Finance – growth nexus: does causality withstand financial liberalisation? Evidence from cointegrated VAR

Alessandra Dal Colle[1]

Banca Prossima, Financial Budgeting and Risk Management Unit

Email: alessandra.dalcolle@bancaprossima.com

August 31st, 2010

Abstract

This paper aims to contribute to the study of the link between financial and economic development within a time series framework and data extending over the Nineties, a period of deep domestic liberalisation and boost in financial openness. A new procedure for the detection and estimations of outliers is also used in order to help identification and estimation of a equilibrium relationship in the twelve developing and High income countries.

The study identifies two cointegrating vectors in financially closed (FC) countries and a single one in financially open (FO) countries. Furthermore, full estimation of cointegrating parameters allows for combinations of FO/FC classification and the level of economic development to find pattern across countries. All countries show a positive effect of capital accumulation on financial development – in line with so called "bank capital channel" – which is more narrow-ranged across financially closed (FC) countries, and a (mostly) negative effect of real interest rate. Only financially open (FO) High income countries are able to sustain financial development with positive real interest rates.

Long run bi-directional causality between financial and economic development is present in some of the countries in the study – although not as frequently as in the related literature – with the second most frequent link supporting Joan Robinson's view on the primacy of economic development over finance.

All in all, financial openness (or lack thereof) seems a much more powerful tool for the interpretation of the long run equilibrium than geographical origin, or the initial level of economic or financial development.

As to the outlier detection and estimation procedure, the paper shows that a) it allows the estimation of stable cointegrating parameters offering a more viable economic interpretation, b) it saves degrees of freedom by reducing the number of dummies with respect to the observations showing excess standard deviation, c) it shows different patterns of outliers with respect to univariate break tests and d) it helps identifying different kinds of events which have had an effect on the economy or the financial sector in the country.

JEL classification:O16, G15, G28

Keywords: Economic growth, Financial Development, Cointegration

[1] This paper draws heavily on Chapter 4 of my PhD dissertation and was mostly written during a summer internship at WIDER. I am highly indebted to George Mavrotas and all partecipants at WIDER seminars and at the Max Fry Conference (Birmingham, UK). John Driffill (Birkbeck College, University of London), Kul Luintel (Cardiff Business School, Cardiff) and Pasquale Scaramozzino (SOAS, University of London) also offered helpful comments. My gratitude is also due to Heino Bohn Nielsen (University of Copenhagen), Andrea Brasili (Unicredit Research Department, Milan), Fabrizio Iacone (University of York, York, UK) and Tommaso Proietti (Università Tor Vergata, Rome, Italy) for their help with stats programs and their patient encouragement. Comments by an anonymous referee on a previous version of the paper are also kindly acknowledged. A special thank you goes to Jinming Luo and Liu Yuntao, former students at the Master in International Management for China at CeFiMS, for the precious help I got in consulting Chinese language sources. All errors remain of course mine. The views expressed in this article are those of the author only and do nor represent those of Banca Prossima or of any member of the Intesa Sanpaolo Group.

1. Introduction

The empirical literature on the links between financial development and economic growth is wide and the question of causality remains unresolved as differences in long run relationship and short-run dynamics or in the non-linearity of the relationship itself, are frequently picked up in different studies and make it impossible to reach a definitive conclusion on the presence and direction of causality.

More specifically, a cornerstone of empirical studies is King and Levine (1993) who, with a cross country regression comprising data from 77 countries over the period 1960-1989, find that the level of financial development stimulates economic growth.

Deidda and Fattouh (2002) with the same data but a threshold regression confirm the positive relationship between the level of financial depth and economic growth for countries with high income per capita but no significant relationship for lower-income countries, which is consistent with the non monotonic relationship implied in the model.

Rousseau and Sylla (2001) study seventeen countries over the period 1850-1997 and find evidence of a leading role for finance. The result is further supported by Rousseau and Wachtel (1998) who, examining the links between the financial and real sectors for five countries that underwent rapid industrialization over the 1870-1929 period, are able to confirm that financial intermediation Granger-cause real output, especially before the Great Depression, with little evidence of feedback from output to intermediation.

Beck, Levine and Loayza (2000) apply to their data (1960 to 1995 for 74 countries) both cross section analysis and panel techniques. The results indicate an ambiguous relation between financial intermediary development and both physical capital accumulation and private savings rates as the relationship is not robust to alterations in estimation techniques and to measures of financial intermediary development.

With the same data Loayza and Ranciere (2002) but applying Pooled Mean Group estimations find a positive long-run relationship between financial intermediation and output growth coexists with a, mostly, negative short-run relationship. The authors also sort the sample countries with significant short term effects in 2 groups according to the presence or lack of systemic banking crises. 75% of the countries in the former group show a short run effect from economic growth to financial development compared with only a minority in the second group. Hence the authors underline the role of crises in the determination of the direction of causality and in particular they suggest that the boom bust credit cycles appear to explain the short run reverse causality. This negative effect, however, appears to occur more generally and can also be linked to experience of soft-landing after credit booms.

The strongest critique to all these studies comes from Aretis and Demetriades (1997). The authors, using King and Levine's data underline that the question of causality cannot be satisfactorily

addressed in a cross-section framework. More specifically, they conclude that "We have warned against the over-simplified nature of results obtained from cross-country regressions in that they may not accurately reflect individual country circumstances such as the institutional structure of the financial system, the policy regime and the degree of effective governance. The econometric evidence we have reviewed using time-series estimations on individual countries suggests that the results exhibit substantial variation across countries, even when the same variables and estimation methods are used. Thus, the 'average' country for which cross-country regressions must, presumably, relate to may well not exist." (p. 796-797).

It is also worth mentioning that consensus is not uniform among time series scholars. Harrison, Sussman and Zeira (1999) using a panel of data for 48 US states from 1982-1994, find a feedback effect between the real and the financial sector that helps to explain intra-national differences in output per capita.

Luintel and Khan (1999) using the VAR technique on ten developing countries with yearly data from the Fifties to the mid-Nineties find two cointegrating vectors identified as long-run financial depth and output relationship linking financial and economic development. They also find concausality between the level of financial development (depth) and growth in per capita income in in all sample countries. This confirms the findings of Demetriades and Hussein (1996) who, with data on 16 developing countries, with 30 to 40 yearly observations from the Sixties on, find that in most countries evidence favours bidirectional causality and in quite a few countries economic growth systematically causes financial development.

Also Shan, Morris and Sun (2001), using quarterly data from the mid-Seventies to end Nineties for nine OECD countries, find evidence of reverse causality, namely from growth to financial development, in some countries and bidirectional causality in others, but no evidence of one-way causality from financial development to growth.

Finally, the fact that many time-series studies yield unreliable results due to the short time spans of typical data sets cannot be ignored. For this reason Christopoulos and Tsionas (2004) analyze ten developing countries and they resort to a panel context that increases sample size. With panel unit root tests and panel cointegration analysis the authors find a single a unique cointegrating vector, implying one-way causality from financial development to economic growth.

A final warning for caution on the above statement comes from Rousseau and Wachtel (2005) who claim that although the time series framework may seem more appropriate to study the long run relationship between finance and growth than cross-section techniques, recent history of mismanaged financial opening and of consequent financial crisis may have hit the relationship hard. On this topic, Loayza and Ranciere (2002) had already pointed out that ad hoc dummy variables were essential in order to obtain results for countries subject to the effects of financial crisis longer than the average economic cycle as "in the case of private credit its correlation with

growth is strongly negative prior to the crisis, and it becomes close to neutral in the aftermath". This effect is at odds with the long run nature of cointegration results and therefore needs proper consideration.

This paper aims at providing empirical evidence supporting a relationship between financial and economic development mostly in developing economies with data extending well after the Nineties – up to 2006 in fact – through a two-step process that firstly identifies a long run equilibrium relationship, with the help of a dedicated procedure to detect and estimate the type of outliers (if any) and then assesses the direction of causality.

The main result of the paper is that, contrary to Rousseau and Wachtel (2005), a long run equilibrium relationship between financial and economic development is identified with time series running to year 2006 – well over the financial openness boom of the Nineties – in countries whose history is characterized by numerous years of high inflation and/or episodes of crisis or other structural change. Also, financial openness, or lack thereof, proves to be an important feature in both explaining differences in sensitivity of financial development to capital accumulation and in determining the direction of causality between financial and economic development. The paper finds that bi-directional causality between economic and financial development is not as frequent an outcome as in Luintel and Khan (1999) and in several cases Joan Robinson's statement on the primacy of economic development over finance is supported by the estimations.

In what follows section 2 will briefly describe the data and section 3 will make the case and describe the procedure for the identification and estimation of outliers. Section 4 will present cointegration estimations, causality tests and discuss the results.

2. Data Description

The VAR model consists of four variables: financial development as measured by credit to the private sector as a percentage of GDP (FD), the logarithm of real income per capita (YP), the logarithm of real capital per capita (KP) and real interest rate (RR). Data frequency is annual and FD, YP, investment and inflation data have been obtained from 2008 World Development Indicators [WDI08]. Nominal interest rates have mostly been obtained from various issues of the International Financial Statistics published by the International Monetary Fund[2]. Data availability - i.e. at least 40 years of data for all the time series - has been the main driver in the choice of sample countries.

FD underpins a view of financial development mainly related to the function of credit as a stimulus of economic growth. This is in accordance with the McKinnon/Shaw view of inside money, namely that the supply of credit is ultimately responsible of the quantity and quality of investment. FD has been preferred to other frequently used measures of financial development such as deposit on

[2] Details on sources and calculations for each variable in each country are detailed in Appendix 1.

GDP that underpins a role for financial development on the saving rather than the demand side. It assumes most economic agents earn more than what they are willing to consume and financial intermediaries are developed enough to be able to gather a sizable part of that savings. This might not be the case in developing countries – which are the main area on interest in this paper – both because of low income per capita and of general lack of knowledge or trust of standard retail banking practice on the side of savers. Scarce diffusion of branches over rural territories *de facto* cutting out large groups of potential savers may also undermine the measurement of financial development through this indicator.

Monetary indicators, such as M2 as a percentage of GDP, have not been considered appropriate indicators of financial development as they are nearer to the role of money as a facilitator of exchange, rather than a facilitator of investment. In fact in the case of "liquidity trap", i.e. availability of money which is not invested in production but treasured, M2 as a percentage of GDP would increase but this would have only second-order effects on aggregate demand and economic growth, and hence on the long run relationship between financial and economic development, which is the topic of this paper. Furthermore, in developing economies, which are the focus of the paper, a large component of the broad money stock is currency held outside the banking system, mainly for transaction purposes (see Demetriades and Hussein (1996) among others). Therefore, measures of financial development based on monetary indicators might result in a severe underestimation of financial development.

Banking credit on GDP would have been a alternative credit channel measure, but it includes net credit to the central government, a use of finance whose effects on economic growth are still not clear cut. Finally, quality of data consideration also prompted the use of credit on GDP as a measure of financial intermediation as it is readily available from WDI08. On the other hand, the latter indicator includes credit from government banks to the private sector which may allocate credit according to criteria which differs, sometimes markedly so, from profit maximization. This may weaken the expected relationship between financial and economic development, despite having been – and partially still being – a prominent feature of several economic systems during the time span considered.

2.1 Stylized facts

Provided time series for all the endogenous variables involved are available for at least 35 years, countries have been chosen mostly among developing economies trying to capture different geographical origin (2 African, 6 Asian and 4 Latin American countries), level of economic development (4 Low income countries, 3 Lower Middle income ones, 3 Upper Middle income ones and 2 High income countries) and average level of financial openness.

In Table 1 the main data on financial and economic development in each country are summarized: financial development is represented through its initial level (IFD), end level (ENDFD) and average

growth rate (DFD) while economic development is represented by Gross National Income (GNI)[3] per capita in the final year of the sample period and average growth rate or real per capita income (DYC). Average financial openness (AFO)[4] from Chinn and Ito (2005) is also shown in the last column of the table. The latter data could not be used in the estimations as their time span is short, they have however been reported as they offer an important interpretation tool. The average of the index for the 41 emerging countries in Chinn and Ito (2005) - among them all of those considered in this study - over the whole time span is -0.1 so Brazil, China, Colombia and Ghana can be considered as relatively financially closed (Financially Closed from now on) while China, India, Korea, Nigeria, Pakistan, Singapore, Sri Lanka and Venezuela (Financially Open from now on).

Table 1 Some Summary Statistics by Country

Country	GNI	WB Class.	IFD	ENDFD	DFD	DYC	C(DY,FD)	C(Y,FD)	Sample	Obs	AFO
Brazil	4710	UM	19.30	36.45	7.00	2.32	-0.09	0.43	1961-2006	46	-1.50
Chile	6810	UM	13.33	82.40	4.74	2.65	0.17	0.73	1961-2005	45	-0.96
China	2000	LM	26.96	114.39	6.83	6.36	0.33	0.87	1961-2006	46	-1.23
Colombia	3120	LM	24.21	35.67	1.64	1.89	-0.32	0.65	1961-2006	46	-1.50
Ghana	510	L	5.83	17.53	5.59	0.30	0.31	0.71	1961-2006	46	-1.36
India	820	L	8.72	40.80	3.90	2.76	0.39	0.76	1961-2005	45	-1.08
Korea	17690	H	19.23	101.97	5.40	5.70	-0.11	0.95	1961-2006	46	-0.61
Nigeria	620	L	3.70	15.22	4.78	1.01	-0.30	-0.01	1961-2005	45	-1.12
Pakistan	800	L	12.20	28.51	2.49	2.69	0.04	0.40	1961-2006	46	-1.16
Singapore	28730	H	36.46	98.58	2.58	5.73	-0.50	0.87	1963-2006	44	1.88
Sri Lanka	1310	LM	6.87	32.84	6.26	3.02	0.22	0.84	1961-2005	45	-0.56
Venezuela	9230	UM	13.39	13.19	1.45	-0.05	-0.14	0.25	1961-2005	45	0.61
Average FC	**2585**		**19.07**	**51.01**	**5.27**	**2.72**	**0.06**	**0.66**			**- 1.40**
Average FO	**8251**		**14.24**	**51.69**	**3.95**	**2.94**	**- 0.03**	**0.60**			**- 0.37**
Average FC/FO	**0.31**		**1.34**	**0.99**	**1.33**	**0.92**	**- 1.94**	**1.11**			**3.73**

NOTES

GNI = Real per capita Gross National Income in current US dollar (Atlas method) for the year 2006; obtained from World Development Report, 2008.

WB Classification: The country groups by GNI are: Low income countries, (GNI of US$875 or less); Lower Middle income countries, (GNI between US$876 and US$3465); Upper Middle income countries, (GNI between US$3466 and $10725); and High income countries (GNI above US$10726).

IFD = financial development as measured by credit to the private sector as a percentage of GDP at the initial (i.e., first) year of the sample period.

ENDFD = financial development at the end (i.e. final) year of the sample period.

DFD = average annual percentage growth rate of financial development during the sample period.

DYC = average annual percentage growth rate of real per capita income during the sample period.

C(DY,FD) = correlation between the level of financial development and the rate of growth of real per capita income.

C(Y, FD) = correlation between the level of financial development and the level of real per capita income.

Obs = number of annual observations.

AFO = average financial openness measured by the average of the indicator from Chinn and Ito (2005) for the period 1970-2005. AFO takes on higher values the more open the country is to cross border capital transactions.

Average FC = average values in the coloumn for relatively Financially Closed countries.

Average FO = average values in the coloumn for relatively Financially Open countries.

Average FC/FO = percentage ratio of the average values in Financially Closed to Financially Open countries.

[3] GNI per capita is the gross national income, converted to U.S. dollars using the World Bank Atlas method, divided by the midyear population. GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.

[4] The index is constructed so that the average across the 108 countries in Chinn and Ito (2005) database over the full time period is zero. The components of the index are equal to one when the capital account restrictions are non-existent, so the more the index for a country is a positive and high number, the more financially open is the country.

FC countries are all Middle Income countries with the exception of Ghana, and as a group they show an average GNI per capita which is one third of that of FO countries. FO countries are more diverse according to the World Bank GNI classification, as all income group are represented, also their average growth in financial development is over 30% faster than the average in FC countries.

Across groups, both economic and financial development show signs non-linearity and geographical connotation. China stands out with the top average growth rate in financial development and economic growth. Geographically, African countries show the lowest growth rates in real per capita income and the highest in financial development. Latin American countries are very diverse as Brazil shows average economic growth and fast financial development while Venezuela sits at the bottom in both dimensions, with a negative growth in income per capita. The only two High income countries, namely Korea and Singapore, are both Asian and FO and together with a high level of development, they show an average growth rate in income that is nearly double that of other FO countries. They share the top level in ENDFD among FO countries although growth in financial development is well below average in Singapore while quite substantial in Korea.

Finally, please note that the three largest countries, namely Brazil, China and India, have a level of GNI relatively to all-country average of 2.7:1.2:0.5 respectively and ENDFD of 0.9:2.8:1. Hence, they represent very diverse combinations of economic and financial development: Brazil and India are quite unbalanced in opposite directions, as the former shows a GNI nearly three times the average and ENDFD below average, and the latter is definitely lacking in GNI. China stands out in both dimensions and looks definitely "overfinanciarized".

Table 1 also shows that the contemporaneous correlations between FD and the level of real income per capita is always positive, with the exception of Nigeria. The correlation between income per capita growth and financial development C(DY,FD) is mixed with an equal proportion of positive and negative signs across FC and FO countries.

Unit root test results on level variables and on first differences of the same variables are represented in Tables 2.1 and 2.2. The presence of a unit root is found in all level variables by both ADF and KPSS test in China, Colombia and Sri Lanka and at least one of the two tests also indicates the presence of a unit root in all variables of Brazil, Ghana and Venezuela. Both test procedures also agree on the interest rates in Chile, India, Korea, Nigeria, Pakistan and Singapore being stationary, as well as financial development in Pakistan. These I(0) variables will all the same be included in the study as literature suggests that treating them as weakly exogenous does not offer substantial differences in terms of interpretation of results (see Luintel and Khan (1999) among others).

Also, either the ADF or the KPSS test provides evidence in support of the possibility of some series being I(2) for several countries. However only in Brazil, China, India, Singapore and Venezuela the

identification of KP as an I(2) series is robust to both the unit root tests and this may be due to the compounding formula used in the perpetual inventory methodology[5]. These variables will however be included in the study, following Johansen (1995), as the number of cointegrating relations exceeds the number of I(2) common trends, as shown in tables 3.1. and 3.2, in Brazil and China with 2 cointegrating relations and one I(2) series, namely capital per capita. According to Johansen's (1995) the combinations of the cointegrating variables in such setting can be stationary by themselves. India, where YP might be considered I(2) as is KP, as well as Singapore and Venezuela, where Johansen's cointegration test identifies only one cointegrating relation and there is one I(2) variable, are more borderline cases.

Table 2.1 Unit Root Tests and Sequential Break Test - FC Countries

COUNTRY	Level Variables						Differentiated Variables			
	ADF(ii)		KPSS (iii)		SBT (iv)			ADF(ii)	KPSS (iii)	
Variable	Lag (i)	Adj. t-stat	No. obs.	LM stat	$T_\square$	T_b	Variable	Adj. t-stat	No. obs.	LM stat
BRAZIL										
FD	4	-2.03	46	0.31	-1.28	1989	**D(FD)**	-3.22 *	45	0.20
YP	4	-2.73	46	0.72 *	-0.03	1976	**D(YP)**	-2.28	45	0.26
KP	4	-2.37	46	0.79 *	0.77	1980	**D(KP)**	-1.24	45	0.48 *
RR	4	-2.40	46	0.17	8.99	1990	**D(RR)**	-3.95 *	45	0.27
CHINA										
FD	3	-0.23	46	0.82 *	-1.73	1976	**D(FD)**	-3.36 *	45	0.15
YP	3	2.51	46	0.87 *	0.15	1976	**D(YP)**	-3.11 *	45	0.41
KP	3	2.41	46	0.87 *	-2.03	1996	**D(KP)**	-2.47	45	0.80 *
RR	3	-2.16	46	0.59 *	-2.76	1972	**D(RR)**	-4.54 *	45	0.33
COLOMBIA										
FD	5	-1.99	46	0.51 *	-2.37	1985	**D(FD)**	-3.25 *	45	0.04
YP	5	-1.95	46	0.85 *	-0.41	1978	**D(YP)**	-2.13	45	0.16
KP	5	-1.68	46	0.86 *	-0.15	1990	**D(KP)**	-2.88	45	0.19
RR	5	-1.99	46	0.60 *	-0.55	1977	**D(RR)**	-2.54	45	0.04
GHANA										
FD	5	-0.13	46	0.28	0.74	1982	**D(FD)**	-1.71	45	0.39
YP	5	-0.71	46	0.25	2.63	1983	**D(YP)**	-1.75	45	0.37
KP	5	-1.10	46	0.19	0.77	1983	**D(KP)**	-0.44	45	0.41
RR	5	-1.25	46	0.22	-0.86	1978	**D(RR)**	-2.29	45	0.05

NOTES

(i) Lag is for variables in level

(ii) H(0) for ADF test: Series has a unit root. ADF test is calculated with the lag set in coloumn 2

(iii) H(0) for KPSS test: Series is stationary.

(iv) SBT is Sequential Break test for IO model 1 from Perron (1997) and the common lag. H(0) for SBT is no-break unit root. SBT critical value is: -5.23 (5% level).

* indicates rejection of H(0) at 5% significance.

[5] See Appendix A.1.

Table 2.2 Unit Root Tests and Sequential Break Test - FO Countries

COUNTRY	Level Variables						Differentiated Variables			
	ADF(ii)		KPSS (iii)		SBT (iv)			ADF(ii)	KPSS (iii)	
Variable	Lag (i)	Adj. t-stat	No. obs.	LM stat	T_λ	T_b	Variable	Adj. t-stat	No. obs.	LM stat
CHILE										
FD	3	-1.35	45	0.71 *	1.09	1982	**D(FD)**	-2.96 *	44	0.08
YP	3	0.43	45	0.78 *	-0.32	1975	**D(YP)**	-3.46 *	44	0.26
KP	3	0.44	45	0.80 *	0.15	1997	**D(KP)**	-2.00	44	0.34
RR	3	-3.62 *	45	0.20	-2.03	1973	**D(RR)**	-5.73 *	44	0.29
INDIA										
FD	4	-0.08	45	0.73 *	-0.51	1990	**D(FD)**	-1.04	44	0.14
YP	4	4.19	45	0.83 *	0.85	1979	**D(YP)**	-1.99	44	0.80 *
KP	4	2.17	45	0.86 *	2.74	1989	**D(KP)**	1.18	44	0.82 *
RR	4	-3.96 *	45	0.33	-4.50	1972	**D(RR)**	-5.69 *	44	0.19
KOREA										
FD	3	-0.58	46	0.82 *	-2.29	1988	**D(FD)**	-3.61 *	45	0.10
YP	3	-1.40	46	0.87 *	-0.90	1991	**D(YP)**	-3.50 *	45	0.15
KP	3	-2.08	46	0.87 *	-0.80	1991	**D(KP)**	-3.01 *	45	0.17
RR	3	-3.61 *	46	0.11	-2.31	1974	**D(RR)**	-5.19 *	45	0.50 *
NIGERIA										
FD	2	-1.55	45	0.50 *	-1.17	1997	**D(FD)**	-4.03 *	44	0.08
YP	2	-2.10	45	0.16	-1.02	1974	**D(YP)**	-3.22 *	44	0.10
KP	2	-2.11	45	0.68 *	1.03	1976	**D(KP)**	-1.95	44	0.28
RR	2	-2.96 *	45	0.16	-2.67	1988	**D(RR)**	-4.67 *	44	0.28
PAKISTAN										
FD	2	-4.07 *	46	0.32	-3.71	1991	**D(FD)**	-4.34 *	45	0.17
YP	2	-1.01	46	0.88 *	-1.26	2002	**D(YP)**	-2.66	45	0.17
KP	2	-0.05	46	0.87 *	-1.51	1973	**D(KP)**	-2.32	45	0.12
RR	2	-3.30 *	46	0.13	10.1	1990	**D(RR)**	-5.44 *	45	0.50 *
SINGAPORE										
FD	3	-2.11	44	0.75 *	-0.61	1987	**D(FD)**	-2.03	43	0.27
YP	3	-3.00 *	44	0.83 *	-1.06	1973	**D(YP)**	-2.35	43	0.45
KP	3	-3.74 *	44	0.80 *	0.11	1980	**D(KP)**	-1.36	43	0.54 *
RR	3	-3.03 *	44	0.08	-1.77	1974	**D(RR)**	-4.34 *	43	0.50 *
SRI LANKA										
FD	3	-1.24	45	0.71 *	-0.48	1994	**D(FD)**	-4.61 *	44	0.06
YP	3	1.18	45	0.86 *	-1.88	1978	**D(YP)**	-3.93 *	44	0.35
KP	3	-0.77	45	0.84 *	0.99	1979	**D(KP)**	-1.91	44	0.13
RR	3	-2.01	45	0.49 *	-2.09	2000	**D(RR)**	-4.67 *	44	0.50 *
VENEZUELA										
FD	4	-1.42	45	0.23	0.11	1994	**D(FD)**	-1.43	44	0.40
YP	4	-1.13	45	0.64 *	-1.09	1985	**D(YP)**	-2.76	44	0.12
KP	4	-1.98	45	0.20	-0.22	1978	**D(KP)**	-1.46	44	0.49 *
RR	4	-1.47	45	0.54 *	-0.95	1989	**D(RR)**	-3.91 *	44	0.17

NOTES

(i) Lag is for variables in level

(ii) H(0) for ADF test: Series has a unit root. ADF test is calculated with the lag set in coloumn 2

(iii) H(0) for KPSS test: Series is stationary.

(iv) SBT is Sequential Break test for IO model 1 from Perron (1997) and the common lag. H(0) for SBT is no-break unit root. SBT critical value is: -5.23 (5% level).

* indicates rejection of H(0) at 5% significance.

ADF and KPSS tests, however, do not take into consideration the possibility of breaks in the series, for this reason their results must be taken with caution in such an uneven environment as that outlined by the endogenous variables and the time span considered here. Hence the

Sequential Break test[6] is carried out on each series and the results presented in columns 5 and 6 of Tables 2.1 and 2.2. Here the null of no break unit root cannot be rejected in any of the series. Therefore all the other series can be considered I(1) and they can be tested under the Johansen's procedure.

Finally, the trace tests in Tables 3.1 and 3.2 indicates a rank equal to 2 in all countries at 5% significance, with the exception of Chile, Korea, Singapore and Venezuela, where the test indicates only one cointegrating relationship. This is confirmed by the maximum eigenvalue statistic for all countries with the exception of China, India and Nigeria, although in the latter 2 countries this result is to be considered valid only at 10% significance level. Following Luintel and Khan (1999), the trace test is considered as more robust than maximal eigenvalue statistics, so of all the countries, 8 will be considered in the study with a rank set at 2 and 4 with a rank of 1. Please note that, as in Demetriades and Hussein (1996), the lag length of the models has been chosen so as to correspond with the longest lag for which evidence of cointegration is found. Tables 3.1 and 3.2 also underline no autocorrelation in the residuals – with the exception of Nigeria and Singapore – confirming the correct choice of the common lag while non normality of residuals is quite widespread across countries. This is usually associated with the presence of outliers and the consequent need to introduce dummy variables.

[6] From Perron (1997) the unit root test for the innovational model is performed estimating by OLS the regression: $y_t = \mu + \theta DU_t + \beta t + \delta D(T_b)_t + \alpha y_{y-1} + \sum_{i=1}^{k} c_i \Delta y_{t-1} + \varepsilon_t$ where $DU_t = 1(t > T_b)$ and $D(T_b)_t = 1(t = T_b + 1)$ and *k* is the lag parameter then obtaining the t-statistic for testing $\alpha=1$. The break date is selected as the value which minimizes the $t_\alpha^*(1) = Min_{T_b \in (k+1,T)} t_{\hat{\alpha}}(T_b, k)$

Table 3.1 Johansen's Cointegration Test - FC Countries

COUNTRY Lag, trend (i)	Eigenv.	Trace Stat	p-val (ii)	Max Eigen St	p-val (ii)	LM(iii) JB(iv)	h+1 df	p-val p-val
BRAZIL	0.63	91.49	0%	42.07	0%			
3,b	0.54	49.42	0%	32.53	0%	20.34	4	21%
	0.28	16.89	14%	13.99	10%	51.66	8	0%
	0.07	2.91	60%	2.91	60%			
CHINA	0.53	64.61	0%	32.90	1%			
2,c	0.33	31.71	3%	17.08	17%	10.22	3	86%
	0.28	14.63	7%	13.84	6%	23.16	8	0%
	0.02	0.79	37%	0.79	37%			
COLOMBIA	0.58	81.04	0%	35.49	1%			
4,b	0.54	45.55	0%	31.79	0%	16.44	5	42%
	0.16	13.76	31%	7.39	62%	5.66	8	69%
	0.14	6.37	16%	6.37	16%			
GHANA	0.61	76.70	0%	38.68	0%			
4,b	0.49	38.01	2%	27.76	1%	24.91	5	7%
	0.19	10.25	62%	8.86	45%	8.12	8	42%
	0.03	1.40	89%	1.40	89%			

NOTES

(i) Lag is in VEC i.e. for differentiated variables. Trend assumptions:

b = No deterministic trend in the data, and an intercept but no trend in the cointegrating equation

c = Linear trend in the data, and an intercept but no trend in the cointegrating equation

d = Linear trend in the data, and both an intercept and a trend in the cointegrating equation

(ii) MacKinnon-Haug-Michelis (1999) p-values

(iii) VEC Residual Serial Correlation LM Test. H0: no residual autocorrelations at lag h+1 where (h+1) = lag((VEC) +1). Prob from chi-square with 16 df.

(iv) JB = Jarque Bera Test.H0: residuals are multivariate N.

Table 3.2 Johansen's Cointegration Test - FO Countries

COUNTRY Lag, trend (i)	Eigenv.	Trace Stat	p-val (ii)	Max Eigen St	p-val (ii)	LM(iii) JB(iv)	h+1 df	p-val p-val
CHILE	0.54	72.31	1%	32.31	5%			
2,d	0.40	40.00	9%	21.69	16%	15.09	3	52%
	0.26	18.31	32%	12.78	35%	132.3	8	0%
	0.12	5.53	52%	5.53	52%			
INDIA	0.54	63.09	0%	32.21	1%			
3,c	0.39	30.88	4%	20.50	6%	21.07	4	18%
	0.15	10.38	25%	6.87	50%	47.03	8	0%
	0.08	3.51	6%	3.51	6%			
KOREA	0.49	57.30	1%	28.56	4%			
2,c	0.30	28.74	7%	15.64	25%	4.08	3	100%
	0.22	13.10	11%	10.94	16%	80.06	8	0%
	0.05	2.16	14%	2.16	14%			
NIGERIA	0.49	67.01	0%	29.34	4%			
1,b	0.40	37.67	3%	22.13	5.3%	28.38	2	3%
	0.22	15.54	20%	10.51	29%	16.83	8	3%
	0.11	5.03	28%	5.03	28%			
PAKISTAN	0.56	71.30	0%	36.29	0%			
1,c	0.39	35.00	1%	22.00	4%	12.08	2	74%
	0.24	13.00	11%	12.16	10%	512.3	8	0%
	0.02	0.85	36%	0.85	36%			
SINGAPORE	0.61	63.25	0%	38.50	0%			
2,c	0.35	24.76	17%	17.68	14%	28.58	3	3%
	0.16	7.08	57%	7.07	48%	27.6	8	0%
	0.00	0.00	96%	0.00	96%			
SRI LANKA	0.62	84.31	0%	40.11	0%			
2,b	0.48	44.20	0%	27.26	1%	16.54	3	42%
	0.27	16.94	13%	13.00	14%	64.9	8	0%
	0.09	3.93	42%	3.93	42%			
VENEZUELA	0.51	50.44	3%	29.36	3%			
3,c	0.28	21.08	35%	13.18	44%	12.77	4	69%
	0.17	7.90	48%	7.43	44%	16.70	8	3%
	0.01	0.46	50%	0.46	50%			

NOTES

(i) Lag is in VEC i.e. for differentiated variables. Trend assumptions:

b = No deterministic trend in the data, and an intercept but no trend in the cointegrating equation

c = Linear trend in the data, and an intercept but no trend in the cointegrating equation

d = Linear trend in the data, and both an intercept and a trend in the cointegrating equation

(ii) MacKinnon-Haug-Michelis (1999) p-values

(iii) VEC Residual Serial Correlation LM Test. H0: no residual autocorrelations at lag h+1 where (h+1) = lag((VEC) +1). Prob from chi-square with 16 df.

(iv) JB = Jarque Bera Test.H0: residuals are multivariate N.

3. The need of proper consideration for dummy variables

Considering that all the countries in the sample are emerging economies and the time span covers over 40 years of decolonisation, economic transition, domestic financial liberalization and financial openness, episodes of financial or economic crisis may not be infrequent.

More specifically, the volatility around shocks causes autocorrelation in the residuals in time series to which the Johansen procedure - on which the determination of the cointegration rank that

identifies the number of long run relationships is based - is very sensitive. The introduction or the omission of dummy variables, which is the standard technical instrument to whiten residuals, has to be done carefully in a cointegration framework as a dummy variables may influence several endogenous variables similarly, such that the effect cancels in a linear combination of them, and no dummy is actually needed. Alternatively, a dummy variable may only affect a subset of the variables (or several, but asymmetrically), and the effect will not disappear in the linear combination of the variable which constitutes the cointegration relation, so a dummy must be included. Furthermore, the properties of the resulting formulation may prove undesirable with respect to the objective of the estimation as parameter inference, policy simulations, and forecasting are much more sensitive to the specification of the deterministic than the stochastic components of the VAR model[7]

Also, the usual practice to detect outliers from the estimated residuals in cointegrated VAR and to include unrestricted, i.e. innovational, dummies to whiten residuals has no sound justification in theory. This is more evident when the specification of the innovational model [IO from now on] is considered and namely:

$$\Delta Y_t = ab'Y_{t-1} + \sum_{i=1}^{k-1}\Gamma_i \Delta Y_{t-i} + ab't + D_t + \mu_0 + \varepsilon_t$$

where Y_t is the vector of the endogenous variables in levels, a is the vector of adjustment parameters, b is the vector of parameters specifying the long term or equilibrium cointegration relationship, k is the number of the lags (of the unrestricted, i.e. level, model), *t* the (eventual) time trend and D_t the dummy variable(s) such that for D_t=1 for t=*t* and D_t=0 otherwise. The additive model [AO from now on] is instead specified as:

$$\Delta Y_t = \begin{pmatrix} b' & b_0' & b_1' \end{pmatrix} \begin{pmatrix} Y_{t-1} \\ t \\ D_t \end{pmatrix} + \sum_{i=1}^{k-1}\Gamma_i \Delta Y_{t-i} + \theta_i \Delta D_t + \sum_{i=1}^{k-1}\theta_i \Delta D_t + \mu_0 + \varepsilon_t$$

$$\text{subject to} \begin{cases} \mathrm{b}_1 = \theta' \mathrm{b} \\ \theta_i = -\Gamma_i \theta \text{ for } i = 1,...,k-1 \end{cases}$$

where θ is the k-dimensional vector of parameters for the full lag structure of the dummy variables. It is important to note that an additive impulse dummy eliminates the contribution from the observation to the likelihood function rather that the contribution from the residual.

Bohn Nielsen (2004) [BN04 from now on] underlines that "in the case of a fixed number of outliers asymptotic inference in the cointegration model is unchanged, in the sense that the asymptotic distributions are unaffected. But the distortionary effects could be important in finite samples".

[7] This non technical discussion of the problems relating to the use of dummy variables within a cointegration framework are taken by Hendry and Juselius (1999b). Readers interested in a more technical discussion should refer to Doornik, Hendry, and Nielsen (1998). On the excessive use of dummies Clements and Sensier (2003) provides useful insights.

More precisely, while ignored innovational outliers have only minor consequences for small sample inference on the cointegration rank of a VAR process, additive outliers may bias inference towards the finding of stationarity or cointegration. Therefore, forcing the unjustified introduction of additive outliers can manipulate the cointegration rank.

Also, BN04 recognizes that "a pretest for the cointegration rank can be applied, and the search for outliers can be made conditional on that estimated rank, $\hat{r}$ [and] ... there might be a gain in the outlier detection from using a rank, $\hat{r}$, close to the true rank, *r*". According to BN04 the alternative procedure of using a stationary model (i.e. rank $\hat{r}$=4 in our case) for the detection of outliers may originate difficulties in distinguishing the type of error, i.e. IO v. AO, in small samples.

Given the above elements and also with reference to Luintel and Khan (1999), the outlier detection and estimation procedure by Bohn Nielsen (2004) will be applied to each sample country with the rank $\hat{r}$ as specified in Tables 3.1 and 3.2.

Detection will be based on a Wald test within in a multivariate framework, while estimation will identify the type of outlier: whether innovative or additive. The procedure is based on Gaussian likelihood function hence it differs from the pseudo-maximum-likelihood (PML) approach to cointegration analysis based on a fat tail distribution for the error term. Although the two techniques may yield similar results in the case of IO-only dummy specification, the BN04 technique is considered better in so far the Gaussian maximum likelihood approach offers an easier rank determination framework[8].

3.1 Outlier Detection & Estimation

Tables A3.1 and A3.2 in Appendix A.3[9] show the results from the application of the Outlier Detection and Estimation procedure outlined in the previous paragraph to each single country. With the exception of Ghana, all other countries end up with less dummy variables than observations showing excess standard deviation, granting a parsimonious approach with regard to degrees of freedom. Also, the procedure has not called for any AO-type dummy, which is usually associated with data errors in time series. This reinforces the claim that the rank specified in Tables 3.1 and 3.2 is the true cointegration rank and it should guarantee a good quality of estimates. Similarly, the estimation of the FD series for China, specified in Appendix A.2, does not seem to have distorted the time series properties of the data.

[8] Intuitively, considering that the PML estimation based on a multivariate student-t distribution corresponds to a "weighted" Gaussian, where the weights involve a Generalised Least Square (GLS)-type transformation, the GLS transformation automatically gives lower weight in the likelihood function to large residuals. Therefore the leptokurtic error distribution will by construction give more robustness to IOs. However, the PML is not automatically robust to AOs as AOs are related to a particular time series and not to the model and to innovations and the PML does not take this into account. Furthermore the pseudo-LR test for rank determination in the PML approach necessitates the use of simulated distributions instead of the asymptotic table of the Gaussian approach. This brief outline of the preference for the Gaussian approach aims at justifying the use of this technique intuitively and it should not be considered exhaustive. Interested readers should refer to para. 5.3 of Bohn Nielsen (2004).

[9] All calculations have been conducted in EViews7 ®. The routines for estimations are available from the author.

The procedure finds outliers in contiguous years in 8 out of 12 countries. This is allowed by its iterative mode, which take into account previously found outliers when testing for the next one, therefore no identified outlier will be excluded[10] from the estimation neither it will be bundled up with some other in one single shift dummy.

Finally, the value added of the Bohn Nielsen procedure can also be seen in the very irregular overlap between the breaks endogenously identified by the Structural Break tests on each series presented in Tables 2.1 and 2.2 and those identified with the procedure. Only in Ghana all of the outliers identified by SBT are also recognised by BN04 procedure, which signals 3 additional outliers as well, while in Colombia, Nigeria, Singapore, Sri Lanka and Venezuela there is only 1 overlap in identified outliers between the two procedures with the BN04 procedure saving degrees of freedom in Colombia and Nigeria, signalling less outliers than the SBT procedure. This is a piece of supportive evidence towards the fact that the cointegration does modify the relative relevance of breaks with respect to testing single time series and the heavy presence of outliers may help explain the contrasting results of the stationarity tests in Tables 2.1 and 2.2. Also, in most cases, the timing of the break dates identified by the Bohn Nielsen procedure corresponds to important events in the countries, as shown in Tables 4.1 and 4.2. The common link among events and outliers is their deep impact on the endogenous variables in the model. In India the only outliers are represented by domestic financial policy events and namely the abolition of ceilings on lending interest rates in 1989 and relaxation on directed credit in 1990, causing a slowdown in credit also fuelled by the economic deceleration of the economy of the early Nineties. In China, the cultural revolution (1967-1969) featuring negative economic growth, the start of liberalization policies (1976-1977) with the last year of negative economic growth and a sharp rebound, and the unification of FEC[11] and domestic currency (1993-1994) with double-digit inflation, are picked out by the procedure.

[10] Exclusion of breaks is quite used in the literature. Arghyrou and Luintel (2007) among others state "We define a period of three years as the neighbourhood of a break and represent it by a single shift. The exact break date (point) in a neighbourhood is identified as the one that produces the highest Chi-square statistic in the sequential tests." [line 3 on page 399]. Because, as specified in the text, the Bohn Nielsen procedure is iterative, such exclusions and/or groupings have been considered unnecessary.

[11] The renminbi was massively overvalued in the 1980s and early 1990s, and a parallel currency, foreign-exchange certificates (FECs), circulated until 1994 to enable entities engaged in foreign trade to purchase foreign exchange at a more reasonable rate. The currencies were unified in 1994 and the renminbi pegged at Rmb 8.7:US$1. The average exchange rate in 1993 was Rmb 5.8:US$1.

Table 4.1 Detected Outliers and Events – FC Countries

Country	Year	Event	Source
BR	1988	Foreign currency bank debt default (1983-1994) + Paris Club Rescheduling	MRS(2003), S&P(2002)
	1989		
	1990	Banking crisis. Deposit converted to bonds	CK(2003)
	1996	Banking crisis (1994-1999)	CK(2003)
CH	1967	Cultural Revolution (1966-1969)	
	1969		
	1976	Death of Chairman Mao, arrest of the Gang of four. Start of liberalization by Deng Xiaoping	
	1977		
	1986	Economic slowdown and pro-democracy student protests	
	1993	Double digit inflation and FEC's unification with RMB	
	1994		
CO	1971	Economic and financial slowdown	
	1974	End of National Front government. Economic slowdown and start of high inflation cycle	
	1990	Start of financial liberalisation. Boom year and start of high inflation cycle	
	1993	Economic slowdown. Expansion of monetary policy. P. Escobar - leader of the Medellin cartel - is killed	
	1999	Economic recession	
GH	1974	Economic stagnation and lack of FX to import fuel + debt	www.ghanaweb.com
	1978	Social unrest, economic stagnation with high inflation and halving of 1960s cocoa production	www.ghanaweb.com
	1982	Stagnation + Banking crisis (1982-1989)	LR(2002);CK(2003)
	1983		
	1984		
	1989		
	1993	Boom year and start of high inflation cycle	

NOTES:

CK(2003): Caprio, G., Klingebiel, D., 2003.

DL(1997): Demetriades, P.O., Luintel, K., 1997.

LR(2002): Loayza, N., Ranciere, R., 2002.

MRS(2003): Manasse, P., Roubini, N., Schimmelpfennig A., 2003.

S&P(2002): Standard and Poor's, 2002.

Table 4.2 Detected Outliers and Events – FO Countries

Country	Year	Event	Source
CL	1972	Expasionary monetary and fiscal policies bringing devaluation of currency. US$ 258 mn debt renegotiated with Paris Club	www.clubdeparis.org
	1973	Coup d'etat	
	1982	Banking crisis (1982-1985) and foreign currency bank debt default (1983-1990)	CK(2003), S&P(2002)
IN	1989 1990	Economic slowdown. Abolition of ceilings on lending rates and relaxation on directed credit	DL(1997)
KO	1965	Ultra-restrictive monetary policystop double digit inflation	
	1974	Social unrest followed by emergeny decrees. Doubling of inflation following oil shock	
	1998	Banking crisis	CK(2003)
NI	1988	Foreign currency bond and bank debt default (1986-1988)	S&P(2002)
PK	1972	Economic slowdown following war with India and exit from Commonwealth because of recognition of Bangladesh. US$ 234 mn debt renegotiated with Paris Club	www.clubdeparis.org
	1989 1990 1991	Economic slowdown and high inflation. Removal of B. Bhutto from presidency and election of M. N. Sharif	
SP	1970	Entry of foreign banks permitted	YL(2010)
	1973	Double digit inflation	
	1998	Negative economic growth following Asian crisis	
	2001	Negative economic growth following world economic slowdown	
SL	1979	End of command economy and import substitution policy. Economic boom	
	1980	High inflation	
VE	1989 1996 1997	Banking crisis, Foreign currency bond (1995-1997) and bank debt (1983-1988, 1990) default	MRS(2003), S&P(2002)
	2004	Sharp rebound after negative economic growth following world economic slowdown	

NOTES:
CK(2003): Caprio, G., Klingebiel, D., 2003.
DL(1997): Demetriades, P.O., Luintel, K., 1997.
LR(2002): Loayza, N., Ranciere, R., 2002.
MRS(2003): Manasse, P., Roubini, N., Schimmelpfennig A., 2003.
S&P(2002): Standard and Poor's, 2002.
YL (2010): Yong, C., Lee Nah, Q., 2010.

4. Model Identification

For countries with a rank of 2, similarly to Luintel and Khan (1999), the normalisation restrictions are chosen with reference to FD and YP (formally $b_{1,1}$=1 and $b_{2,2}$=1) as to obtain a financial depth relationship (FD cointegration vector) and an (aggregate) production function (Economic Development cointegration vector). The other over-identifying restrictions are:

1. the coefficient of the per capita income in the FD cointegrating relationship is zero ($b_{1,2}$=0), since income has no direct effect in the economy's supply of credit to the private sector. According to McKinnon/Shaw view of inside money $b_{1,3}$ is expected to be positive as it reflects complementarity between money and capital, based on the hypotheses that

investment cannot take place unless it is preceded by the accumulation of financial capital. $b_{1,3}>0$ also reflects the so called "bank capital channel"[12] whereby well capitalized banks need to adjust lending less during economic downturns in order to avoid regulatory capital shortfalls. Also, if well capitalized banks are more risk-adverse, they select ex-ante a pool of borrowers who are on average less financially fragile, thus containing their exposure to default risk when an economic downturn occurs

2. the coefficient of FD in the Economic Development vector is zero ($b_{2,1}=0$), as economic theory suggests that financial development has no direct effect in the economy's production function

3. the coefficient on RR is non negative in at least one of the two cointegrating relationships (either $b_{1,4}\geq 0$ or $b_{2,4}\geq 0$). $b_{1,4}>0$ captures profit for financial institutions, which is a main driver of financial development. $b_{2,4}>0$ can be interpreted either as a proxy of technological progress or the so called "financial repression", i.e. the belief that "keeping down the cost of capital is good for the economy" [p. 796 Aretsis and Demetriades (1997)]. The latter assumption has been at the core of financial liberalization policies in many countries in the Eighties which aimed at lowering interest rates through access to international financial markets[13].

For Chile, Korea, Singapore and Venezuela, which share the common feature of a single cointegrating vector, the normalisation variable is FD and the coefficient of YP in the relationship is set to zero for the above mentioned reasons.

[12] The bank capital channel relies on three main hypotheses. First, there is an imperfect market for bank equity: banks cannot easily issue new equity because of the presence of agency cost and tax disadvantages. Second, banks are subject to interest rate risk because their assets typically have longer maturities and liabilities. Third, banks have to meet regulatory capital requirements linked to credit supply. For further details see: Gambacorta and Mistrulli (2004) and Diamond and Rajan (2000) and on the empirical side see Kleff and Weber (2008).

[13] See Rousseau and Wachtel (2005) for a review of financial liberalisation with respect to evolution of both the theoretical and the policy framework.

Table 4 Identified Cointegrating Vectors and Causality Tests

Country	Financial Development Cointegrating Vector (i)					Economic Development Cointegrating Vector (i)					OR (ii)	IO dummies (iii)	WEAK EXOGENEITY TEST (iv)				BLOCK EXOGENEITY WALD TEST (v)					
	$FD=b_{1,0}+b_{1,3}KP+b_{1,4}RR+b_{1,5}t$					$YP=b_{2,0}+b_{2,3}KP+b_{2,4}RR+b_{2,5}t$							$a_{1,2}=0$		$a_{2,1}=0$		DEP: D(CR) EXC: D(YC)			DEP: D(YC) EXC: D(FD)		
	$b_{1,0}$ p-val	$b_{1,3}$ p-val	$b_{1,4}$ p-val	$b_{1,5}$ p-val	$a_{1,1}$ p-val	$b_{2,0}$ p-val	$b_{2,3}$ p-val	$b_{2,4}$ p-val	$b_{2,5}$ p-val	$a_{2,2}$ p-val	$Chi^2(1)$ p-val		$Chi^2(2)$	p-val	$Chi^2(2)$	p-val	Chi^2	df	p-val	Chi^2	df	p-val
Brazil	-2.96 0%	0.34 0%			-0.32 3%	-1.0 1%	1.02 0%	-0.001 0%		-0.06 0%	**0.67 41%**	d1_90 d2_88 d3_89 d4_96	22.11	0%	20.01	0%	4.45	3	22%	21.06	3	0%
Chile	6.79	-0.47 0%	-0.001 1%	-0.03 0%	-0.22 0%						**0.75 39%**	d1_73 d2_82 d3_72					7.22	2	3%	5.07	2	8%
China	-1.54	0.31 0%	-0.077 0%		-0.08 8%	-0.72	0.97 0%	0.017 0%		-0.30 0%	**0.00 98%**	d1_77 d2_69 d3_93 d4_67 d5_76 d6_94 d7_86	6.22	4%	1.91	39%	4.19	2	12%	0.02	2	99%
Colombia	-3.29 0%	0.24 0%	-0.005 0%		-0.83 0%	3.92 0%	0.70 0%	0.005 0%		-0.16 0%	**0.26 61%**	d1_99 d2_90 d3_93 d4_74 d5_71	0.73	69%	6.92	3%	13.00	4	1%	67.88	4	0%
Ghana	-1.23 0%	0.19 0%	0.001 0%		-0.71 0%	2.56 0%	0.54 0%	0.003 0%		-0.61 0%	**0.00 100%**	d1_78 d2_83 d3_82 d4_84 d5_89 d6_93 d7_74	10.69	0%	0.03	99%	22.52	4	0%	7.89	4	10%
India	3.67	-0.34 0%			-0.07 2%	-1.95	1.12 0%	-0.030 0%		-0.17 1%	**0.00 99%**	d1_90 d2_89	2.56	28%	0.29	87%	6.28	3	9.9%	0.99	3	8%
Korea	-2.41	0.18 0%	0.018 0%		-0.12 1%						**1.01 32%**	d1_65 d2_74 d3_98					0.60	2	74%	1.68	2	43%
Nigeria	-0.56 0%	0.09 0%	0.002 0%		-0.26 2%	4.73 0%	0.31 0%			-0.62 0%	**0.05 83%**	d1_88	3.26	20%	0.31	85%	3.63	1	6%	0.56	1	45%
Pakistan	-0.13	0.03 2%	-0.0002 1%		-0.45 0%	0.43	0.88 0%	-0.001		-0.39 1%	**0.00 99%**	d1_91 d2_89 d3_72 d4_90	0.29	87%	4.05	13%	3.24	1	7%	0.05	1	82%
Singapore	-2.34	0.29 0%	0.022 0%		-0.44 0%						**0.63 43%**	d1_01 d2_73 d3_70 d4_98					8.19	2	2%	9.33	2	1%
Sri Lanka	-0.72 0%	0.08 0%	0.011 0%		-0.64 0%	3.13 0%	0.68 0%	0.013 0%		-0.06 1%	**0.00 98%**	d1_79 d2_80	0.92	63%	0.04	98%	0.05	2	100%	0.07	2	97%
Venezuela	-17.70	1.16 0%	-0.008 0%		-0.21 1%						**0.65 42%**	d1_96 d2_97 d3_89 d4_04					5.84	3	12%	4.56	3	21%

NOTES

(i) Percentage figures within parenthesis are the marginal p-values i.e., marginal significance level of likelihood ratio tests under the null that the coefficient under consideration is zero; they are $Chi^2(1)$ distributed. a_{ij} are the associated loading factors.

(ii) OR are Over-identifying Restrictions which are Chi2(1) distributed.

(iii) dn_yy = dummy at year yy obtained at iteration n. dn_yy=0 t≠yy and dn_yy=1 t=yy

(iv) If the null a(i,j)=0 where i≠,j is rejected, then the vector j causes variable i. Rejection of both a(i,j)=0 for each i≠j implies bi-directional causality between Financial and Economic Development

(v) H(0) is that the Excluded variable does not Granger-cause the Dependent variable. Chi-square and p-values are of the Wald statistics test for the significance of the lagged endogenous variable in each equation.

The results in Table 4 show for each country the identified cointegrating vectors, the overidentifying restriction test with $\chi^2(1)$ distribution of probability and two exogeneity/causality tests. The results of the weak exogeneity test show no evidence of causality in India, Nigeria, Pakistan and Sri Lanka. As in Demetriades and Hussein (1996) this contradicts the representation theorem of Engle and Granger, thereby casting some doubt on the cointegration results for these countries, which will therefore be excluded from the subsequent analysis.

Among the 8 remaining countries few common elements seem to emerge. First of all, the detection and estimation technique helps in identifying a long run relationship between financial and economic development with statistically significative parameters in all countries. The estimations show a clear-cut divide between FC countries, where 2 cointegration vectors are estimated, and FO countries, where only one cointegrating vector is found. The presence of thresholds in the finance-growth nexus is not new as both Deidda and Fattouh (2002) and Rousseau and Wachtel (2005) find some evidence of non linearity with respect to the level of development of the sample countries. What is new here is that non linearity does persist through longer time series and idiosyncratic shocks and it is also more consistent with a financial openness threshold rather than the level of economic development per se.

Secondly, good quality parameter estimates are found for high-inflation countries too, namely Brazil (30 years of yearly price growth above 25%, the threshold chosen by Rjoja and Valev (2004)), Chile (18 years), Colombia (9 years), Ghana (22 years) and Venezuela (13 years). This goes against Rjoja and Valev (2004) who maintain that high inflation leads not only to an underdeveloped financial system but also to a breakdown of the finance-growth nexus.

Also, in all countries a Financial Development cointegrating vector is identified with a positive coefficient for KP, with the exception of Chile. FC countries, namely Brazil, China, Colombia and Ghana that were identified in table 1, show a much narrower range of values for $b_{1,3}$, the effect of capital per capita on financial development, while for FO countries $b_{1,3}$ ranges on a wider spectrum. More specifically, Chile and Venezuela, both FO, Latin American, Upper Middle income countries, are found at the extremes of the range FO of $b_{1,3}$ values. A maybe less evident common element of these two countries is that they both share a FD path showing an “inverted U pattern”. But while economic development is substantially increasing in Chile, it shows no such trend in Venezuela where economic development indicators YP and KP also share the same concave pattern; hence the (unfortunately) high correlation between FD and KP giving way to the high $b_{1,3}$.

Also, Chile has long[14] been cited as “the” textbook case for successful liberalisation reforms; but recent research[15] has shed light on why Chile, as well as other countries with a high level of inequality before reforms, might not have reaped full welfare gains in particular from financial

[14] And, even on a much more balanced way, still is see Hernández and Parro (2008).
[15] See Claessens and Perotti (2005) for further details.

reforms. In Chile, following liberalization in the late Seventies, groups played a perverse role with many privatizations of state-owned banks to groups of insiders so that the benefits reached fewer individuals; also UNU-WIDER World Inequality Map ranks Chile in the top 10 among the countries with the highest Gini index both in 1985 and in 2000mgiving further support to this hypothesis.

Furthermore, setting at 1 the level of FD and of YP at the beginning of sample period, FC countries end the sample with an average FD to YP ratio of 1:0.98 and FO countries of 1:0.94, whereas the level of Chile is 1:1.97. Only Ghana in the former group shows a more unbalanced value with a ratio larger than 1:2. So all in all, $b_{1,3}<0$ in Chile can be attributed to the lack of trickle down of financial reform benefits, which have not got accumulation and growth going fast enough to keep up[16]. By comparison Venezuela, a similarly FO economy of Latin America, which at the beginning of the Sixties started at about the same level of FD as Chile and went though liberalisation and financial reforms in the Seventies as well, despite a negative average growth in income per capita over the period shows a FD to YP ratio of 1:1.06. According to the above mentioned literature, a Gini index which is 20% lower than that of Chile might help in explaining why this country ends up with the largest $b_{1,3}$ in the sample: its ENDFD backtracks its initial level following closely its (poor) economic performance.

Finally, $b_{1,4}$ although significantly different from zero is much smaller than other coefficient. The highest $b_{1,4}>0$ values are found in Financially Open, High Income countries and, in line with Arestis, Demetriades, Fattouh and Mouratidis (2002), the value can be interpreted as the return on financial intermediation. In such advanced countries, well integrated in the world economy, profitability must be an important driving force of financial development. On the other hand, in China, where the heavy presence of the government, described in Appendix A.2, is still felt and financial closeness protects the sector from international the estimation results in the lowest value for the estimation of $b_{1,4}$.

For Financially Closed countries the Economic Development cointegrating vector show a positive coefficient for $b_{2,3}$, in line with the expectation that the second cointegrating vector represents an aggregate production function. Brazil and China, not surprisingly, show a value compatible with endogenous growth theory.

$b_{2,4}>0$ in all countries with the exception of Brazil. In this country the standard deviation of real interest rates is over three times its average, vs. a multiple of 1.3 for FC countries and such excess volatility might have played a negative role in the real economy.

In order to check robustness of the estimations, the cointegrating vectors estimated with Johansen's methodology have been estimated with dynamic OLS (DOLS). Table 5 compares the parameters estimations reported in table 4 with the DOLS estimations, which are carried out with the same leads and lags as the order of differentiation of the variables in the Johansen's

[16] For a theoretical model supporting effects of income distribution on capital accumulation see Galor and Moav (2004).

methodology and with the dummy variables as exogenous regressors. The main differences between Johansen's and DOLS estimations are found in FC countries as they are cointegrated of rank 2 and Johansen's methodology seems more appropriate as it allows estimations of all parameters of the two vectors simultaneously, taking full advantage correlations among endogenous differentiated and lagged variables. More precisely, with DOLS $b_{1,3}$ and $b_{1,4}$ would not be significative in Colombia and $b_{2,3}$ in Ghana but also in Chile ($b_{1,3}$ not significative) and Korea ($b_{1,4}$ not significative). Other parameters are all significative and with values in line with those obtained from Johansen's ECM estimations, with the largest difference in percentage again in countries of rank 2 (FC).

Also, results of the Hansen's parameter instability test[17] on DOLS confirm the absence of parameter instability, further supporting the quality of the model estimations.

[17] Hansen (1992) proposes the use of the LC test statistic, which arises from the theory of Lagrange Multiplier tests for parameter instability, to evaluate the stability of the parameters. The LC statistic examines time-variation in the scores from the estimated equation. Let $\hat{s}_t$ be the vector of estimated individual score contributions from the estimated equation, and define the partial sums, $\hat{S}_t = \sum_{\tau=1}^{t} \hat{s}_\tau$ where $\hat{S}_t = 0$ by construction. Then Hansen chooses a constant measure of the parameter instability $\hat{G}$ and forms the statistic $LC = tr\left(\sum_{\tau=1}^{T} \hat{S}'_t \, G^{-1} \hat{S}_t \right)$. For DOLS $\hat{s}_t$ is defined for the subset of original regressors, and G may be computed using the method employed in computing the original coefficient standard errors.

Table 5 Comparison of DOLS and Johansen's estimations and Hansen's Instability test

Country	Financial Development Cointegrating Vector FD=$b_{1,0}$+$b_{1,3}$KP+$b_{1,4}$RR +$b_{1,5}$t						Economic Development Cointegrating Vector YP = $b_{2,0}$+$b_{2,3}$KP+$b_{2,4}$RR+$b_{2,5}$t							dummies
	$b_{1,0}$ p-val	$b_{1,3}$ p-val	$b_{1,4}$ p-val	$b_{1,5}$ p-val	$a_{1,1}$ p-val	Adj R^2 LC	$b_{2,0}$ p-val	$b_{2,3}$ p-val	$b_{2,4}$ p-val	$b_{2,5}$ p-val	$a_{2,2}$ p-val	Adj R^2 LC	OR p-val	
Brazil	-2.96	0.34			-0.32		-1.0	1.02	-0.001		-0.06		0.67	d1_90 d2_88 d3_89 d4_96
	0%	0%			3%		1%	0%	0%		0%		41%	
	-2.88	0.33	0.000			0.97	-0.69	0.98	0.000			1.00		
	0%	0%	0%			0.02	0%	0%	0%			0.04		
Chile	6.79	-0.47	-0.001	-0.03	-0.22								0.75	d1_73 d2_82 d3_72
		0%	1%	0%	0%								39%	
	5.98	-0.41	0.002	0.03		0.94								
	7%	8%	0%	0%		0.02								
China	-1.54	0.31	-0.077		-0.08		-0.72	0.97	0.017		-0.30		0.00	d1_77 d2_69 d3_93 d4_67 d5_76 d6_94 d7_86
		0%	0%		8%			0%	0%		0%		98%	
	-2.53	0.39	0.000			0.94	-0.42	0.95				1.00		
	0%	0%	0%			0.01	4%	0%				0.01		
Colombia	-3.29	0.24	-0.005		-0.83		3.92	0.70	0.005		-0.16		0.26	d1_99 d2_90 d3_93 d4_74 d5_71
	0%	0%	0%		0%		0%	0%	0%		0%		61%	
	-3.16	0.23	-0.002			0.49	-3.54	1.18	-0.009			0.98		
	13%	11%	61%			0.01	4%	0%	2%			0.01		
Ghana	-1.23	0.19	0.001		-0.71		2.56	0.54	0.003		-0.61		0.00	d1_78 d2_83 d3_82 d4_84 d5_89 d6_93 d7_74
	0%	0%	0%		0%		0%	0%	0%		0%		100%	
	-1.38	0.21				0.74	4.22	0.30	0.006			0.85		
	0%	0%				0.03	0%	7%	1%			0.04		
Korea	-2.41	0.18	0.018		-0.12								1.01	d1_65 d2_74 d3_98
		0%	0%		1%								32%	
	-2.86	0.23	-0.002			0.96								
	0%	0%	64%			0.02								
Singapore	-2.34	0.29	0.022		-0.44								0.63	d1_01 d2_73 d3_70 d4_98
		0%	0%		0%								43%	
	-2.34	0.29	0.022			0.97								
	0%	0%	1%			0.02								
Venezuela	-17.70	1.16	-0.008		-0.21								0.65	d1_96 d2_97 d3_89 d4_04
		0%	0%		1%								42%	
	-13.36	0.88	-0.005			0.99								
	0%	0%	0%			0.03								

NOTES

For every country the first two rows indicate the results from Johansen's cointegration methology and the third and fourth line those from DOLS

Percentage figures within parenthesis are the marginal p-values i.e., marginal significance level of likelihood ratio tests under the null that the coefficient under consideration is zero; they are $Chi^2(1)$ distributed. a_{ij} are the associated loading factors. OR are Over-identifying Restrictions which are $Chi^2(1)$ distributed.

Percentage figures within parenthesis are the marginal p-values i.e., marginal significance level of t-student test under the null that the coefficient under consideration is zero. In DOLS regression leads and lags are simmetrical (r=q) and are the same as the lags used in the Johansen's cointegrated model

LC is Hansen instability test. H0: cointegration. Rejection of H0 might indicate parameter instability. Hansen (1992) indicates that all p-values of LC statistic in the table are larger than 20%

In the last 2 sections of Table 5 are presented the results of two tests of direction of causality as there are 2 sources of causation: the error correction term and the lagged dynamic terms which are measured respectively by the weak exogeneity test – the lack of which implies long run causality[18] – and block exogeneity Wald test[19], based on the predictability of the dependent variable by the

[18] Long run causality is found when weak exogeneity of a variable with respect to a single cointegrating vector is not present. Hence, if $a_{1,2}=0$ is rejected at the conventional significance level, one can conclude that the second cointegrating vector, which represents Economic Development, causes the first cointegrating variable, namely Financial Development. Similarly, if $a_{2,1}=0$ is rejected at the conventional significance level, one can conclude that financial development causes economic development. If both the hypotheses that $a_{1,2}=0$ and $a_{2,1}=0$ are rejected at the conventional significance level, then one concludes that there is bi-directional causality between economic and financial development in the long run.

[19] Block Exogeneity Wald test approach is based on the question of whether *x* causes *y* is to see how much of the current *y* can be explained by past values of *y* and then to see whether adding lagged values of *x* can improve the explanation. *y* is said to be Granger-caused by *x* if *x* helps in the prediction of *y*, or equivalently if the coefficients on the lagged *x*'s are statistically significant. In other words, tests are carried out on single elements of the vector Γ.

lagged variable excluded by the test. The results show a clear-cut divide between FC and FO countries as long run causality for the latter countries is necessarily from economic development to financial development, given the specification with a single cointegrating vector. For FC countries long run causality runs from economic development to financial development in China and Ghana, from financial development to economic development in Colombia and both ways in Brazil. These results seem to underline a pattern whereby FC, Low income countries (Ghana and China which has just very recently reached the ranks of Middle income countries) are associated with the primacy of economic development whereas Middle income countries (Brazil and Colombia) with bi-directional causality or the primacy of financial development.

If the results of both tests are considered then bi-directional causality becomes the most frequent outcome with exception of China, Korea and Venezuela. In all the latter cases the *primum movens* is economic development.

One last word on the countries excluded from the analysis. As to the exclusion of India and Pakistan, further reasons in addition to the ones mentioned in para 2.1. – namely interest rates being I(0) in both countries as well financial development being stationary in Pakistan and KP being I(2) in India – may be the cause of doubtful cointegration results.

Lack of evidence of cointegration in India may be explained by domestic financial repression. The latter phenomenon is well described in Demetriades and Luintel (1996) who maintain that in the Sixties the government of India tightened its controls over the financial system introducing liquidity requirements and lending rate controls; domestic financial repression stepped up in 1969 with the nationalization of the 14 largest commercial banks and was further extended in 1980. Domestic financial liberalization followed only in 1990 with the end of directed credit and concessionary lending. Furthermore, market-driven credit lending has decreased for the first 5 years of liberalization, when India re-started up to develop financially with the same level of credit to the private as at the beginning of the Eighties. This leaves India without a market-oriented financial market for over half of the time span of the analysis, thereby undermining the cointegrating relationship.

The minor role played by the banking system in the country, as mentioned by Demetriades and Hussein (1996), due to the extensive role of agricultural cooperatives and informal financial market in providing funds to the economy, surely influences the absence of strong evidence of cointegration between any FD and economic development in Pakistan. Also 18 years of inflation above 25% per annum, in the mechanics described by Rjoja and Valev (2004), might have played a role.

Finally, in addition to unique traits, common elements across these countries should not be underestimated as well. These are all Financially Open and Low or Lower Middle income countries as to the level of economic development. Their level of financial openness is relatively low within

the FO group, but the hypothesis that the disruption of the relationship between financial and economic development might be linked on a threshold level of income per capita to be reached before financial openness cannot be easily dismissed.

Discussion

This paper aims to contribute to the study of the link between financial and economic development within a time series framework and data extending over the Nineties. On the one hand, the choice of time series analysis tries to address the concerns about structural homogeneity, i.e. parameter constancy, which has raised many reservations in the empirical literature based on cross-section techniques, as reviewed by Andersen and Tarp (2003). The time series approach allows the analysis on the finance-growth nexus to be carried out for each country singularly and therefore does not need instruments in order to take care of cross-country heterogeneity, as suggested by Aretsis and Demetriades (1997) among others. On the other hand, the time span of the analysis (1961-2006) has been characterized by structural changes and episodes of crisis calling for the use of dummy variables to obtain meaningful estimates. Hence a newly developed technique has been applied to detect and estimate outliers and create ad hoc dummies.

The study identifies a long run equilibrium relationship between financial development and economic growth represented by a Financial Development cointegrating vector, with mostly a positive effect of capital per capita and real interest rates, and an Output vector, with the positive effects of capital stock and real interest rate expected in an aggregate production function. While in Financially Closed countries both cointegrating vectors are identified and their parameters estimated, in Financially Open countries a single Financial Development vector is found. Furthermore, parameter estimates underline a narrow-ranged effect of the capital per capita in the Financial Development cointegrating vector in Financially Closed countries (between 0.2 and 0.35) and a much wider one in Financially Open countries.

Also, with the exception of FC Ghana, real interest rates in the FD cointegrating vector shows a positive coefficient only in FO countries. As this coefficient is considered a proxy of profitability of the financial sector, estimations seem to confirm that as FO countries are less protected from competition, at least internationally, their financial sector has to be profitable to survive, while in most FC countries financial development has occurred notwithstanding interest rate dynamics. Negative signs for this coefficient might signal a limp functioning of the market mechanism, which is more probable in protected economies. This is exemplified by China which shows the largest effect - in absolute value - of real interest rates on FD but with a negative sign.

The importance of the level of economic development, together with financial openness must not be underestimated in the interpretation of results. If on hand it is true that FC countries are on average less developed (1 Low Income country, 2 Lower Middle income countries and 1 Upper Middle Income country) than FO countries (2 Upper Middle Income countries and 2 High income

countries), on the other hand it cannot be ignored that Upper Middle income Brazil (FC) and Colombia (FC) show a definite more regular FD relationship than their Upper Middle income FO counterparties, Chile and Venezuela. Such evidence seems to confirm that in FO countries the contribution of capital per capita to financial development is more volatile, as if financial openness may somehow act as major shaping force of the finance-growth relationship. The fact that in presence of economic development, featuring an increasing capital stock, a FC country might witness a more regular financial development than a FO country seems to call for regulations, maybe as stringent as postponing financial openness up to the reach of a minimum level of economic development. This latter claim might also be indirectly supported by the countries which had to be excluded from the analysis and share the common features of being FO as well as having a low level of economic development.

One of the main hypotheses on which this result is based, i.e. the working of the bank capital channel, is also one of the main assumptions in favour of a minimum capital standard for financial intermediaries and evidence that this channel works differently in FC and FO countries could also prove useful in the discussion following the review and subsequent implementation of Basel II Capital accords.

Financial closeness (or lack thereof), combined with the level of economic development, comes useful for the interpretation of causality too. Differently from Luintel and Khan (1999), only few countries show long run bi-directional causality between financial and economic development while the most frequent link goes from economic growth to financial development, which characterises Colombia as well as all FO countries. A (Lower) Middle income per capita combined with lack of financial openness or a (Upper) Middle income or High income per capita combined with financial openness features among the main traits of Joan Robinson's view on the primacy of the economy over finance. If both indicators of causality are used, the outcome of bi-directional causality becomes more common.

As to the usefulness of the outlier detection and estimation procedure, it can be directly assessed by the comparison of the results of the estimates obtained including dummy variables and excluding them[20]. More specifically in Brazil and Colombia only one of the 2 loading factors would be significant without dummies, none in Chile, Korea or Singapore. Neither Brazil nor Singapore would pass the overidentification test and Ghana and Venezuela just barely so. Also $b_{1,3}$ would not be significantly different from zero in Brazil and Chile. Therefore it can be concluded that the use of the dummies does increase significance of the parameters' estimates, allowing for meaningful comparisons among countries and groups, and in the end improves the identification of the model. The use of the detection and estimation procedure also allows a parsimonious use of dummies with respect to the standard use of "rules of thumb" on observations showing excess standard

[20] Data are available from the author on request.

deviation which are frequently applied in practice. The procedure therefore saves degrees of freedom, which are precious in time series studies with low frequency data. In this study only in Ghana, out of all sample countries, the procedure identifies the same number of dummies as observations showing excess volatility while the number of dummies is lower for all other countries. Also, only in this county all of the outliers identified by Structural Break test are also recognised by detection and estimation procedure, while in most countries the overlap is minimal, signalling that cointegration does modify the relative relevance of breaks with respect to testing single time series and should be treated with a specific technique, as the one developed by Bohn Nielsen.
On the other hand, one should underline that the sequential procedure to identify and estimate outliers is based on the initial estimation of the cointegration rank by Johansen's methodology. Therefore the criticism about the sensitivity of the latter methodology to VAR lag length by Andersen and Tarp (2003) does apply here.

Appendices

The Appendices cover three topics: data, with a detailed description of data sources (Appendix A.1), some technical details on the construction of financial data for China (App. A.2) and the extended results from the Outliers' Detection and Estimation Procedure (App. A.3).

A.1 Data & Sources

Variable	Description	Source
FD	Credit to private sector as a percentage of GDP	WDI (2008)
YC	(Log of) real income per capita in national currency calculated as ratio of real national GDP to population	Real GDP: WDI (2008) and Population: WDI (2008)
KC	(Log of) real capital stock per capita in national currency calculated with perpetual inventory formula from Easterly and Levine (2001)[21] gross capital formation data	Gross capital formation: WDI (2008)
RR	Real interest rate = Discount rate net of inflation rate	Discount rate: IFS (various years), Consumer price annual growth: WDI (2008)

[21] Specifically, let K(t) equal the real capital stock in period t. Let I(t) equal the real investment rate in period t. Let d equal the depreciation rate, which we assume equals 0.07. Thus, the capital accumulation equations states that K(t+1)=(1-d)K(t)+I(t). To make an initial estimate of the capital stock, the country is assumed to be at its steady-state capital-output ratio. Thus, in terms of steady-state value, let k=K/Y, let g = the growth rate of real output, let i=I/Y where Y is GDP. Then, from the capital accumulation equation plus the assumption that the country is at its steady-state, it must be that k=i/[g+d]. Thus, a reasonable estimate of the steady-state values of i,g, and d, is obtained.
To make the initial estimate of k, the steady state capital output ratio for each individual country, is set at d is set at 0.07. g – the steady-state growth rate – is a weighted averaged of the countries average growth rate during the first ten years for which there are output and investment data. The world growth rate is computed as 0.0423 and a weight of 0.75 is given to the world growth rate. i is then computed as the average investment rate during the first ten years for which there are data. Thus, with values for d,g, and i for each country, we can estimate k for each country. To reduce the influence of business-cycles in making the estimate of Y(initial), the average real output value between 1960-1969 is used as an estimate of initial output. Thus, the capital stock in 1960 is given as Y(initial)*k. Given depreciation, the guess at the initial capital stock becomes relatively unimportant decades later. For further details see Easterly and Levine (2001).

Please note that:

- for China data for FD in 1961-1977 are calculated as specified in the Appendix A.2.
- discount rate in the calculation of RR has been substituted with:
    - the money market rate (60B ... series from the IFS) in Brazil
    - short run lending rate for the period 1961-1976, supplied by the Central Bank of Chile, and lending rate (60P ... series from the IFS) in Chile
    - the annual rate on demand deposit as calculated from monthly interest rate from table 10 p. 154 of Byrd (1983) for the period 1961-1978 in China
    - the bank rate (60... series from the IFS) in India
    - the Malaysian money market rate (60B ... series from the IFS) from 1961-1972 and the money market rate (60P ... series from the IFS) in Singapore
- Inflation has been measured by the GDP deflator instead of the annual increase in consumer price in Brazil and Nigeria.

A.2 Credit to private sector as a percentage of GDP (CHFD) for China in 1961-1976

Credit to the private sector for China in the period 1961-1976 has been calculated applying the average yearly growth rate of loans to enterprises from table 2 page 138 (gr) of Byrd (1983) to:

1. initial working capital loans in 1957 (L57) as estimated on page 125 of Hsiao (1971) + Investment in Fixed assets funded by domestic loans (FX) of column 3 of table on page 25 of Department of Statistics on Investment in Fixed Assets National Bureau of Statistics of China (2002) and to
2. the level of bank loans in 1980 by table 2 page 27 Hsiao (1984).

So the final formula sums the (forward) smoothed working capital loans from 1957 and the (backward) smoothed bank loans from 1980

$CHFD_{year}=[f_{year}+h_{year}]/(2*nominalGDP_{year})$

where

$f_{year} = gr(L57)_{year}+FX_{year}$

$h_{year} = gr^{-1}(L80)_{year}$

The reasons for using working capital loans as proxy for credit from the banking sector for China before 1976 stems from the role, or rather lack thereof, of the banking system in a centrally planned socialist economy. In fact the banking system plays no role in financing fixed investment, which is funded entirely by the state budget. It only finances a small part of investments in circulating capital, i.e. working capital; most of which is provided by the state budget as well.

A.3 Results from the Detection and Estimation Procedure

Please note that dark lines in tables A3.1. and A3.2. start from the iteration of the procedure when D_t (t=1 if year equals that in the corresponding row of 2nd column, 0 otherwise) has been introduced in the estimation model.
The values of the test and significance level for IO and AO are indicated in the columns with reference to successive iteration of the procedure.

Table A3.1 Outlier Detection and Estimation - FC Countries

COUNTRY	Excess standard dev					Iteration 0		Iteration 1		Iteration 2		Iteration 3		Iteration 4		Iteration 5		Iteration 6		Iteration 7	
	Year	CR	YR	KC	RR	IO	AO	IO	AO	IO	AO	IO	AO	IO	AO	IO	AO	IO	AO	IO	AO
BRAZIL	1969			2.05		7.14	7.47	6.43	10.65	18.70 *	14.01	16.66	13.11	17.19	16.23						
Rank = 2	1976		2.54	0.25		17.77	7.10	19.50 *	6.55	17.66	8.27	19.81 *	8.02	20.52 *	8.03						
Lag, trend = 3,b	1981		-2.92			17.33	5.54	17.77	3.90	20.52 *	4.19	12.46	3.05	8.43	2.26						
	1988	3.86	-0.01			95.53 *	28.20 *	97.87 *	2.20												
	1989		-0.08		-2.05	58.27 *	13.88	93.09 *	3.97	94.98 *	2.82										
	1990	-2.79		-2.11	4.03	170.74 *	14.78														
	1995				-2.15	51.73 *	3.88	2.96	1.03	13.24	1.56	17.76	3.04	16.93	4.95						
Chi sq. = 18.23	1996	-2.06			2.10	51.22 *	2.74	12.46	1.37	8.84	2.94	23.41 *	8.98								
CHINA	1967		-2.14	-2.86		28.35 *	18.78 *	23.52 *	16.16	24.07 *	8.21	27.34 *	9.98								
Rank = 2	1969		2.25			27.01 *	6.64	29.26 *	9.01												
Lag, trend = 2,c	1975	-2.01				12.23	2.60	5.04	5.82	7.31	9.14	7.35	8.87	8.98	16.14	10.28	1.87	10.16	1.71	10.25	1.79
	1976		-3.20	-2.88		21.38 *	9.12	15.50	2.51	20.97 *	4.11	19.96 *	4.12	31.67 *	3.25						
	1977	3.32				53.64 *	13.46														
	1986	2.07			2.41	14.21	3.28	15.19	6.21	17.79	7.76	17.34	9.50	17.30	10.25	21.23 *	9.95	19.56 *	7.07		
	1993			2.14	-2.27	18.07	10.06	27.00 *	16.30	31.06 *	15.96										
Chi sq. = 18.23	1994				-2.14	16.49	7.01	19.29 *	5.56	19.58 *	5.69	19.73 *	6.23	20.95 *	6.22	21.32 *	6.39				
COLOMBIA	1971			-2.05		10.16	1.29	15.24	2.90	24.36 *	24.94 *	2.17	26.60 *	4.35							
Rank = 2	1974	2.36				14.41	2.17	16.01	0.90	15.98	29.28 *	1.94									
Lag, trend = 4,b	1985				-2.12	19.93 *	3.74	20.72 *	7.31	17.65	16.70	10.51	13.41	10.35	16.89	14.71					
	1990		2.03			15.99	4.70	37.39 *	0.26												
	1993	2.25	-2.09			36.92 *	4.17	34.62 *	5.31	33.47 *											
Chi sq. = 18.23	1999		-2.73	-2.57		37.82 *	1.08														
GHANA	1974			2.12		18.61 *	2.40	20.72 *	0.75	20.37 *	2.27	18.55 *	2.44	19.81 *	7.89	18.65 *	7.11	21.31 *	5.25		
Rank = 2	1978				-2.74	64.82 *	10.79														
Lag, trend = 4,b	1982		-2.74			45.64 *	4.06	32.74 *	5.56	37.75 *	0.41										
	1983				-2.65	33.49 *	4.53	39.06 *	2.96												
	1984	2.03			2.49	39.76 *	1.47	30.26 *	1.70	33.49 *	0.33	42.28 *	1.59								
	1989	2.20				11.00	7.36	16.64	7.14	16.60	3.63	20.46 *	2.24	30.02 *	4.35						
Chi sq. = 18.23	1993			2.72		16.43	4.24	22.29 *	0.17	22.87 *	0.88	27.22 *	6.00	23.29 *	11.92	29.21 *	8.18				

NOTES

Lag is in VEC i.e. for differentiated variables. Trend assumptions: b = no deterministic trend in the data, and an intercept but no trend in the cointegrating equation; c = linear trend in the data, and an intercept but no trend in the cointegrating equation; d = linear trend in the data, and both an intercept and a trend in the cointegrating equation

Chi. Sq = critical value calculated with the Bonferroni inequality to ensure an overall type I error probability below 5%

IO (AO) = likelihood ratio test obtained by difference of the unrestricted ECM model and that with innovative (additive) dummy. IO (AO) values for iteration n+1 are obtained from ECM model with all dummies detected up to iteration n

* indicates 5% significance with respect to critical value in column 1

Table A3.2 Outlier Detection and Estimation - FO Countries

COUNTRY	Excess standard dev					Iteration 0		Iteration 1		Iteration 2		Iteration 3		Iteration 4		Iteration 5		Iteration 6		Iteration 7	
	Year	CR	YR	KC	RR	IO	AO	IO	AO	IO	AO	IO	AO	IO	AO	IO	AO	IO	AO	IO	AO
CHILE	1972		-2.20	-2.33		8.12	0.64	26.63 *	24.01 *	23.08 *	21.56 *										
Rank = 1	1973		-2.37	-2.48		61.72 *	1.93														
Lag, trend = 2,d	1978				2.43	13.06	2.49	16.84	1.26	14.19	4.25	16.43	3.13								
Chi sq. = 18.18	1982	4.15	-3.08	-3.06		61.17 *	14.69	71.80 *	12.77												
INDIA	1975				-4.06	4.91	6.23	4.87	6.12	4.93	3.27										
Rank = 2	1989		2.05			28.36 *	17.75														
Lag, trend = 3,c	1990	-3.59				4.72	6.68	37.16 *	15.61												
KOREA	1965				3.84	65.47 *	15.56														
Rank = 1	1974				-2.71	29.92 *	12.67	42.99 *	17.69												
Lag, trend = 2,c	1980		-2.40			9.52	5.14	8.01	3.46	9.08	6.28	17.41	5.67								
	1998		-3.99	-3.11		25.97 *	12.98	32.91 *	14.10	34.18 *	10.37										
18.23	2004	-2.22				15.01		11.15		12.91		12.39									
NIGERIA	1968		-2.55			2.97	3.58	5.41	3.77												
Rank = 2	1970		2.29			3.68	3.55	3.48	3.44												
Lag, trend = 1,b	1975			-2.18		5.28	14.79	7.56	12.52												
	1977			3.59		4.19	3.24	4.14	3.21												
	1984				-2.06	2.31	14.18	1.68	10.48												
	1987	2.95				12.78	8.53	9.92	14.94												
	1988	-2.42				19.75 *	13.82														
	1989				-2.77	2.76	7.63	2.95	8.46												
	1991				2.54	5.61	4.52	6.06	1.82												
Chi sq. = 18.23	1996				-2.46	4.88	6.60	7.15	2.33												
PAKISTAN	1966			-2.88		17.94	7.52	16.55	7.34	17.17	7.57	18.17	8.29	16.51	7.74						
Rank = 2	1970		2.50			8.54	12.42	8.61	11.81	8.60	12.57	8.81	11.63	14.26	11.24						
Lag, trend = 1,c	1971		-2.44			9.10	4.45	9.04	4.50	10.63	4.28	10.30	4.56	6.32	2.74						
	1972	2.21	-2.01			18.01	6.24	18.33 *	6.65	18.76 *	6.64										
	1974	-2.30				10.28	3.72	10.80	3.51	10.97	3.87	12.70	4.45	14.15	5.69						
	1989				-2.27	7.88	0.43	116.56 *	18.96 *												
	1990				-5.16	73.51 *	46.31 *	82.51 *	0.45	18.55 *	0.01	18.90 *	0.00								
Chi sq. = 18.23	1991				2.52	118.75 *	10.96														
SINGAPORE	1970			3.27		22.75 *	7.09	23.74 *	9.52	29.97 *	3.67										
Rank = 1	1973			-2.05	-2.73	24.60 *	3.69	32.70 *	3.85												
Lag, trend = 2,c	1978				2.56	12.92	2.39	13.94	2.43	15.70	3.16	15.97	2.99	16.36	0.20						
	1998	2.45	-3.27	-2.39		17.53	10.94	25.79 *	16.46	27.36 *	19.00 *	29.89 *	20.18 *								
18.13	2001	3.50	-3.29			36.04 *	16.94														
SRI LANKA	1979			2.70		40.73 *	7.48														
Rank = 2	1980		3.50	3.72		38.40 *	7.19	28.45 *	3.46												
Lag, trend = 2,b	1981		-2.48			1.97	0.99	1.91	0.92	4.06	0.09										
	1986				2.09	2.43	5.68	3.28	4.08	1.73	0.78										
	1991				-2.35	6.11	14.51	7.54	14.51	7.46	15.91										
Chi sq. = 18.23	1996	4.11				5.38	10.28	6.95	8.84	6.93	10.83										
VENEZUELA	1983			-2.49		13.11	9.77	15.05	0.97	13.14	11.57	13.44	8.88	14.80	6.93						
Rank = 1	1986	2.01				9.51	3.70	11.27	4.66	10.98	3.64	9.67	8.93	11.31	9.14						
Lag, trend = 3,c	1989	-2.94	-2.46	-2.03	3.07	20.66 *	8.88	45.07 *	11.70	46.35 *	5.24										
	1996				3.19	37.64 *	18.21														
	1997	2.33				31.36 *	6.66	28.55 *	9.91												
Chi sq. = 18.23	2004		2.31			17.87		19.90 *		21.39 *		21.672 *									

NOTES

Lag is in VEC i.e. for differentiated variables. Trend assumptions: b = no deterministic trend in the data, and an intercept but no trend in the cointegrating equation; c = linear trend in the data, and an intercept but no trend in the cointegrating equation; d = linear trend in the data, and both an intercept and a trend in the cointegrating equation

Chi. Sq = critical value calculated with the Bonferroni inequality to ensure an overall type I error probability below 5%

IO (AO) = likelihood ratio test obtained by difference of the unrestricted ECM model and that with innovative (additive) dummy. IO (AO) values for iteration n+1 are obtained from ECM model with all dummies detected up to iteration n

* indicates 5% significance with respect to critical value in column 1

References

[1] Andersen, T. P., Tarp, F., 2003. Financial Liberalisation, Financial Development and Economic Growth in LDCs, Journal of International Development, 15, 189-209.

[2] Arestis P., Demetriades P., 1997. Financial development and economic growth: assessing the evidence, Economic Journal, 107, 783-799.

[3] Arestis, P., Demetriades, P., Fattouh, B., Mouratidis, K., 2002. The impact of financial liberalisation policies on financial development, evidence from developing economies, International Journal of Finance and Economics, 7, 109-121.

[4] Arghyrou, M.G., Luintel, K.B., 2007. Government solvency: revisiting some EMU countries, Journal of Macroeconomics, 29, 387-410.

[5] Beck, T., Levine, R., Loayza, N., 2000. Finance and the sources of growth, Journal of Financial Economics, 58,261-300.

[6] Bohn Nielsen, H., 2004. Cointegration Analysis in the Presence of outliers, The Econometrics Journal, 7, 1, 249-271.

[7] Byrd, W., 1983. China's Financial System, the Changing Role of Banks, Westview, Colorado.

[8] Caprio, G., Klingebiel, D., 2003. Episodes of Systemic and Borderline Financial Crises, World Bank, mimeo.

[9] Chinn, M.D., Ito, H., 2005. What Matters for Financial Development?, Capital Controls, Institutions, and Interactions, mimeo.

[10] Christopoulos, D. K., Tsionas, E. G., 2004. Financial Development and Economic Growth: Evidence from Panel Unit Root and Cointegration Tests, Journal of Development Economics, 73, 55-74.

[11] Chuhan, P., Sturzenegger, F., 2003. Default Episodes in the 1980s &1990s, what have we learnt?, mimeo.

[12] Claessens, S., Perotti, E., 2005. The links between finance and inequality: channels and evidence, University of Amsterdam, mimeo.

[13] Clements, M.P., Sensier, M., 2003. Asymmetric Output-Gap Effects in Phillips Curve and Mark up Pricing Models: Evidence for the US and the UK, Scottish Journal of Political Economy, 50, 4, 359-374.

[14] Deidda, L., Fattouh, B., 2002. Non linearity between finance and growth, Economic Letters, 74, 3, 339-345.

[15] Demetriades, P.O., Hussein, K.A., 1996. Does Financial Development causes Economic Growth? Time series evidence from 16 countries, Journal of Development Economics, 51, 387-411.

[16] Demetriades, P.O., Luintel, K., 1997. The direct costs of Financial Repression: evidence from India, The Review of Economics and Statistics, 311-320.

[17] Demetriades, P.O., Luintel, K., 1996. Financial Development, Economic Growth and Banking sector controls: evidence from India, The Economic Journal, 106, 359-374.

[18] Department of Statistics on Investment in Fixed Assets National Bureau of Statistics of China, 2002. Statistics on Investment in Fixed assets of China 1950-2002, Beijing, People's Republic of China.

[19] Diamond, D.W., Rajan R.G., 2000. A Theory of Bank Capital, Journal of Finance, 55, 6, 2431-2465.

[20] Doornik, J.A., Hendry, D.F. and Nielsen, B., 1998. Inference in Cointegrating Models: UK M1 Revisited, Journal of Economic Surveys, 12, 533-572.

[21] Dornbusch, R., Giavazzi, F., 1999. Heading Off China's Financial Crisis, Bocconi University, mimeo.

[22] Easterly, W., Levine, R., 2001. It's not Factor Accumulation, Stylized Facts and Growth, World Bank, mimeo.

[23] Galor, O., Moav, O., 2004. From Physical to Human Capital Accumulation: Inequality and the Process of Development, Review of Economic Studies, 71, 1001-1026.

[24] Gambacorta, L., Mistrulli, P.E., 2004. Does bank capital affect lending behaviour? Journal of Financial Intermediation, 13,436-457.

[25] Hansen, B. E., 1992. Tests for Parameter Instability in Regressions with I(1) Processes, Journal of Business and Economic Statistics, 10, 321-335.

[26] Hansen, H., Johansen, S., 1999. Some Tests for Parameter Constancy in Cointegrated VAR-models, Econometrics Journal, 2, 306-333.

[27] Harrison, P., Sussman, O., Zeira J., 1999. Finance and Growth, Theory and New Evidence, Federal Reserve Board, July, mimeo.

[28] Hendry, D.F., Juselius, K., 1999a. Explaining Cointegration Analysis, Part I, mimeo.

[29] Hendry, D.F., Juselius, K., 1999b. Explaining Cointegration Analysis, Part II, mimeo.

[30] Hernández, L., Parro, F., 2008. Economic Reforms, Financial Development and Growth: Lessons from the Chilean Experience, Cuadernos de Economía, 45, 59-103.

[31] Hsiao, K., 1984. Money and banking in the Chinese Mainland, Tzong-shian Yu, Taiwan, Republic of China.

[32] Hsiao, K., 1971. Money and Monetary Policy in Communist China, Columbia University Press, NY.

[33] International Monetary Fund, International Financial Statistics, various years.

[34] Jacobson, T., Lindé, J., Roszbach, K., 2005. Exploring Interactions between Real Activity and the Financial Stance, Working Paper no. 184, Sveriges Riksbank.

[35] Johansen, J., 1995. A statistical analysis of Cointegration for I(2) variables, Econometric Theory, 11, 25-29.

[36] Juselius, K., 2002. The Cointegrated VAR model, Econometric Methodology and Macroeconomic Applications, Lecture Notes, CIdE, Bertinoro, Italy.

[37] King, R. G., Levine, R., 1993. Finance and Growth: Schumpeter Might Be Right, Quarterly Journal of Economics, 108, 717-38.

[38] Kleff, V., Weber, M., 2008. How Do Banks Determine Capital? Evidence from Germany, German Economic Review, 9, 3, 354-372.

[39] Levine, R., 2006. Finance and Growth: Theory and Evidence, in Handbook of Economic Growth, Aghion, P. (Eds.), North Holland.

[40] Loayza, N., Ranciere, R., 2002. Financial Development, Financial Fragility, and Growth, Central Bank of Chile, Working Papers n. 145.

[41] Luintel, K. B., Khan, M. 1999. A quantitative reassessment of the finance-growth nexus, Evidence from a multivariate VAR, Journal of Development Economics, 60, 381-405.

[42] Manasse, P., Roubini, N., Schimmelpfennig, A., 2003. Predicting Sovereign Debt Crises, IMF, Working Paper 03/221.

[43] Moody's Investors Service, 2003. Sovereign Bond Defaults, Rating Transitions, and Recoveries 1985-2002.

[44] Perron, P., 1997. Further evidence on breaking trend functions in macroeconomic variables, Journal of Econometrics, 80, 355-385.

[45] Robinson, J., 1952. "The Generalization of the General Theory," in The rate of interest, and other essays, Macmillan: London, pp. 67-142.

[46] Rioja, F., Valev, N., 2004. Dose one size fit all? A re-examination of the finance and growth relationship, Journal of Development Economics, 74, 429-447.

[47] Rousseau, P.L., Sylla, R., 2001. Financial Systems, Economic Growth and Globalization, NBER Working Paper 8323.

[48] Rousseau, P.L., Wachtel, P., 2005. Economic Growth and Financial Depth. Is the Relationship Extinct Already? UNU-Wider Discussion Paper no. 2005/10.

[49] Rousseau, P.L., Wachtel, P., 1998. Financial Intermediation and Economic Performance: Historical Evidence from Five Industrialized Countries, Journal of Money, Credit, and Banking, 30, 4, 657-678.

[50] Shan, Z. J., Morris, A.G., Sun, F., 2001. Financial Development and Economic Growth: an Egg-and-Chicken Problem?, Review of International Economics, 9, 3, 443-454.

[51] Standard & Poor's, 2002. Sovereign Defaults, Moving Higher Again in 2003?, Credit Week, October.

[52] UNU-WIDER World Inequality Map, www.wider.unu.edu/wiid/wiid.htm.

[53] Yong, C., Lee Nah, Q. (2010) Financial Growth in Singapore, mimeo, Nanyang Business School

[54] World Bank (2008), World Development indicators ®.

[55] www.parisclub.org