

The Long-Run Relation among Financial Development, Technology and Economic Growth: A Panel Cointegration Study

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Abstract

This paper examines the dynamic relationship among financial development, ICT, and economic growth in a panel cointegration framework using 86 sample countries. The long-run relationships are identified using panel unit root tests, panel cointegration analysis, and panel dynamic OLS. The ICT indicators are proxied by the number of personal computers, Internet users, and mobile phone subscribers. Our first finding is that personal computers and GDP per capita increase the liquidity, size, and activity of financial systems. Second, we find that the Internet and GDP per capita improve the liquidity, size, stock trading, and activity of financial markets. Third, we show that mobile phones and GDP per capita stimulate liquidity, financial market size, and expansion of credit. The results provide clear support for an equilibrium relation among financial development, ICT networks, and economic growth.

Why financial development, ICT, and GDP per capita?

- The global economy is driven by technological progress
- Mobile phone subscriptions have doubled since 2001
- "In 2005, the number of Internet users in developing countries crossed the 500 million mark, surpassing industrial nations for the first time." - Information Society: The Next Steps, Development Gateway
- E-Business, E-Payment, E-trading, and E-Banking
- Financial services are information intensive
- Electronic data processing has reduced costs, increased scope, accessibility, and timely transfer of information

Research Questions

- Liquid liabilities have long-term equilibrium relation with real per capita GDP and ICT indicators
- The size of the financial sector has long-term equilibrium relation with real per capita GDP and ICT indicators
- Financial sector activity proxies have long-term equilibrium relation with real per capita GDP and ICT indicators

Econometric Methodology

Model:

$$FIN_{it} = \beta_{0i} + \beta_{1i}ICT_{it} + \beta_{2i}GDP_{it} + e_{it}$$

Panel Unit Root Tests at Levels and First Differences:

$$\Delta y_{it} = \beta_{0i} + \beta_{1i}t + \gamma_i y_{it-1} + \sum_{j=1}^{p_i} \phi_{ij} \Delta y_{it-j} + \epsilon_{it}$$

Kao's Cointegration Tests:

$$\hat{e}_{it} = \alpha_i + \rho \hat{e}_{it-1} + v_{it}$$

$$\hat{e}_{it} = \alpha_i + \bar{\rho} \hat{e}_{it-1} + \sum_{j=1}^p \psi_j \Delta \hat{e}_{it-j} + v_{it}$$

Pedroni's Cointegration Tests:

$$\hat{e}_{it} = \alpha_i + \beta_i t + \rho_i \hat{e}_{it-1} + \sum_{j=1}^{p_i} \psi_{ij} \Delta \hat{e}_{it-j} + v_{it}$$

PDOLS Equation:

$$FIN_{it} = \beta_0 + \beta_1 ICT_{it} + \beta_2 GDP_{it} + \sum_{j=-p}^p \phi_{1j} \Delta ICT_{it-j} + \sum_{j=-p}^p \phi_{2j} \Delta GDP_{it-j} + \epsilon_{it}$$

Data

- Large panel dataset consisting of 86 countries from 1991-2006, World Bank & World Development Indicators
- GDP = Log(GDP Per Capita PPP Constant 2000 Int.\$)
- LIQLIAB = Log(Liquid Liabilities / GDP)
- FDSIZE = Financial Development Size = Log((Stock Market Capitalization + Public&Private Bond Market Capitalization + Deposit Money Bank Assets) / GDP)
- FDACTIC = Financial Development Activity = Log((Stock Market Total Value Traded + Private Credit by Deposit Money Banks and Other Fin. Institutions) / GDP)
- STVAL = Log(Stock Market Total Value Traded/ GDP)
- PCRDB = Log(Private Credit by Deposit Money Banks and Other Financial Institutions/ GDP)
- PC = Personal computers per 100 people
- INTERN = Internet users per 100 people
- MPH = Log(Mobile Phone Subscribers per 100 people)

Summary Statistics

GDP Per Capita PPP Constant 2000 International Dollars				
Categorized by Values of Income Group				
Income Group	Mean	Std. Dev.	Obs.	Countries
High Income: nonOECD	27910.15	7376.44	48	3
High Income: OECD	27989.47	6245.29	352	22
Upper Middle Income	10060.85	2824.9	264	17
Lower Middle Income	4207.19	1797.08	384	24
Low Income	1128.78	438.09	317	20
All	11590.79	11593.54	1365	86

Panel Cointegration Tests

		rho	t-Statistic	No. Obs.
LIQLIAB	DF	6.623 ***	-2.127 **	927
PC	DF*	5.268 ***	-3.697 ***	927
GDP	ADF		-5.808 ***	838
		Statistic	Wtd Stat.	No. Obs.
	Panel ADF	1.101	-2.693 ***	874
	Group ADF	-7.665 ***		874
		rho	t-Statistic	No. Obs.
LIQLIAB	DF	6.651 ***	-1.863 **	968
INTERN	DF*	5.679 ***	-3.086 ***	968
GDP	ADF		-5.661 ***	879
		Statistic	Wtd Stat.	No. Obs.
	Panel ADF	-1.281 *	-5.127 ***	906
	Group ADF	-10.588 ***		906
		rho	t-Statistic	No. Obs.
LIQLIAB	DF	6.725 ***	-2.223 **	1048
MPH	DF*	5.490 ***	-3.699 ***	1048
GDP	ADF		-6.320 ***	960
		Statistic	Wtd Stat.	No. Obs.
	Panel ADF	-7.449 ***	-6.589 ***	984
	Group ADF	-13.891 ***		984
		rho	t-Statistic	No. Obs.
FDSIZE	DF	4.763 ***	-10.516 ***	1115
MPH	DF*	4.854 ***	-10.429 ***	1115
GDP	ADF		-11.667 ***	1029
		Statistic	Wtd Stat.	No. Obs.
	Panel ADF	-11.673 ***	-11.815 ***	1060
	Group ADF	-12.100 ***		1060
		rho	t-Statistic	No. Obs.
FDACTIV	DF	5.437 ***	-7.188 ***	969
PC	DF*	4.901 ***	-7.723 ***	969
GDP	ADF		-12.462 ***	882
		Statistic	Wtd Stat.	No. Obs.
	Panel ADF	-12.842 ***	-8.056 ***	911
	Group ADF	-8.811 ***		911
		rho	t-Statistic	No. Obs.
FDACTIV	DF	5.479 ***	-4.933 ***	1023
INTERN	DF*	5.471 ***	-4.942 ***	1023
GDP	ADF		-9.197 ***	935
		Statistic	Wtd Stat.	No. Obs.
	Panel ADF	-12.783 ***	-10.900 ***	966
	Group ADF	-11.574 ***		966
		rho	t-Statistic	No. Obs.
STVALHM	DF	2.470 ***	2.564 ***	549
MPHHM	DF*	2.980 ***	3.071 ***	549
GDPHM	ADF		-2.590 ***	506
		Statistic	Wtd Stat.	No. Obs.
	Panel ADF	-6.201 ***	-11.851 ***	514
	Group ADF	-11.607 ***		514
		rho	t-Statistic	No. Obs.
PCRDB	DF	7.001 ***	0.172	1056
MPH	DF*	5.534 ***	-1.721 **	1056
GDP	ADF		-5.166 ***	970
		Statistic	Wtd Stat.	No. Obs.
	Panel ADF	-8.300 ***	-10.726 ***	990
	Group ADF	-13.837 ***		990

Panel DOLS Results

Panel A: Dynamic OLS		DOLS 1		DOLS 2	
Dependent	Independ.	Coef.	Std.Err.	Coef.	Std.Err.
LIQLIAB	GDP	0.288 ***	(0.041)	0.287 ***	(0.047)
	PC	0.004 ***	(0.001)	0.004 **	(0.002)
LIQLIAB	GDP	0.314 ***	(0.030)	0.302 ***	(0.035)
	INTERN	0.003 ***	(0.001)	0.003 ***	(0.001)
LIQLIAB	GDP	0.321 ***	(0.034)	0.308 ***	(0.037)
	MPH	0.034 ***	(0.007)	0.038 ***	(0.010)
Panel B: Dynamic OLS		DOLS 1		DOLS 2	
Dependent	Independ.	Coef.	Std.Err.	Coef.	Std.Err.
FDSIZELM	GDPLM	0.591 ***	(0.104)	0.543 ***	(0.136)
(LowMidInc)	PCLM	0.029 ***	(0.010)	0.050 ***	(0.018)
FDSIZELM	GDPLM	0.571 ***	(0.085)	0.428 ***	(0.088)
(LowMidInc)	INTERNLM	0.011 **	(0.004)	0.020 ***	(0.006)
FDSIZE	GDP	0.758 ***	(0.048)	0.779 ***	(0.054)
	MPH	0.062 ***	(0.013)	0.038 **	(0.018)
Panel C: Dynamic OLS		DOLS 1		DOLS 2	
Dependent	Independ.	Coef.	Std.Err.	Coef.	Std.Err.
FDACTIV	GDP	0.636 ***	(0.065)	0.565 ***	(0.079)
	PCP2	0.011 ***	(0.003)	0.013 ***	(0.004)
FDACTIV	GDP	0.738 ***	(0.052)	0.729 ***	(0.064)
	INTERNP2	0.008 ***	(0.002)	0.007 ***	(0.003)
STVAL	GDP	1.217 ***	(0.144)	1.087 ***	(0.141)
	INTERNP2	0.012 **	(0.005)	0.011 *	(0.006)
STVALHM	GDPHM	1.618 ***	(0.337)		
(HighUpMidInc)	MPHHM	0.152 **	(0.059)		
PCRDB	GDP	0.653 ***	(0.045)		
	MPH	0.024 **	(0.012)		

Contribution of the Paper

- Investigate Long-Run Equilibrium Relations
- Evaluate the impact of ICT variables and GDP on financial markets development
 - Advances in ICT facilitate financial development
- Shed light on how to enhance the breath and depth of financial systems
- Large dataset of 86 sample countries, 1991-2006
- Implications for developed and developing countries

Conclusions

- The paper provides strong evidence supporting the long-run relation among GDP growth, ICT indicators, and financial development measures
- GDP and ICT indicators are important factors for cross-country differences in financial development
- PCs, the Internet, mobile phones and GDP increase the liquidity, size, stock trading, expansion of credit, and the activity of financial markets