090	1,00%
Long-term Bonds	324.933.043	8,30%
Municipal Bonds	649.822	0,02%
Treasury Bonds	513.505.008	13,12%
Coupons	31.365.532	0,80%
Fixed-term Deposits	2.677.919.641	68,40%
Treasury Notes	195.643.736	5,00%
Promissory Notes	18.158.424	0,46%
Debt Securities	64.903.530	1,66%
Promissory Notes for SMEs	4.796.242	0,12%
Subtotal	3.870.999.068	98,87%
Variable Income		
Stocks	11.333.056	0,29%
Participation quotas in investment funds	32.890.734	0,84%
Subtotal	44.223.790	1,13%
TOTAL	**3.915.222.858**	**100,00%**

Source: Own elaboration based on Bolsa Boliviana de Valores (2010a).

2.2.2 Types of operations

In the Bolivian capital market securities can be traded in or out of the BSE. The trading mechanisms in and outside the BSE are the following:

a) *Trading mechanisms inside the BSE.* Trading inside the Bolivian Capital Market is done through three different mechanisms:

- In *ruedo* which is the physical infrastructure in which authorized trading activities are done. This mechanism allows the following types of transactions: (1) sale transactions, (2) repo transactions and (3) crossed sale or crossed repo transactions, those in which an operator acts simultaneously as buyer and seller.
- In negotiation round, in which selling transactions of promissory notes previously registered at the BSE take place.
- In auction of non-registered stocks, in which sale transactions of stocks not registered at the BSE take place and are assigned to the best bidder.

b) *Trading mechanisms outside the BSE.* There are two types of transactions carried out outside the Bolivian Stock Exchange (Bolsa Boliviana de Valores, 2011a):
   - Crossed entry transactions. These include repo transactions with the Bolivian Central Bank and transactions with public securities.
   - Auctions of the Bolivian Central Bank. These are transactions in which treasury notes and treasury bonds are auctioned by the Bolivian Central Bank to financial institutions previously approved by the Treasury Securities Administration Council (Concejo de Administración de Títulos del Tesoro General de la Nación).

2.3 The participants in the Bolivian Capital Market

2.3.1 Regulating Authority

Until 2009 the Superintendence of Pensions, Securities and Insurances (*Superintendencia de Pensiones, Valores y Seguros*) was in charge of the supervision of the capital market. This superintendence, along with the Superintendence of Banks and Financial Institutions (*Superintendencia de Bancos y Entidades Financieras*), the Superintendence of Enterprises and the General Superintendence formed the Financial Regulation System (*Sistema de Regulación Financiera, SIREFI*), constituted as an independent body part of the Ministry of Economics.

In February 2009 the Executive Order No. 29894 restructured the executive power in order to adapt it to the new political constitution approved that same year in January. This executive order renamed the Superintendence of Banks and Financial Institutions as Financial System Supervision Authority and established it to also assume the supervision and control of capital markets and insurances (Gaceta Oficial de Bolivia, 2009).

With respect to capital markets, the main functions of the Financial System Supervision Authority are to regulate, supervise and control the capital market and people, institutions and activities related to it, to authorize the creation and modification of rules of the institutions it supervises, to give, modify and renew licenses to people and institutions participating in the capital market, to authorize the issue of new securities, to present accounting rules which must be followed by all supervised institutions and to establish responsibilities and apply sanctions to all institutions under its jurisdiction, among others (Gaceta Oficial de Bolivia, 1998).

2.3.2 Issuers

The issuers in the BSE are organized by sector and they represent a wide range of industries in the country, from financial institutions to manufacturing firms, passing through oil and agro-industrial companies. There were a total of 82 issuing institutions up to December 2010, 37 of which had issued stocks. These are mainly banks and other financial institutions, insurance

companies, electricity companies, oil and transport companies with a total stock market capitalization of $us. 3.363 million by December 2010. Even though they constitute a numerous group, the amount of stocks traded has never exceeded 3,6% of the total amount traded at the BSE (Bolsa Boliviana de Valores, 2010a).

The number of issuers by sectors listed in the BSE is presented in Table 2. The financial sector which includes banks, financial funds, insurance companies, financial cooperatives and other institutions that provide financial services, comprises the largest number of issuers. Also, financial institutions are the only firms that issue Fixed-term Deposits, which are the most actively traded securities at the BSE with a value traded of $us. 2.700 million, which represented 68.40% of the total amount traded in 2010 (Bolsa Boliviana de Valores, 2010a).

Table 2. Number of issuers by sector.

Sector	# of Issuers	% of the total
Agro-industry	3	3,66%
Financial Institutions	32	39,02%
Electricity	10	12,20%
Closed-end Investment Funds	6	7,32%
Industry	8	9,76%
Commercial	1	1,22%
Autonomous Equity	10	12,20%
Oil	3	3,66%
Services	5	6,10%
Transport	2	2,44%
Public	2	2,44%
TOTAL	**82**	**100,00%**

Source: Own elaboration based on Bolsa Boliviana de Valores (2010a).

According to the BSE, Small and Medium-sized Enterprises (SMEs) are technically able to issue any type of securities in the Bolivian capital market; however, there is a specific type of promissory notes (Promissory notes traded in the negotiation round for SMEs) that are to be issued exclusively by firms that comply with the definition of an SME. In spite of this, during 2010, there were ten firms that issued promissory notes of which only five had issued those exclusively for SMEs (Bolsa Boliviana de Valores, 2010a). The number of institutions issuing the different types of securities in 2010 is presented in Table 3. Apart from ordinary stocks, the securities with the largest number of issuers are Fixed-term Deposits and long-term bonds.

Table 3. Number of issuers by type of security issued in 2010.

Issued Securities	# of Issuers
Fixed Income	
Bank Bonds	8
Municipal Bonds	1
Long-term Bonds	15
Treasury Bonds	1
Fixed-term Deposits	18
Treasury Notes	1
Promissory Notes	5
Promissory Notes for SMEs	5
Debt Securities	10
Variable Income	
Ordinary Stocks	36
Preference Stocks	3
Participation quotas in inv. Funds	6

Source: Own elaboration based on Bolsa Boliviana de Valores (2010a).

The number of issuers listed in the BSE is very small compared to the number of enterprises registered in the Bolivian Commercial Registry, which in 2010 reached almost 13.000 without including uni-personal enterprises which represent 69,7% of the total enterprises registered (Fundempresa, 2010) In addition to this, the informal sector in Bolivia is considered to be one of the largest in Latin America, estimated to contribute 22,1% of the GDP[2] and with a proportion of 55,6% of the urban employment (Evia, Pacheco, & Quispe, 2010). This shows the reduced reach of the Bolivian capital market in financing economic activities in the country.

2.3.3 Investors

The largest investors in the Bolivian capital market are institutional investors (Bolsa Boliviana de Valores, 2010b). There are three different types of institutional investors at the BSE:

a) *Pension Fund Administrators (Administradoras de Fondos de Pensiones, AFP's)*. These are private institutions in charge of the administration and provision of social security services: retirement, disablement, death and professional risk, as well as the administration of shares belonging to Bolivian nationals in capitalized enterprises (Gaceta Oficial de Bolivia, 1996). They were established as part of the pension system reform in 1996. Currently there are two Pension Fund Administrators in Bolivia: *AFP Futuro de Bolivia*, belonging to Zurich Financial Services Group and *BBVA Previsión AFP*, belonging to the BBVA Group. However, with the new Pension Law No. 65 approved in December 2010, Pension Fund Administrators must transfer all their accounts to the Public Social Security Administrator (*Gestora Pública de la Seguridad Social*), with which they will stop their activities in the country (Gaceta Oficial de Bolivia, 2010). They are currently the largest institutional investors in the BSE. The total amount invested by December 2010 reached $us. 5.468 million, representing 80% of the total investments by institutional investors. Their portfolio is formed mainly by public sector securities (Treasury Bonds and Treasury Notes) and Fixed-term Deposits which represent 57% and 24,5% of their portfolio respectively (see Table 4). The study

[2] Evia, Pacheco & Quispe (2010) mention that there are studies that have estimated a much larger contribution of the informal sector to GDP reaching 68% in 2002-2003 (see Schneider (2006)).

carried out by Córdova (2010) points out the important contribution made by the private pension fund system in improving regulations, transparency and the overall development of the Bolivian capital market.

b) *Insurance Companies.* Insurance companies are classified as providers of personal or general insurances. Until December 2010 there were six providers of personal insurances and eight providers of general insurances. The total amount invested was $us. 544 million, which represents 8% of the total institutional investments. Their portfolio is composed mainly by Treasury Bonds, Fixed-term Deposits and Long-term Bonds which make up 52%, 26% and 8% of their investments respectively. They also include a small participation of stocks constituting 1,25% of their portfolio (see Table 4).

c) *Investment Fund Administrating Societies, IFAS (Sociedades Administradoras de Fondos de Inversión).* These are established as corporations whose stockholders may only be broker agencies, banks, insurance companies or other institutions authorized by the Financial System Supervision Authority. By December 2010 there were seven IFAS participating in the BSE and they made up a total of twenty-five investment funds (including both open and closed-end funds) with 52.630 participants (Bolsa Boliviana de Valores, 2010a). The total amount invested by this date was $us. 772 million, representing 11% of total institutional investments. Their portfolio is composed mainly by Fixed-term Deposits (83%) and Treasury Bonds (12%). Although with a low percentage (0,4%), they also include stocks in their portfolio.

Table 4. Investment Portfolios of Institutional Investors by December 2010.

	Pension Fund Administrators	**Insurance Companies**	**IFAS**	**Total**	**%**
Instrument	**in 1000 $us**	**in 1000 $us**	**in 1000 $us**	**in 1000 $us**	
Stocks		6.789	2.187	8.976	0,13%
Bank Bonds	52.907	8.662	3.223	64.792	0,96%
Long-term Bonds	552.451	43.295	27.840	623.585	9,19%
Municipal Bonds	11.724	1.368	550	13.641	0,20%
Treasury Bonds	1.269.257	285.100	66.734	1.621.091	23,90%
Part. shares inv. Funds	78.389	13.661		92.050	1,36%
Coupons	9.507	28.494	510	38.511	0,57%
Fixed-term Deposits	1.339.550	140.145	453.554	1.933.248	28,50%
Treasury Notes	1.822.652	6.101	12.679	1.841.432	27,15%
Promissory Notes	607	553	9.473	10.632	0,16%
Prom. Notes for SMEs			228	228	0,00%
Debt Securities	250.213	9.378	4.407	263.998	3,89%
Investment abroad			69.378	69.378	1,02%
Liquidity	80.448		121.171	201.619	2,97%
TOTAL	**5.467.705**	**543.545**	**771.932**	**6.783.183**	**100,00%**
Participation %	**80,61%**	**8,01%**	**11,38%**		

Source: Own elaboration based on Bolsa Boliviana de Valores (2010a) and Autoridad de Supervisión del Sistema Financiero (2010a).

Approximately 80% of the investments made by institutional investors are in public securities (Treasury Bonds and Treasury Notes) and Fixed-term Deposits (which are issued only by financial institutions).

2.3.4 Brokerage Firms

Brokerage firms are the only authorized intermediaries for trading securities registered at the Capital Market Registry. They must be established as corporations and, even though they may trade securities in or outside of a Stock Exchange, they must be stockholders of at least one in Bolivia (Gaceta Oficial de Bolivia, 1998).

They are authorized to intermediate securities on the account of third parties, provide services of financial assessment, represent foreign brokerage firms and people which have activities related to the Bolivian capital market and to make public offers of securities in the account of issuing institutions, among others (Gaceta Oficial de Bolivia, 1998).

By December 2010 there were nine brokerage firms registered by the Financial System Supervision Authority, all of them working in relation with the Bolivian Stock Exchange (Autoridad de Supervisión del Sistema Financiero, 2010a). Table 5 presents the total amount traded and the number of customers of each brokerage firm. It can be seen that over 50% of the total amount traded in 2010 has been concentrated in only two brokerage firms: *Compañía Americana de Inversiones S.A.* and *Bisa S.A. Agencia de Bolsa*.

Table 5. Brokerage Firms by December 2010.

	Total Amount Traded		
Brokerage Firm	**in 1000 $us**	**%**	**# of Customers**
Bisa S.A. Agencia de Bolsa	682.583	17,43%	85
BNB Valores S.A.	522.502	13,34%	102
Compañía Americana de Inversiones S.A.	1.295.494	33,08%	19
Credibolsa S.A.	131.516	3,36%	28
Mercantil Santa Cruz Agencia de Bolsa S.A.	177.201	4,52%	29
Panamerican Securities S.A.	255.191	6,52%	106
Santa Cruz Securities S.A.	161.654	4,13%	18
Sudaval Agencia de Bolsa S.A.	538.602	13,75%	12
Valores Unión S.A.	151.664	3,87%	46
Total Brokerage Firms	**3.916.406**	**100,00%**	**445**

Source: Own elaboration based on Autoridad de Supervisión del Sistema Financiero (2010a)

2.3.5 Securitization Companies

According to the Bolivian law of capital markets, securitization companies are institutions established as corporations which have the function of representing and managing autonomous equity constituted through a securitization process. They are also in charge of issuing the securities backed by the assets that form the autonomous equity and of paying the obligations emerging from the issued securities (Gaceta Oficial de Bolivia, 1998). The Law of Capital Markets (1998) allows the following assets to form part of autonomous equity: public debt securities, securities registered in the capital market registry, receivables, cash flows, sale contracts of goods and services, contracts of financial leasing and factoring, real-estate projects and others according to regulation.

There are currently two securitization companies working with the BSE: *BDP Sociedad de Titularización S.A.* and *BISA Sociedad de Titularización S.A*. which started working in October 2004 and in January 2001 respectively. Besides managing autonomous equity, these two firms securitize assets, future cash flows and structured notes, and they are an additional means by which small and medium sized firms gain access to sources of financing. However, the securities issued through securitization process in 2010 were only $us. 64,9 million, which represents 1,7% of the total amount traded that year at the BSE.

2.3.6 Rating Agencies

All issuers of securities must have a risk rating computed by authorized risk rating agencies (Gaceta Oficial de Bolivia, 1998). There are three rating agencies operating in Bolivia: Pacific Credit Rating S.A., Moody's Investor Service Inc. and Fitch Ratings Ltd. These are obliged to do quarterly reviews of all the risk ratings they are in charge of. They must comply with the categories and rating levels established in the Regulation for Rating Agencies determined by the Financial System Supervision Authority. These are determined for issuers, for long- and short-term debt securities, for variable income securities (ordinary and preference stocks), for participation quotas in investment funds and for insurance companies (Autoridad de Supervisión del Sistema financiero, 2010b).

2.3.7 Security Depositories

Security depositories are established as corporations whose stock-holders are issuers, stock exchanges, brokerage firms, investment and pension fund administrators, banks, insurance companies and international financing organizations (Gaceta Oficial de Bolivia, 1998). The Bolivian Securities Depository Institution (*Entidad de Depósito de Valores de Bolivia S.A.*) is the only institution of this nature working in Bolivia. It was created in March 2002 and it started offering services of custody and administration of physical and dematerialized securities in April 2003. It extended its services to compensation and settlement of stock market operations in January 2005. In 2009 the custody balance was $us. 6.619 million and the total amount of settled operations was $us. 1.828 million which correspond to 5.699 operations (Entidad de Depósito de Valores de Bolivia, 2010).

Currently, the Bolivian Securities Depository Institution provides services to several financial institutions that participate in the Bolivian capital market including all brokerage firms, pension fund administrators, several commercial banks, the National Treasury and the Bolivian Central Bank.

2.4 Capital market size and volume

The Bolivian Stock Exchange had a total of 82 issuers registered by 2010. The total amount traded reached that year its highest level with $us. 3.915 million showing an increase of 40,7% with respect to the previous year (Bolsa Boliviana de Valores, 2010a).

There are 60 issuers that participate in the fixed income security market. The total amount traded in this market has increased from almost $us. 30 million in 1989, which represented 100% of the total trades, to $us. 3.871 million in 2010, representing 98,97% of total trades. At year end 2010 the total amount outstanding of fixed income instruments was $us. 5.011 million (excluding fixed-term deposits which represented 68% of the total amount traded that year) of which 81%

was issued by the public sector and 19% by the private sector[3] (Bolsa Boliviana de Valores, 2010a). The total amount traded in fixed-income instruments in 2010 has increased by 40,4% with respect to the previous year and it is the highest in the history of the BSE. According to the data provided by the Federation of Ibero-American Stock Exchanges (*Federación Ibero-Americana de Bolsas*), the Bolivian Stock Exchange's fixed income market was the fourth largest in Latin America in terms of total value traded.

With respect to the stock market, its market capitalization in 2010 was $us. 3.364 million corresponding to 36 issuing firms. Oil companies' stocks represent over 60% of the total stock market capitalization, followed by electric companies and banks, representing 14,5% and 12% of total market capitalization respectively (see Table 6).

Table 6. Stock Market Capitalization by sector at year end 2010.

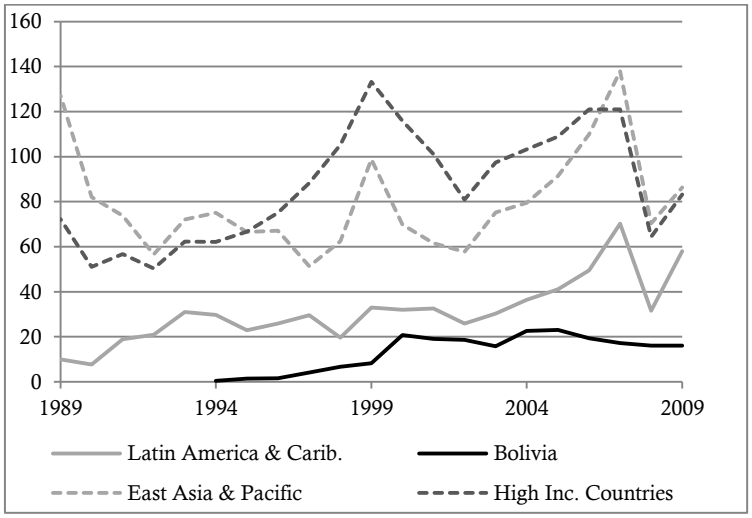
Sector	Market Capitalization in $us	% of total
Agro-industry	4.382.367	0,13%
Banks	404.509.202	12,02%
Electricity Companies	487.782.606	14,50%
Financial Funds	21.710.407	0,65%
Industries	172.872.075	5,14%
Oil Companies	2.070.521.636	61,55%
Financial Services	6.311.131	0,19%
Insurance Companies	84.879.208	2,52%
Services	9.010.388	0,27%
Transport	102.010.745	3,03%
TOTAL	**3.363.989.765**	**100,00%**

Source: Own elaboration based on Bolsa Boliviana de Valores (2010a).

In 2009, stock market capitalization was 16.1% of the GDP, a value slightly lower than that in 2008. The ceiling was reached in 2005 when stock market capitalization was 23% of the GDP. Compared to stock markets in the Latin America & Caribbean region, the Bolivian stock market capitalization has always remained below average. Figure 2 compares the evolution of stock market size measured as percentage of GDP of high income countries, East Asia & the Pacific and Latin America & the Caribbean. Latin American stock markets are smaller than their Asian counterparts, which in the most recent years have been very close to those in high income countries. It can be noted that the most recent financial crisis has had an important impact on the size of stock markets. The Latin American & the Caribbean, East Asian & Pacific stock markets and those of high income countries were reduced by 55%, 49% and 47% respectively from 2007 to 2008. In contrast, the Bolivian stock market capitalization was reduced by only 7% in the same period.

[3] Values calculated from data of the BSE's statistical data base and using the exchange rate of 31st December, 2010.

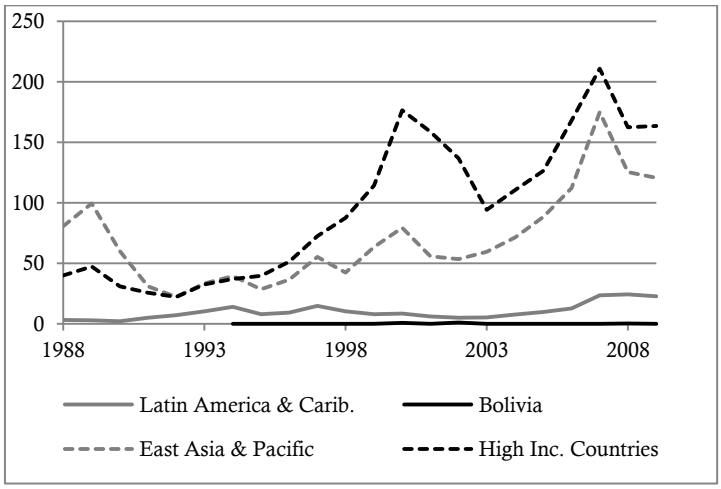
Figure 2. Stock Market Capitalization as % of GDP.



Source: Own elaboration based on The World Bank (2010)

Stock market trades in the BSE during 2010 were only $us. 11,3 million of which $us. 0,58 million were sold in judicial auctions and $us. 10,7 million as regular trades in the BSE. Stock market liquidity measured as the total value of stocks traded as percentage of GDP was 0,014% in 2009 which is extremely low compared to the Latin America & the Caribbean region that reached a liquidity of 23% of GDP in the same year. In turn, next to stock market activity in East Asia & the Pacific and in high income countries which, in 2009, reached 120% and 163% of GDP respectively, Latin American and Caribbean stock markets have a reduced liquidity (see Figure 3).

Figure 3.Stocks Traded as % of GDP



Source: Own elaboration based on The World Bank (2010) and Instituto Nacional de Estadística (2011).

In conclusion, even though the Bolivian fixed income security market seems to be quite developed in comparison to its Latin American counterparts, a large part of its trades are composed by fixed-term deposits which are issued only by financial institutions. This is not the case in other Latin American markets (Federación Iberoamericana de Bolsas, 2010). On the

other hand, stock markets in Latin America are clearly smaller and less active in comparison with those in larger economies and East Asia. The Bolivian stock market is particularly underdeveloped and especially in terms of stock market liquidity. As mentioned previously, this situation may be the consequence of three factors. First, stock trades in BSE are recent and have not been consolidated as regular investment and financing instruments for investors and firms respectively. Second, most Bolivian companies are small, family-owned and are not listed in the Stock Exchange making the number of stock-issuing firms very small. And, third, it is common for firms to sell stocks directly to interested parties and not through the BSE, with which it is not possible to keep a track of stock trades. With respect to the number of issuers, although it has increased since the creation of the BSE, when compared with the total amount of registered firms in Bolivia and considering the size of the informal economy, the number of issuers represents a very small proportion of firms.

CHAPTER 3. Economic Growth in Bolivia.

Bolivia is one of the poorest countries in Latin America. Its economy has been historically based on the extraction and export of natural resources with none or very low levels of transformation going from silver and tin to petroleum and more recently, natural gas and soya, leaving no contribution to technological development and demanding unskilled labor. The country has experimented with many different economic policies in different moments, going from nationalization to privatization, capitalization and, more recently, nationalization again. In spite of this, its economic growth since the 1950's has been very modest and it has been largely determined by the growth in population. Poverty has become an endemic issue and Bolivia has remained one of the poorest countries in Latin America (Mercado, Leitón, & Chacón, 2005). This chapter will briefly describe the economic growth starting from the 1970's and the most relevant economic policies and political events over the last 30 years.

During the right-winged military dictatorship of Hugo Bánzer, during most of the 1970's, Bolivia lived a period of economic prosperity with an average annual growth rate of the GDP of 5,4%. However, it merely reflected the large increase in prices of export products -mostly oil- and the ease of obtaining international credits (Mendieta & Martin, 2009). In this decade Bolivia's external debt increased dramatically as a result of three forces. First, the resources from external debt would be used in investment projects as an attempt to widen the export base. Second, the resources were oriented to cover government expenditure and finally, they were used to enrich elites through the public sector's access to foreign financial resources (Morales & Sachs, Bolivia's Economic Crisis, 1989).

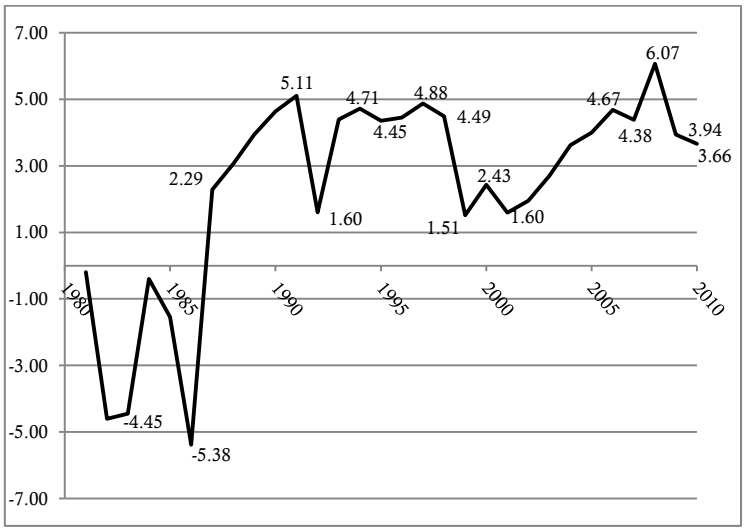
By 1978 political pressures forced Bánzer out of presidency and Bolivia started a period of political and economic instability with several governments, successive coups and failed elections during the following 4 years. None of these governments was capable of establishing measures to counteract the economic situation that was deteriorated by the large external debt, the inability of getting further credit and the fall of commodity prices in 1981. Democracy was restored in 1982 with the appointment of Hernán Siles Suazo as president. The economic situation, however, was in decline and it led to the second largest hyperinflation in world history that was not occasioned by a war or revolution (Morales & Sachs, Bolivia's Economic Crisis, 1989).

The recently established civilian government tried in several occasions to implement programs for stabilizing the economy. Nevertheless, these efforts were rejected by Siles' political allies or by the opposition in congress and caused a loss of credibility in the authorities. The hyperinflation was caused by a conjunction of an enormous effort to fulfill external debt and the impossibility of accessing other internal sources of money in order to comply with it in middle of a conflicting social climate; along with the reduction of tax revenues and an increasing deficit in public budget that the government tried to cover with seignorage. The inflation rate increased from 25% in 1981 to its highest level, 8.170,5% in 1985 (Mendieta & Martin, 2009; Morales & Sachs, Bolivia's Economic Crisis, 1989).

Hernán Siles was forced to shorten his mandate calling for elections one year in advance in 1985. The newly elected president, Víctor Paz Estenssoro, implemented a new economic policy that basically dismantled the state capitalism that prevailed during the previous decades leading to a liberalization of the economy. It was comprised of several measures to stabilize the economy including the liberalization of prices, the reduction of internal controls, the relaxation of employment laws and the establishment of a stable unified exchange rate backed by fiscal and

monetary policies. The stabilization measures managed to control the hyperinflationary process, the exchange rate maintained an acceptable range and the recession in the real sector during the 1978-1986 period was reverted. Also, the international reserves increased during this period. In late 1985, however, the international prices of tin and petroleum dropped and, in order to maintain the fiscal balance, the government reduced employment in the public mining company (COMIBOL) and in the public oil company (YPFB). COMIBOL reduced its amount of employees from 30.000 in 1985 to 7.000 in 1987 and YPFB from 9.000 to 5.000 in the same period. These workers remained un-employed, marginally employed or obtained employment in the coca-leaf producing region in the country (Morales & Sachs, Bolivia's Economic Crisis, 1989; Mercado, Leitón, & Chacón, 2005). The lowest GDP growth rate during this period of crisis reached a negative 5,38% in 1986 and a negative growth of GDP per capita of 7,3% (see Figure 4).

Figure 4. Evolution of real GDP growth rates in Bs. of 1990 (basic prices).



Source: Own elaboration based on Instituto Nacional de Estadística (2011).

The economic reforms during the Paz Estenssoro government were extended during the government of Gonzalo Sánchez de Lozada from 1993 to 1997 in what were referred to as *second generation reforms*, among which the most relevant were the capitalization of state-owned companies, the reform of the pension system and the Popular Participation program. State-owned companies including the railway company (ENFE), the national airline (LAB), the oil company (YPFB), the electricity company (ENDE) and the national telecommunications company (ENTEL) were immersed in a deep crisis facing annual losses and incapable of expanding. The capitalization of these companies implied the sale of 50% of the shares of these companies to foreign investors that, unlike a regular privatization, would be paid in the form of direct investments in the companies. The remaining 50% of the shares were transferred to Bolivian citizens of more than 21 years of age and managed by private pension fund administrators (Mercado, Leitón, & Chacón, 2005; Requena, 1996).

The pay-as-you-go pension system in force was substituted by an individual capitalization pension system in order to overcome several problems due to demographic transition, a low relation of contributors to beneficiaries, an insufficient level of reserves and high administration

costs[4]. This change was carried out without external financing and became a heavy load in public finances. The third reform to be highlighted in this period is the Popular Participation. It was established as a mechanism to change the structure of the government into a more decentralized one. Priority was given to the development of municipal governments, resources of the central government were transferred to them and mechanisms that eased the participation and the control of native and rural communities and neighborhood associations were established (Terán, 1997).

The economy during the 1993-1997 period improved considerably. The international reserves reached $us. 1.000 million, the inflation rate was kept low and in 1997 it reached its lowest level in 22 years with 6,7%. During this period the annual average GDP growth rate was 4,6% while the GDP per capita increased by an average of 1,6% (UDAPE, 1998).

The global crisis which had its origins in Asia in 1997 and the natural disasters that hit the region[5] had a large impact on the economic performance of Latin America as a whole in 1998. The GDP growth rate in the region fell from 5,4% in 1997 to 2,3% in 1998. However, the Bolivian economy in 1998 had a growth rate of 4.5%, above the regional average while the GDP per capita grew in 2,01%. The effects of the external scene along with internal factors such as the completion of the sales contract of natural gas to Argentina, the termination of the construction of the gas pipeline to Brazil and the delay in negotiations to sell gas to this country were felt in Bolivia in 1999 when GDP growth rate fell to 1,5% and the GDP per capita growth was a negative 0,88% (UDAPE, 1999; ECLAC, 1999; Banco Central de Bolivia, 1999). Although in 2000 the GDP growth rate rose up to 2,4%, in 2001 it dropped again to 1,6% while the GDP per capita growth in these years was 0,06% and a negative 0,72% respectively.

Gonzalo Sánchez de Lozada won the 2002 elections with only 22% of the votes and through several political negotiations in congress was re-elected president[6]. Since the beginning of his government he had a fragile coalition to face a very strong opposition. In February 2003 an attempt to increase wage taxes by the government generated several protests which ended up in violent confrontations between the National Army and the Police. The social discontent increased in the following months together with severe criticism to the government's economic policy. The announcement of a project to export natural gas to the United States through Chile, Bolivia's historical enemy since the War of the Pacific, triggered a harsh political crisis in October in which massive protests demanded the resignation of the President. More than 60 people were killed during the confrontations and the 17th of that month Gonzalo Sánchez de Lozada resignated and fled the country[7]. The presidency was assumed by the vice-president Carlos Mesa. This situation emphasized the need to establish a new political and economic

[4] The main difference between the pay-as-you-go and the individual capitalization pension systems is in the financing. In the pay-as –you-go system pensions are financed partly by the contribution of active workers and partly by the state. These resources go to a common fund from which pensions are paid. In the individual capitalization system each contributor has an individual account in which contributions are made and earn profit from the investments made by the pension fund administrators. These funds are given back to the contributor upon retirement.

[5] The Andean region was the most affected by "El Niño" including Peru and Ecuador and large regions of Chile, Argentina, Paraguay and Brazil.

[6] Before the new Political Constitution of 2009, if none of the presidential candidates obtained majority of the votes, the presidency would be defined through political negotiations by members of the political parties that had obtained a seat in congress.

[7] Gonzalo Sánchez de Lozada is currently living in the United States. The Bolivian government made a request of extradition to the United States in 2007 and has received no response up to date.

agenda that would generate institutional changes in strategic areas such as the hydrocarbon sector. In 2004 the new government implemented an austerity program aimed at reducing public spending, introduced a new transitory tax, carried out a referendum regarding the export of natural gas, and established measures to stimulate domestic demand. The GDP growth rate, which in 2003 reached 2,7%, increased to 3,62% in 2004 and the inflation rate which was 3,94% in 2003 increased to 4,6% in 2004 (ECLAC, 2004; ECLAC, 2003; ECLAC, 2005; Villar, 2003).

In 2005 the discussion of the new Law to regulate the Hydrocarbon sector and its approval in May of that year generated movements demanding the nationalization of these resources. This situation eventually ended up in the resignation of the president in June and, through constitutional succession, the appointment of Eduardo Rodríguez as President, who, up to that moment, was president of the Supreme Court. His government was in charge of calling for elections in December that year. In spite of the internal political crisis, the economy was favored by the implementation of a direct tax to hydrocarbon resources, by the increase of the internal demand and by external circumstances such as the rise in prices of petroleum (44,1%) and natural gas (28,9%), increasing the growth rate of GDP to 4% and of GDP per capita to 1,8% (ECLAC, 2006; Banco Central de Bolivia, 2005).

In the elections of December 2005 the Movimiento al Socialismo headed by Evo Morales won the elections with 54% of the votes, being the first indigenous President in the country and the first time since Bolivia's return to democracy in 1982 that a political party won the presidency and the majority in the lower chamber of Congress. These elections were also particular because, in response to several movements demanding departmental autonomies, they were the first in which regional governors, which up to that moment were appointed by the president, were elected directly by the population. The following year was characterized by several reforms leading to the nationalization of the economy, reverting the liberalization process that had been introduced during the late 1980's and further deepened in the mid 1990's. The most important measure taken in this direction was the nationalization of the Hydrocarbon sector through the executive decree of May 1st, 2006. With this decree all companies involved in the production of petroleum and natural gas were forced to pass all production to the national oil company, YPFB, which would be in charge of assuming its industrialization, internal commercialization and exports. In the same way, the capitalized companies would have to sell the amount of shares necessary for YPFB to control at least 50% plus 1 of the shares (ECLAC, 2007; Gaceta Oficial de Bolivia, 2006).

The nature of international integration agreements also changed and relations with Cuba and Venezuela were deepened. The demands for structural changes in the state as a response to the continuous political crises lived in the country led to the elections for members of the constitutional assembly in July 2006 and to the further installment of the constitutional assembly in August of the same year. The economic performance of the country during this transition period was positive. The GDP grew in 4,7%, the GDP per capita grew in 2,5% and the international reserves reached a historical ceiling with $us. 3.178 million. Most of this growth was due to the policies implemented by the government in the hydrocarbon sector starting with the Law regulating the hydrocarbon sector approved during President Mesa's administration in 2005 and to the rise in prices of natural gas. In addition, the external public depth was reduced from 52,8% to 30,6% of the GDP due to debt cancellations by the World Bank, the International Monetary Fund, the Government of Japan and the Inter-American Development Bank (ECLAC, 2007; Weisbrot & Sandoval, 2007).

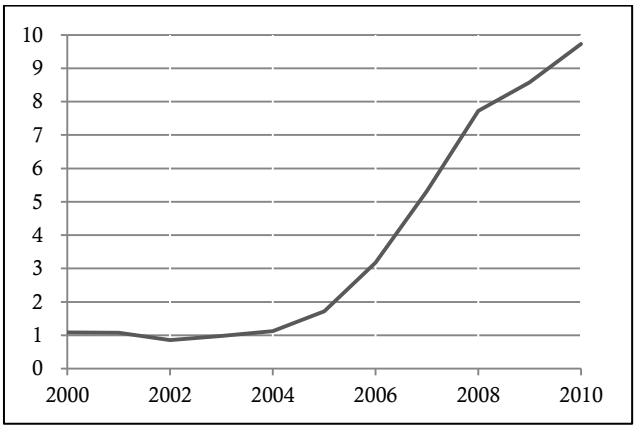
In 2007, the "El Niño" phenomenon had a negative impact in the agricultural sector particularly in the departments of Beni and Santa Cruz. The GDP grew in 4,4%, which was caused mainly by the increase in domestic demand driven by private consumption and by public investment; the GDP per capita increased by 2,2%. In 2008 the political scene was marked by several tensions between the ruling party and the opposition, which was gathered around regional governments. This situation led to a referendum for regional autonomies and for revoking the mandate of the President and governors. The president was confirmed in his position as well as the governors of all departments except La Paz, Cochabamba and Oruro. In the economic scene during 2008, the Bolivian GDP reached its highest historical level with a growth rate of 6,1% and the GDP per capita increased by 3,95%. These growth rates are estimated to be caused by the increase of export prices of natural gas and soya and to the increase in the export of minerals. The economic sectors that had the largest contribution to GDP growth were metal and non-metal minerals, construction, and commerce. The inflation rate during this period reached 11,8% and the international reserves reached a historical ceiling once again with $us. 7.722 million (ECLAC, 2009; ECLAC, 2008b).

During 2009 the political scene was also marked by electoral processes: the referendum for the approval of the new political constitution and Presidential elections in December in which the president was re-elected with 64% of the votes. The GDP growth rate during that year decreased to 3,9%, a value higher, however, than the International Monetary Fund Estimates. This reduction was caused mainly by the decrease in international prices of Bolivia's main export goods during the last quarter of 2008 and other effects of the global financial crisis such as the decline in foreign investment, the drop of remittances and the revocation of trade preferences by the United States. The international reserves, on the other hand, increased up to $us. 8.580 million (ECLAC, 2008a; Weisbrot, Ray, & Johnston, 2009).

In 2010 the Bolivian economy grew by 3,7%, the GDP per capita increased to 1,68% and the international reserves increased to $us. 9.729 million. The economic sectors with more dynamism were the construction sector and the hydrocarbon sector due to the increase in the demand of natural gas in Argentina and Brazil (ECLAC, 2011). On December 26th, 2010, by executive decree, the government increased the prices of gasoline and diesel by 73% and 82% respectively (Bolpress, 2010). This situation unchained several protests against the government and the president was forced to repeal the decree 5 days later. This situation together with several scandals of corruption involving some of the most important people of the government and the increase in the production of cocaine has led to the drop of popular support to the president and his government.

It is important to highlight the increase in international reserves which have reached unprecedented levels in Bolivia. As a percentage of the economy, it has reached higher international reserves than China and, in comparison with countries that have a similar exchange rate regime such as Nicaragua and Botswana, Bolivia has more than twice the level of international reserves (Weisbrot, Ray, & Johnston, 2009; IMF, 2008). The evolution of the level of international reserves from 2000 to 2010 can be seen in Figure 5. By January 2011 the international reserves exceeded $us. 10.000 million and currently the government is planning to invest $us. 2.000 million of the international reserves in productive projects aimed at promoting development, which shall be discussed with several social organizations in the country.

Figure 5. Evolution of the International Reserves in billions of $us.



Source: Own elaboration based on Banco Central de Bolivia (2011)

With respect to poverty, Bolivia has had the highest levels in South America and this situation has changed little in the past 50 years. The data available on poverty and inequality goes up to 2007 besides estimates for 2008, which can be found in Table 7. Although there has been a slight improvement in the most recent years, it remains a big problem particularly in the rural area (Mercado & Leitón-Quiroga, 2009).

Table 7. Poverty and Inequality Indices in Bolivia.

Indicator	1996	1997	1999	2000	2001	2002	2003-2004	2005	2006	2007 (p)	2008 (e)
Moderate Poverty incidence (%)	64,8	63,6	63,5	66,4	63,1	63,3	63,1	60,6	59,9	60,1	59,3
Extreme Poverty incidence (%)	41,2	38,1	40,7	45,2	38,8	39,5	34,5	38,2	37,7	37,7	32,7
Gini coefficient	0,60	0,60	0,58	0,62	0,59	0,60	n.a.	0,60	0,59	0,56	n.a.

Notes: (p): preliminary data; (e): estimates by UDAPE
Source: Unidad de Análisis de Políticas Sociales y Económicas (2011)

The most recent economic growth and the increase in the level of international reserves opened the opportunity to implement projects aimed at reducing poverty. The Morales administration has increased spending in social programs promoting health and education for the poor using revenues from the hydrocarbon sector. These are: (i) Bono Juancito Pinto, which gives Bs. 200 (approximately $us. 29) per year to children enrolled in school as an incentive to continue their education beyond sixth grade. (ii) Bono Juana Azurduy de Padilla, which gives money to uninsured mothers as an incentive to seek medical attention during and after their pregnancy in order to reduce maternal and infant mortality. It gives Bs. 50 (approximately $us. 7,2) each of four prenatal controls, Bs. 120 (approximately $us. 17,4) for the first post-partum control and Bs. 125 (approximately $us. 18) in each bi-monthly control until the child is two years old. And (iii) Renta Dignidad, which is an extension of the previously implemented Bonosol program, which gives an annual payment to people over 60 years of age. The payment consists of Bs. 1.800 (approximately $us. 261) to those who receive a pension and Bs. 2.400 (approximately $us. 348) to those who do not and it is aimed to reduce poverty among the elder citizens. It is still not possible to assess the real impact of these programs in increasing the quality of life and reducing poverty (Weisbrot, Ray, & Johnston, 2009).

CHAPTER 4. Financial development and economic growth: Literature review

There are many different points of view with respect to the relevance of financial systems[8] for economic growth. As quoted in Levine (2005), while economists such as Schumpeter, Hicks and Miller point out that ignoring the role and importance of finance would greatly limit our understanding of economic growth, others consider that finance has been given more importance than it should and that financial systems adapt to the development and requirements of the productive sector. This chapter is divided in two main sections, the first one will review theoretical approaches of the relationship between finance and economic growth and the second will make a review of some of the most relevant empirical studies that assess this relationship.

4.1 Theoretical studies on finance and growth

In general there are four views on the relationship between financial development and economic growth. The *supply-leading view* supports that the causal direction goes from financial development to economic growth. The *demand-following view* supports that financial development follows economic growth and responds to the requirements and demands of the real sector. Another view is that financial development and economic growth have a mutual impact on each other. And the last view argues that there is no relationship at all between financial development and economic growth (Apergis, Filippidis, & Economidou, 2007; Graff, 1999).

Most of the theoretical studies attempt to explain the relationship between financial development and economic growth and the mechanisms through which financial systems influence the development of the productive sector from a supply-leading view. According to Levine (2005), the evidence goes as far as Schumpeter who pointed out that a well-functioning banking system is capable of promoting technological innovation by identifying entrepreneurs with high growth potential, which in turn, contribute to economic growth. In order to describe the literature on this subject, the present study will develop on a functional approach to financial systems developed by Levine (2005) in an attempt to organize the several theoretical studies that address the finance-growth relationship.

As pointed out by Merton & Bodie (1995), the main function of financial systems is to allocate economic resources, through space and time, in an uncertain environment. This central function was split up by Levine (2005) in five basic functions: (1) to produce information about possible investments and allocate capital, (2) to monitor investments and exert corporate control, (3) to facilitate diversification and management of risk, (4) to mobilize and pool savings and (5) to facilitate the exchange of goods and services. These functions impact growth through (i) capital accumulation or (ii) technological innovation. In capital accumulation growth models, financial systems affect the accumulation of capital by reallocating savings to capital producing technologies or by altering savings rates. In technological innovation growth models that focus on the development of new products and processes, financial systems can affect the rate of steady-state growth by altering the rate of technological innovation. Figure 6 shows Levine's theoretical approach to finance and growth.

[8] As mentioned previously, in this study a financial system will be understood as the system which allows the transfer of money between lenders and borrowers and which comprises a wide set of financial institutions, markets, services, transactions, regulations and practices.

Figure 6. Theoretical approach to finance system and economic relationship

Source: Levine (1997)

1. *Producing information and allocating capital.*

Investment decisions require information on firms and market conditions in order to allocate financial resources to their most profitable use. For individual investors obtaining this information is very costly since it would imply incurring in fixed costs associated with evaluating firms and market conditions. Financial intermediaries are capable of reducing these costs by constituting themselves in institutions dedicated to the collection and analysis of information, which will enable them to channel several investors' resources to the best possible investments (Levine, 2005; Greenwood & Smith, 1997). In this sense, investors gain access to the expertise and knowledge of intermediaries at much lower costs and will be able to invest in activities that provide higher returns and lower risk (Greenwood & Jovanovic, 1990). Stock markets in particular, have an important role in enhancing information about firms; since stock markets offer investors the possibility of making profit from information before it is openly available, they provide incentives for them to monitor and do research on firms (Levine & Zervos, 1996; Allen, 1993).

At the same time, the improvement of information for investments, considering that investment resources are scarce, will channel resources to the most promising firms. Equivalently, better information will allow intermediaries to identify those firms with better prospects for innovation and new product development. This will reduce financial constraints for the firms and enable them to incur in innovative activities enhancing their productivity, giving better returns for investors and generating growth (King & Levine, 1993b). Growth, in turn, allows more individuals to participate with intermediaries making it possible to generate better information and channel it into better investments generating more growth (Greenwood & Jovanovic, 1990).

2. Monitoring firms and exerting corporate control

The problem of corporate governance is studied in agency theory which deals with how to solve two issues that arise in agency relationships[9]. The first problem is that the principal and the agent have conflicting interests and the second is that it is difficult for the principal to know what the agent is actually doing (Eisenhardt, 1989). In the context of a firm the principal are the shareholders or capital providers and the agent is the manager.

The extent to which capital providers can influence and monitor how firms use resources will improve allocation decisions and increase profitable investments. This will have an impact on firm performance and ultimately, lead to economic growth. Levine (2005) argues that when shareholders are too diffuse, huge asymmetries of information will arise between shareholders and managers and the costs of monitoring they will have to incur in will increase. This will keep shareholders from efficiently exerting corporate governance and may have negative impacts on firm performance since managers may take decisions in favor of their own interest. Although this problem may not occur with the presence of a large concentrated shareholder, this new situation changes the nature of the agency problem and conflict arises between the controlling shareholder and the minorities since the controlling shareholder may manipulate the firm to benefit its own interests to the detriment of those of the others (Levine, 2005).

In this context, financial arrangements arise as a more effective means of monitoring and exerting corporate governance. The trading of a firm's stocks in a well-developed stock market that links information to stock prices will help align interests of shareholders and managers by associating stock prices to managerial compensation through managerial ownership of stocks and stock options (Agrawal & Mandelker, 1987). In the same way, well-functioning stock markets ease corporate takeovers and, assuming that the executives of a poorly performing firm are fired after a takeover, they have more incentives for improving firm performance (Levine, 1997; Holmstrom & Tirole, 1993).

In the case of financial intermediaries such as banks and similar financial institutions, since they mobilize savings of several individuals, they perform monitoring activities for all the participating investors. This reduces the aggregate costs of monitoring and obtaining information. Closer long-run relationships between firms and financial intermediaries can further reduce costs of obtaining information and improve the monitoring of firms (Levine, 2005).

With respect to economic growth, Bencivenga & Smith (1993) argue that better corporate governance exerted by financial intermediaries will reduce credit rationing for productive activities which will be reflected in real growth. Similarly, an active monitoring performed by financial intermediaries may have an influence on innovation since it will improve capital allocation decisions and channel resources to the development of technologies that show to be more promising and that may have a significant impact on economic growth (De la Fuente & Marín, 1996).

3. Facilitating diversification and management of risk

Financial intermediaries, financial contracts and capital markets play an important role in the diversification and management of risk. Levine (2005) distinguishes three types of risk whose

[9] Agency relationships are relationships in which one party, the principal, delegates work to another, the agent, who is in charge of performing that work.

diversification may influence on economic growth. The first type of risk is liquidity risk, which is that associated to the uncertainty of trading an asset quickly enough in the market in order to prevent a loss. Liquidity is important in economic development because some projects may require long-term use of capital and this may cause investors to hold back since they might want to be able to sell their assets quickly in order to access their savings. This may cause a lack of investment in long-term projects that can contribute to economic development. In order to avoid this, the financial system can increase liquidity of investments in this kind of projects in order to raise the participation of investors and channel resources to them (Levine, 1997). Well-developed stock markets reduce liquidity risk by reducing transaction costs and facilitating trade.

The second type of risk is idiosyncratic risk, which is the risk associated to an individual investment independently of others (Black, Hashimzade, & Myles, 2009). Financial systems provide vehicles that facilitate the cross-sectional diversification of idiosyncratic risk therefore reducing the risks associated with individual projects, firms, industries or regions. The financial system's ability to diversify risk may alter savings rates and promote a more efficient allocation of resources. While savers are generally risk averse and higher return projects tend to be riskier, financial systems, through portfolio diversification, will stimulate the shift of resources to riskier projects associated with higher expected returns (Levine, 2005). King & Levine (1993b) argue that financial systems contribute to increase firm performance and economic growth by revealing the potentially large profits of uncertain innovative activities and by offering superior diversification vehicles for the risk associated with them.

The third type or risk is inter-temporal risk, which is a risk that cannot be diversified away at a specific point in time. Examples of such kind of risk are oil shocks which are considered to be highly correlated with most assets and cannot be avoided by portfolio diversification. Financial intermediaries with long life-spans can improve the diversification of inter-temporal risk through inter-generational risk sharing, which spreads the risks associated to certain assets across generations with different experiences (Allen & Gale, 1997; Levine, 2005).

4. Mobilizing and pooling savings

Mobilizing savings is the process of gathering the savings of different individuals and to channel them into investments. This entails overcoming transaction costs of collecting savings from different people and overcoming informational asymmetries in order to make savers more willing to transfer their savings. These issues can be overcome by financial arrangements that facilitate the pooling and mobilization of savings (Levine, 2005). Financial systems which are effective in mobilizing savings can have a large impact on economic development since they can increase capital accumulation, improve resource allocation and promote technological innovation which will have a direct impact on economic growth (Levine, 1997).

The mobilization of savings through the capital market involves multiple bilateral contracts between firms that require capital and individuals that have surplus resources. Such is the case of joint stock companies that issue stocks in order to attract resources from individuals. On the other hand, financial intermediaries can economize on transaction and information costs associated with multiple bilateral contracts by gathering resources of several individuals and allocating them in different firms (Levine, 1997).

5. Facilitating the exchange of goods and services

Financial arrangements can also facilitate the exchange of goods and services by lowering transaction costs, which may promote specialization of functions, technological innovation and economic growth (Levine, 2005). As argued by Greenwood & Smith (1997), the development of production technologies tends to shift firms towards producing increasingly specialized outputs that require specialized inputs. This increases trades between suppliers and buyers. Therefore, taking the most of these production technologies requires financial markets that facilitate the trade of specialized goods and services. However, Levine (1997) points out that although financial markets with lower transaction costs may facilitate and promote specialization, they do not necessarily stimulate the innovation of production technologies, since they may simply expand the set of already available production processes that are economically attractive.

4.2 Empirical studies on finance and growth

The empirical studies on the relationship between financial development and economic growth can be organized into three different categories depending on the type of data they use: cross-country studies, time-series studies and panel studies. Different proxies for financial development and economic growth are used in the different studies; many of them use measures of financial depth, others focus on the role of the banking sector and on stock markets. This section will present a review of the empirical studies in these three categories. An overview of the main strengths and limitations of each of them is left for the following chapter.

4.2.1 Cross-country studies

The first empirical analyses to assess the finance-growth relationship studied the cross-country correlations between measures of financial development and economic growth. Most of these studies include both measures of stock market development and banking sector development in their analyses and they are based predominantly on Ordinary Least Square (OLS) regressions. Many different results have been found among cross-country studies. The results vary according to the countries examined and the proxies and methods used to establish these relationships.

Several studies find a positive association between financial development and economic growth. For example, King & Levine (1993a) who analyze the finance-growth relationship focusing on the banking sector, use an 80 country sample regression and find a strong positive relationship between four measures of banking sector development and three growth indicators, concluding that the initial level of financial development is a good predictor of economic growth. Atje & Jovanovic (1993) include stock markets in the analysis on a sample of 94 countries from the period between 1970 and 1988. They find a positive relationship between stock market development and economic growth but no significant relationship between banking sector development and economic growth. Bekaert & Harvey (1998) focus on six different measures of stock market development in 18 countries from the period between 1986 and 1996 and find a strong positive correlation between stock market development and economic growth. In a subsequent cross-country regression study Levine & Zervos (1998), include measures of stock market and banking development in a sample of 47 countries for the period 1976 to 1993 concluding that stock market liquidity and banking development are both positively and robustly correlated with current and future rates of economic growth, productivity growth and capital accumulation. Furthermore, they suggest that the service provided by stock markets is different than that of the banking sector and can, therefore, provide different means for economic growth.

More recently, Tang (2006) applies both OLS and two-stage least square regressions to assess the finance-growth relationship including stock market, banking sector development and foreign direct investment measures in 14 Asia-Pacific Economic Cooperation (APEC) countries. He finds a positive link between bank and stock market measures and economic growth with both regression methods. With foreign investment measures, however, no relationship is obtained.

Differences between the role of the banking sector and of stock markets in economic growth are found in studies such as those carried out by Shen & Lee (2006) and Fink & Haiss (1999). In the former study Shen & Lee (2006) analyze the impact of both the stock market and the banking sector on GDP per capita growth in a sample of 48 countries concluding that only stock market development has a positive effect on economic growth and that the development of the banking sector has an unfavorable, if not negative effect on economic growth. On the other hand, Fink & Haiss (1999) in a sample of 27 countries, conclude that stock market capitalization has a weak and sometimes negative impact on economic growth but that the banking sector is positively linked to growth.

Differences in the finance-growth relationship among countries with different levels of economic development are also found in several studies. De Gregorio & Guidotti (1995) examine the empirical relationship between financial development measured as the ratio of bank credit to private sector to GDP and economic growth based on a sample of 100 countries using OLS regressions and find a positive correlation with growth; however, when considering panel data from Latin-American countries they find that these measures are negatively correlated. Harris (1997) uses a two stage least squares regression in order to assess the relationship between investments and stock trades and GDP growth in a sample of 49 countries finding a positive relationship only in high income countries. These differences are also pointed out in a study carried out by Minier (2003), which uses regression tree techniques finding that measures of financial development and economic growth are positively correlated in countries with high levels of market capitalization but not in countries with low market capitalization. Rousseau & Wachtel (2001) use a sample of 84 countries to analyze the effects of inflation in the finance-growth relationship finding a strong positive link between financial development measures and real GDP per capita growth; this relationship, however, is weaker in countries with high inflation rates. Finally, Ram (1999) finds evidence of huge structural heterogeneity ignored by cross-country studies when dividing a 95 country sample in three subgroups with respect to their performance level and finds a weakly negative correlation between financial development and economic growth.

A summary of empirical cross-country studies is presented in Table 17 in Appendix A.

4.2.2 Time series studies

The limitations of cross-country studies and the fact that they assume homogeneity across countries have oriented research towards considering time-series analyses. While cross-country studies generally assume that financial development causes economic growth, time-series studies attempt to bring light on the causal relationship issue. This has been done mainly through Granger causality tests within Vector Auto-regressive (VAR) frameworks.

Many time-series studies using multiple country samples have provided further evidence on the cross-country heterogeneity of the finance-growth nexus. For example, the study carried out by Gupta (1984) in 14 developing countries considering the period between 1959 and 1980

considers financial development measures such as M1 and M2 monetary aggregates, domestic and private credit and, due to a lack of data and uses an index of industrial production as a proxy for economic growth. The results obtained differ from country to country: uni-directional causality was found running from financial development to industrial sector development in 8 countries of the sample and a bi-directional causality in the remaining 6 countries. Neusser & Kugler (1998) focused on the effects of financial development on the growth of the manufacturing industry in 13 OECD countries which they considered to be homogeneous using data from 1960 to 1997. They use GDP of the financial sector as a measure for financial development and total factor productivity (TFP) and GDP of the manufacturing industry as measures of the manufacturing sector. Their results show that the GDP of the financial sector is cointegrated mostly with TFP and with the GDP of the manufacturing sector only in 7 of the 13 countries. On the other hand, causality from the financial to the real sector was found only in three countries.

Differences in the finance-growth relationship among countries have also been found by Abu-Bader & Abu-Qarn (2008a) in six Middle-East and North Africa countries using VAR models and Granger causality tests. Arestis & Demetriades (1997) focus their study in Germany and the United States in the 1979-1991 period finding that the links between financial sector and economic growth variables are different in both countries: while the causal direction in Germany goes from financial development to economic growth, in the United States no evidence for causality is found. Another two-country study was done by Jalil & Ma (2008) in China and Pakistan in the period between 1960 and 2005 finding that financial measures have an important impact on economic growth in Pakistan but the effects found in China were not significant. Boubakari & Jin (2010) run Granger causality tests in five countries in the 1995-2008 period and find that stock market development has strong causal links with economic growth only in countries in which the stock market is liquid and highly active.

Among studies that find evidence of bi-directional causality between finance and growth are those carried out by Demetriades & Hussein (1996), Luintel & Khan (1999) and Al-Yousif (2002). The study of Demetriades & Hussein (1996) carries out Granger causality tests in 16 countries between 1960 and 1995 using banking sector development measures and real GDP per capita as proxy for economic growth. Most of their results show bi-directional causality and few evidence is found supporting the supply-leading view that financial intermediary development leads to economic growth. Luintel & Khan (1999) find evidence of bi-directional causality in all of the 10 countries used in their study. Similar results are found by Al-Yousif (2002) in a sample of 30 developing countries in the period between 1970 and 1999.

Support for the leading role of the financial sector in economic growth is found by Rousseau & Wachtel (1998), who use VEC models and Granger causality tests finding strong support for the leading role of financial sector variables, composed by monetary base and banking-sector variables, on growth of real GDP per capita in six industrialized countries between 1870 and 1929. Similar results are found by Xu (2000) in a sample of 41 countries in the 1963-1993 period using VAR models finding that financial development stimulates GDP growth and that investments are an important channel for this.

Focusing on the role of stock markets on economic growth, Arestis *et al.* (2001) use time-series data from six developed countries and, controlling for the effects of stock market volatility and of the banking sector, find that although both banks and stock markets enhance economic growth, the role of stock markets is smaller. Caporale *et al.* (2005) also consider the impact of stock

market development on economic growth in Chile, Korea, Philippines and Malaysia finding that the causal direction goes from stock market development to economic growth.

Numerous country-specific studies of the finance-growth nexus have been carried out yielding many different results. Only in India differences are found among studies carried out using different measures for financial development and considering data from different time spans. For example, Demetriades & Luintel (1996) study the effect of bank deposit liabilities on real GDP per capita in this country from 1961 to 1991 using error correction models and exogeneity tests finding that economic growth and financial development are jointly determined while Bell & Rousseau (2001) find that the financial sector has an important role in promoting economic growth using data from 1951 to 1991. Azarmi *et al.* (2005) use time series regressions focused on analyzing the association between stock market development and economic growth in both pre- and post-financial liberalization periods in India finding that stock market development is associated with economic growth only in the pre-liberalization period and, when considering the post-liberalization period and the whole time span, no correlation is found. More recent studies also find contradictory results in India: while Pradhan (2009) finds that financial development and economic growth are interdependent during the period 1993-2008, Chakrabory (2010), focusing more on stock markets, finds no support that stock markets are important promoters of economic growth using data from 1993 to 2005.

Country-specific studies in other countries include Hansson & Jonung (1997), which studies the finance-growth relationship during the 1834-1991 period in Sweden finding that the relationship between variables are unstable and causality direction depends on the time period being analyzed. In Turkey, Kar & Pentecost (2000) use five different measures of financial sector development and using VEC models find that the causal direction varies with the financial development proxy considered. Thangavelu & Jiunn (2004) with data from 1960 to 1999 in Australia find evidence that the causal direction runs from economic growth to the development of financial intermediaries. A similar result is found in Malaysia in which, in the long-run, the causal direction goes from economic growth to financial development (Ang & McKibbin, 2007) and in Northern Cyprus in which the causal direction runs from economic growth to the development of financial intermediaries (Güryay, Şafakli, & Tüzel, 2007).

Among the country-specific studies that find a unidirectional relationship from financial development and economic growth are the following: In Taiwan Chang & Caudill (2005), using M2/GDP as measure of financial development found uni-directional causation. With data from Tunisia from the period between 1963 and 1993, Ghali (1999) uses VAR models and Granger causality tests obtaining results that establish causal links from financial development to growth using two measures of financial development. In Romania Obreja *et al.* (2008) focusing on different measures of stock market development find that the causal direction goes from stock market development to economic growth and in Nigeria, Nurudeen (2009), finds evidence that stock market development has a positive influence on economic growth.

Finally, there are also country-specific studies that find support of bi-directional causality. Abu-Bader & Abu-Qarn (2008b) find evidence supporting that financial development and economic growth have mutual causation and that financial development causes economic growth through increasing investments and efficiency in Egypt with data from 1960 to 2001. In Sri Lanka, Perera & Paudel (2009) find different causal directions depending on the variables considered for measuring financial development.

A summary of empirical studies based on time-series analysis is presented in Table 18 in Appendix A.

4.2.3 Panel studies

Most of the panel studies carried out to assess the finance-growth relationship use panel root and cointegration tests, dynamic panel data models and panel Vector Auto-regressions and Vector Error correction Models. Some of the strengths of panel studies pointed out by Yu-Jun (2007) are that they allow controlling for country and time-specific effects which can avoid omitted variable bias and that they can assess both the long- and short-run relationship between finance and growth by combining cross-country and time-series data.

Several panel studies using different country samples, data from different time spans and diverse proxies have found many different results regarding the association between financial development and economic growth. For example, a positive relationship was found in the study carried out by Odedokun (1996) which used liquid liabilities as measure of financial depth in 71 countries from 1960-1980 and found evidence that this measure is positively related with the growth of real GDP and that, although financial intermediation more strongly promotes growth in low income countries, its effects are invariant across countries. Similar results were found by Beck *et al.* (2000) and Levine *et al.* (2000) who also included credits to the private sector and commercial bank assets as indicators of financial development. In transition economies Akimov *et al.* (2009) found a robust positive link between finance and growth and the same result was found in a sample of less developed countries by Dawson (2010). Loayza & Ranciere (2002), on the other hand, focused on the long- and short-run association of finance and growth using pooled mean group estimators and found that a positive long-run relationship between financial development and economic growth co-exists with mostly negative short-run relationships.

A negative relationship between financial development and growth was found by De Gregorio & Guidotti (1995) with panel data from Latin American countries. Benhabib & Spiegel (2000), in a sample of four countries concluded that the results of assessing the finance-growth relationship largely depend on the indicators used and on country-specific effects. In samples of 22 market economies and 11 transition countries Fink *et al.* (2005) find that, while in transition economies financial development seems to induce economic growth, in market economies the link appears to be weak and fragile, concluding that, in general, the financial sector and its different segments have diverse effects on economic growth in each country. Rioja & Valev (2004) find that the effect of finance on growth is not uniformly positive and that financial development strongly contributes to economic growth when a size threshold is reached. Rousseau & Wachtel (2000) find a strong positive relationship that weakens with the increase in inflation rates.

Panel studies introducing specific measures of stock market development were carried out by Beck & Levine (2004) and Hagmayr & Haiss (2007). In the former study along with a measure for banking development, the measures of stock market development (stock market capitalization, value traded and turnover ratio) were found to have a strong positive association with real GDP growth in a sample of 40 countries. The latter study focuses on a sample of four south-east European countries and, in addition to banking and stock market development measures, includes a measure for domestic bond markets. Their findings show an important association of domestic bonds and capital stock, with growth of real GDP per capita, while stock markets and banking sector measures appear to have minor and negative effects on economic growth.

Finally, in addressing the causality issue, different results are also obtained; while Christopoulos & Tsionas (2004) find that causality runs from financial depth to economic growth in a sample of 10 developing countries, Apergis *et al.* (2007) in a sample of 15 OECD and 50 non OECD countries find evidence of bi-directional causality between financial depth and growth. Distinguishing between long- and short-run relatsionships, Bangake & Eggoh (2011), in a sample of 71 developing and developed countries, find evidence of bi-directional causality for the long-run finance-growth relationship; in the short-run differences are found among country groups: while in low and middle income countries no short-run effects were found, in high income countries economic growth significantly affects financial development.

A summary of the panel studies discussed is presented in Table 19 in Appendix A.

CHAPTER 5. Capital market development and economic growth in Bolivia

In order to assess the relationship between capital market development and economic growth in Bolivia this chapter will start by presenting a critical review of the different types of empirical approaches followed in the literature in order to provide a solid basis for the choice of the most adequate approach for this study. Next, it will describe the variables that will be used to assess this relationship and their sources. Finally, it will present the empirical methodology in detail and the results obtained.

5.1 Critical review and choice of the empirical approach

As presented in Section 4.2, the empirical studies assessing the finance-growth relationship can be broadly classified in three groups: cross-country studies, time series studies and panel studies. Each of these types is based on determined econometric techniques and has its own strengths and limitations. The following paragraphs will present a critical review on these empirical approaches followed by the choice of the most adequate one for this particular study.

The first studies to assess the finance-growth relationship were based on cross-country regressions. These studies have been adequate as a response to unavailability of data and have proven to be very useful in giving initial insights to the finance-growth relationship. However, they are subject to several limitations which have made them object of much criticism. First, they ignore the time series characteristics of the data used by averaging the variables over the time period considered. Second, with respect to the causality issue, in most cases the studies take for granted that financial development leads economic growth and use single equation models with economic growth as the dependent variable. This may cause conceptual problems making it likely to obtain inconsistent and biased estimators (Ang, 2008). Third, as argued by Ram (1999), the effect of financial development in economic growth appears to be heterogeneous across countries and cross-country studies gather all in the same sack and extend conclusions that may not necessarily hold for countries with different economic conditions. Arestis & Demetriades (1997) consider that cross-country studies present over-simplified results that do not accurately reflect individual country characteristics. Evidence for this can be found in Minier (2003), De Gregorio & Guidotti (1995) and Harris (1997). Thus, although cross-country studies have given an important insight to the relationship between financial development and economic growth, they cannot be generalized since this relationship is determined also by the economic, institutional and policy characteristics of each individual country. In addition, Levine & Zervos (1996) recommend that cross-country regressions should be viewed only as suggestive correlations that stimulate further research on the issue.

Panel studies on the finance-growth relationship have been developed as an attempt to incorporate the time dimension to cross-sectional data in their analysis. This has allowed for several benefits: first, they enable the possibility of exploiting time-series and cross-sectional variation. Second, panel estimators make use of instrumental variables based on previous realizations of the explanatory variables in order to account for potential endogeneity of other regressors. This is not possible in cross-country studies. And, third, there are specialized techniques that help avoiding biases associated with unobserved country-specific effects which are present in cross-country studies (Levine, 2005).

The main drawback of this approach is that it requires to average data over a certain period, usually five years, which may not be adequate to assess the long-run finance-growth relationship. Hence, this method may be less adequate than methods based on data with lower-frequency (Levine, 2003). This makes it difficult to derive reliable policy implications from these studies (Demetriades & Andrianova, 2004).

The weaknesses of cross-country studies have geared the attention to country-specific studies which have generally been based on time series analyses. Although these give a significant assessment on the country-specific relationship between financial development and economic growth which may be used as reference for policy development, they are also subject to limitations. The availability of data is a particular problem for these studies since large amounts of data through long time spans are necessary in order to obtain valid results; this issue is particularly hampering for developing countries where financial systems have low levels of development and the data available is scarce and may invalidate the results obtained. The unavailability of data can also cause omitted-variable problems that increase the unreliability of the results. Additionally, such as in the many studies presented that focus on India, different proxies for financial development and data from different time periods provide different results, showing the importance of choosing the variables that adequately address the relationships to be studied. Finally, Ang (2008) also points out that, when applying time series analyses, the results obtained may also be sensitive to the lag length chosen and the inclusion of trends in the econometric specification.

By focusing on a specific country, this study automatically overcomes the limitations of both cross-country and panel studies and the econometric techniques available are narrowed down to those that respond to the characteristics of country-specific data. Given that economic growth and financial development are measured by indicators which have time series characteristics (they evolve and are measured over time, they are chronologically ordered and they are available in defined frequencies) and that the interest of the study is to assess the relationship between multiple variables, the study will be based in econometric techniques that allow the modeling of multiple time series.

Brandt & Williams (2007) consider four approaches for modeling multiple time series data: (1) the Simultaneous Equation Approach, which builds a model based on a single theory to determine the relationships between several variables and then turns them into a set of equations defining beforehand which variables are endogenous and which are exogenous. (2) The ARIMA approach is also based on a single theory that explains the relationship between the variables at hand. It consists of analyzing univariate time series individually and, once the dynamics are known, a model is built in which some of the variables are introduced as pulse or intervention. (3) The Error Correction approach which is a specialized case of the ARIMA and the Simultaneous Equation approaches. It considers elements that allow the description of both long- and short-run behavior between the variables. (4) The Vector Auto-regression Approach focuses on the underlying correlation and dynamic structure of the time series studied. It does not assume knowledge on the structure of the primary relationship which generated the time series. The VAR model is a multivariate model in which each variable is assumed to be dependent on its past values and on past values of all the other variables in the system.

The Vector Auto-regression approach has several advantages over the other approaches in modeling multiple time-series. First, from the perspective of model formation and theory testing the VAR approach is the most general one since it is able to recognize multiple theories by

including variables as endogenous and it does not require a precise knowledge of the underlying structure of the relationship between the variables (Brandt & Williams, 2007). In the context of assessing the finance-growth relationship this characteristic allows not to assume that financial development generates economic growth or vice-versa, which may lead to making incorrect inferences, but to obtain evidence on the nature of the relationship based on the time series analyzed. Second, if cointegration tests provide evidence of long-run relationship between the variables, the VAR model can be modified to its Vector Error Correction form in order to account for this relationship. Third, they allow performing tests for the direction of causality, which, in the context of assessing the finance-growth relationship, may help establish action guidelines to develop policies that promote economic development. Finally, estimation of VAR models is simple in the sense that Ordinary Least Squares methods may be used to estimate each equation of the model separately.

VAR models, however, are also subject to limitations. The first one is concerned with the a-theoretic nature of the VAR approach. Since it is not based on a solid economic theory all variables can be cause or consequence of all others. In the context of assessing the finance-growth relationship, however, this can be considered as an advantage since it allows to avoid making incorrect assumptions regarding the exogeneity and endogeneity of the variables. Second, the inclusion of several lags in the model leads to the loss of degrees of freedom, which can become a serious issue when the amount of data available is limited. Finally, VAR models are sensitive to the inclusion or exclusion of variables, thus, the results obtained must be interpreted cautiously (Lu, 2001).

In spite of their limitations, VAR models are a useful method for analyzing the relationship between multiple time series. Therefore, this study will develop a Vector Autoregressive (VAR) approach in order to provide insights of the relationship between the development of the Bolivian capital market and its economic growth for the period between 1994 and 2010.

5.2 Variables and data sources

Throughout the literature that assesses the finance-growth relationship, researchers use many different measures for economic growth which are mainly related to GDP such as real GDP, real GDP per capita and real GDP per capita growth. The measures of financial development go from measures oriented to provide insights of the banking system, such as bank assets and credits of commercial banks, to measures that provide insights of stock market development, such as stock market capitalization and stock market liquidity[10].

The purpose of this study is to assess the impact of the development of the Bolivian capital market in its economic growth; therefore, it focuses on indicators that reflect the state of development of the capital market, more specifically, of the Bolivian Stock Exchange, since it is the only stock exchange in the country. As described in Chapter 2, the Bolivian capital market is quite underdeveloped and most of the instruments traded are bonds, fixed-term deposits and other fixed-rent instruments. The indicators used attempt to capture the particular characteristics of the Bolivian capital market and follow, to some extent, the indicators presented by the World Bank's Financial Sector Development Indicators and the different indicators of financial development used in the literature that addresses this issue.

[10] The different measurements used in the literature can be found in Tables 17, 18 and 19.

Although the BSE started its operations in 1989, the data covers the 1994-2010 period because the trading of stocks was introduced just in 1994. Given the short time-span for the analysis this study uses quarterly data with the purpose of increasing the number of observations in order to obtain more significant results from the time series analysis.

Stock market development is measured in size and liquidity and relative to GDP in order to reflect stock market development relative to the size of the economy. Although, as argued in previous sections, it is common for firms to trade stocks outside the BSE there are no data available for these transactions; therefore, these measures represent only the stocks listed and traded at the BSE. It is important to highlight that, given that the amount of stocks traded in the BSE has always represented small fractions of the total value traded (e.g. only 0,29% in 2010), it is possible that the impact on economic growth is reduced. *Stock market capitalization to GDP (SMC)*, defined as the value of listed shares divided by GDP is used as a measure of size. Since the value of listed shares is a stock variable and is measured at the end of a period and GDP is a flow variable measured relative to a period, adjustments must be made in terms of deflating and correcting timing. In order to address this issue the stock market capitalization variable is calculated with the following formula (Beck, Demirgüc-Kunt, & Levine, 1999):

$$SMC = \frac{0.5 * \left(\frac{Stock\ mkt\ capitalization_{\ t}}{CPI_{e,t}} + \frac{Stock\ mkt\ capitalization_{\ t-1}}{CPI_{e,t-1}}\right)}{\frac{GDP_t}{CPI_{a,t}}} \qquad (5.1)$$

Where $CPI_{e,t}$ and $CPI_{a,t}$ are the consumer price indexes at the end of period t and the average during period t respectively. On the other hand the proxy for stock market liquidity is the *total value of stocks traded to GDP (VST)*, defined as total amount of shares traded in the BSE divided by GDP. In this case, since both are flow variables measured over the same time period, no deflating is necessary.

The development of the fixed-income security market is measured in terms of size and liquidity of fixed-income securities issued by the public and private sector and relative to GDP. *Public fixed-income securities registered to GDP (PSR)* is defined as the total amount of registered domestic debt securities issued by the public sector divided by GDP[11]. *Private fixed-income securities registered to GDP (PvSR)* is the total amount of registered domestic debt securities issued by private institutions divided by GDP[12]. The proxies for the liquidity of the fixed-income security market is the total value of *public fixed-income securities traded to GDP (PST)* and *private fixed-income securities traded to GDP (PvST).* Since both the numerator and denominator of these measures are flow variables measured over the same time period, no adjustments are necessary[13].

As measure of economic growth, this study uses *real GDP per capita (GDPpc)*. This indicator is widely used in the literature, it has been found to be related to many measures of economic

[11] Following the categories of securities traded at the BSE, public securities include Central Bank Bonds, Municipal Bonds, Treasury Bonds, Treasury Notes, Deposit Certificates issued by the Central Bank, Tax refund Certificates and Fiscal Credit Notes.

[12] Private securities include Bank Bonds, Convertible Bonds, Long- and Short-term Bonds, Bank deposit Certificates, Deposit Refund certificates, Negotiable Credit Note Certificates, Bills of Exchange, Coupons, Fixed-term deposits, Promissory Notes and Promissory Notes for SME's.

[13] An alternative measure of the size of fixed-income security markets proposed by Beck *et al.* (1999) is the value of public and private outstanding securities to GDP; however, it was not possible to obtain this data from the Bolivian Stock Exchange.

performance such as infant mortality and adult literacy, and it has been used by economists and other social scientists as the preferred measure of economic growth (Quah, 2001). Quarterly real GDP is available in Bs. of 1990 at the National Institute of Statistics' (*INE*) database. Quarterly population, however, had to be estimated from annual population projections obtained from the International Monetary Fund's World Economic Outlook database. The annual population data was converted into quarterly population following a method presented by Celi & Cadena (2000) which assumes that the quarterly population growth rate is constant between years *n-1* and *n.* The quarterly growth rate during year *n* (r_n) is determined using the following equation:

$$r_n = \left(\frac{x_n}{x_{n-1}}\right)^{1/4} - 1 \qquad (5.2)$$

Where x_n and x_{n-1} are the population in years *n* and *n-1* respectively.

All Gross Domestic Product data were obtained from the National Institute of Statistics' (*INE*) database and at basic prices in order to avoid distortions due to import rights, value added tax and other indirect taxes. The measures related to the Bolivian Stock Exchange (stock market capitalization, value of stocks traded and fixed-income securities traded and registered) were obtained upon request from the BSE's Development and Information department.

5.3 Empirical methodology

As described by Brandt & Williams (2007, p. 14), "vector autoregression models are an approach to modeling dynamics among a set of endogenous variables". These models focus on the data and their dynamics and they are based on the idea that restrictions on the data analyzed and on the parameters should be viewed with skepticism in order to maintain the most complete perception of the data and their interrelations with the purpose of avoiding incorrect assumptions.

The basic Vector Autoregression models are, then, interdependent reduced form dynamic models. They consist of a set of equations, one for each endogenous variable in the system, which makes each of them dependent on their own past values and on the past values of all other variables in the system (Brandt & Williams, 2007).

Estimating a VAR model requires following several steps in order to deal with several issues. The first one is the stationarity of the variables included in the model. Most time series variables in economics are trended and, hence, non-stationary. Working with non-stationary data may cause large problems in modeling due to the risk of obtaining spurious regressions; however, transformations of the variables may be carried out in order to make them stationary. Usually, when the variables at their levels are non-stationary, their first differences are and, if there is a linear combination of these which is stationary, then the variables are said to be cointegrated, meaning that they share a common trend. This linear combination connects the variables in the long-run. If this is the case the VAR framework must be modified into its error correction representation which will allow obtaining consistent estimates of the relationships between the variables specifying how they are related both in their short-run dynamics and in their long-run trends (Brandt & Williams, 2007; Asterious & Hall, 2007).

Once stationarity and cointegration issues have been dealt with, the next step is to estimate the model. For this it is necessary to determine a lag length which ensures Gaussian residuals. Once

the model is adequately estimated, Granger causality tests can be carried out in order to assess the causal relationship between the variables. In the following subsections each of these issues is dealt with in detail.

5.3.1 Unit root tests and cointegration analysis

In general terms a time series is considered to be stationary if its statistical properties do not change over time. Considering a more precise definition two different forms of stationarity can be distinguished. A time series is considered to be *strictly stationary* if the entire joint distribution is independent of the time in which it is measured and depends only on the lag. That is, a time series y is considered to be strictly stationary if the distribution of the set $(y_{t_1}, y_{t_2}, \dots, y_{t_n})$ is the same as the distribution of $(y_{t_1+s}, y_{t_2+s}, \dots, y_{t_n+s})$ for every n, t_1, t_2, …, t_n and s (Hannan, 1967). On the other hand, a time series is considered to be *weakly stationary* if its expected value, its variance and its covariance do not change with time. For a time series y, this can be expressed in the following way (Alexander, 2001):

$$E(y_t)\ is\ a\ finite\ constant$$
$$V(y_t)\ is\ a\ finite\ constant$$
$$cov(y_t, y_{t-s})\ depends\ only\ on\ the\ lag\ s$$

A weakly stationary time series is also referred to as *stationary in the wide sense, second order stationary, covariance stationary* or simply *stationary* (Fuller, 1996). Since the statistical methods to be used in this study require time series to be weakly stationary, the term *stationarity* will refer to the weak form.

Besides making sure to avoid spurious regressions, stationarity tests are important because if the time series are non-stationary, the standard assumptions for asymptotic analysis of the estimated models will not be valid (Brooks, 2008). There exist statistical tests for determining whether a time series is stationary or not. If it is not, it can be differenced as many times as needed in order to achieve stationarity. Thus, after differencing the time series, stationarity tests must be performed again in order to see if stationarity has been achieved. A time series is integrated of order x or *I(x)* if it has to be differenced x times in order to become stationary. Note that following this notation a stationary time series is *I(0)*.

The most commonly used tests for stationarity are unit root tests. These are based on Autoregressive processes and can be explained considering the following AR(1) model of the time series y:

$$y_t = \mu + \lambda t + \phi y_{t-1} + \varepsilon_t \qquad (5.3)$$

Where μ is a constant and λ is the coefficient of a trend which may be included in the model depending on how the series behaves; ϕ is the coefficient of the lagged term of the variable and ε_t are the residuals. There are three possible cases regarding ϕ: (1) if $|\phi| < 1$ then y_t is a stationary series; (2) if $|\phi| > 1$ then y_t is an explosive series; and (3) $|\phi| = 1$ in which case the series is non stationary and is said to have a unit root (Asterious & Hall, 2007). Unit root tests are tests for the null hypothesis that $|\phi| = 1$ (the series has a unit root and is non-stationary) against the alternative that $|\phi| < 1$ (the series is stationary).

The most important tests for unit roots are the augmented Dickey-Fuller (ADF) test and the Philips-Perron (PP) test. These tests are based on taking the first differences of the model in equation (5.3):

$$\Delta y_t = \mu + \lambda t + \gamma y_{t-1} + \varepsilon_t \tag{5.4}$$

Where $\gamma = \phi - 1$. The ADF and the PP tests are *t* tests for the null and alternative hypotheses that $H_0: \gamma = 0$ (the series y_t has a unit root and is non-stationary) and $H_1: \gamma < 0$ (the series y_t is stationary).

The ADF test is an extension of the simpler Dickey-Fuller test including additional lagged terms of the dependent variable in order to eliminate autocorrelation in the residuals. The model in (5.4) is modified to the following form (Kirchgässner & Wolters, 2007):

$$\Delta y_t = \mu + \lambda t + \gamma y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t \tag{5.5}$$

The number of lags to be considered is usually determined by the Akaike Information criterion (AIC), the Schwarz Bayesian criterion (SIC) or the Hannan-Quinn criterion and it must ensure that serial correlation is eliminated from the residuals[14].

While the ADF test assumes that the error terms are independent and corrects for any serial-correlation by adding lagged values of the dependent variable, the PP test allows milder assumptions on the distribution of the errors by making corrections to the *t* statistic in order to account for serial correlation in the residuals (Asterious & Hall, 2007). The test procedure is similar to the one used in DF and ADF tests considering the following regression equation:

$$\Delta y_t = \mu + \lambda t + \gamma y_{t-1} + \varepsilon_t \tag{5.6}$$

Besides the advantage of relaxing assumptions regarding the correlation of the error term, the PP test, in contrast with the ADF test, does not require specifying the lag length.

The only remaining issue in testing for unit roots is dealing with whether or not exogenous parameters must be included in the regression model. This can be determined by plotting and observing the data in order to get an idea of the presence of deterministic regressors or by estimating the most general case in which both a constant and a trend are included, assessing if it is the most adequate one and if not, moving to the less general ones until the best model is found (Asterious & Hall, 2007).

With the purpose of getting a broad idea of the behavior of the series over time, Figure 7 presents plots of the time series analyzed in this study. Generally, macroeconomic aggregates such as real *GDP* per capita present both a constant and a trend as deterministic regressors (Zivot & Wang, 2006); this can be seen in Figure 7a since the shape of the series plotted shows an upward trend and an intercept. However, a more detailed look at the plot in Figure 7a suggests also the presence of seasonal effects since the same pattern is repeated every four quarters. In order to eliminate seasonality, a series of real *GDP* per capita in 4th differences was generated and its plot is presented in Figure 7b. With the purpose of having an idea of the effects of seasonality in real

[14] The lag selection process will be explained in more detail in sub-Section 5.3.2, where the specification of a Vector Autoregressive model is described.

GDP per capita on the capital market development - economic growth relationship, this study uses both real *GDP* per capita and real *GDP* per capita in 4th differences *(GDPpc4)* as economic growth proxies. Therefore, the estimation of regression models and causality tests are done using both proxies separately.

Returning to the other variables, the value of stocks traded (Figure 7d) seems to be stationary over time with the presence of three large peaks whose effects do not further affect the behavior of the series. Finally, for stock market capitalization, public and private fixed-income securities traded and public and private fixed-income securities registered (Figures 7c, 7e, 7f, 7g and 7h), it is hard to assess their stationarity and the presence of deterministic regressors from their plots.

In order to make a comprehensive assessment of the stationarity of the time series, models with a constant and with a constant and a trend are both estimated for each series and both the Phillips-Perron and the Augmented Dickey-Fuller tests are performed.

Figure 7. Plots of the series.

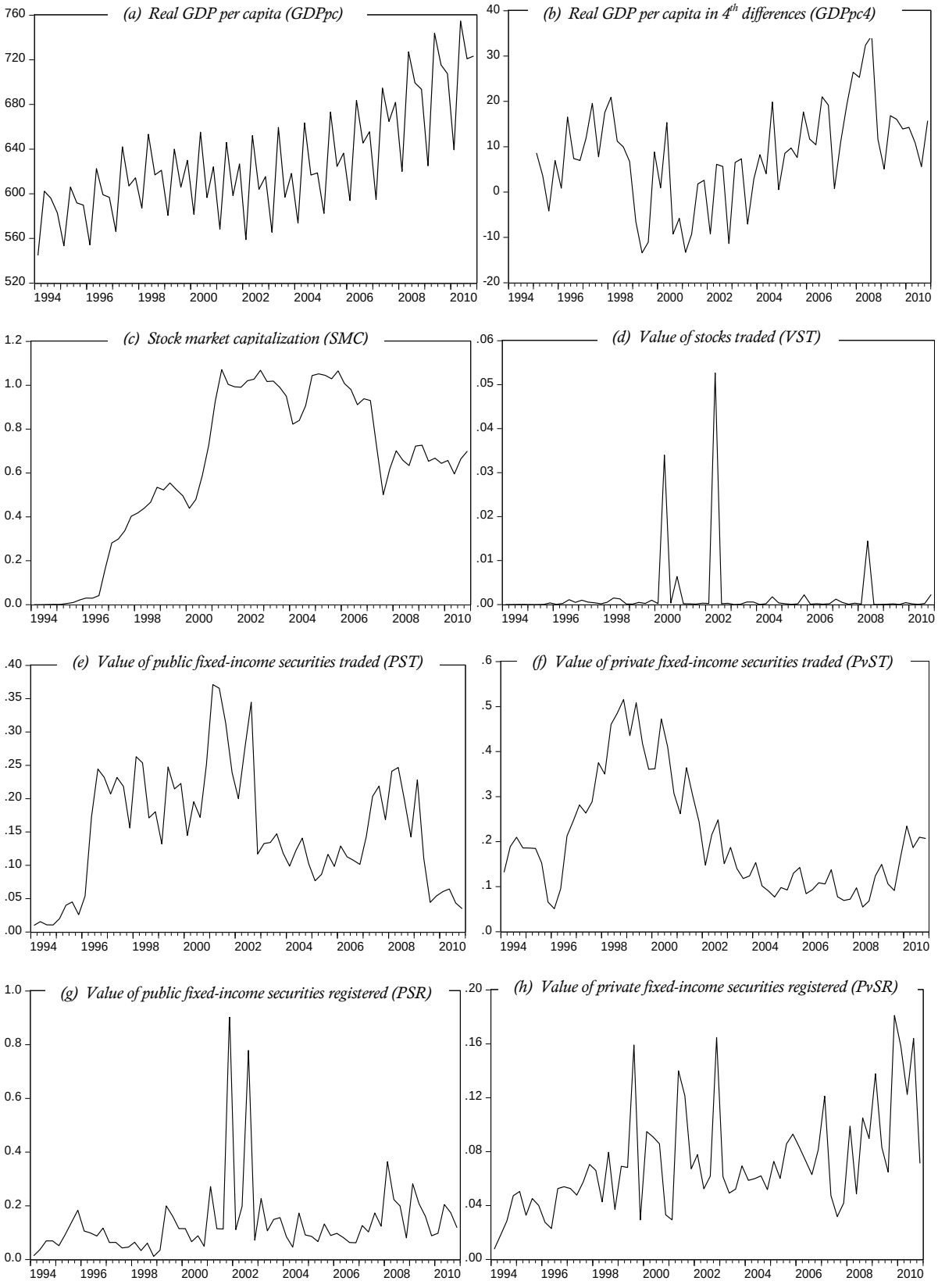


Table 8 presents the results of the unit root tests performed in Eviews for the variables in their levels and in their first differences. The real GDP per capita in 4th differences (*GDPpc4*), the value of stocks traded (*VST*) and the value of private fixed-income securities registered (*PvSR*) were found to be stationary in their levels according to both the PP and the ADF tests, therefore, they are integrated of order zero *I(0)*. In the case of real GDP per capita (*GDPpc*) and public securities registered (*PSR*) their PP tests reject the null hypothesis of a unit root while their ADF tests fail to reject it. Given these different results the variables are considered to be non-stationary. This is especially relevant for *GDPpc* since its plot and the nature of GDP series suggest the presence of a unit root. Tests on the first differences of these series show that they are *I(1).* The remaining variables (*SMC, PST* and *PvST*) were found to be non-stationary in levels and stationary in first differences, therefore they are *I(1)*.

Table 8. Results of unit root tests.

Test stat.	***GDPpc***	***GDPpc4***	***SMC***	***VST***	***PST***	***PvST***	***PSR***	***PvSR***
Unit root tests in levels								
τ_τ *(PP)*	-9,61*	-4,79*	-1,08	-8,41*	-2,66	-2,15	-8,13*	-7,27*
τ_μ *(PP)*	-5,24*	-4,27*	-1,78	-8,48*	-2,70	-1,82	-8,00*	-5,88*
τ_τ *(ADF)*	-0,26	-4,68*	-1,49	-8,41*	-2,82	-2,13	-2,48	-7,27*
τ_μ *(ADF)*	1,42	-4,19*	-1,92	-8,48*	-2,83	-1,78	-2,48	-5,88*
Condition	Non-Stationary	Stationary	Non-Stationary	Stationary	Non-Stationary	Non-Stationary	Non-Stationary	Stationary
Unit root tests in first differences								
τ_τ *(PP)*	-48,55*	-	-5,29*	-	-12,04*	-8,39*	-21,36*	-
τ_μ *(PP)*	-43,83*	-	-5,30*	-	-9,57*	-8,46*	-21,48*	-
τ_τ *(ADF)*	-4,46*	-	-5,95*	-	-8,97*	-3,21***	-14,35*	-
τ_μ *(ADF)*	-3,99*	-	-5,52*	-	-8,89*	-3,25**	-14,45*	-
Condition	Stationary	-	Stationary	-	Stationary	Stationary	Stationary	-
Order of Integration	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*	*I(1)*	*I(1)*	*I(0)*

Notes: τ_τ*(PP)* and τ_μ*(PP)* represent the values of the test statistics of the Phillips-Perron test for models including a constant and a trend, and a constant respectively; τ_τ*(ADF)* and τ_μ*(ADF)* represent the values of the test statistics of the Augmented Dickey-Fuller tests for models including a constant and a trend, and a constant respectively; * and ** represent that the null hypothesis of a series having a unit root was rejected at the 1% and 5% level respectively

As mentioned previously, two or more time series are cointegrated if they share a similar stochastic trend. A more formal definition of cointegration is the following: two or more time series are cointegrated of order *y* if (1) they are integrated of the same order *x* and (2) there is a linear combination of these variables which is integrated of order $x - y$ (Asterious & Hall, 2007). However, unless assessing the relationship between only two variables, it is not necessary for them to have the same order of integration in order for cointegrating relationships to exist. As Harris & Sollis (2003) argue, when considering a mix of *I(0)* and *I(1)* variables, the *I(0)* variables may play a crucial role in establishing cointegrating relationships between non-stationary variables.

The relevance of determining the presence of cointegration relies on the fact that if the variables being analyzed are cointegrated, the usual VAR model will account only for their short-run dynamics and their long-run trend would be pushed into the residuals. In order to recover

information on the long-run trends a Vector Error Correction (VEC) representation of the VAR model must be estimated (Brandt & Williams, 2007).

The most widely used methods for testing for cointegration are tests based on the Engle-Granger methodology and the Johansen cointegration test. The Engle-Granger method consists of performing an Ordinary Least Squares (OLS) regression of an equation of one integrated variable on the other integrated variables. Then, a stationarity test must be performed on the residuals. If the residuals are stationary then the integrated variables are cointegrated. This method has several shortcomings: first, when performing the OLS regression, there is nothing that indicates which of the variables should be used as regressors and why. This problem can become more complicated when there are more than two variables involved in the analysis. Second, when there are more than two variables involved, there may be more than one cointegrating relationship which is not able to be identified by this method. Finally, given the fact that this method relies on a two-step estimator, any error introduced in the first step will be carried to the second step (Asterious & Hall, 2007).

The Johansen cointegration test has been preferred by economists and it overcomes the problems of the Engle-Granger method when there are more than two variables in the analysis (Alexander, 2001). This method is based on Vector Autoregressive models and it can be explained considering the following VAR(p) model:

$$y_t = \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t \tag{5.7}$$

Where y_t is a vector of variables in the model, A_i is the matrix of coefficients of the lagged terms of the variables and ε_i is a vector of residuals. Following Harris & Sollis (2003) this can be reformulated in its error correction form:

$$\Delta y_t = \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{\mathrm{p}-1} \Delta y_{t-p+1} + \Pi y_{t-p} + \varepsilon_t \tag{5.8}$$

Where $\Gamma_i = -(I - A_1 - \cdots - A_i),\ i = 1, \ldots, p-1$, and $\Pi = -(I - A_1 - \cdots - A_p)$

If the variables in the system are integrated of order 1, each equation in the system has a stationary variable on the left-hand side. The matrix Π contains information about the long-run relationship between the variables in the system and its rank will determine the number of linearly independent cointegrating relationships. There are three possible cases that can be obtained (Harris & Sollis, 2003): (1) the matrix Π is of full rank, in which case all the variables in y_t are stationary. (2) The rank of Π is zero, in which case there are no cointegrating relationships between the variables and the model in (5.8) is just a VAR model in differences. And (3) the matrix Π has a reduced rank $0 < r \leq (n-1)$, in which case the matrix Π can be represented as $\Pi = \alpha\beta'$ where α represents the speed of adjustment to equilibrium and β is the matrix of coefficients of the long-run relationships (Asterious & Hall, 2007).

The Johansen method determines the rank of the matrix Π based on the fact that the rank of a matrix is equal to the number of its characteristic roots or eigenvalues that are different from zero (Enders, 2010). To carry out this method it is necessary to first estimate the VEC model by determining its appropriate lag length, choosing the most appropriate model regarding the inclusion of a constant and/or a trend in both the short- and long-run relationships (note that the basic model presented in equation (5.8) does not include constants nor trends) and finally,

determining the rank of the matrix Π. The latter step is done by computing the characteristic roots of Π and calculating the trace test statistic[15] (Alexander, 2001):

$$Tr = -T \sum_{i=R+1}^{n} \ln(1 - \hat{\lambda}_i) \qquad (5.9)$$

Where T is the number of observations and the $\hat{\lambda}_i$'s are the estimated values of the characteristic roots. This test statistic determines the number of cointegrating vectors by testing for the number of characteristic roots with the null hypothesis that $H_0: r \leq R$ versus the alternative that $H_1: r > R$.

Given the limitations of the Engle-Granger methodology, especially when more than two variables must be tested for cointegration, the Johansen method is used for testing cointegration between the time series in this study.

The variables among which cointegrating relationships are tested depend on the models that want to be estimated. As it will be explained in detail in the following section, this study considers two different types of models: (1) bivariate models for assessing the relationship between economic growth and each capital market development measure separately and (2) trivariate models which assess the relationship between economic growth and stock market development measures (*SMC* and *VST*), public fixed-income security market measures (*PST* and *PSR*) and private fixed-income security market measures (*PvST* and *PvSR*). These two types of models are estimated using both *GDPpc* and *GDPpc4* as proxies for economic growth.

For estimating bivariate models with *GDPpc* as economic growth proxy it is necessary to carry out cointegration tests between *GDPpc,* which is *I(1),* and each *I(1)* capital market development proxy (*SMC, PST, PvST* and *PSR*). On the other hand, for estimating bivariate models with *GDPpc4* as economic growth proxy, there is no need to perform cointegration tests. Since *GDPpc4* is an *I(0)* variable and, as explained before, in the case of analyzing the cointegration of two variables it is necessary for them to have the same order of integration, cointegration tests between *GDPpc4* and capital market development proxies which are *I(1)* are meaningless. The same occurs in cointegration tests between *GDPpc4* and stock market development proxies which are *I(0)* because any linear combination of stationary variables will be stationary.

In the case of trivariate models it is important to take into account that, as explained before, when considering a combination of more than two variables, the presence of an *I(0)* variable may play a significant role in creating cointegrating relationships between the variables. It is important, however, to bear in mind that introducing *I(0)* variables in the Johansen cointegration test will increase the rank of the matrix Π because each *I(0)* variable forms by itself a linearly independent column in the matrix ∏ (Harris & Sollis, 2003). This issue must be considered when interpreting the results of the Johansen cointegration test. For instance, if two *I(1)* variables and one *I(0)* variable are tested for cointegration and the results of the Johansen test show that Π has a rank of 1, there are actually no cointegating relationships between the variables because the linearly independent vector in Π represents only the *I(0)* variable.

[15] Although it is also possible to use the maximal eigenvalue test, as quoted in Alexander (2001), Johansen and Juselius recommend using the trace test because the maximal eigenvalue test does not have nested hypotheses and in some cases leads to different conclusions.

All the trivariate models that are estimated, whether they use *GDPpc* or *GDPpc4* as economic growth proxy, require performing cointegration tests because they involve, or only *I(1)* variables or a mix of *I(0)* and *I(1)* variables. In the latter case, however, the practical implications of introducing *I(0)* variables in the Johansen cointegration test must be considered.

In order to perform Johansen tests, once the variables to be tested for cointegration have been determined, the adequate lag length of the underlying VEC model must be defined. This is done by estimating the VAR models in levels of the variables that want to be tested and determining their adequate lag length based on the information criteria (*AIC, SIC* and *HQ*) and additionally, ensuring that the residuals of the model do not present serial correlation and non-normality (Asterious & Hall, 2007)[16].

The next step is choosing the adequate VEC model with respect to whether or not deterministic components should be included. There are five possibilities of including deterministic components both in the part that models the short-run relationship between the variables, usually referred to as the VAR component, and the part that defines the long-term relationship, referred to as the cointegrating equation. The five possibilities are the following: (1) without intercept or trend in the cointegrating equation or the VAR model, (2) with intercept and without trend in the cointegrating equation and without trend or intercept in the VAR model, (3) with intercept in the cointegrating equation and in the VAR and without trends in the cointegrating equation or VAR, (4) with intercept in the cointegrating equation and VAR, linear trend in the cointegrating equation and no trend in the VAR, and (5) intercept and quadratic trend in the cointegrating equation and intercept and linear trend in the VAR (Asterious & Hall, 2007). Being model 1 the most unrestricted model and model 5 the most restricted one.

Determining which of these models is the most adequate one for the data at hand can be done using the Pantula principle. This method is considered to be valid only when comparing models 2, 3 and 4. Nevertheless, models 1 and 5 are considered to be highly unlikely and are generally ruled out of the process being models 2, 3 and 4 the only ones that can be realistically considered (Hjelm & Johansson, 2005; Harris & Sollis, 2003). The Pantula principle consists in using the Trace test to test the null hypothesis of zero cointegrating relationships for the most unrestricted model (model 2). If the hypothesis is rejected the same is tested for the less restricted model and so on, stopping only when the null hypothesis of no cointegration is not rejected for the first time. If the hypothesis is rejected for the most restricted model (model 4) the process must be continued testing the null hypothesis of at most one cointegrating vector, again with the most unrestricted model and continued in the same way.

The results of the application of the Pantula principle to the variables tested for cointegration are presented in Table 9. It can be seen that model 2 (i.e. with an intercept and without trend in the cointegrating equation and without trend or intercept in the VAR component) is the most adequate one to test for cointegration between the variables except between *GDPpc - PvST* and *GDPpc4 – SMC - VST,* for which model 3 is the most adequate and between *GDPpc – PST* for which the most adequate is model 4. Note that the trace statistic for model 4 is not presented for cointegration between *GDPpc – SMC – VST* and between *GDPpc4 – SMC – VST.* This is because the number of observations available is not enough for computing the trace statistic for this

[16] A more detailed description on the information criteria and on determining the adequate lag length will be presented later on.

model due to the large amount of lags required to eliminate serial correlation and non-normality in the residuals.

Table 9. Pantula principle test results.

Cointegration between:	***Hypothesized # of coint. Equations (H_0)***	***# of lags***	***Trace Statistic***		
			Model 2	***Model 3***	***Model 4***
GDPpc - SMC	None	5	13,38*	5,92	19,49
	At most 1		3,68	0,69	5,23
GDPpc - PST	None	7	24,61	21,19	24,03*
	At most 1		4,57	2,24	5,05
GDPpc - PvST	None	5	20,59	12,18*	16,66
	At most 1		2,98	1,20	5,62
GDPpc - PSR	None	14	32,63	31,19	40,80
	At most 1		2,59*	1,50	10,84
GDPpc - SMC – VST	None	15	277,52	227,09	-
	At most 1		142,26	109,74	-
	At most 2		43,20	12,30	-
GDPpc – PST – PSR	None	13	53,76	51,32	64,53
	At most 1		19,04*	16,65	29,75
	At most 2		8,48	6,69	9,88
GDPpc – PvST - PvSR	None	11	55,59	50,53	83,39
	At most 1		17,21*	12,91	38,96
	At most 2		5,67	1,57	6,59
GDPpc4 – SMC - VST	None	14	270,78	261,07	-
	At most 1		114,42	104,71	-
	At most 2		11,46	1,84*	-
GDPpc4 – PST - PSR	None	11	61,33	56,50	96,92
	At most 1		27,69	22,86	44,69
	At most 2		4,18*	0,005	11,17
GDPpc4 – PvST - PvSR	None	8	39,12	31,83	48,20
	At most 1		19,96*	12,85	21,18
	At most 2		7,06	1,39	7,25

Note: * indicates the first time the null hypothesis was not rejected.

The results of the Johansen cointragration tests for the most adequate models according to the Pantula principle are presented in Table 10. The test indicates cointegration between *GDPpc* and *PSR,* therefore, a VEC model must be estimated for assessing the relationship between these two variables. For the case of *GDPpc – SMC – VST* the test indicates the presence of 3 cointegrating equations, however, since one of the variables (*VST*) is *I(0)*, it accounts for one of the cointegrating equations found, hence, there are only two cointegrating equations between these variables.

Between *GDPpc – PST – PSR* one cointegrating equation has been found and all variables are *I(1)*, therefore, a VEC model must be estimated for this case. On the other hand, although one cointegrating equation has been found between *GDPpc – PvST – PvSR* it accounts only for *PvSR* which is *I(0)*, thus, there are no actual cointegrating relationships between the variables.

With respect to the relationship between *GDPpc4 – SMC – VST,* two cointegrating equations have been found, however, both *GDPpc4* and *VST* are *I(0)* variables and they account for the two cointegrating equations obtained, thus there is no cointegration between the variables. Conversely, between *GDPpc4 – PST – PSR,* two cointegrating equations were also found and one of them corresponds to *GDPpc4,* therefore, there is only one cointegrating equation between the

variables. Finally, between *GDPpc4 – PvST – PvSR*, although both *GDPpc4* and *PvSR* are *I(0),* only one cointegrating equation was found, (note, however, that the null of at most one cointegrating equation, $r \leq 1$, for this case is very close to being rejected at the 5% level of significance), hence, it can be concluded that there is no cointegration between the variables.

Table 10. Johansen Cointegration test results.

Null hypothesis	***Alternative Hypothesis***	***Trace Statistic***	***P-value***	***Condition***	***Actual number of coint. Eqs.***
GDPpc – SMC					
$H_0: r = 0$	$H_1: r > 0$	13,38	0,3346	Not cointegrated	None
$H_0: r \leq 1$	$H_1: r > 1$	3,68	0,4616		
GDPpc – PST					
$H_0: r = 0$	$H_1: r > 0$	24,03	0,0833	Not cointegrated	None
$H_0: r \leq 1$	$H_1: r > 1$	5,05	0,5890		
GDPpc – PvST					
$H_0: r = 0$	$H_1: r > 0$	12,18	0,1483	Not cointegrated	None
$H_0: r \leq 1$	$H_1: r > 1$	1,20	0,2734		
GDPpc – PSR					
$H_0: r = 0$	$H_1: r > 0$	32,63*	0,0006	1 cointegrating equation	1 cointegrating equation
$H_0: r \leq 1$	$H_1: r > 1$	2,59	0,6591		
GDPpc-SMC-VST					
$H_0: r = 0$	$H_1: r > 0$	277,52*	0,0000	3 cointegrating equations [a]	2 cointegrating equations
$H_0: r \leq 1$	$H_1: r > 1$	142,26*	0,0001		
$H_0: r \leq 2$	$H_1: r > 2$	43,20*	0,0000		
GDPpc – PST – PSR					
$H_0: r = 0$	$H_1: r > 0$	53,76*	0,0002	1 cointegrating equation	1 cointegrating equation
$H_0: r \leq 1$	$H_1: r > 1$	19,04	0,0729		
$H_0: r \leq 2$	$H_1: r > 2$	8,48	0,0674		
GDPpc – PvST – PvSR					
$H_0: r = 0$	$H_1: r > 0$	55,59*	0,0001	1 cointegrating equation [a]	None
$H_0: r \leq 1$	$H_1: r > 1$	17,21	0,1248		
$H_0: r \leq 2$	$H_1: r > 2$	5,67	0,2176		
GDPpc4 – SMC – VST					
$H_0: r = 0$	$H_1: r > 0$	261,07*	0,0001	2 cointegrating equations [a]	None
$H_0: r \leq 1$	$H_1: r > 1$	104,71*	0,0001		
$H_0: r \leq 2$	$H_1: r > 2$	1,84	0,1753		
GDPpc4 - PST – PSR					
$H_0: r = 0$	$H_1: r > 0$	61,33*	0,0000	2 cointegrating equations [a]	1 cointegrating equation
$H_0: r \leq 1$	$H_1: r > 1$	27,69*	0,0039		
$H_0: r \leq 2$	$H_1: r > 2$	4,18	0,3853		
GDPpc4 – PvST – PvSR					
$H_0: r = 0$	$H_1: r > 0$	39,12*	0,0179	1 cointegrating equation	None
$H_0: r \leq 1$	$H_1: r > 1$	19,96	0,0550		
$H_0: r \leq 2$	$H_1: r > 2$	7,06	0,1233		

Notes: * indicates rejection of the null hypothesis at the 5% level; [a] indicates that the number of cointegrating equations obtained does not correspond to actual number of cointegrating relationships between the variables due to the presence of *I(0)* variables in the test.

5.3.2 Estimation of the VAR models

In order to assess the relationship between economic growth and capital market development it is necessary to specify and estimate the VAR models or their error correction variants that most adequately represent the relationships that want to be assessed. Two different types of models are estimated in this study: bivariate models and trivariate models. Recall that six indicators of capital market development were defined is subsection 5.2: two for the stock market (*SMC* and *VST*), two for the public fixed-income security market (*PST* and *PSR*) and two for the private fixed-income security market (*PvST* and *PvSR*). The bivariate models assess the relationship between economic growth and each capital market development variable separately while the trivariate models assess the relationship between economic growth and each pair of indicators of stock market, public fixed-income security market, and private fixed-income security market development. Before estimating these models theoretical considerations for the specification and estimation of VAR and VEC models will be presented.

The basic VAR model of order *p* for *n* time series is the following (Lütkepohl, 2005):

$$y_t = v + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t \tag{5.10}$$

Where y_t is an *n* x *1* vector formed by the variables of the system, *v* is an *n* x *1* vector of coefficients, the A_i's are the matrices of coefficients of the variables and ε_t is the vector of residuals. Given that the residuals in equation (5.10) are assumed to be serially uncorrelated and to follow a normal distribution and that the right hand side of the equation contains only predetermined variables, each equation in the model can be individually determined by Ordinary Least Squares (OLS) regression (Enders, 2010).

The covariance matrix of the residuals can be calculated as follows (Brandt & Williams, 2007):

$$\hat{\Sigma} = \frac{1}{\mathrm{T}} \sum_{\mathrm{t}=1}^{\mathrm{T}} \hat{\varepsilon}_{\mathrm{t}}' \hat{\varepsilon}_{\mathrm{t}} \tag{5.11}$$

Where $\hat{\varepsilon}_{\mathrm{t}}$ is the vector of residuals from the multivariate regression in equation (5.10). If cointegrating relationships exist among the variables in the system, the basic VAR model fails to represent their short- and long-run relationships separately. In order to overcome this problem, a VAR model can be modified to its Vector Error Correction representation which will account for both the long-run trends and short-run dynamics between the variables (Harris & Sollis, 2003):

$$\Delta y_t = v + \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{\mathrm{p}-1} \Delta y_{t-p+1} + \Pi y_{t-p} + \varepsilon_t \tag{5.12}$$

Where $\Gamma_i = -(I - A_1 - \cdots - A_i),\ i = 1, \ldots, p-1$, and $\Pi = -(I - A_1 - \cdots - A_p)$

Equation (5.12) is the VEC model of order *p-1* in which the short-run relationships between the variables are captured in the Γ_i terms and their cointegrating long-term relationships are captured in the *n* x *n* matrix Π. As mentioned in the description of the Johansen cointegration test, if the rank of the matrix Π is $0 < r \leq (n-1)$ then it can be decomposed into $\Pi = \alpha\beta'$ where α and β are *n* x *r* matrices of rank *r*. The elements of matrix β set the basis for the cointegrating vectors and the elements of α distribute the impact of the cointegrating vectors to the evolution of Δy_t (Zivot & Wang, 2006). The estimation of the model cannot be achieved directly by using OLS

regressions as in the case of VAR models because it is necessary to impose cross-equation restrictions on the matrix Π (Enders, 2010). The procedure for estimating VEC models consists in estimating the coefficients of the cointegrating equations with Gaussian Maximum Likelihood estimation. Once these coefficients are known, the coefficients Γ_i, v and α can be estimated with OLS regression by replacing the already known values in equation (5.12) (Brüggemann, Lütkepohl, & Saikkonen, 2006).

In order to entirely specify VAR or VEC models the number of lags to be included must be chosen. There are statistical tests available for determining the adequate lag length for the model. These tests are based on information criteria measures which are an effort of determining the trade-off between model fit and parsimony. They are based on penalizing the likelihood function of a model by the number of parameters it includes, the more parameters the higher the penalty. Thus, for two models that fit the data equally well, the most parsimonious one has a lower penalty and is considered to be the most adequate one. The most commonly used information criteria are the Akaike information criterion (AIC), the Schwarz or Bayesian information criterion (SIC) and the Hannan-Quinn criterion (HQ), which differ in the penalty for including additional factors (Brandt & Williams, 2007):

$$AIC(p) = T\ log\left|\hat{\Sigma}\right| + 2(n^2p + n) \tag{5.13}$$

$$SIC(p) = T\ log\left|\hat{\Sigma}\right| + \log(T)\ (n^2p + n) \tag{5.14}$$

$$HQ(p) = T\ log\left|\hat{\Sigma}\right| + 2(\log(\log(T)))\ (n^2p + n) \tag{5.15}$$

In these equations n is the number of variables in the model, T is the size of the sample and $\hat{\Sigma}$ is the covariance matrix of the residuals which is calculated with equation (5.11). Then, the procedure for determining the adequate lag length for a VAR model consists in selecting an upper bound for lag lengths p_{max}, and estimating models with lags 0 to p_{max}. The adequate lag length of the model is then the lag length of the model that yields the smallest information criterion (Brandt & Williams, 2007).

The lag length of the models must also ensure that the residuals do not present serial correlation and do not suffer from non-normality, therefore once the adequate lag length of a VAR model according to the information criterion has been found it is necessary to perform tests for serial correlation and normality of the residuals[17]. In case serial correlation or non-normality are present, these may be removed by increasing the number of lags or including potentially omitted variables to the model (Asterious & Hall, 2007). In this study, however, this problem is addressed only by increasing the lag length due to the impossibility of obtaining the required data for including additional variables to the model.

These guidelines for determining the order of a VAR model are also applicable for choosing the number of lagged differences in a VEC model. This is because a VECM of order *p–1* corresponds to a VAR of order *p* (Lütkepohl, 2005).

An additional problem that must be dealt with is the estimation of VAR models with a mix of *I(1)* and *I(0)* variables. Enders (2010) points out that if two variables have different orders of integration regression equations between them are meaningless. This problem is dealt with in

[17] These tests are presented in subsection 5.3.3

two different ways. First, by estimating the VAR model with the *I(0)* variables in levels and the *I(1)* variables in first differences (hereafter, this approach will be referred to as the differencing approach). Second, by using an alternative approach for testing Granger causality proposed by Toda & Yamamoto (1995). This approach consists in determining the maximum order of integration d_{max} of the variables in the system and estimating a VAR model in levels of order $k + d_{max}$, where k is the appropriate lag length for the model. While the coefficients of the last d_{max} lags of the model are ignored since they are assumed to be zero, Toda & Yamamoto (1995) show that Granger causality tests on the coefficients of the first k lags in the model can be performed using the standard Wald test regardless of the order of integration of the variables and whether or not cointegrating relationships exist among them.

Although the Toda & Yamamoto (1995) approach simplifies the process of assessing the relationship between variables in a VAR model and it could be used as the main approach in this study, it also suffers of a loss of power because it requires estimating an intentionally over-fitted VAR. Therefore, it is used only when it is necessary to estimate models involving variables with different orders of integration or when additional problems such as having a number of observations which is insufficient for estimating the regular VAR or VEC models.

5.3.2.1 Bivariate VAR and VEC models

The idea behind estimating bivariate models is to be able to assess each capital market development measure's particular nexus with economic growth. The basic VAR model in equation (5.10) can be expressed in its bivariate version as the following:

$$EG_t = v_1 + \sum_{i=1}^{p} \zeta_{1,i} EG_{t-i} + \sum_{i=1}^{p} \varphi_{1,i} CMD_{t-i} + \varepsilon_{1t} \tag{5.16a}$$

$$CMD_t = v_2 + \sum_{i=1}^{p} \zeta_{2,i} EG_{t-i} + \sum_{i=1}^{p} \varphi_{2,i} CMD_{t-i} + \varepsilon_{2t} \tag{5.16b}$$

Where EG_t is the economic growth measure at time t represented by either *GDPpc* or *GDPpc4*, CMD_t is one of the measures of capital market development at time t (*SMC, VST, PST, PvST, PSR* or *PvSR*), and the ε_i's are the residuals. The Vector Error Correction representation of this model can be obtained from equation (5.12):

$$\Delta EG_t = v_1 + \sum_{i=1}^{p-1} \zeta_{1,i} \Delta EG_{t-i} + \sum_{i=1}^{p-1} \varphi_{1,i} \Delta CMD_{t-i} + \alpha_1 ECT_{t-1} + \varepsilon_{1t} \tag{5.17a}$$

$$\Delta CM_t = v_2 + \sum_{i=1}^{p-1} \zeta_{2,i} \Delta EG_{t-i} + \sum_{i=1}^{p-1} \varphi_{2,i} \Delta CMD_{t-i} + \alpha_2 ECT_{t-1} + \varepsilon_{2t} \tag{5.17b}$$

Where the α_i's are the error correction coefficients which represent how much of the equilibrium error is corrected each period and ECT_{t-1} is the cointegrating equation, also known as the error correction term.

The issue is now estimating six bivariate VAR models with *GDPpc* as measure of economic growth and six bivariate VAR models with *GDPpc4* as measure of economic growth.

a) Bivariate models with GDPpc as economic growth proxy.

The economic growth proxy *GDPpc* has been found to be cointegrated only with public securities registered (*PSR*). Therefore, a VEC model must be estimated for assessing the *GDPpc - PSR* relationship. Conversely, in order to estimate the models for *GDPpc – SMC, GDPpc – PST* and *GDPpc – PvST* it must be taken into account that these are all *I(1)* variables that are not cointegrated. In these cases it is preferable to estimate VAR models in 1st differences, first, because the requirements for estimation entail stationarity of the variables, second, estimating the VAR in levels can cause a reduction in the power of the test since it is required to estimate one additional lag for each variable in each equation and, finally, the standard F and χ^2 tests cannot be used to test for Granger causality when working with *I(1)* variables (Enders, 2010; Brandt & Williams, 2007). Therefore, VAR models in 1st differences is estimated for assessing the relationship between these variables.

In the case of estimating the VAR for *GDPpc – VST* and *GDPpc - PvSR*, there is a mix of *I(0)* and *I(1)* variables. As previously mentioned, this issue is dealt with following two different approaches: (1) following the differencing approach, which consists in estimating the VAR using the *I(0)* variables in levels and the *I(1)* variables in first differences, and (2) following the Toda & Yamamoto (1995) approach for testing for causality.

A summary of the required bivariate models with *GDPpc* as proxy for economic growth are presented in Table 11.

Table 11. Bivariate models with GDPpc as economic growth proxy.

Variables	***Model***	***Lags***
GDPpc – SMC	VAR model in 1st differences: *D(GDPpc) –D(SMC)*	9
GDPpc – VST	Mix of *I(0)* and *I(1)* variables: - VAR model following the differencing approach: *D(GDPpc) – VST* - VAR model following the TY approach: *GDPpc – VST*	 20 -
GDPpc – PST	VAR model in 1st differences: *D(GDPpc) –D(PST)*	6
GDPpc – PvST	VAR model in 1st differences: *D(GDPpc) –D(PvST)*	6
GDPpc – PSR	VEC model: *GDPpc – PSR*	13
GDPpc – PvSR	Mix of *I(0)* and *I(1)* variables: - VAR model following the differencing approach: *D(GDPpc) – PvSR* - VAR model following the TY approach: *GDPpc – PvSR*	 8 7

Notes: *D()* is the difference operator indicating the variable was taken in its first differences; TY stands for Toda & Yamamoto

The adequate number of lags to include in each model is determined following the same procedure previously described. That is, by estimating each model using several lag lengths, comparing the information criteria of each estimated model and choosing the lag length that yields the smallest information criteria. Once this is determined autocorrelation and non-normality tests are preformed to the residuals and in case they are found to be serially correlated or non-normal, the number of lags is increased until serial independence and normality of the residuals are obtained.

The VAR models were estimated using Eviews; the parameters obtained in each model are presented in Table 20 in Appendix B. The number of lags for the *GDPpc – VST* model required for eliminating serial correlation and non-normality in the residuals following the Toda & Yamamoto (1995) approach was too large for the number of observations available, hence, it was

not possible to estimate this model. On the other hand, the number of lags for the *GDPpc – PvSR* model following the Toda & Yamamoto (1995) approach was found to be $k = 7$ and the maximum order of integration $d_{max} = 1$; therefore a VAR model in levels of order 8 was estimated, however, only the coefficients of the first seven lags are presented in Table 20 since the 8th is regarded as zero.

b) Bivariate models with GDPpc4 as economic growth proxy.

For these models it is important to consider that *GDPpc4* is an *I(0)* variable. Two different types of models are estimated depending on the order of integration of each capital market development measure: VAR models in levels, when the capital market development measure used is also *I(0),* and VAR models with a mix of *I(0)* and *I(1)* variables, when the capital market development measure is *I(1)*. For the latter type, the same two approaches used in the previous subsection are applied, that is, estimating the VAR using the differencing approach and using the Toda & Yamamoto (1995) approach for testing causality.

A summary of the models required is presented in Table 12 while the parameters estimated for each model are presented in Table 21 in Appendix B. For assessing the relationship between *GDPpc4 – VST*, although both variables are *I(0)*, a VAR model in 1st differences was estimated because the amount of lags required in order to eliminate serial correlation and non-normality in the residuals in the VAR in levels was too large for the number of observations available.

Table 12. Bivariate models with GDPpc4 as economic growth proxy.

Variables	***Model***	***Lags***
GDPpc4 – SMC	Mix of *I(0)* and *I(1)* variables: - VAR model: *GDPpc4 – D(SMC)* - VAR model following the TY approach: *GDPpc4 – SMC*	 1 6
GDPpc4 – VST	- VAR model in levels: *GDPpc4 – VST* * - VAR model in 1st differences: *D(GDPpc4) – D(VST)* [a]	- 16
GDPpc4 – PST	Mix of *I(0)* and *I(1)* variables: - VAR model: *GDPpc4 – D(PST)* - VAR model following the TY approach: *GDPpc4 – PST*	 2 3
GDPpc4 – PvST	Mixture of *I(0)* and *I(1)* variables: - VAR model: *GDPpc4 – D(PvST)* - VAR model following the TY approach: *GDPpc4 – PvST*	 3 3
GDPpc4 – PSR	Mix of *I(0)* and *I(1)* variables: - VAR model: *GDPpc4 – D(PSR)* - VAR model following the TY approach: *GDPpc4 – PSR*	 13 15
GDPpc4 – PvSR	VAR model in levels: *GDPpc4 – PvSR*	6

Notes: *D()* is the difference operator indicating the variables was taken in its first differences; *TY* stands for Toda & Yamamoto; * indicates that it is not possible to estimate the model due to the large amount of lags required to eliminate serial correlation and non-normality.

5.3.2.2 Trivariate VAR and VEC models

The bivariate models estimated in the previous section only assess the individual relationship between each capital market development indicator and economic growth. In order to get a broader picture regarding the nature of this relationship, this study also estimates trivariate models which assess the relationship between economic growth and indicators of the level of development of: (1) the stock market (*SMC* and *VST*), (2) the public fixed-income security market

(*PST* and *PSR*), and (3) the private fixed-income security market (*PvST* and *PvSR*)[18]. The trivariate version of the basic VAR model in equation (5.10) is the following:

$$EG_t = v_1 + \sum_{i=1}^{p} \zeta_{1,i} EG_{t-i} + \sum_{i=1}^{p} \varphi_{1,i} CMD1_{t-i} + \sum_{i=1}^{p} \delta_{1,i} CMD2_{t-i} + \varepsilon_{1t} \quad (5.18a)$$

$$CMD1_t = v_2 + \sum_{i=1}^{p} \zeta_{2,i} EG_{t-i} + \sum_{i=1}^{p} \varphi_{2,i} CMD1_{t-i} + \sum_{i=1}^{p} \delta_{2,i} CMD2_{t-i} + \varepsilon_{2t} \quad (5.18b)$$

$$CMD2_t = v_3 + \sum_{i=1}^{p} \zeta_{3,i} EG_{t-i} + \sum_{i=1}^{p} \varphi_{3,i} CMD1_{t-i} + \sum_{i=1}^{p} \delta_{3,i} CMD2_{t-i} + \varepsilon_{3t} \quad (5.18c)$$

Where EG_t is the economic growth measure at time *t* represented by either *GDPpc* or *GDPpc4;* $CMD1_t$ and $CMD2_t$ are either *SMC* and *VST, PST* and *PSR* or *PvST* and *PvSR*; and the ε_i's are the residuals. As in the case of bivariate models, in order to incorporate the long-run relationship between the variables the model in equations (5.18) can be modified into its error correction representation. The resulting trivariate VEC model is the following:

$$\Delta EG_t = v_1 + \sum_{i=1}^{p-1} \zeta_{1,i} \Delta EG_{t-i} + \sum_{i=1}^{p-1} \varphi_{1,i} \Delta \mathrm{CMD1}_{t-i} + \sum_{i=1}^{p-1} \delta_{1,i} \Delta \mathrm{CMD2}_{t-i} + \sum_{j=1}^{r} \alpha_{1j} ECT_{j,t-1} + \varepsilon_{1t} \quad (5.19a)$$

$$\Delta \mathrm{CMD1}_t = v_2 + \sum_{i=1}^{p-1} \zeta_{2,i} \Delta EG_{t-i} + \sum_{i=1}^{p-1} \varphi_{2,i} \Delta \mathrm{CMD1}_{t-i} + \sum_{i=1}^{p-1} \delta_{2,i} \Delta \mathrm{CMD2}_{t-i} + \sum_{j=1}^{r} \alpha_{2j} ECT_{j,t-1} + \varepsilon_{2t} \quad (5.19b)$$

$$\Delta \mathrm{CMD2}_t = v_3 + \sum_{i=1}^{p-1} \zeta_{3,i} \Delta EG_{t-i} + \sum_{i=1}^{p-1} \varphi_{3,i} \Delta \mathrm{CMD1}_{t-i} + \sum_{i=1}^{p-1} \delta_{3,i} \Delta \mathrm{CMD2}_{t-i} + \sum_{j=1}^{r} \alpha_{3j} ECT_{j,t-1} + \varepsilon_{3t} \quad (5.19c)$$

Where α_{ij} is the error correction coefficient for the j^{th} cointegrating vector, the $ECT_{j,t-1}$ is the j^{th} cointegrating equation and *r* is the number of cointegrating relationships between the variables.

a) Trivariate models with GDPpc as economic growth proxy

The trivariate models to be estimated depend on the order of integration of the variables and on the results of cointegration tests. First, for the model *GDPpc – SMC –VST* that assesses the relationship between economic growth and stock market development, two cointegrating equations were found in the Johansen test, therefore, a VEC model is required in order to take into account the long-run relationship between the variables. However, the amount of lags required for serial correlation and non-normality to be eliminated from the residuals was too large for the number of observations available. In order to overcome this problem a VAR model in levels was estimated in order to perform causality tests following the Toda & Yamamoto (1995) approach. The same situation occurs for the model *GDPpc – PST – PSR*. Hence, the Toda & Yamamoto (1995) approach was also used.

[18] Another possibility that was considered in this study was to estimate an hepta-variate model in order to have an idea of the interaction between economic growth and all capital market development measures simultaneously. However, the number of observations available is insufficient to estimate a model with seven variables and with serially independent and normal residuals. In general, if there are *x* variables in a VAR model and there are *p* lags of each variable in each equation, the number of parameters that need to be estimated is ($x+k*x^2$). In cases of small sample sizes the degrees of freedom are rapidly consumed (Brooks, 2008).

Finally, for the model for economic growth and the private fixed-income security market, *GDPpc - PvST – PvSR,* no cointegrating relationships were found in the Johansen cointegration test. The model required contains then mix of *I(0)* and *I(1)* variables. Thus, the two approaches previously described for estimating models with a mix of *I(0)* and *I(1)* variables should be followed. However, for the differencing approach, the number of lags required for eliminating serial correlation and non-normality in the residuals is too large for the amount of data available, therefore, only the Toda & Yamamoto (1995) approach was followed.

A summary of the estimated trivariate models with *GDPpc* as economic growth proxy is presented in Table 13 and the estimated parameters for each model are presented in Table 22 in Appendix B.

Table 13. Trivariate models with GDPpc as economic growth proxy.

Variables	***Model***	***Lags***
GDPpc – SMC – VST	- VEC model: *GDPpc – SMC – VST **	-
	- VAR model following the TY approach: *GDPpc – SMC – VST*	15
GDPpc – PST – PSR	- VEC model: *GDPpc – PST – PSR **	-
	- VAR model following the TY approach: *GDPpc – PST – PSR*	13
GDPpc – PvST – PvSR	Mix of *I(0)* and *I(1)* variables:	
	- VAR model following the differencig approach *D(GDPpc) – D(PvST) – D(PvSR)**	-
	- VAR model following the TY approach: *GDPpc – PvST – PvSR*	11

Notes: *D()* is the difference operator indicating the variables was taken in its first differences; TY stands for Toda & Yamamoto; * indicates that it is not possible to estimate the model due to the large amount of lags required to eliminate serial correlation and non-normality.

b) Trivariate models with GDPpc4 as economic growth proxy

For the model between economic growth and stock market development proxies with *GDPpc4* as proxy for economic growth, no cointegrating relationships were found between the variables, hence, there is a mix of *I(0)* and *I(1)* variables. The two approaches for dealing with this issue were followed, however, the number of lags required for eliminating serial correlation and non-normality in the residuals when following the differencing approach was too large for the number of observations available, therefore, only the Toda & Yamamoto (1995) approach was followed.

On the other hand, one cointegrating equation was found between *GDPpc4 – PST – PSR,* hence, a VEC model should be estimated in order to take into account the long-run trend between the variables. In the case of the model for relating economic growth to the private fixed-income security market, *GDPpc4 – PvST – PvSR,* no cointegration was found between the variables, therefore, models with a mix of *I(0)* and *I(1)* variables are estimated following the differencing approach and the Toda & Yamamoto (1995) approach.

A Summary of the trivariate models estimated is presented in Table 14, and the parameters of each model is presented in Table 23 in Appendix B.

Table 14. Trivariate models with GDPpc4 as economic growth proxy.

Variables	***Model***	***Lags***
GDPpc4 – SMC – VST	Mix of *I(0)* and *I(1)* variables: - VAR model following the differencing approach: *GDPpc4 – D(SMC) – VST* * - VAR model following the TY approach: *GDPpc4 – SMC – VST*	- 14
GDPpc4 – PST – PSR	VEC model: *GDPpc4 – PST – PSR*	10
GDPpc4 – PvST – PvSR	Mix of *I(0)* and *I(1)* variables: - VAR model: *GDPpc4 – D(PvST) – PvSR* - VAR model following the TY approach: *GDPpc4 – PvST – PvSR*	9 8

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; TY stands for Toda & Yamamoto; * indicates that it is not possible to estimate the model due to the large amount of lags required to eliminate serial correlation and non-normality.

5.3.3 Tests for model adequacy

Once a time series model has been estimated it is necessary to perform tests to assess its adequacy. These tests are generally based on the residuals of the estimated models and include tests for serial correlation and normality. Both of these tests are performed for the estimated models presented in the previous section.

Brandt & Williams (2007) remark that the estimation of VAR and VEC models is robust as long as the residuals of the fitted models are uncorrelated over time. The presence of correlation in the residuals may indicate the existence of an omitted variable in the analysis and the estimated error term will differ from the true error term. There are several methods for testing serial correlation which range from graphical methods (such as analyzing the plotted residuals over time for each variable in the system and analyzing autocorrelation and cross-correlation plots of the variables over different time lags) to more formal methods such as the Breusch-Godfrey Lagrange Multiplier test (Brandt & Williams, 2007). With respect to normality, the presence of non-normal residuals may indicate that the model does not represent the data generating process satisfactorily (Lütkepohl, 2005).

The Breusch-Godfrey Lagrange Multiplier test (LM test) for serial correlation assumes the following VAR model for the vector of residuals of the fitted model (Lütkepohl, 2005):

$$\varepsilon_t = D_1\varepsilon_{t-1} + \cdots + D_h\varepsilon_{t-h} + \epsilon_t \qquad (5.20)$$

Where $D_1, \ldots, D_h$ are matrices of coefficients, and ϵ_t is white noise and is equal to ε_t if the residuals at time *t* are not correlated with any of their *h* previous values. The null and alternative hypotheses are then:

$$H_0: \quad D_1 = \cdots = D_h = 0$$

$$H_1: \quad D_i \neq 0 \ \ for\ at\ least\ one\ i \in \{1, \ldots, h\}$$

The test statistic is based on the residual covariances of the following unrestricted and restricted artificial VAR models (Lütkepohl, 2005):

$$\varepsilon_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + D_1 \varepsilon_{t-1} + \cdots + D_h \varepsilon_{t-h} + u_t^U \tag{5.21}$$

$$\varepsilon_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + u_t^R \tag{5.22}$$

Where u_t^U and u_t^R are the residuals of the restricted and unrestricted models respectively. The covariance matrices of these models are the following:

$$\tilde{\Sigma}_U = \frac{1}{T}\sum_{t=1}^{T} \hat{u}_t^{U\prime}\, \hat{u}_t^U \tag{5.23}$$

$$\tilde{\Sigma}_R = \frac{1}{T}\sum_{t=1}^{T} \hat{u}_t^{R\prime}\, \hat{u}_t^R \tag{5.24}$$

The LM test statistic is the following:

$$LM = T(m - tr(\tilde{\Sigma}_U \tilde{\Sigma}_R^{-1})) \tag{5.25}$$

Where *m* is the number of variables in the system and tr() is the trace operator, which is the sum of the diagonal elements of the matrix. The LM statistic follows a χ^2 distribution (Brandt & Williams, 2007). The number of lags *h* to use for performing the test may be determined according to the frequency of the data; however, if the model is statistically adequate the null hypothesis should not be rejected regardless of the value of *h* chosen (Brooks, 2008).

The LM statistics and P-values of the estimated models are presented in Tables 24, 25, 26 and 27 in Appendix B. It can be seen that the null hypothesis of no serial correlation cannot be rejected at the 5% level in every case.

For testing for normality, the most commonly used test is the Jarque-Bera test (JB test) which is based on the third and fourth moments of the normal distribution[19] ($E[x^3]$ and $E[x^4]$ respectively). A normal distribution is symmetric with respect to its mean, which can be represented as $E[x^3] = 0$, and mesokurtic, that is, it has a coefficient of kurtosis $E[x^4] = 3$. The JB test is a test for the null hypothesis that the distribution of the tested series is symmetric and mesokurtic. The test statistic which follows a χ^2 distribution is the following (Brooks, 2008):

$$JB = \frac{T}{6}\left(S^2 + \frac{1}{4}(K-3)^2\right) \tag{5.26}$$

Where T is the number of observations and S and K are the coefficients of skewness and kurtosis respectively which are computed as follows:

$$S = \frac{E[\varepsilon^3]}{(\sigma^2)^{3/2}} \tag{5.27}$$

[19] The third and fourth moments are the skewness and kurtosis respectively. Skewness measures the extent to which a distribution is not symmetric respect to its mean and kurtosis measures how peaked the distribution is and how fat its tails are.

$$K = \frac{E[\varepsilon^4]}{(\sigma^2)^2} \tag{5.28}$$

Where ε are the errors and σ^2 their variances. The Jarque-Bera statistics and their corresponding P-values are presented in Tables 28, 29, 30 and 31 for each model estimated in the previous section. It can be seen that the null hypothesis that series of residuals of each of the fitted models follows a normal distribution is not rejected.

5.3.4 Tests for Granger Causality

VAR and VEC models represent the correlations among a set of variables, hence, they can be used in analyzing the relationships existing between them. Granger causality tests allow assessing the relationships between the variables in terms of their relevance for explaining the other variables in the model. Although there are additional methods, such as impulse response analysis and variance decomposition, that allow analyzing the dynamics of VAR and VEC models providing more insights on the relationship between the variables, this study focuses only on Granger causality since its aim is to provide initial insights on the nexus between the capital market and economic growth in Bolivia.

As described by Lütkepohl (2005, p. 41), the idea behind Granger causality is that "a cause cannot come after an effect. Thus, if a variable *x* affects a variable *z*, the former should help improving the predictions of the latter variable". In the following bivariate VAR model of order *p*, the variable x_t is said to Granger cause z_t if the behavior of past values of x_t can better predict the behavior of z_t than the past values of z_t alone.

$$z_t = v_1 + \sum_{i=1}^{p} a_i z_{t-i} + \sum_{i=1}^{p} b_i x_{t-i} + \varepsilon_{1t} \tag{5.29a}$$

$$x_t = v_2 + \sum_{i=1}^{p} c_i z_{t-i} + \sum_{i=1}^{p} d_i x_{t-i} + \varepsilon_{2t} \tag{5.29b}$$

Therefore, if x_t Granger causes z_t, the coefficients of x_t in the equation of z_t are non-zero. That is, the b_i's are different from zero for at least one of the $i = 1, \ldots, p$. This can be formally tested with the following hypotheses (Brandt & Williams, 2007):

$$H_0: Granger\ non-causality: x_t\ does\ not\ predict\ z_t\ if\ b_1 = b_2 = \cdots = b_p = 0$$

$$H_1: Granger\ causality: x_t\ does\ predict\ z_t\ if\ b_1 \neq 0, b_2 \neq 0, \ldots, or\ b_p \neq 0$$

This hypothesis test is usually implemented with an *F* test or a χ^2 test. In the presence of large numbers of variables and lags in the model, however, *F* tests may become biased towards the null hypothesis of non-causality. In such cases χ^2 tests should be performed constructed using a ratio test or a Wald test (Brandt & Williams, 2007). This procedure for testing for causality can be extended to a multivariate setting (Kirchgässner & Wolters, 2007).

Depending on the results of the Granger causality tests four possible cases can be distinguished with respect to the relationship between the variables in the VAR model in equations 5.29 (Gujarati, 2003):

i. *Unidirectional Granger causality running from x to z:* This occurs when at least one of the b_i coefficients of the lagged x variable of equation (5.29a) is statistically different from zero and all the coefficients c_i of the lagged z variable in equation (5.29b) are not statistically different from zero.
ii. *Unidirectional Granger causality running from z to x:* This situation occurs when at least one of the c_i coefficients of the lagged z variable in equation (5.29b) is statistically different from zero and all the b_i coefficients of the x variable in equation (5.29a) are not statistically different from zero.
iii. *Bidirectional Granger causality or feedback:* This occurs when at least one of the b_i coefficients of the variable x in equation (5.29a) and at least one of the c_i coefficients of the z variable in equation (5.29b) are all statistically different from zero.
iv. *Independence:* There is no Granger causality in the system when all the b_i coefficients of the variable x in equation (5.29a) and all the c_i coefficients of the z variable in equation (5.29b) are not statistically different from zero.

The interpretation of Granger causality must be done cautiously due to several reasons. First, considering that the standard definition of causality implies finding a relationship which is time-consistent, supported by a statistically significant correlation and non-spurious, Granger causality tests provide support for the first two of these conditions but not for the third. To determine that the relationship between the variables is non-spurious a theoretical background is necessary (Brandt & Williams, 2007). A second issue has to do with the existence of contemporaneous relationships between the variables in the system. Granger causality tests can only assess if past values of variables in the system can predict other variables. Even if no evidence of Granger causality has been found the variables in the system may be highly contemporaneously correlated. Therefore, finding no evidence of Granger causality does not imply that the time series in the system are uncorrelated (Brandt & Williams, 2007). A third issue has to do with the structure of the data because, even if a true causal relationship exists between the variables, its structure does not necessarily have to coincide with the structure in the data (Kirchgässner & Wolters, 2007). Finally, the term Granger causality must not be understood as causality in the general sense but only as a correlation between the current value of a variable and past values of others (Brooks, 2008).

The Granger causality tests for the estimated models were performed in Eviews using Wald tests. The χ^2 statistics are presented along with their corresponding P-values in Tables 32, 33, 34 and 35 in Appendix B. The results are presented in a more graphical format in Table 15 for the bivariate models and in Table 16 for trivariate models estimated.

Table 15. Granger causal relationships in bivariate models.

EG proxy	***Direction of causality***	***CMD proxy***	***EG proxy***	***Direction of causality***	***CMD proxy***
GDPpc	⊢⊣	*SMC* [a]	*GDPpc4*	⊢⊣ ⊢⊣	*SMC* [b] *SMC* [d]
	⊢⊣	*VST* [b]		⊢⊣	*VST* [a]
	⊢⊣	*PST* [a]		⊢⊣ ⊢⊣	*PST* [b] *PST* [d]
	⊢⊣	*PvST* [a]		→ →	*PvST* [b] *PvST* [d]
	→	*PSR* [c]		⊢⊣ →	*PSR* [b] *PSR* [d]
	⊢⊣ →	*PvSR* [b] *PvSR* [d]		→	*PvSR* [e]

Notes: [a] indicates the model estimated is a VAR in 1st differences; [b] indicates the model is estimated with a mix of *I(0)* and *I(1)* variables where the *I(1)* variables are taken in 1st differences while the *I(0)* variables in levels; [c] indicates the model estimated is a VECM; [d] indicates the model was estimated using the Toda & Yamamoto (1995) approach; [e] indicates the estimated model is a VAR in levels; ⊢⊣ indicates no causal relationship; → indicates uni-directional causality; ↔ indicates bi-directional causality.

Table 16. Granger causal relationships in trivariate models.

GDPpc – SMC – VST [a]	*SMC*	*VST*	***GDPpc4 – SMC – VST*** [a]	*SMC*	*VST*
GDPpc	↑	↑	*GDPpc4*	←	↑
SMC		←	*SMC*		↑
GDPpc – PST – PSR [a]	*PST*	*PSR*	***GDPpc4 – PST – PSR*** [b]	*PST*	*PSR*
GDPpc	⊣	⊣	*GDPpc4*	⊣	⊣
PST		⊣	*PST*		⊣
GDPpc – PvST – PvSR [a]	*PvST*	*PvSR*	***GDPpc4 – PvST – PvSR*** [c]	*PvST*	*PvSR*
GDPpc	←	↑	*GDPpc4*	⊣	↑
PvST		⊣	*PvST*		↑
			GDPpc4 – PvST – PvSR [a]	*PvST*	*PvSR*
			GDPpc4	⊣	↑
			PvST		⊣

Notes: [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach; [b] indicates the model estimated is a VECM; [c] indicates the model is estimated with a mix of *I(0)* and I(1) variables where the *I(1)* variables are taken in 1st differences while the *I(0)* variables in levels; ⊢⊣ indicates no causal relationship; → indicates uni-directional causality; ↔ indicates bi-directional causality.

There are three issues that must be discussed regarding the results from the Granger causality tests. First, the differences in the results when dealing with a mix of *I(0)* and *I(1)* variables by following the Toda & Yamamoto *(1995)* approach or by using the differencing approach; second, the differences in the results obtained when using *GDPpc* and *GDPpc4* as economic growth proxies; and third, the differences between the results found using bivariate and trivariate models. These issues are discussed separately in the following paragraphs.

First, with respect to the approaches used for dealing with a mix of *I(0)* and *I(1)* variables, the use of the Toda & Yamamoto (1995) and the differencing approach yielded similar results in causality tests in bivariate models except in the models between *GDPpc – PvSR* and *GDPpc4 – PSR* in which, while the Toda & Yamamoto (1995) approach shows Granger causality running from the economic growth proxy to the capital market development proxy, the differencing approach showed no causal relationship. In the trivariate model between *GDPpc4 – PvST – PvSR* while causality was found running from *PvST* to *PvSR* when using the differencing approach, no relationship between these two variables was found when following the Toda & Yamamoto (1995) approach.

From this it can be concluded that, although in some cases the two approaches for dealing with a mix of stationary and non-stationary variables yield similar results, this does not necessarily hold. Therefore, although the Toda & Yamamoto (1995) is subject to limitations, it should preferred with respect to the differencing approach.

Second, with respect to the difference between using *GDPpc* and *GDPpc4* as economic growth proxies, in bivariate models different results were found only in the relationship with the value of private securities traded (*PvST*): when using *GDPpc* as economic growth proxy no Granger causal relationship was found, while when using *GDPpc4*, causality running from economic growth to *PvST* was found. In trivariate models relating economic growth to stock market development measures (*SMC* and *VST*), while using *GDPpc* as economic growth proxy shows uni-directional causality from economic growth to the two stock market development variables, using *GDPpc4* as economic growth proxy shows the presence of bi-directional causality between all the variables in the model. In trivariate models relating economic growth to the development of the public fixed-income security market (*PSR* and *PST*), whereas no causal relationships were found among any of the variables when using *GDPpc* as economic growth proxy, causalilty was found from the value of public fixed income securities registered (*PSR*) to economic growth when using *GDPpc4*. Finally, in trivariate models relating economic growth to the development of the private fixed-income security market, using *GDPpc* as economic growth proxy shows the presence of causality from economic growth to the value of private securities registered (*PvSR*) and from the value of private securities traded (*PvST*) to economic growth, while models with *GDPpc4* as economic growth proxy show causality from economic growth to the value of private securities registered (*PvSR*) and from the value of securities traded (*PvST*) to the value of securities registered (*PvSR*). Although this latter causal relationship is found only in the model following the differencing approach for dealing with a mix of *I(0)* and *I(1)* variables.

Finally, the results from Granger causality tests differ when using bivariate or trivariate models. While no Granger causal relationship was found between economic growth and indicators of stock market development in bivariate models with either of the two economic growth proxies, in trivariate models with *GDPpc* as economic growth proxy, uni-directional Granger causality was found from economic growth to both stock market capitalization (*SMC*) and value of stocks

traded (*VST*) and from the value of stocks traded to stock market capitalization. In trivariate models with *GDPpc4* as economic growth proxy, bi-directional Granger causality is found between economic growth, stock market capitalization and value of stocks traded and also between value of stocks traded and stock market capitalization.

In the same way, while Granger causality tests based on bivariate models between economic growth and public fixed-income security market development proxies (*PST* and *PSR*) indicate the presence of Granger causal relationships running from economic growth to the value of public fixed-income securities registered (*PSR*), causality tests using trivariate models indicate no Granger causal relationship between economic growth and public fixed-income securities traded and registered when using *GDPpc* as proxy for economic growth. And only one uni-directional Granger causal relationship is found from the value of public securities registered to economic growth when using *GDPpc4* as economic growth proxy.

When considering the development of the private fixed-income security market, while in bivariate models with *GDPpc* as economic growth proxy there is no Granger causality between economic growth and the value of private securities traded (*PvST*), in the trivariate model *PvST* Granger causes economic growth. With respect to the value of private securities registered (*PvSR*), both bivariate and trivariate models with *GDPpc* as economic growth proxy indicate Granger causality from economic growth to *PvSR*. When using *GDPpc4* as proxy for economic growth, while causality tests in bivariate models indicate Granger causality from economic growth to the value of private securities traded (*PvST*), trivariate models show no causal relationship between these variables. On the other hand, both bivariate and trivariate models indicate Granger causality from economic growth to the value of securities registered (*PvSR*).

Overall, these results show no conclusive evidence that the development of the Bolivian capital market has Granger caused economic growth during the time period analyzed. Moreover, the only causal relationship that is maintained invariant in all models is unidirectional causality running from economic growth to the value of private fixed-income securities registered.

CHAPTER 6. Summary and Conclusions

This thesis has dealt with the issue of analyzing the nexus between economic growth and capital market development in Bolivia. In particular, it has focused on the relationship between economic growth and the development of the Bolivian stock exchange (Bolsa Boliviana de Valores) which is, at the moment, the only officially established stock exchange in Bolivia.

Chapter 2 presented a broad perspective of the historical development and the present state of the Bolivian capital market including a description of the institutions involved in its functioning, investors, issuers, types of securities and volumes traded. The Bolivian capital market is of recent creation. The legal basis for its functioning was established in the late 1970's, while the Bolivian Stock Exchange started operating just in 1989 and stock trading was introduced in 1994. Currently, most of the issuing firms listed at the BSE are financial institutions; the largest investors are institutional investors, of which Pension Fund Administrators are the most important. They represented more than 80% of the total institutional investments in 2010. Although the fixed-income security market is the largest one leaving the trading of stocks with a minor role, fixed-term deposits, which are issued by financial institutions, are by far the most heavily traded instruments in this market. The stock market, on the other hand, has a low market capitalization as a percentage of *GDP* and it has a limited penetration in comparison to its Latin American counterparts. It has never exceeded 3,7% of the total securities traded and in 2010 it represented only 1,13% of securities traded.

Several conclusions can be drawn from this chapter. First, the fact that most issuers are financial institutions which are, by the nature of their business, more familiar with capital markets, shows that enterprises of non-financial sectors are still not active participants of the capital market. Second, the predominance of fixed-term deposits in the Bolivian Stock Exchange suggests that issuers and investors are still not familiar with or remain reluctant to the possibility of issuing or investing on other less-conventional securities. Third, the limited state of development of the stock market is a possible reflection of the fact that, on the one hand, most firms in Bolivia are small and family-owned and that it is common for stocks to be traded outside the Bolivian Stock Exchange, and, on the other, that stocks have not yet been consolidated as regular financing and investment instruments. To sum up, the level of development of the Bolivian capital market is very low and it is still in process of getting consolidated as a source of financing for firms and as a means of investment for investors.

Chapter 3 presented a description of the evolution of the Bolivian economy over the last 30 years together with the most relevant economic policies implemented. In broad strokes, growth rates of the Bolivian economy between 1980 and 2010 have been low. However, there are two periods in which it had a positive performance reflected on an increase in the GDP growth rate and in the level of international reserves. First, between 1993 and 1997 in which economic reforms such as the capitalization of state-owned companies, the Popular Participation program and the pension system reform were implemented. The latter reform in particular, which implied the creation of Pension Fund Administrators that became the largest institutional investors of the Bolivian Stock Exchange, was expected to largely contribute to the development of the Bolivian capital market. The second period with positive economic performance was between 2005 and 2010 which was characterized by the implementation of reforms leading to the nationalization of the economy and the reactivation of state-owned companies. In particular, the reforms in the hydrocarbon sector and the increase of the international prices of hydrocarbon resources and other

commodities have had a positive impact on the economy in the past few years and it has led to a very significant rise in the level of international reserves from around $us. 1.000 million in 2004 to over $us. 10.000 million in 2011.

In Chapter 4 theoretical and empirical studies on the relationship between financial development and economic growth were presented. In the first part of the chapter the focus is on the theoretical link between financial development and economic growth which has been widely analyzed by Levine (2005). The basic functions of financial systems, which are: facilitating the trading of goods and services, exerting corporate control, mobilizing savings, allocating capital and facilitating the diversification of risk, can contribute to economic growth by increasing capital accumulation and promoting technological innovation. In the second part of Chapter 4 several studies assessing the empirical nexus between the level of financial development and economic growth were presented. Three different econometric approaches have been identified throughout the literature: studies based on cross-country data, on panel data and on time-series data. The most important conclusions drawn from this are, first, that while cross-country studies have provided an important insight on the nexus between financial development and economic growth, more recently, this relationship has been found to be heterogeneous across countries, highlighting the importance of conducting country-specific studies on this issue. And second, that the results obtained from empirical analyses of the finance growth-relationship depend on the econometric approach followed, on the specification of the models, on the time span analyzed and on the proxies used, suggesting the importance of resolving carefully all these elements making sure they are the most adequate for the relationship analyzed.

Chapter 5 has developed the empirical analysis of the relationship between capital market development and economic growth in Bolivia in the 1994-2010 period by estimating bivariate and trivariate Vector Autoregressive models and performing Granger causality tests using proxies for the size and liquidity of the fixed-income security and the stock market. The use of different proxies, models, and approaches to assess the relationship between capital market development and economic growth evidences the need of, on the one hand, contrasting the results obtained using different models and approaches and, on the other, based on the different results obtained, analyzing the overall relationship between capital market development and economic growth in Bolivia. These two aspects will be developed in the following paragraphs.

The first issue has to do with the use of two different proxies for economic growth: *GDP* per capita or *GDP* per capita in 4^{th} differences. The latter was used to remove seasonal effects present in the *GDP* per capita series. The use of different proxies modifies the nature of the cointegrating relationships between the variables analyzed and, hence, the models themselves. However, although the results of causality tests are not identical when using one or the other proxy for economic growth, they do not differ too much. Thus, it can be concluded that seasonality in the *GDP* per capita series appears not to distort too much the relationships between the variables in the models estimated.

Another issue has to do with the fact that, in some cases, models had to be estimated with a mix of *I(0)* and *I(1)* variables. Two approaches were used for dealing with this issue. The first one, which has been referred to as the differencing approach, consisted of taking the *I(1)* variable in 1^{st} differences and the *I(0)* variables in levels in order to have only stationary variables in the model. The second approach used was proposed by Toda & Yamamoto (1995) and allows performing Granger causality tests regardless of the order of integration of the variables and whether or not there are cointegrating relationships among them. The models estimated using the differencing

approach and the Toda & Yamamoto (1995) approach yielded similar results but not in all the cases considered. In view of this, and since the Toda & Yamamoto (1995) approach has an entire theoretical back-up developed by its proponents which supports the validity of the approach, it can be concluded that the differencing approach, in spite of its intuitive appeal, is not the most appropriate for dealing with variables with different orders of integration; hence, the Toda & Yamamoto (1995) approach must be preferred when dealing with issues of this sort.

Finally, differences in results arise when using bivariate and trivariate models. It is difficult to draw conclusions here since most of the relationships obtained in bivariate models are altered when using trivariate models. Trivariate models appear to show more interaction between the variables in some cases (while bivariate models relating economic growth to stock market development show no causal relationships, trivariate models relating the same variables do) and less interaction in others (whereas bivariate models relating economic growth to the public fixed-income security market show the presence of few causal relationships, trivariate models show no causality among the variables). The only results of causality tests that remain unchanged in bivariate and trivariate models are, first, that there is no Granger causal relationship between economic growth and the value of public securities traded and, second, that there is Granger causality running from economic growth to the value of private securities registered.

A general conclusion that can be drawn from the numerous differences presented above is that the results obtained are highly dependent on the proxies, models, and approaches chosen to assess the relationship between capital market development and economic growth.

Considering the different results and observations presented in the previous paragraphs, the general results of this study with respect to the overall relationship and direction of causality between capital market development and economic growth in Bolivia can be summarized as follows:

The empirical results show no conclusive support of the presence of Granger causality between variables of capital market development and economic growth. The only causal relationship that persists in all the models estimated goes from economic growth to the value of private fixed-income securities registered. Therefore, the main conclusion drawn is that the Bolivian capital market has not significantly contributed to economic growth during the time period analyzed.

This suggests that the stock market is too small and illiquid to contribute to economic growth; and that the fixed-income security market, although larger and more liquid, has also a limited impact on the economy. However, this does not imply that the Bolivian capital market is unimportant or that it should not be considered as a means for promoting economic growth. It rather seems to suggest that there might be a threshold to reach in terms of size and liquidity before the capital market is able to influence the economic dynamics of the country.

In addition, it may be presumed that the current configuration of issuers and investors participating in the Bolivian capital market, characterized by a predominant presence of firms coming from the financial sector and a very modest presence of enterprises from the productive sector, limits the possibility for this mechanism to boost economic growth.

In order to enhance the relevance of the capital market in promoting growth it is necessary to carry out measures oriented towards expanding the presence of the capital market reaching a broader sector of the economy and establishing it as a more regular source of financing and means for investment.

Increasing the base of issuers and investors of the Bolivian capital market may be of particular importance to enhance its contribution to economic growth. The number of firms that have access to funding through capital markets is very small in comparison with the total amount of officially registered enterprises in the country. This situation is made more evident when considering that the informal sector of the economy is the largest source of urban employment and a significant contributor to *GDP*. Bearing this in mind, it is not surprising to have found no significant contribution of the Bolivian capital market to economic growth. The extent to which the capital market contributes to boost the economy will depend on the extent to which it achieves to respond to the financing needs of micro and small enterprises and on the extent to which it can extend access to funding to these economic units. Work in this direction started in 1995 when *Bancosol*, a micro-finance oriented bank, issued bonds in the BSE channeling, in this way, financial resources through the BSE to micro and small enterprises, and was then followed by other financial institutions specialized in micro-finance. However, the amount of these issues is still very small with respect to other instruments, especially when considering the relevance of micro and small enterprises for the Bolivian economy.

Limitations and further research

This study is subject to limitations which may also provide guidelines for future research on the relationship between capital market development and economic growth in Bolivia.

First, the econometric models estimated in this study may be subject to omitted variable problems since they consider only economic growth and capital market development variables excluding other possible variables that may play an important role in economic growth such as real interest rates, government expenses and investment rates, among others; it is possible that the introduction of these variables allows a better specification of the models especially in terms of the amount of lags required in order to ensure serial independence and normality of the residuals.

Second, the proxy used for measuring the size of the private and public fixed-income security market in this study is the value of securities *registered*, however, the most recommended proxy for this is the value of securities *outstanding*; using the value of fixed-income securities outstanding may yield more reliable results when assessing the relationship between economic growth and the fixed-income security market.

A third limitation of this study has to do with the availability of data. On the one hand, time-series studies require observations during long time spans; given how recent the Bolivian capital market is, the data available covers at most 20 years which may not be enough in order to reflect the behavior of the series. On the other hand, the data used in this study corresponds to the securities registered and traded only at the Bolivian Stock Exchange, ignoring any other transactions which may take place outside the BSE. This is particularly relevant for the trades of stocks which, as mentioned before, are common to occur outside the Bolivian Stock Exchange.

Finally, this study has provided insights only on the Granger-causal relationship between capital market development and economic growth in Bolivia. Further analyses focusing on the dynamics between the variables in the estimated VAR or VEC models may provide a more in-depth understanding of the relationship between capital market development and economic growth in Bolivia. This can be carried out following methods such as the so called impulse response analysis or decomposition of the forecast error variance.

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Appendix A
Empirical studies on the Finance-Growth relationship

Table 17. Cross-country studies of the financial development-economic growth relationship

Article	Dependent variables	Independent variables	Sample	Methods	Findings
King & Levine (1993a)	- Real per capita GDP growth - Total factor productivity growth - Capital stock per capita growth	- Liquid liabilities/GDP - Credit allocation: bank credit/bank credit and domestic assets of the central bank - Credit to private firms/total domestic credit - Credit to private firms/GDP	80 countries 1960-1989	OLS regression	Positive correlation between measures of financial development and real GDP growth, total factor productivity growth and the rate of capital stock.
Atje & Jovanovic (1993)	- Real per capita income growth	Banking sector measures: - Credit by private and public banks/GDP Stock market measures: - Stock market trades/GDP	94 countries 1970-1988	OLS regression	Positive relationship between stock markets and growth. No relationship between banks and growth.
Japelli & Pagano (1994)	- Real per capita income growth	- Credit accessible for private households relative to secured assets	30 countries 1960-1985	OLS regression	Negative relationship between access to credit and real per capita income growth.
De Gregorio & Guidotti (1995)*	- Real per capita income growth	- Bank credit to private sector/GDP	100 countries 1960-1985	OLS regression	Positive relationship between the measure of financial development and growth in the whole sample but negative relationship found with panel data of a sample of Latin American countries.
Bekaert & Harvey (1998)	- Real GDP growth	- Number of stocks listed - Total value traded - Market capitalization - Turnover ratio - Market capitalization/GDP - Total value traded/GDP	18 countries 1986-1996	OLS regression	The evidence broadly confirms a positive correlation between financial development and economic growth.

* Also carries out panel studies.

Harris (1997)	- Real per capita GDP growth	- Investment/GDP - Stocks traded/GDP	49 countries 190-1991	Two stage least squares regression	Positive relationship between finance and growth only in high-income countries. This relationship is very weak in developing countries.
Levine & Zervos (1998)	- Real GDP per capita growth - Total factor productivity growth - Capital stock per capita growth - Gross private savings	Stock market measures: - Size: Stock market Capitalization. - Liquidity: Turnover ratio and Value traded. - Volatility: 12-month rolling standard deviation. - International Integration: *CAPM* integration and APT integration. Banking development measures: - Value of loans made by banks to the private sector divided by GDP: Bank Credit.	47 countries 1976-1993	OLS regression	Positive and robust correlation between measures of stock market and banking sector development and economic growth.
Andrés, Hernando & López-Salido (1999)	- Real per capita output growth	Stock market measures: - Stock market capitalization/GDP Banking development measures - Liquid liabilities and credit to non-financial firms/GDP	21 Countries	OLS regression and VAR analysis	Inflation has a negative effect on growth even after introducing financial market variables in the analysis. On the other hand, the link between financial market proxies and economic growth is found to be weak.
Fink & Haiss (1999)	- GDP	Stock market measures: - Stock market capitalization - Bond market capitalization Banking development measures - Bank assets	27 countries	OLS regression	Stock markets have a weak and sometimes negative impact on growth. Bond markets can be substitutes for credit from the banking sector; and banking sector has a positive link with growth.
Ram (1999)	- Real GDP per capita	- Liquid liabilities/GDP	95 countries 1960-1989	OLS regression	The correlation between financial development and economic growth is found

					to be weakly negative or insignificant. The same results are obtained by grouping countries by level of performance.
Rousseau & Wachtel (2000)*	- Real GDP per capita growth	- M3/GDP - (M3-M1)/GDP - Total credit/GDP	84 countries 1960-1995	Cross-sectional regression analysis	Strong positive relationship between financial development and economic growth. This relationship, however, weakens at high levels of inflation
Levine, Loayza & Beck (2000)*	- Real GDP per capita growth	- Liquid liabilities of the financial system/GDP - Commercial bank assets/commercial banks plus central bank assets - Credits by financial intermediaries to the private sector/GDP	74 countries 1960-1995	Pure cross-country regressions and GMM panel estimators	Development of financial intermediaries is positively related with economic growth
Minier (2003)	- Real GDP per capita growth	Stock market measures: - Stock market turnover ratio Banking sector measures: - Bank credit to the private sector/GDP	42 countries 1976-1993	Regression tree techniques	The sample is split in two groups. Measures of financial development and economic growth are positively correlated in countries with high levels of market capitalization. This does not hold in countries with low levels of market capitalization.
Shen & Lee (2006)	- Real GDP per capita growth	Stock market measures: - Total stocks traded/GDP - Market capitalization /GDP - Stock turnover ratio Banking sector measures:	48 countries 1976-2001	OLS regression	Only stock market development has a positive effect on growth. Banking sector development has an unfavorable or insignificant

* Also carries out panel studies.

		- Bank claims on the private sector			effect on growth.
Tang (2006)	- Real GDP per capita growth	- Foreign direct investment and portfolio inflows and outflows/GDP - Foreign direct investment and portfolio inflows/GDP Stock market measures: - Total stocks traded/GDP - Market capitalization /GDP - Stock turnover ratio - Number of domestic companies listed Banking sector measures: - Liabilities of bank and non-bank institutions/GDP - Commercial bank assets/commercial and central bank assets - Credits by commercial banks to the private sector/GDP	14 APEC countries 1981-2000	OLS regression and Two-stages least square estimation	Strong positive relationship between financial development measures and economic growth. No relationship found between capital flow measures and economic growth. These results are the same using both OLS regression and two-stage least square estimation.
Huang & Lin (2007)	- Real GDP per capita growth	Stock market measures: - Stock market turnover ratio Banking sector measures: - Bank credit to the private sector/GDP	42 countries 1976-1993	Threshold regression approach	It re-examines the study by Minier (2003) and finds no evidence that the full sample can be classified in two groups.

Table 18 Time-series studies of the financial development-economic growth relationship

Article	Dependent variables	Independent variables	Sample	Methods	Findings
Gupta (1984)	- Index of industrial production	- M1: Currency plus demand deposits - M2: M1 plus quasi money - Total domestic credit - Total private credit - M1 plus quasi money plus postal savings deposits plus bonds plus capital accounts	14 developing countries 1959-1980	VARs and Granger causality tests	Causality goes from financial development to the industrial sector in 8 countries and bi-directional causality in 6 countries.
Demetriades & Hussein (1996)	- Real GDP per capita	- Bank deposit liabilities/GDP - Bank claims on the private sector/GDP	16 countries 1960-1995	Granger causality tests	Bi-directional causality between banking intermediation and growth is found for most countries and some from growth to banking intermediation. Few evidence found that shows that financial intermediary development leads to economic growth.
Demetriades & Luintel (1996)	- Real GDP per capita	- Bank deposit liabilities to nominal GDP	India 1961-1991	Error-correction models and exogeneity tests	Financial development and economic growth are jointly determined based on the exogeneity tests.
Hansson & Jonung (1997)	- Real GDP per capita	- Lending from the financial sector to non-bank public per capita - Total investment per capita - Increase in years of schooling - Number of patent applications	Sweden 1834-1991	VEC models and Granger causality tests	Interaction between variables determines an unstable relationship between them. The causality direction depends on the time period analyzed.
Arestis & Demetriades (1997)	- Real GDP per capita	Stock market measures - Stock market capitalization - Stock market volatility Banking sector development - Log of M2/GDP - Domestic bank credit/GDP	German and United States Quarterly data 1979-1991	Granger causality tests	Links between the financial sector and economic growth are different in Germany and the United States. The causal direction in Germany is from financial sector to

					economic growth and there is no evidence for causality in the case of the United States.
Neusser & Kugler (1998)	- Total factor productivity of the manufacturing industry - GDP of the manufacturing industry	- GDP of the financial sector	13 countries 1960-1997	Cointegration analysis and Granger causality tests	Cointegration between financial sector GDP and manufacturing industry GDP are found in 7 of the 13 countries. Cointegration is more often with TFP. The causal relationship from financial to real sector only found in 3 countries.
Rousseau & Wachtel (1998)	- Real GDP per capita growth	- Money base - Assets of commercial banks - Combined assets of commercial banks and savings institutions - Combined assets of commercial banks, savings institutions, insurance firms, credit cooperatives and pension funds - Deposits of commercial banks - Combined deposits of commercial banks and savings institutions	United States United Kingdom Canada Norway Sweden 1870-1929	VEC models and Granger causality tests	Leading role of financial variables in the real sector activity.
Luintel & Khan (1999)	- Real GDP per capita	- Total deposit liabilities of deposit banks/lagged nominal GDP - Real interest rate - Capital stock	10 countries Time span of 36 to 41 years	VEC models and Granger causality tests	Evidence is found for bi-directional causality in all the countries in the sample.
Ghali (1999)	- Real GDP per capita	- Bank deposit liabilities/GDP - Bank claims on the private sector/nominal GDP	Tunisia 1963-1993	VAR models and Granger causality tests	The results show that there is a causal link between both financial development measures and economic growth.
Xu (2000)	- Real GDP gowth - Real domestic investment growth	- Financial development index	41 countries 1960-1993	VAR models	Investments are an important channel to economic growth and

					financial development stimulates growth.
Kar & Pentecost (2000)	- Real GDP growth	- Money/GDP - Banking deposit liabilities/GDP - Private sector credit/GDP - Private sector credit share in domestic credit - Domestic credit/GDP	Turkey 1963-1995	Cointegration and VEC methodologies	The causal direction in Turkey depends on the financial development proxy used.
Arestis, Demetriades & Luintel (2001)	- Real GDP	Stock market measures: - Stock market capitalization ratio: stock market value/GDP Banking sector measures - Domestic bank credit/nominal GDP	Germany France United Kingdom United States Japan	VEC models	Both banks and stock markets promote economic growth, however, the contribution of stock markets is smaller and has possibly been exaggerated in other studies.
Bell & Rousseau (2001)	- Real per capita NDP	- Domestic assets of deposit money banks - Total domestic credit to money banks - Credit allocated to the private sector	India 1951-1995	VAR and VEC models	The financial sector has an important role for promoting economic growth.
Al-Yousif (2002)	- Real GDP per capita growth	- Currency ratio: currency/narrow money stock - Broad money stock (M2)/GDP	30 developing countries 1970-1999	VEC models and Granger causality tests	Evidence found for bi-directional causality between financial measures and GDP per capita growth. Small evidence for other causal directions between the variables.
Ghirmay (2004)	- Real GDP growth	- Credit to the private sector by financial intermediaries	13 Sub-Saharan countries	VEC models and Granger causality tests	Long run relationship between financial development and economic growth is found in 12 countries. The direction of causality is found to be from financial development to economic growth in 8 of

					the 12 countries.
Thangavelu & Ang (2004)	- Real GDP growth	- Bank claims on private sectors/ nominal GDP - Domestic bank deposit liabilities/nominal GDP - Equities turnover/nominal GDP	Australia 1960-1999	VAR models and Granger causality tests	There is evidence of Granger causality that economic growth leads development of financial intermediaries.
Caporale, Howells & Soliman (2005)	- Real GDP growth	- Gross fixed capital formation/nominal GDP - Real change of GDP/real level of total investment - Stock market capitalization/GDP - Value stocks traded/GDP	Chile Korea Malaysia Philippines 1979-1998 quarterly data	VAR models and Granger causality tests through Wald tests	The causal direction runs from stock market development to economic growth and investment is the channel through which stock markets promote economic growth in the long run.
Azarmi, Lazar & Jeyapul (2005)	- Real GDP per capita	- Index containing stock market capitalization, total value traded and turnover ratio - Financial depth: M3/GDP - Bank demand deposit claims/GDP - Total foreign trade - Inflation rate	India 1981-2001	Time series regressions	The data is divided into pre and post-liberalization periods. Stock market development is associated with economic growth in the pre-liberalization period but not in the post-liberalization period. When considering the whole time span, no correlation is found between economic growth and financial development
Chang & Caudill (2005)	- Real GDP per capita	- M2/GDP	Taiwan 1962-1998	VEC models and Granger causality tests	Granger causality tests suggest uni-directional causality running from financial development, measured as M2/GDP, to economic growth.
Ang & McKibbin (2007)	- Logarithm of real GDP per capita	- Logarithm of liquid liabilities (M3)/nominal GDP - Logarithm of commercial bank assets/commercial bank plus	Malaysia 1960-2001	VEC models and Granger causality tests	Financial depth and economic development are positively related and the causal direction goes from

		central bank assets - Logarithm of domestic credit to private sectors/nominal GDP			economic growth leading o higher financial depth in the long run.
Güryay, Şafakli & Tüzel (2007)	- Real GDP growth	- Loans/GDP - Domestic investments/GDP - Deposits/GDP	Northern Cyprus 1986-2004	Granger causality tests	Negligible positive effect of financial development to economic growth. The causal direction goes from economic growth to the development of financial intermediaries.
Jalil & Ma (2008)	- Real GDP per capita	- Credit to the private sector/nominal GDP - Deposit liability/nominal GDP	China Pakistan 1960-2005	Bound testing ARDL approach	Financial measures have a significant impact on economic growth in Pakistan whereas, the effects on China are not significant.
Obreja, Dragota, Catarama & Semenescu (2008)	- Real GDP per capita growth	- Stock market capitalization/GDP - Turnover ratio - Value traded ratio - Stock market volatility: eight-quarter moving standard deviation of the end-of-quarter change of stock market prices	Romania 2000-2006	Linear regressions and VAR models	Stock market development is positively correlated with economic growth. The causal direction seems to be from economic growth to stock market development, which suggests that economic growth leads financial development.
Abu-Bader & Abu Qarn (2008a)	- Real GDP per capita	- Money stock (M2)/nominal GDP - M2 minus currency/nominal GDP - Bank credit to the private sector/nominal GDP - Credits to non-financial private firms/Total domestic credit	Algeria Egypt Israel Morocco Syria Tunisia 1960-2004	VAR models and Granger causality	Strong evidence is found for causality running from financial development to economic growth for all countries except Israel. Only in Algeria and Egypt financial development contributes to economic growth through enhancing investments.
Abu-Bader & Abu Qarn (2008b)	- Real GDP per capita	- Money stock (M2)/nominal GDP	Egypt 1960-2001	Cointegration analysis, VEC	Financial development and economic growth have

		- M2 minus currency/nominal GDP - Bank credit to the private sector/nominal GDP - Credits to non-financial private firms/Total domestic credit		models and Granger causality tests	mutual causation and financial development causes economic growth through increasing resources and for investment and enhancing efficiency.
Perera & Paudel (2009)	- Real GDP per capita	- Narrow money/nominal GDP per capita - Broad money/nominal GDP per capita - Total deposits/nominal GDP per capita - Private sector credit/nominal GDP per capita - Total credit/nominal GDP per capita - Private sector credit/total domestic credit	Sri Lanka 1955-1995	Cointegration tests, VEC models and Granger causality tests	The results do not support the view that financial development strongly contributes to economic growth. Causality tests establish bi-directional causality between broad money and economic growth. Private sector credit leads economic growth and there is causal direction from economic growth to narrow money, total credit and private sector credit.
Nurudeen (2009)	- Real GDP	- Market capitalization/GDP - Stock market turnover ratio - Total imports and exports/GDP - All-share index of the Nigerian stock market	Nigeria 1981-2007	VEC models and Granger causality tests	Stock market development measured as stock market capitalization/GDP has a positive influence on economic growth.
Pradhan (2009)	- Index of industrial production	- Stock market capitalization - Broad money supply - Foreign trade - Bank credit	India 1993-2008	VAR models and Granger causality tests	Financial development and economic growth are inter-dependent in India during the study period. Bi-directional causality is found between economic growth and money supply, economic growth and bank credit; market capitalization and foreign

					trade and money supply and foreign trade. And Uni-directional causality from Market capitalization to economic growth, foreign trade to economic growth and money supply to market capitalization.
Boubakari & Jin (2010)	- Real GDP	- Foreign direct investment - Total stock value traded - Turnover ratio - Stock market capitalization	Belgium France Portugal Netherlands United Kingdom 1995-2008 Quarterly data	Granger causality tests	There are positive causal links showing that stock market development promotes economic growth for countries in which the stock market is liquid and highly active. No causality is found for which stock markets are small and less liquid.
Chakraborty (2010)	- Real GDP growth	- Index of Industrial Production - Stock market capitalization/GDP - Stock market turnover/GDP - Money market rate - External debt burden: External debt/Exports	India 1993-2005 Quarterly data	Cointegration and Error Correction Models	Cointegration analyses show that increase in market capitalization dampens economic growth and money market interest rate has a positive effect on growth. The error correction model does not support that stock market development is an important promoter of economic growth.

Table 19 Panel studies of the financial development-economic growth relationship

Article	Dependent variables	Independent variables	Sample	Methods	Findings
De Gregorio & Guidotti (1995)*	- Real per capita income growth	- Bank credit to private sector/GDP	100 countries 1960-1985	OLS regression and panel data analysis	Positive relationship between the measure of financial development and growth in the whole sample but negative relationship in panel data from a sample of Latin American countries.
Odedokun (1996)	- Real GDP growth	- Population growth rate - Investment/GDP - Growth of real exports - Financial depth: Value of stock of liquid liabilities/nominal GDP	71 countries 1960-1980	Generalized least squares regression and panel data estimation	Financial intermediation promotes economic growth in 85% of the countries studied. Financial intermediation causes growth more predominantly in low income countries and its effects on economic growth are invariant around the world.
Beck, Levine & Loayza (2000)	- Real GDP per capita growth - Total factor productivity growth - Physical capital accumulation - Private savings rate	- Credits to the private sector/GDP, excluding credits issued by central banks and development banks - Liquid liabilities of the financial system/GDP - Commercial bank assets/Commercial and central bank assets - Credits of deposit money banks to private sector/GDP	61 countries 1960-1995	Generalized method of moments panel estimator	Large and significant relationship between financial intermediary development and real per capita GDP growth and total factor productivity growth. However, there is an ambiguous relation between financial intermediary development and physical capital accumulation and savings rate.
Benhabib & Spiegel (2000)	- Real GDP growth - Total factor productivity growth	- Liquid liabilities of the financial sector/GDP (financial depth)	Argentina Chile Indonesia	GMM panel estimators	Financial development has a positive influence on growth of investment and

* Also carries out cross-section studies.

		- Domestic assets of deposit-money domestic banks/domestic assets of deposit-money banks plus central bank - Claims on the non-financial sector/GDP - Gini coefficient interacting with financial depth - Initial income interacting with financial depth	Korea 1965-1985		total factor productivity. Results are found to depend on the indicators used and on specific-country effects.
Levine, Loayza & Beck (2000) *	- Real GDP per capita growth	- Liquid liabilities of the financial system/GDP - Commercial bank assets/commercial banks plus central bank assets - Credits by financial intermediaries to the private sector/GDP	74 countries 1960-1995	GMM dynamic panel estimators and cross-sectional instrumental variable estimator.	Development of financial intermediaries is positively related with economic growth.
Rousseau & Wachtel (2000)*	- Real GDP per capita growth	- M3/GDP - (M3-M1)/GDP - Total credit/GDP	84 countries 1960-1995	Cross-sectional regression analysis and panel Vector auto-regressions	Strong positive relationship between financial development and economic growth. This relationship, however, weakens at high levels of inflation.
Loayza & Ranciere (2002)	- GDP per capita growth	- Financial intermediation measure: Private domestic credit/GDP	75 countries 1960-2000	Pooled Mean Group estimators	A positive long-run relationship between financial intermediation

		- Control variables: Initial level of GDP per capita, Volume of trade/GDP and inflation rate.			and economic growth co-exists with a mostly negative short-run relationship.
Beck & Levine (2004)	- Real GDP growth	Stock market measures: - Stock market Capitalization. - Value traded - Turnover ratio Banking development measures: - Value of loans made by banks to the private sector divided by GDP: Bank Credit.	40 countries 1976-1998	GMM panel estimators	Stock markets and banks have a positive influence on economic growth.
Christopoulos & Tsionas (2004)	- Real GDP per capita growth	- Measure of financial depth: Total banks deposits liabilities/nominal GDP - Share of gross fixed capital formation/nominal GDP	10 developing countries 1970-2000	Panel unit root tests and panel cointegration analysis	Findings support there is a single equilibrium relation between financial depth economic growth and auxiliary variables and that causality runs from financial depth to economic growth.
Rioja & Valev (2004)	- Real GDP per capita	- Private sector credit/GDP - Liquid liabilities/GDP - Commercial bank loans/Central bank loans	74 countries 1960-1995	GMM dynamic panel techniques	The effect of finance on growth is not uniformly positive and even when it is positive, the magnitude of the effect varies. Financial development has an important impact on economic growth only when it has reached a certain size threshold.
Fink, Haiss & Mantler (2005)	- Real GDP growth	- Domestic claims of banking institutions/GDP - Stock market capitalization/GDP - Bonds: Outstanding debt	22 market economies 11 transition countries 1990-2001	Dynamic panel data estimators	Weak and fragile link between finance and growth was found in market economies and strong short-run growth induced by

		securities/GDP			finance in transition countries. In general, financial sector and its different segments have different effects on growth in different countries.
Ketteni, Theofanis, Mamuneas & Stengos (2007)	- Real GDP per capita growth	- Liquid liabilities of the financial system/GDP - Commercial bank assets/Commercial bank plus central bank assets - Credit to the private sector/GDP - Initial income per capita - Openness to trade - Inflation - Government size - Black market premium	74 countries 1961-1995	GMM dynamic panel estimator	Financial development and economic growth are linear only when non-linearities between economic growth and initial per capita income are considered.
Hagmayr & Haiss (2007)	- Real GDP per capita growth	- Capital stock growth - Loans of deposit money banks and monetary authorities/GDP - Loans of deposit money banks and monetary authorities to the private sector/GDP - Stock market capitalization/GDP - Bonds outstanding/GDP	Turkey Croatia Bulgaria Romania 1995-2005	Panel data estimation	Domestic bonds and capital stocks appear to have had an important impact on economic growth in the countries of the sample. Private credit and stock markets, however, appear to have minor and negative effects on economic growth.
Apergis, Filippidis & Economidou (2007)	- Real GDP per capita	- Liquid liabilities of the financial system/GDP - Credit gdp - of deposit banks to the private sector/	15 OECD countries 50 non OECD countries 1975-2000	Panel integration and cointegration techniques	Results show single long-run equilibrium relation between financial deepening, economic growth and the control variables. A bi-directional causality between financial deepening and growth is also found in the evidence.

Akimov, Wijeweera & Dollery (2009)	- Real GDP growth	- Liquid liabilities/GDP - Commercial bank assets/Commercial bank plus central bank assets - Claims on the private nonfinancial sector/Total domestic credit - Claims on the private nonfinancial sector/total domestic credit	27 transition countries 1989-2004	Panel data analysis techniques	There is evidence of robust positive link between financial development and economic growth in countries in transition.
Dawson (2010)	- Real GDP	- Liquid liabilities/GDP - Investment	58 Less developed countries 1960-2002	Panel cointegration methods and Fully modified Ordinary Least Squares methods	Evidence is found supporting a positive relationship between financial development and GDP. The magnitude of the effect, however, is not comparable to those found in other studies that use growth rates or other measures of financial development.
Bangake & Eggoh (2011)	- GDP per capita	- Liquid liabilities/GDP - Deposit money bank assets/GDP - Domestic private credit/GDP - Control variables: Government expenditure and openness to trade	71 developed and developing countries 1960-2004	Dynamic OLS estimator and panel VEC model estimation	Evidence is found for bi-directional causality between finance and growth. When considering long- and short-run causality several differences are found among country groups: in low and middle income countries there is no evidence of short-run causality while in high income countries financial development has a significant impact on economic growth.

Appendix B

Results of the Econometric Analysis

Table 20. Estimated bivariate models with GDPpc as proxy for economic growth.

Model:	***D(GDPpc) –D(SMC)***		***D(GDPpc) – VST***		***D(GDPpc) –D(PST)***	
Lags	*EG*	*CMD*	*EG*	*CMD*	*EG*	*CMD*
EG(-1)	-0,695173	0,001629	-0,124512	-0,000276	-0,560545	-0,001151
EG(-2)	-0,585665	0,001048	-0,319561	0,000073	-0,544436	-0,001043
EG(-3)	-0,437261	0,000383	0,087231	0,000322	-0,312107	-0,000251
EG(-4)	0,396523	0,001249	0,800362	-0,000111	0,746685	-0,000331
EG(-5)	0,061207	-0,000597	-0,488884	-0,000334	0,287945	0,00056
EG(-6)	0,137945	-0,001511	0,332707	0,000038	0,255457	0,000378
EG(-7)	-0,010860	-0,001437	-0,096090	-0,000863	-	-
EG(-8)	0,162354	-0,002503	-0,297726	-0,000099	-	-
EG(-9)	0,198193	-0,001806	0,084040	0,000377	-	-
EG(-10)	-	-	-0,162372	-0,000210	-	-
EG(-11)	-	-	-0,257654	-0,000273	-	-
EG(-12)	-	-	-0,022306	-0,000399	-	-
EG(-13)	-	-	-0,674010	-0,000788	-	-
EG(-14)	-	-	-0,887927	-0,000992	-	-
EG(-15)	-	-	-0,787473	0,000171	-	-
EG(-16)	-	-	0,153906	0,000364	-	-
EG(-17)	-	-	0,358048	0,000400	-	-
EG(-18)	-	-	0,230500	0,000461	-	-
EG(-19)	-	-	-0,009658	-0,000134	-	-
EG(-20)	-	-	-0,657932	-0,000482	-	-
CMD(-1)	-29,031530	0,582471	-783,9665	0,032154	-24,73347	-0,123676
CMD(-2)	-2,037217	-0,191664	-254,6055	-0,213150	35,05514	-0,180885
CMD(-3)	-1,263806	-0,147021	-3,567388	-0,065406	21,17863	-0,078864
CMD(-4)	-34,669180	0,353417	-6,394688	0,088739	31,41496	0,062635
CMD(-5)	7,439677	-0,369410	123,6552	0,267612	-10,631	0,070616
CMD(-6)	-2,219830	0,244446	-635,5282	-1,123013	15,417	0,109009
CMD(-7)	-28,201430	-0,106128	-228,8694	-0,123560	-	-
CMD(-8)	17,989790	-0,042527	-164,1511	0,301631	-	-
CMD(-9)	-42,882670	0,070889	289,2419	-0,191838	-	-
CMD (-10)	-	-	-697,4804	-0,224578	-	-
CMD (-11)	-	-	663,8561	0,376513	-	-
CMD (-12)	-	-	-264,6716	-0,337203	-	-
CMD (-13)	-	-	-343,5335	-0,392005	-	-
CMD (-14)	-	-	-219,4786	0,108993		
CMD (-15)	-	-	-187,9772	-0,238419	-	-
CMD (-16)	-	-	-129,4299	-0,231189	-	-
CMD (-17)	-	-	46,11864	-0,222163	-	-
CMD (-18)	-	-	-454,6467	-0,087141	-	-
CMD (-19)	-	-	-408,4879	-0,162712	-	-
CMD (-20)	-	-	108,2562	-0,020628	-	-
v	5,003704	0,012578	15,2699	0,013143	2,481014	0,003961
R^2	0,98208	0,47299	0,996217	0,811582	0,979501	0,187434
AIC	5,20135		-0,244857		4,804729	
SIC	6,55129		2,98306		5,704445	

Continues…

Table 20. Estimated bivariate models with GDPpc as proxy for economic growth. (Continued)

Model:	***D(GDPpc) – D(PvST)***		***VECM: GDPpc – PSR***		***D(GDPpc) – PvSR***	
Lags	*EG*	*CMD*	*EG*	*CMD*	*EG*	*CMD*
EG(-1)	-0,559956	0,000551	-0,386868	-0,004924	-0,408057	0,000069
EG(-2)	-0,466017	0,002291	-0,272134	-0,008777	-0,485641	0,000960
EG(-3)	-0,231838	0,001932	-0,18742	-0,008783	-0,277465	-0,000008
EG(-4)	0,795308	0,001929	0,882559	-0,007373	0,582704	-0,000414
EG(-5)	0,351622	0,001416	0,092032	-0,007633	0,128655	0,001000
EG(-6)	0,252405	-0,000376	0,259857	0,001892	0,183546	0,000069
EG(-7)	-	-	0,33194	-0,002778	-0,026394	0,001097
EG(-8)	-	-	0,130256	-0,00375	0,139358	0,001436
EG(-9)	-	-	0,318554	-0,004955	-	-
EG(-10)	-	-	0,042205	-0,016082	-	-
EG(-11)	-	-	-0,176162	-0,009961	-	-
EG(-12)	-	-	0,007558	-0,009728	-	-
EG(-13)			0,045905	-0,005893	-	-
CMD(-1)	-11,168060	-0,135045	-13,49724	0,613984	54,517060	0,085784
CMD(-2)	-26,719960	-0,218105	15,96629	0,447118	-34,21536	0,122498
CMD(-3)	-23,832800	-0,194338	12,80301	1,178886	-1,380406	-0,048475
CMD(-4)	8,152878	0,3027	-4,946644	1,518814	-26,06648	0,199153
CMD(-5)	-14,447410	0,004314	-19,22092	1,595445	28,629200	0,307437
CMD(-6)	26,048910	-0,012199	-16,45145	0,753393	-68,20099	0,035801
CMD(-7)	-	-	-14,56558	0,200436	60,289640	0,042376
CMD(-8)	-	-	3,225455	-0,193309	-52,84138	0,100800
CMD(-9)	-	-	5,095573	0,215743	-	-
CMD(-10)	-	-	-1,481922	0,639335	-	-
CMD(-11)	-	-	3,869305	0,813599	-	-
CMD(-12)	-	-	-13,77298	0,545607	-	-
CMD(-13)	-	-	-0,820511	0,375962	-	-
v	2,051754	-0,013982	-0,024046 [b]	0,00414 [b]	5,082717	0,009779
Cointegrating equation						
EG	-	-	1	-	-	-
CMD1	-	-	-454.5289	-	-	-
v_{CE}	-	-	-531.4654	-	-	-
R^2	0,977581	0,292802	0,986372	0,853994	0,979926	0,339984
AIC	0,000893		6,577548		3,860399	
SIC	0,144333		8,677031		5,057624	

Model:	***GDPpc – PvSR*** [a]	
Lags	*EG*	*CMD*
EG(-1)	0,474974	-0,000555
EG(-2)	-0,036101	0,000728
EG(-3)	0,114653	-0,001282
EG(-4)	1,046589	0,000173
EG(-5)	-0,452823	0,000925
EG(-6)	0,037026	-0,000480
EG(-7)	-0,099745	0,001606
CMD(-1)	39,52586	-0,105768
CMD(-2)	-59,32899	-0,123920
CMD(-3)	-27,51983	-0,213488
CMD(-4)	-41,42135	0,037667
CMD(-5)	-4,751489	0,030693
CMD(-6)	-63,32319	0,009758
CMD(-7)	42,10469	-0,074607
v	-40,80434	-0,576764
R^2	0,972081	0,425503
AIC	3,550300	
SIC	4,588435	

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach; [b] indicates the coefficients correspond to the error correction term of the VEC model.

Table 21. Estimated bivariate models with GDPpc4 as proxy for economic growth.

Model:	***GDPpc4 – D(SMC)***		***GDPpc4 – SMC*** [a]		***D(GDPpc4) – D(VST)***	
Lags	*EG*	*CMD*	*EG*	*CMD*	*EG*	*CMD*
EG(-1)	0,516729	0,000903	0,375259	0,001624	0,008641	-0,000256
EG(-2)	-	-	0,120507	-0,000791	-0,529981	-0,000028
EG(-3)	-	-	0,138659	-0,001041	-0,379362	0,000032
EG(-4)	-	-	-0,161189	0,001	0,037480	0,000006
EG(-5)	-	-	-0,015767	-0,000176	-0,694020	-0,000673
EG(-6)	-	-	0,279762	-0,001408	-0,174453	0,000056
EG(-7)	-	-	-	-	-0,012576	-0,000458
EG(-8)	-	-	-	-	-0,371579	-0,000051
EG(-9)	-	-	-	-	-0,284765	0,000064
EG(-10)	-	-	-	-	0,076993	0,000201
EG(-11)	-	-	-	-	-0,068859	-0,000498
EG(-12)	-	-	-	-	-0,271204	-0,000120
EG(-13)	-	-	-	-	-0,252457	-0,000244
EG(-14)	-	-	-	-	-0,082799	-0,000286
EG(-15)	-	-	-	-	-0,614851	0,000015
EG(-16)	-	-	-	-	0,075046	0,000260
CMD(-1)	-20,77879	0,382632	-39,20494	1,323433	-727,6054	-0,718562
CMD(-2)	-	-	48,88526	-0,604708	-536,4412	-0,682884
CMD(-3)	-	-	-21,42507	-0,020845	-401,1012	-0,595863
CMD(-4)	-	-	-12,38265	0,548318	-904,9808	-0,628658
CMD(-5)	-	-	26,74282	-0,665846	-495,3772	-0,083879
CMD(-6)	-	-	-11,68464	0,387059	-471,1483	-0,797083
CMD(-7)	-	-	-	-	-849,9704	-0,846466
CMD(-8)	-	-	-	-	-930,1942	-0,311275
CMD(-9)	-	-	-	-	-231,2455	-0,296909
CMD(-10)	-	-	-	-	-952,5044	-0,355439
CMD(-11)	-	-	-	-	-520,4443	0,006526
CMD(-12)	-	-	-	-	-161,4683	-0,012606
CMD(-13)	-	-	-	-	-431,4240	-0,300651
CMD(-14)	-	-	-	-	-184,4835	0,205262
CMD(-15)	-	-	-	-	-103,0610	0,084489
CMD(-16)	-	-	-	-	-74,30084	-0,008908
v	4,141319	-0,000061	4,91278	0,11245	1,055929	0,000017
R^2	0,317219	0,141341	0,475546	0,956745	0,692967	0,838609
AIC	4,768844		4,895904		0,602846	
SIC	4,972952		5,971194		3,200925	
Model:	***GDPpc4 – D(PST)***		***GDPpc4 – PST*** [a]		***GDPpc4 – D(PvST)***	
Lags	*EG*	*CMD*	*EG*	*CMD*	*EG*	*CMD*
EG(-1)	0,488698	-0,001176	0,434689	-0,001195	0.419866	0.000483
EG(-2)	0,139926	0,000643	0,076381	0,000039	0.123988	0.00187
EG(-3)			0,185508	0,000989	0.233603	0.000049
CMD(-1)	-20,68208	-0,11272	-24,382860	0,752728	-17.65795	-0.206731
CMD(-2)	20,21042	-0,246563	39,457010	-0,135888	-16.67367	-0.303952
CMD(-3)			-12,542840	0,048356	-26.45675	-0.239973
v	3,102502	0,00434	6,383586	0,057071	2.142225	-0.017842
R^2	0,34775	0,088905	0,399933	0,562398	0.362902	0.213561
AIC	4,547826		4,632559		4,357159	
SIC	4,890912		5,260863		4,841622	

Continues…

Table 21. Estimated bivariate models with GDPpc4 as proxy for economic growth. (Continued)

Model:	***GDPpc4 – PvST*** [a]		***GDPpc4 – D(PSR)***		***GDPpc4 – PSR*** [a]	
Lags	*EG*	*CMD*	*EG*	*CMD*	*EG*	*CMD*
EG(-1)	0,300762	0,000495	0,578849	-0,001269	0,502177	0,001837
EG(-2)	0,054060	0,001962	0,180591	-0,00631	0,181966	-0,006459
EG(-3)	0,180824	0,000319	-0,033803	0,003467	-0,092029	0,002302
EG(-4)	-	-	-0,026536	0,003893	0,099325	0,002221
EG(-5)	-	-	-0,188529	-0,000821	-0,191402	-0,002184
EG(-6)	-	-	0,29492	0,003474	0,332086	0,009121
EG(-7)	-	-	0,182715	-0,004273	0,166453	-0,002623
EG(-8)	-	-	-0,051552	0,000364	-0,243040	-0,003000
EG(-9)	-	-	-0,191433	0,00223	-0,121120	0,000094
EG(-10)	-	-	0,069409	-0,005821	0,072595	-0,008181
EG(-11)	-	-	0,251916	-0,001274	0,356278	-0,002373
EG(-12)	-	-	-0,122123	0,002896	0,046984	0,001272
EG(-13)	-	-	-0,209044	0,005689	-0,234076	-0,000760
EG(-14)	-	-	-	-	0,135171	-0,001504
EG(-15)	-	-	-	-	0,018090	0,006503
CMD(-1)	-14,39377	0,772944	3,621538	-1,10595	7,333977	-0,559494
CMD(-2)	-4,893726	-0,067532	24,67568	-0,823118	34,230540	-0,135938
CMD(-3)	-13,32452	0,058110	16,2965	0,139567	6,575907	0,549318
CMD(-4)	-	-	-13,48655	0,653623	-20,110230	0,787136
CMD(-5)	-	-	-23,11306	0,452843	-15,008680	0,381221
CMD(-6)	-	-	-5,18362	-0,515382	-1,206424	-0,568294
CMD(-7)	-	-	12,83441	-1,085417	7,352953	-0,816709
CMD(-8)	-	-	21,71495	-0,872818	16,169450	-0,606150
CMD(-9)	-	-	5,057373	-0,16524	5,383794	0,025793
CMD(-10)	-	-	-19,41626	0,51327	1,697384	0,732882
CMD(-11)	-	-	-2,137177	0,35232	20,075870	0,488746
CMD(-12)	-	-	1,541674	-0,017351	-7,871986	-0,055415
CMD(-13)	-	-	12,11112	-0,021923	-10,623080	-0,108026
CMD(-14)	-	-	-	-	-9,599650	-0,475367
CMD(-15)	-	-	-	-	12,193070	-0,187457
v	10,142930	-0,023840	1,585318	0,001732	-10,631540	0,209779
R^2	0,434461	0,869127	0,654645	0,782096	0,72791	0,790603
AIC	4,343461		7,005522		6,670093	
SIC	4,971765		9,050984		9,242994	

Model:	***GDPpc4 – PvSR***	
Lags	*EG*	*CMD*
EG(-1)	0,515577	-0,000104
EG(-2)	-0,012447	0,000995
EG(-3)	0,208083	-0,001002
EG(-4)	-0,132527	-0,000616
EG(-5)	-0,005825	0,001145
EG(-6)	0,197126	0,000819
CMD(-1)	38,04377	-0,032435
CMD(-2)	-25,45239	0,142406
CMD(-3)	20,92492	-0,029381
CMD(-4)	-40,37772	0,187288
CMD(-5)	21,96272	0,280906
CMD(-6)	-36,10209	0,139233
v	3,301126	0,020611
R^2	0,44872	0,344922
AIC	3,583978	
SIC	4,507625	

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach.

Table 22. Estimated trivariate models with GDPpc as proxy for economic growth.

Model:	***GDPpc – SMC – VST*** [a]			***GDPpc – PST – PSR*** [a]		
Lags	*EG*	*CMD1*	*CMD2*	*EG*	*CMD1*	*CMD2*
EG(-1)	0,69291	-0,00456	-0,0002	0,270632	0,000056	0,002119
EG(-2)	-1,09501	0,00306	-0,0001	-0,139959	0,000043	-0,005295
EG(-3)	0,63286	-0,00357	0,00068	0,238728	0,001291	0,000115
EG(-4)	0,60724	0,00396	0,00007	0,999203	-0,000671	-0,004534
EG(-5)	-0,61159	0,00555	0,00046	-0,689704	-0,000401	0,000954
EG(-6)	1,23661	-0,00374	-0,0004	0,513561	-0,000751	0,009755
EG(-7)	-0,48495	-0,00221	-0,0001	-0,045593	-0,002470	-0,000995
EG(-8)	-0,94132	-0,00698	-0,0011	0,431095	-0,001412	0,002086
EG(-9)	0,02504	-0,00215	-0,0001	0,563568	-0,000598	-0,007733
EG(-10)	-0,28130	-0,00052	0,00149	-0,485863	0,000529	-0,007812
EG(-11)	-0,05507	-0,00006	-0,0010	-0,243472	0,002285	0,002890
EG(-12)	-0,30557	0,00179	0,00095	-0,457928	0,002347	0,002603
EG(-13)	-0,48937	0,00426	-0,0002	-0,216178	0,000250	0,006043
EG(-14)	0,72509	0,00484	-0,0006	-	-	-
EG(-15)	0,36285	0,00724	0,00149	-	-	-
CMD1(-1)	-192,5342	0,63877	-0,1226	29,312890	0,293170	0,324264
CMD1(-2)	113,1006	0,11146	0,08054	54,189050	0,120898	0,474397
CMD1(-3)	101,6077	-0,25021	0,09716	-51,554190	-0,164817	-0,921563
CMD1(-4)	-146,76990	0,16836	0,05795	19,931900	0,105563	0,565196
CMD1(-5)	114,49230	-0,11502	-0,1536	-80,039090	0,121353	-0,447438
CMD1(-6)	-106,99640	0,15471	0,17914	7,393976	0,345753	0,861358
CMD1(-7)	174,95070	0,54734	-0,0716	-13,007910	-0,149440	-1,144406
CMD1(-8)	-124,58530	-1,02136	0,09340	-57,705190	-0,265887	0,269333
CMD1(-9)	68,44405	0,81828	-0,2397	41,861870	0,267578	0,041564
CMD1(-10)	-217,48410	-0,13380	0,17005	-90,170390	-0,001114	0,501371
CMD1(-11)	348,93720	-0,85083	-0,1777	8,536797	-0,072663	-0,731070
CMD1(-12)	-299,24960	0,61457	0,31211	-4,594065	0,020920	1,539506
CMD1(-13)	157,86220	-0,30730	-0,2625	11,484780	0,168076	-1,224272
CMD1(-14)	-79,07909	1,16699	0,12973	-	-	-
CMD1(-15)	259,35690	-0,55581	0,20558	-	-	-
CMD2(-1)	-1159,286	2,24603	-0,850	-3,969115	-0,063696	-0,245298
CMD2(-2)	662,88420	-5,78034	-0,1192	28,520630	0,048093	-0,342646
CMD2(-3)	-571,82970	-3,69036	-0,5982	7,071570	-0,012956	0,804665
CMD2(-4)	-602,63180	-3,16165	-0,80481	11,322980	-0,209512	0,151650
CMD2(-5)	-140,03640	-4,65232	0,00101	13,427620	-0,283022	0,435366
CMD2(-6)	-558,46370	-6,64733	-0,20438	33,729600	-0,073409	-0,755706
CMD2(-7)	-2079,758	-5,75338	-2,42074	19,109110	0,073643	-0,414468
CMD2(-8)	-1361,092	-5,46864	-1,29787	19,059170	0,070274	-0,799352
CMD2(-9)	-220,67870	-5,52999	-0,24479	-20,375290	-0,158988	0,155311
CMD2(-10)	-1416,167	-2,96308	-1,07829	-2,777505	-0,044879	0,481013
CMD2(-11)	-272,37050	-2,27363	-0,37614	14,208180	-0,055209	0,581886
CMD2(-12)	-389,82670	4,79468	0,12364	2,860738	-0,024640	-0,169467
CMD2(-13)	284,30560	-0,61923	0,07278	24,188870	-0,107638	-0,135502
CMD2(-14)	-51,21880	1,23125	-0,13829	-	-	-
CMD2(-15)	8,69141	-0,22638	0,37659	-	-	-
v	-631,63860	-4,35491	-0,69853	108,570800	-0,360296	-3,041369
R^2	0,99754	0,99906	0,96135	0,993034	0,886162	0,836235
AIC		-8,82466			2,985049	
SIC		-3,30865			7,736511	

Continues…

Table 22. Estimated trivariate models with GDPpc as proxy for economic growth. (Continued)

Model:	***GDPpc – PvST – PvSR*** [a]		
Lags	*EG*	*CMD1*	*CMD2*
EG(-1)	0,44590	0,00054	-0,00151
EG(-2)	-0,34080	0,00021	0,00092
EG(-3)	0,18295	-0,00056	-0,00087
EG(-4)	0,75253	-0,00010	-0,00111
EG(-5)	-0,68940	0,00001	0,00217
EG(-6)	0,47394	-0,00064	-0,00055
EG(-7)	-0,08911	-0,00126	0,00061
EG(-8)	0,11490	0,00145	0,00138
EG(-9)	0,37357	-0,00026	-0,00014
EG(-10)	-0,13055	0,00046	0,00028
EG(-11)	-0,09620	0,00232	0,00100
CMD1(-1)	-64,6148	0,57993	0,32645
CMD1(-2)	9,60062	0,28159	-0,29423
CMD1(-3)	64,27876	-0,03204	-0,29796
CMD1(-4)	-71,8081	0,25712	0,27648
CMD1(-5)	6,63509	-0,19347	0,19147
CMD1(-6)	80,66623	0,12623	-0,20987
CMD1(-7)	-74,9416	0,33256	0,04993
CMD1(-8)	77,76862	-0,42690	-0,17678
CMD1(-9)	-92,2767	-0,26481	0,01393
CMD1(-10)	-47,4690	0,15411	0,17699
CMD1(-11)	91,21610	0,01591	-0,13374
CMD2(-1)	-8,21836	-0,14330	-0,48274
CMD2(-2)	-127,947	-0,59568	0,06083
CMD2(-3)	-25,1814	-0,21556	-0,11960
CMD2(-4)	-40,8244	0,34851	-0,44425
CMD2(-5)	-21,1428	0,15192	-0,23569
CMD2(-6)	-49,0493	-0,99359	-0,12810
CMD2(-7)	-82,6248	-0,28323	0,03043
CMD2(-8)	-93,3927	-0,04942	-0,14185
CMD2(-9)	91,78066	-0,41574	-0,59790
CMD2(-10)	-126,773	-0,53525	-0,07228
CMD2(-11)	-68,8588	-0,43866	0,03572
v	-102,605	-0,62459	-1,16900
R^2	0,990255	0,949758	0,775615
AIC		0,205846	
SIC		4,220383	

Notes: [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach.

Table 23. Estimated trivariate models with GDPpc4 as proxy for economic growth.

Model:	***GDPpc4 – SMC – VST*** [a]			***VECM: GDPpc4 – PST – PSR***		
Lags	*EG*	*CMD1*	*CMD2*	*EG*	*CMD1*	*CMD2*
EG(-1)	0,69624	-0,00429	0,00008	-0,51476	0,000126	-0,00308
EG(-2)	1,45644	-0,00229	0,00314	-0,465094	0,000414	-0,01215
EG(-3)	0,25426	-0,01358	0,00063	-0,496718	0,001579	-0,00945
EG(-4)	1,41116	-0,00161	0,00329	-0,603475	0,00108	-0,01177
EG(-5)	-0,80633	-0,00053	-0,00130	-0,810216	0,000754	-0,008097
EG(-6)	1,25586	-0,00427	0,00172	-0,530183	0,000671	-0,005651
EG(-7)	0,19508	-0,00416	-0,00006	-0,154798	3,77E-05	-0,005659
EG(-8)	0,29999	-0,00822	0,00102	-0,113901	-0,001599	-0,002637
EG(-9)	0,18516	0,00182	0,00058	-0,213887	-0,000632	0,004528
EG(-10)	0,41352	-0,00170	0,00007	0,055511	0,000191	0,003547
EG(-11)	0,78514	-0,01059	0,00119	-	-	-
EG(-12)	1,02361	-0,01078	0,00299	-	-	-
EG(-13)	0,49795	-0,00808	0,00210	-	-	-
EG(-14)	1,88977	-0,00631	0,00282	-	-	-
CMD1(-1)	126,2707	-0,21553	0,27976	81,52408	-0,565605	1,57866
CMD1(-2)	9,17532	-0,61193	0,01854	146,7337	-0,504761	2,26464
CMD1(-3)	154,9262	-0,15929	0,20405	96,04237	-0,50268	2,04811
CMD1(-4)	-34,57999	-0,38397	0,09087	114,3543	-0,17668	2,666617
CMD1(-5)	-89,34916	0,35617	-0,17857	82,43454	-0,184899	1,723763
CMD1(-6)	249,7846	-0,95315	0,31072	87,63608	-0,053406	1,730544
CMD1(-7)	-124,7948	1,14886	-0,02181	53,38284	-0,173612	0,515147
CMD1(-8)	-21,15201	-1,66926	-0,24303	31,2344	-0,215568	0,622811
CMD1(-9)	131,6076	1,71276	0,43746	39,08627	-0,166065	-0,227379
CMD1(-10)	-326,4402	-0,57461	-0,69908	-10,84988	-0,396539	0,549547
CMD1(-11)	385,2816	-1,05613	0,62245	-	-	-
CMD1(-12)	-67,67668	1,19949	-0,07749	-	-	-
CMD1(-13)	-86,66556	-1,99416	-0,13063	-	-	-
CMD1(-14)	151,9950	1,91954	0,33325	-	-	-
CMD2(-1)	-547,3792	1,56956	-0,06229	-111,3742	0,344026	-2,35522
CMD2(-2)	-1038,535	2,75507	-2,15838	-96,54527	0,369502	-2,515067
CMD2(-3)	282,9302	7,48471	-0,53904	-86,83895	0,329492	-1,625091
CMD2(-4)	-1136,370	5,48740	-2,30154	-92,83571	0,169094	-0,999257
CMD2(-5)	-668,5752	4,86192	-1,42594	-74,25364	0,044488	-0,293541
CMD2(-6)	-1332,072	6,88743	-2,34844	-44,56918	0,075139	-0,486015
CMD2(-7)	-1018,437	-0,62705	-1,49515	-31,09892	0,171215	-0,644356
CMD2(-8)	310,2237	-3,48919	1,24068	-26,07433	0,232261	-0,953002
CMD2(-9)	1366,295	-5,42360	1,65876	-38,26507	0,117157	-0,706849
CMD2(-10)	1074,051	-9,29728	2,86547	-30,43968	0,101487	-0,175207
CMD2(-11)	1061,331	-8,26715	2,39639	-	-	-
CMD2(-12)	751,5544	2,03840	1,75819	-	-	-
CMD2(-13)	-54,12658	-5,52746	-0,25108	-	-	-
CMD2(-14)	950,9147	0,30212	2,16052	-	-	-
v	-225,5301	1,90384	-0,44917	-0,058503 [b]	0,000261 [b]	-0,000586 [b]
Cointegrating Equation						
EG	-	-	-	1	-	-
CMD1	-	-	-	772,2185	-	-
CMD2	-	-	-	-1682,699	-	-
v_{CE}	-	-	-	67,12275	-	-
R^2	0,9766	0,998824	0,959474	0,739967	0,624252	0,848638
AIC		-8,573878				
SIC		-3,245894				

Continues…

Table 23. Estimated trivariate models with GDPpc4 as proxy for economic growth. (Continued)

Model:	***GDPpc4 – PST – PSR*** [a]			***GDPpc4 – D(PvST) - PvSR***		
Lags	*EG*	*CMD1*	*CMD2*	*EG*	*CMD1*	*CMD2*
EG(-1)	0,165046	-0,001225	-0,003317	0,799177	0,001253	-0,001529
EG(-2)	-0,061328	0,000537	-0,007176	-0,322532	0,001541	0,001477
EG(-3)	-0,142942	0,001011	0,001982	0,473775	-0,000295	-0,001259
EG(-4)	-0,106861	-0,000863	-0,002254	-0,325309	-0,000119	-0,000156
EG(-5)	-0,272188	-0,000932	0,003048	0,124799	0,000588	0,001036
EG(-6)	0,232486	-0,000345	0,003696	0,092062	0,000402	0,000852
EG(-7)	0,341031	-0,001637	-0,000633	0,139279	-0,001989	-0,000275
EG(-8)	0,162862	-0,001593	0,002227	-0,042191	0,000691	0,000891
EG(-9)	-0,032800	-0,000098	0,006022	0,000776	-0,000588	0,001052
EG(-10)	0,369042	0,000005	-0,001766	-	-	-
EG(-11)	0,068745	0,000492	-0,002890	-	-	-
CMD1(-1)	16,452900	0,363106	0,989822	-29,71189	-0,417457	0,309812
CMD1(-2)	70,947530	-0,086149	0,695812	-39,6917	-0,29827	-0,030841
CMD1(-3)	-20,683090	-0,075113	-0,307289	6,963378	-0,236953	-0,368024
CMD1(-4)	-8,312187	0,443876	0,845103	-0,776464	0,284581	-0,086787
CMD1(-5)	-26,706970	0,087478	-0,740361	-1,815345	0,210103	-0,009073
CMD1(-6)	-12,633850	0,145737	0,032399	3,651776	0,036294	-0,129577
CMD1(-7)	-49,929770	-0,079659	-1,043667	-46,82007	0,256862	-0,077131
CMD1(-8)	-33,129890	-0,254003	-0,306691	44,477	0,041372	-0,263401
CMD1(-9)	-4,592355	0,057550	-0,564509	-33,14422	-0,086103	-0,22077
CMD1(-10)	-71,508970	-0,342848	0,698934	-	-	-
CMD1(-11)	-0,596224	0,114012	-0,817630	-	-	-
CMD2(-1)	-11,995150	-0,051592	-0,413687	63,8338	0,201059	-0,231505
CMD2(-2)	8,403613	0,076741	-0,173735	-57,57846	0,005453	0,340959
CMD2(-3)	9,642973	0,006228	0,845477	18,76767	0,03596	0,016603
CMD2(-4)	3,154772	-0,193037	0,565237	-63,65748	0,245096	-0,071805
CMD2(-5)	22,448820	-0,254237	0,645478	31,23929	0,306229	-0,026362
CMD2(-6)	44,894710	-0,085879	-0,259203	-24,0802	-0,497609	0,104678
CMD2(-7)	25,808460	0,116337	-0,203549	24,90991	-0,071395	0,123055
CMD2(-8)	11,083370	0,201037	-0,286123	-84,18796	-0,102222	0,126732
CMD2(-9)	-16,850870	0,048545	0,335173	79,78658	-0,400461	-0,460533
CMD2(-10)	1,836230	0,001967	0,557740	-	-	-
CMD2(-11)	28,865820	-0,195240	0,161470	-	-	-
v	14,996220	0,185928	-0,040956	1,377941	-0,000222	0,069268
R^2	0,838459	0,890564	0,744181	0,632188	0,630731	0,649066
AIC		3,259949			0,596139	
SIC		7,425104			3,661885	

Continues…

Table 23. Estimated trivariate models with GDPpc4 as proxy for economic growth. (Continued)

Model:	***GDPpc4 – PvST – PvSR*** [a]		
Lags	*EG*	*CMD1*	*CMD2*
EG(-1)	0,50286	0,00086	-0,00138
EG(-2)	-0,38958	0,00155	0,00207
EG(-3)	0,31246	-0,00055	-0,00140
EG(-4)	-0,33221	-0,00008	0,00015
EG(-5)	0,02137	0,00039	0,00077
EG(-6)	0,02617	0,00035	0,00108
EG(-7)	0,08970	-0,00202	-0,00007
EG(-8)	-0,05235	0,00060	0,00047
CMD1(-1)	-38,58788	0,56506	0,28242
CMD1(-2)	-11,05252	0,10104	-0,43522
CMD1(-3)	37,85261	0,07311	-0,19859
CMD1(-4)	-9,61800	0,52323	0,30615
CMD1(-5)	1,64154	-0,08025	0,02312
CMD1(-6)	10,62913	-0,15086	-0,03182
CMD1(-7)	-49,46748	0,21414	0,00773
CMD1(-8)	81,69159	-0,22855	-0,18259
CMD2(-1)	51,90667	0,19932	-0,14458
CMD2(-2)	-58,60021	0,01184	0,38559
CMD2(-3)	0,86162	0,01209	0,02619
CMD2(-4)	-63,96332	0,24954	-0,04402
CMD2(-5)	24,20535	0,29332	-0,04268
CMD2(-6)	-21,63628	-0,46888	0,24832
CMD2(-7)	2,04582	-0,10011	0,14533
CMD2(-8)	-84,80853	-0,13267	-0,04144
v	24,57758	0,02908	0,04761
R^2	0,72456	0,942436	0,605421
AIC		0,501471	
SIC		3,567216	

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach.

Table 24. LM test Results for bivariate models with GDPpc as proxy for economic growth.

Model	***D(GDPpc) – D(SMC)***		***D(GDPpc) - VST***		***D(GDPpc) – D(PST)***		***D(GDPpc) – D(PvST)***	
Lag	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value
1	0,6697	0,9550	2,633872	0,6208	3,529947	0,4733	3,7165	0,4457
2	6,3287	0,1759	9,017025	0,0607	1,661927	0,7976	2,7600	0,5988
3	6,3995	0,1712	5,565281	0,2341	4,557115	0,3358	1,2420	0,8711
4	3,1653	0,5306	7,073179	0,1321	7,189481	0,1262	5,0666	0,2805
5	1,2572	0,8686	6,755704	0,1494	1,485112	0,8293	4,5797	0,3332
6	2,0139	0,7332	4,418883	0,3523	5,997757	0,1993	7,9690	0,0927
7	8,5628	0,0730	3,368433	0,4982	5,400189	0,2486	8,0580	0,0895
8	2,5631	0,6334	1,13357	0,8889	7,154366	0,1280	1,5379	0,8199
9	1,7599	0,7798	5,750915	0,2185	3,34407	0,5020	5,4802	0,2415
10	5,2866	0,2591	3,005172	0,5570	5,42687	0,2462	3,7672	0,4384
11	2,5330	0,6387	5,985841	0,2002	1,978206	0,7398	1,0520	0,9018
12	1,6281	0,8037	1,978744	0,7397	8,215993	0,0840	1,3508	0,8527
Model	***VECM: GDPpc – PSR***		***D(GDPpc) – PvSR***		***GDPpc – PvSR*** [a]			
Lag	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value		
1	2,243896	0,6910	7,700361	0,1032	2,9751	0,5620		
2	3,56201	0,4685	3,908397	0,4185	5,6319	0,2284		
3	3,622415	0,4595	3,970676	0,4100	8,5014	0,0748		
4	6,219299	0,1834	1,96623	0,7420	9,4862	0,0500		
5	1,341815	0,8542	4,442548	0,3494	0,3416	0,9870		
6	3,374503	0,4972	4,218085	0,3773	4,1459	0,3866		
7	3,790047	0,4352	4,370223	0,3582	1,3578	0,8515		
8	1,54194	0,8192	2,484151	0,6475	1,9781	0,7398		
9	6,998744	0,1360	2,262073	0,6877	2,0063	0,7346		
10	1,781765	0,7758	2,914709	0,5722	2,6983	0,6095		
11	6,316486	0,1767	1,312148	0,8593	0,7233	0,9484		
12	2,433881	0,6565	2,364863	0,6690	1,5951	0,8097		

Notes: *D()* is the difference operator indicating that the variable was used in its first differences; [a] indicates the model was estimated following the Toda & Yamamoto (1995) approach.

Table 25. LM test results for bivariate models with GDPpc4 as proxy for economic growth.

Model	***GDPpc4 – D(SMC)***		***GDPpc4 – SMC*** [a]		***D(GDPpc4) – D(VST)***		***GDPpc4 – D(PST)***		***GDPpc4 – PST*** [a]	
Lag	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value
1	5,6340	0,2282	5,6334	0,2283	4,328269	0,3634	5,483249	0,2412	1,4772	0,8307
2	2,9023	0,5743	4,5160	0,3407	0,707227	0,9504	5,095391	0,2776	3,1303	0,5363
3	6,2273	0,1828	1,5393	0,8197	0,753246	0,9446	5,573776	0,2333	3,7011	0,4480
4	7,5333	0,1103	4,4658	0,3466	4,128789	0,3889	0,872905	0,9284	3,6202	0,4598
5	1,7858	0,7751	3,7224	0,4449	7,769811	0,1004	1,048744	0,9023	2,5803	0,6303
6	4,6769	0,3221	0,9308	0,9201	1,658084	0,7983	2,659823	0,6163	2,5441	0,6368
7	9,2261	0,0557	9,1575	0,0573	1,558514	0,8162	1,821275	0,7686	3,4735	0,4819
8	2,8563	0,5822	2,8169	0,5889	1,17595	0,8820	4,641846	0,3261	4,3688	0,3584
9	2,2562	0,6888	1,5535	0,8171	0,745176	0,9456	4,117465	0,3903	1,8221	0,7684
10	5,4221	0,2467	2,0978	0,7178	6,498976	0,1649	6,715047	0,1517	7,4043	0,1160
11	5,0884	0,2783	6,4577	0,1675	4,895553	0,2982	2,928514	0,5699	2,8502	0,5832
12	0,8799	0,9274	0,7775	0,9414	4,135392	0,3880	2,030996	0,7301	2,0195	0,7322
Model	***GDPpc4 – D(PvST)***		***GDPpc4 – PvST*** [a]		***GDPpc4 – D(PSR)***		***GDPpc4 – PSR*** [a]		***GDPpc4 – PvSR***	
Lag	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value
1	2,8462	0,5839	5,9418	0,2035	1,843066	0,7646	7,893141	0,0956	1,938558	0,7471
2	6,2089	0,1841	4,6397	0,3263	3,781386	0,4364	3,981846	0,4085	2,055241	0,7256
3	0,7947	0,9392	2,8732	0,5793	1,909501	0,7524	7,677591	0,1041	2,932077	0,5693
4	6,3318	0,1757	8,4105	0,0776	2,683536	0,6121	3,722614	0,4448	2,892339	0,576
5	2,3031	0,6802	2,1496	0,7083	5,125133	0,2747	7,98054	0,0923	2,511829	0,6425
6	6,5135	0,1639	7,3131	0,1202	7,661934	0,1048	8,838715	0,0653	1,584687	0,8115
7	6,4918	0,1653	3,5641	0,4682	2,985645	0,5602	2,09286	0,7187	3,065437	0,5469
8	1,2943	0,8623	3,8567	0,4257	0,356552	0,9859	2,032096	0,7299	1,31521	0,8588
9	6,2474	0,1814	1,7535	0,7810	3,924607	0,4163	0,852469	0,9313	3,362369	0,4991
10	4,7011	0,3194	3,2354	0,5192	1,837201	0,7657	1,008937	0,9084	3,541362	0,4716
11	0,8185	0,9360	1,1665	0,8836	4,286932	0,3686	6,132794	0,1894	3,874514	0,4233
12	0,3773	0,9843	0,5954	0,9636	4,202199	0,3793	8,071791	0,089	1,469014	0,8321

Notes: *D()* is the difference operator indicating that the variable was used in its first differences; [a] indicates the model was estimated following the Toda & Yamamoto (1995) approach.

Table 26. LM test results for trivariate models with GDPpc as proxy for economic growth.

Model	***GDPpc – SMC – VST*** [a]		***GDPpc – PST - PSR***		***GDPpc – PvST - PvSR***	
Lag	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value
1	8,3251	0,5017	3,0111	0,9639	4,756404	0,8550
2	3,2629	0,9530	9,8372	0,3638	6,563586	0,6825
3	7,9097	0,5433	10,2251	0,3326	8,464699	0,4881
4	13,967	0,1235	4,6718	0,8619	15,73886	0,0725
5	8,5601	0,4788	14,0799	0,1195	7,95901	0,5383
6	7,6446	0,5703	3,2871	0,9518	14,1647	0,1166
7	9,2789	0,4119	7,0154	0,6355	15,95119	0,0679
8	9,8508	0,3627	14,4437	0,1074	15,49687	0,0782
9	6,4486	0,6943	6,9577	0,6415	7,709088	0,5637
10	4,3897	0,8839	7,9791	0,5362	4,412812	0,8822
11	8,4998	0,4847	9,3046	0,4096	11,83662	0,2227
12	9,4796	0,3942	10,3576	0,3223	8,698013	0,4656

Notes: [a] indicates the model was estimated following the Toda & Yamamoto (1995) approach.

Table 27. LM test results for trivariate models with GDPpc4 as proxy for economic growth.

Model	***GDPpc4 – SMC – VST*** [a]		***VECM: GDPpc4 – PST – PSR***		***GDPpc4 – PST – PSR*** [a]		***GDPpc4 – D(PvST) - PvSR***		***GDPpc4 – PvST – PvSR*** [a]	
Lag	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value	LM-stat.	P-Value
1	16,34073	0,0601	3,663174	0,9322	8,405297	0,4939	11,24203	0,2595	11,88757	0,2197
2	10,49786	0,3117	9,831632	0,3643	10,11176	0,3415	1,931253	0,9925	12,78762	0,1725
3	12,76053	0,1737	3,678451	0,9313	3,049076	0,9623	2,913509	0,9676	5,864678	0,7534
4	7,650286	0,5697	6,816403	0,6562	5,470288	0,7915	12,60936	0,1811	9,359908	0,4047
5	5,48794	0,7899	15,31392	0,0827	11,00898	0,2751	8,064014	0,5277	15,6526	0,0745
6	5,597545	0,7794	5,050033	0,8299	4,592629	0,8683	10,94301	0,2796	10,91556	0,2815
7	3,802467	0,9239	7,85584	0,5487	7,774526	0,5570	14,0514	0,1205	12,87396	0,1684
8	13,37591	0,1463	11,20402	0,2620	8,657049	0,4695	6,782483	0,6598	8,903105	0,4463
9	4,384364	0,8843	3,116732	0,9595	8,877096	0,4487	7,50645	0,5845	5,538365	0,7851
10	11,77215	0,2265	10,17877	0,3362	9,144068	0,4241	8,693118	0,4661	5,746427	0,7650
11	12,23644	0,2003	4,850106	0,8472	4,139242	0,9020	7,303987	0,6055	10,91089	0,2819
12	10,96189	0,2783	8,335043	0,5008	7,203084	0,6160	8,682885	0,4670	5,625523	0,7767

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated following the Toda & Yamamoto (1995) approach.

Table 28. J-B normality test results for bivariate models with GDPpc as proxy for economic growth.

Model:	***D(GDPpc) –D(SMC)***		***D(GDPpc) – VST***		***D(GDPpc) –D(PST)***	
Component	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*
EG	0,754137	0,6859	0,442036	0,8017	1,927875	0,3814
CMD	3,041495	0,2185	2,706645	0,2584	5,652951	0,0592
Joint	3,795632	0,4344	3.148681	0,5333	7,580826	0,1082
Model:	***D(GDPpc) – D(PvST)***		***VEC: D(GDPpc) – D(PSR)***		***D(GDPpc) – PvSR***	
Component	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*
EG	2,061876	0,3567	1,214346	0,5449	1,407902	0,4946
CMD	2,298714	0,3168	0,751351	0,6868	5,652452	0,0592
Joint	4,360589	0,3594	1,965698	0,7421	7,060353	0,1327
Model:	***GDPpc – PvSR*** [a]					
Component	*J-B Statistic*	*P- value*				
EG	2,569182	0,2768				
CMD	0,555581	0,7575				
Joint	3,124763	0,5372				

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach.

Table 29. J-B normality test results for bivariate models with GDPpc4 as proxy for economic growth.

Model:	***GDPpc4 – D(SMC)***		***GDPpc4 – SMC*** [a]		***D(GDPpc4) – D(VST)*** [d]	
Component	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*
EG	2,231091	0,3277	1,702806	0,4268	1,170862	0,5569
CMD	2,852858	0,2402	3,112437	0,2109	2,01128	0,3658
Joint	5,083949	0,2788	4,815244	0,3068	3,182142	0,5278
Model:	***GDPpc4 – D(PST)***		***GDPpc4 – PST*** [a]		***GDPpc4 – D(PvST)***	
Component	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*
EG	2,455404	0,2930	1,669698	0,4339	2,58974	0,2739
CMD	5,64111	0,0596	1,23344	0,5397	1,342207	0,5111
Joint	8,096515	0,0881	2,903137	0,5742	3,931948	0,4153
Model:	***GDPpc4 – PvST*** [a]		***GDPpc4 – D(PSR)***		***GDPpc4 – PSR*** [a]	
Component	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*
EG	0,807746	0,6677	0,446802	0,7998	0,679002	0,7121
CMD	1,347769	0,5097	3,009771	0,2220	0,055822	0,9725
Joint	2,155515	0,7072	3,456573	0,4845	0,734824	0,9470
Model:	***GDPpc4 – PvSR***					
Component	*J-B Statistic*	*P- value*				
EG	1,381782	0,5011				
CMD	3,303266	0,1917				
Joint	4,685048	0,3212				

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach.

Table 30. J-B normality test results for trivariate models with GDPpc as proxy for economic growth.

Model:	***GDPpc – SMC – VST*** [a]		***GDPpc – PST – PSR*** [a]		***GDPpc – PvST – PvSR*** [a]	
Component	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*
EG	0,327176	0,8491	0,116995	0,9432	0,341306	0,8431
CMD1	5,915936	0,0519	1,029239	0,5977	1,664711	0,4350
CMD2	1,310053	0,5194	0,656112	0,7203	5,111828	0,0776
Joint	7,553165	0,2727	1,802345	0,9369	7,117844	0,3101

Notes: [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach.

Table 31. J-B normality test results for trivariate models with GDPpc4 as proxy for economic growth.

Model:	***GDPpc4 – SMC – VST*** [a]		***VECM: GDPpc4 – PST – PSR***		***GDPpc4 – PST – PSR*** [a]	
Component	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*
EG	1,555547	0,4594	0,188245	0,9102	2,12903	0,3449
CMD1	0,452859	0,7974	1,051963	0,5910	0,215424	0,8979
CMD2	0,837218	0,6580	2,719088	0,2568	1,670169	0,4338
Joint	2,845623	0,8280	3,959295	0,6822	4,014624	0,6747
Model:	***GDPpc4 – D(PvST) – PvSR***		***GDPpc4 – PvST – PvSR*** [a]			
Component	*J-B Statistic*	*P- value*	*J-B Statistic*	*P- value*		
EG	1,850024	0,3965	2,402646	0,3008		
CMD1	1,757839	0,4152	0,70547	0,7028		
CMD2	4,207905	0,1220	3,369883	0,1855		
Joint	7,815769	0,2519	6,477999	0,3718		

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach.

Table 32. Granger causality tests in bivariate models with GDPpc as proxy for economic growth.

Model	Null Hypothesis	Lags	χ^2-stat.	P-val.
D(GDPpc) – D(SMC)	*SMC does not Granger cause GDPpc*	9	7,691640	0,5655
	GDPpc does not Granger cause SMC		10,51759	0,3102
D(GDPpc) – VST	*VST does not Granger cause GDPpc*	20	19,85215	0,4672
	GDPpc does not Granger cause VST		17,80764	0,6001
D(GDPpc) – D(PST)	*PST does not Granger cause GDPpc*	6	7,982563	0,2394
	GDPpc does not Granger cause PST		5,846208	0,4406
D(GDPpc) – D(PvST)	*PvST does not Granger cause GDPpc*	6	3,189535	0,7847
	GDPpc does not Granger cause PvST		8,347464	0,2137
VECM: GDPpc – PSR	*PSR does not Granger cause GDPpc*	13	12,35877	0,4985
	GDPpc does not Granger cause PSR		33,50472*	0,0014
D(GDPpc) – PvSR	*PvSR does not Granger cause GDPpc*	8	7,401674	0,4940
	GDPpc does not Granger cause PvSR		12,16774	0,1439
GDPpc – PvSR [a]	*PvSR does not Granger cause GDPpc*	7	7,343995	0,3940
	GDPpc does not Granger cause PvSR		20,75382*	0,0042

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach; * indicates rejection of the null hypothesis at the 5% level of significance.

Table 33. Granger causality tests in bivariate models with GDPpc4 as proxy for economic growth.

Model	Null Hypothesis	Lags	χ^2-stat.	P-val.
GDPpc4 – D(SMC)	*SMC does not Granger cause GDPpc4*	1	1,692181	0,1933
	GDPpc4 does not Granger cause SMC		1,146165	0,2844
GDPpc4 – SMC [a]	*SMC does not Granger cause GDPpc4*	6	3,843011	0,6979
	GDPpc4 does not Granger cause SMC		7,024162	0,3186
D(GDPpc4) – D(VST)	*VST does not Granger cause GDPpc4*	16	13,51474	0,6348
	GDPpc4 does not Granger cause VST		20,69491	0,1905
GDPpc4 – D(PST)	*PST does not Granger cause GDPpc4*	2	2,334121	0,3113
	GDPpc4 does not Granger cause PST		1,909095	0,3850
GDPpc4 – PST [a]	*PST does not Granger cause GDPpc4*	3	2,272585	0,5178
	GDPpc4 does not Granger cause PST		2,923068	0,4036
GDPpc4 – D(PvST)	*PvST does not Granger cause GDPpc4*	3	1,793024	0,6165
	GDPpc4 does not Granger cause PvST		10,83708*	0,0126
GDPpc4 – PvST [a]	*PvST does not Granger cause GDPpc4*	3	2,523835	0,4710
	GDPpc4 does not Granger cause PvST		8,401450*	0,0384
GDPpc4 – D(PSR)	*PSR does not Granger cause GDPpc4*	13	13,19187	0,4331
	GDPpc4 does not Granger cause PSR		13,71051	0,3945
GDPpc4 – PSR [a]	*PSR does not Granger cause GDPpc4*	15	11,76403	0,6968
	GDPpc4 does not Granger cause PSR		26,13278*	0,0367
GDPpc4 – PvSR	*PvSR does not Granger cause GDPpc4*	6	3,013755	0,8071
	GDPpc4 does not Granger cause PvSR		14,87214	0,0213

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach; * indicates rejection of the null hypothesis at the 5% level of significance.

Table 34. Granger causality tests in trivariate models with GDPpc as proxy for economic growth.

Model	Null Hypothesis	Lags	χ^2-stat.	P-val.
GDPpc – SMC – VST [a]	*SMC does not Granger cause GDPpc*	15	13,35655	0,5748
	VST does not Granger cause GDPpc		10,76986	0,7687
	GDPpc does not Granger cause SMC		145,8024*	0,0000
	VST does not Granger cause SMC		67,78624*	0,0000
	GDPpc does not Granger cause VST		28,94863*	0,0163
	SMC does not Granger cause VST		23,87026	0,0673
GDPpc – PST – PSR [a]	*PST does not Granger cause GDPpc*	13	17,17486	0,1914
	PSR does not Granger cause GDPpc		10,08534	0,6869
	GDPpc does not Granger cause PST		10,45414	0,6564
	PSR does not Granger cause PST		12,80598	0,4629
	GDPpc does not Granger cause PSR		17,14745	0,1927
	PST does not Granger cause PSR		7,513704	0,8738
GDPpc – PvST – PvSR [a]	*PvST does not Granger cause GDPpc*	11	21,59413*	0,0277
	PvSR does not Granger cause GDPpc		10,96091	0,4465
	GDPpc does not Granger cause PvST		7,155411	0,7864
	PvSR does not Granger cause PvST		12,28121	0,3429
	GDPpc does not Granger cause PvSR		26,24995*	0,0060
	PvST does not Granger cause PvSR		17,16202	0,1032

Notes: [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach;
* indicates rejection of the null hypothesis at the 5% level of significance.

Table 35. Granger causality tests in trivariate models with GDPpc4 as proxy for economic growth.

Model	Null Hypothesis	Lags	χ^2-stat.	P-val.
GDPpc4 – SMC – VST [a]	*SMC does not Granger cause GDPpc4*	14	31,04054*	0,0055
	VST does not Granger cause GDPpc4		28,09285*	0,0138
	GDPpc4 does not Granger cause SMC		114,8556*	0,0000
	VST does not Granger cause SMC		46,79292*	0,0000
	GDPpc4 does not Granger cause VST		37,08872*	0,0007
	SMC does not Granger cause VST		24,00856*	0,0457
VECM: GDPpc4 – PST - PSR	*PST does not Granger cause GDPpc4*	10	14,81288	0,1390
	PSR does not Granger cause GDPpc4		19,88376*	0,0304
	GDPpc4 does not Granger cause PST		5,314437	0,8692
	PSR does not Granger cause PST		4,543854	0,9195
	GDPpc4 does not Granger cause PSR		17,11212	0,0719
	PST does not Granger cause PSR		15,06189	0,1298
GDPpc4 – PST – PSR [a]	*PST does not Granger cause GDPpc4*	11	18,36817	0,0734
	PSR does not Granger cause GDPpc4		16,70535	0,1169
	GDPpc4 does not Granger cause PST		12,8005	0,3066
	PSR does not Granger cause PST		21,86894*	0,0254
	GDPpc4 does not Granger cause PSR		10,20437	0,5121
	PST does not Granger cause PSR		10,97642	0,4452
GDPpc4 –D(PvST) – PvSR	*PvST does not Granger cause GDPpc4*	9	6,849014	0,6528
	PvSR does not Granger cause GDPpc4		7,490278	0,5862
	GDPpc4 does not Granger cause PvST		12,71814	0,1758
	PvSR does not Granger cause PvST		7,133805	0,6232
	GDPpc4 does not Granger cause PvSR		20,39218*	0,0156
	PvST does not Granger cause PvSR		20,71164*	0,0140
GDPpc4 –PvST – PvSR [a]	*PvST does not Granger cause GDPpc4*	8	7,459822	0,4879
	PvSR does not Granger cause GDPpc4		8,346342	0,4004
	GDPpc4 does not Granger cause PvST		6,98233	0,5385
	PvSR does not Granger cause PvST		5,026621	0,7547
	GDPpc4 does not Granger cause PvSR		17,11362*	0,0289
	PvST does not Granger cause PvSR		14,97484	0,0596

Notes: *D()* is the difference operator indicating that the variable was taken in its first differences; [a] indicates the model was estimated using the Toda & Yamamoto (1995) approach; * indicates rejection of the null hypothesis at the 5% level of significance.