“The Relationship Between Economic Growth and Banking Sector Development”

AUTHORS	Hshin-Yu Liang Alan Reichert

ARTICLE INFO	Hshin-Yu Liang and Alan Reichert (2006). The Relationship Between Economic Growth and Banking Sector Development. *Banks and Bank Systems*, *1*(2)
RELEASED ON	Monday, 05 June 2006
JOURNAL	"Banks and Bank Systems"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
0	0	0

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THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND BANKING SECTOR DEVELOPMENT

Hshin-Yu Liang, Alan Reichert

Abstract

Given that the causal relationship between changes in a country's financial sector development (FSD) and its rate of economic growth is expected to be sensitive to the country's stage of economic development, two sets of country data are analyzed: Emerging/Developing countries and Advanced countries. While the results of the Granger causality and the Odedokun model yield mixed results, the production function multivariate approach appears to be more informative. The pooled models consistently indicate a strong supply-leading relationship between FSD and aggregate output. At the same time, the results of the single equation estimates appear to suggest that the impact of FSD is less pervasive today than in the earlier Odedokun study. Perhaps over time the level of FSD has become more uniform as the level of international trades has increased, promoting the globalization of the financial markets. Thus, this evidence of a reduced emphasis on a "supply-leading" relationship may reflect a changing role for FSD in the economic development process. Furthermore, as suggested by Granger causality tests, at some point in the economic growth cycle, the driving force turns into a "demand-following" relationships, as increased economic growth leads to higher income and education levels, which in turn generates greater demands for more sophisticated financial and risk management services. The study has important implications for financial policies which impact efficiency and the structure of the financial system.

Key words: financial market development, banking sector growth
JEL classifaction: G21

1. Introduction

The need to stimulate and manage economic growth is a global topic of up most importance in advanced, emerging, and less-developed countries. While the subject is not new, given the continued population growth in many less developed countries and the changing demographic and widening income disparities in many of the most advanced economies, the issue of economic growth has taken on increased importance. Economic historians, such as Patrick (1966) and Richard (2003), find that the most successful economics tend to be ones that developed sophisticated financial systems at an early stage. Financial sector development (FSD) can play either a leading role in economic growth or it may take a more passive role (derived demand) in response to expanding economics needs. The paper empirically examines these relationships, addressing issues of causality and controls for non-financial factors which impact economic growth. The empirical results indicate a strong supply-leading relationship between FSD and aggregate output. At the same time, the results suggest that the impact of FSD is less pervasive today than in the earlier Odedokun study. This evidence of a reduced emphasis on a "supply-leading" relationship may reflect a changing role for FSD in the economic development process. Furthermore, the results indicate that at some point in the economic growth cycle, the driving force turns into a "demand-following" relationship. The paper is organized as follows: Section II provides the literature review relating FSD and economic growth. Section III presents the methodology and data source for this study. Section IV discusses the empirical results and Section V concludes the paper.

2. Literature Review

In an early paper, Patrick (1966) states that in the beginning stages of economic development, causation runs from economic development to FSD. This view has been labeled "demand-following" with the lack of financial institutions in underdeveloped countries viewed as an indication of the

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low of demand for their services. As economic growth occurs the direction of causality may reverse and a "supply-leading" relationship develops, where the efficiency gains associated with the

intermediation process help stimulate continued economic growth in the later stages of a county's economic growth cycle. Furthermore, expanded FSD can take place along a "financial sector broadening" dimension where consumers and firms, acting as both investors and borrowers, have more efficient access to basic intermediation service. Expanded access to financial services saves time and lowers transactions costs. To the extent that economies of scale exist, the development of large scale financial intermediaries and markets drives information and transaction costs even lower.

Thus, the more efficient the financial sector becomes, the more likely a country's scarce resources can be directed to their most productive use. As this occurs, economic growth can reach its full potential. (See Levine (1997) for an excellent review of the literature regarding possible linkages or channels of influence between financial market and economic growth). During the later stage of economic development, both households and firms demand more sophisticated risk management related services (Allen and Santomero, 2002). Financial intermediates, attempting to take advantage of economies of scope, offer both traditional credit products and risk management services. The result is to move the economy towards a Pareto optimal allocation of both real and financial sector resources. This is an example of "financial sector deepening". This paper focuses on an examination of "financial sector broadening" and employs a broad definition of the money supply (M3) as our measure of FSD. (In the U.S., M3 includes currency in circulation, travelers checks, demand and other checkable deposits, savings deposits, both small and large denomination time deposits, retail and institutional money market mutual funds, repurchase agreements, and Eurodollar deposits). Thus, M3 is a broad definition of money and is one measure of the amount of financial sector liquidity in the economy.

Various researchers have empirically estimated the relationship between FSD and economic growth. Some of the earlier efforts were relatively crude. For example, using simple correlation analysis, Lin (1981) has found causation runs from financial development to economic growth, i.e., a "supply-leading" relationship. In Odedokun (1996) view, these earlier papers have neglected other growth-determining variables, such as the level of real investment, plus labor force and export growth. Hence, these early findings may likely be biased due to omitted variables. Using an expanded model which includes a number of growth-determining variables, Odedokun analyzes the economic and FSD status of a number of less-developed countries from mid-1960 to the late 1980s. Odedokun confirms that FSD plays a leading role in economic growth. Furthermore, FSD has a more consistently positive and statistically significant relationship with economic growth than the other variables in his study. However, his time-series results fail to adjust for autocorrelation and no bi-directional test of causality is presented. In the current paper, we re-estimate Odedohun's second model (Equation 4) using an alternative set of data provided by the World Bank for a longer and recent period of time (1980-2000). Furthermore, our data include both developed and less developed countries. In addition, the time series estimates are corrected for autocorrelation and formal Granger causality tests are included.

Empirical evidence of the relationship between FSD and economic growth has been mixed. In contrast to Patrick (1966), several empirical researches find the causation runs from FSD to economic growth or "supply-leading". However, a 1975 study of less-developed African countries found no evidence to support the supply-leading thesis (Bhatia and Khatkhate, 1975). More recently, Jung (1986), explored the causality issue in both developed and developing countries and obtained a supply-leading relationship, irrespective of the stage of economic development.

Levine has written extensively on the topic of economic and FSD. For example, a 1997 paper by Levine provides an extensive and in-depth review of the literature regarding the relationship between economic growth and financial development. In his review, Levine concludes that a growing body of empirical work, employing a wide range of time-series and cross-country data, reveals a strong positive link between financial sector development and long-run economic growth. Consistent with this conclusion, Levine and Zervos (1998) find that after controlling for economic and

political factors, that banking development and stock market growth positively impact future economic growth, capital formation, and enhanced productivity. They conclude that stock markets and banks appear to have a separate and distinct important role to play. More recently, using panel data from 1976-1998, and several more advanced estimation techniques, Beck and Levine (2004) reaffirm their earlier finding mentioned above, but conclude that it is difficult to identify the precise aspects of the financial system that is mostly associated with economic growth. In a recent review of the empirical literature, Levine (2003) concludes that: 1) financial intermediaries and markets matter in that nations with more well-developed financial sectors generally grow faster, 2) simultaneous equation bias may not be driving the estimation results found in the literature, and 3) countries with more efficient financial sectors provide firms with expanded access to external capital for growth and expansion.

3. Methodology and data source

Methodology

The GDP growth model is based on Odedokun's model which postulates that causation runs from financial development to economic growth. The model is based upon the conventional neoclassical one-sector aggregate production in which financial development constitutes an input, along with other real sector variables as depicted in equation 1. To facilitate comparison with the Odedokun model, the same notation is used to describe the variables.

$$Y_t = f(L_t, K_t, F_t, Z_t), \quad (1)$$

where, Y represents aggregate output or real GDP; L represents labor; K indicates the capital stock; F is a measure of the level of financial sector development (FSD); Z represents a vector of other factors, such as the level of exports, that can be regarded as inputs in the aggregate production process, and t represents annual time series. A variable's annual rate of growth was computed as the first-difference of its natural logarithm. The equation was estimated by ordinary least squares. The presence of first-order serial correlation was detected by examining the Durbin-Watson (DW) statistic and corrected where necessary by including an autoregressive term in the estimation equations using the EVIEWS time series program. All of the data were obtained from 2002 World Bank Economic Indicators database. A brief definition of each variable is presented in Table 1, while a more detailed explanation is presented in the Appendix. Equation 2 depicts the estimation equation with the level of exports included as an important control variable.

Table 1

Variable from World Bank 2002 Indicators

Definition	Abbreviation
Population growth (annual %)	Pop
Gross fixed capital formation (constant 1995 USD)	Investment
Exports of goods and services (constant 1995 USD)	Export
Liquid liabilities (M3) as % of GDP	M3%
GDP (constant 1995 USD)	GDP
Model Variables	Calculation
a) Y*	=100*[log(GDP)-log(GDP(-1))]
b) L*	Pop
c) I/Y	=100*[Investment/GDP]
d) X*	=100*[log(Export)-log(Export(-1))
e) F*	=100[log(f)-log(f(-1))]
	where f =(M3%/100)*GDP

$$Y^*_t = a + b^*L^*_t + c^*(I/Y)_t + d^*F^*_t + e^*X^*_t + u_t, \quad (2)$$

where, Y_t = Economic growth was measured as the annual growth rate of the real GDP.
L^*_t = Labor force growth was proxied by population growth which was calculated as the annual population growth rate.
$(I/Y)_t$ = The investment/GDP ratio was computed as gross nominal fixed capital formation divided by nominal GDP.
F^*_t = Financial sector development (FSD) was computed as the annual growth rate of the real stock of liquid liabilities (M3).
X^*_t = Real export growth was calculated as the annual growth rate of exports of goods and services.

The precise regression and Granger causality tests are given below.

Testable Hypotheses

H_1: F* does not Granger cause Y*. If the estimation results reject this null hypothesis at the 10% significant level, it supports Granger causality running from FSD to economic development (Supply-leading).

H_2: Y* does not Granger cause F* . If the estimation results reject this null hypothesis at the 10% significance level, it supports the Granger causality running from economic development to FSD (Demand-following).

H_3: In the Odedohun, multi-factor production function model, the percentage change of financial sector development (FSD) is positively related with the GDP growth. If the regression coefficient on F* in equation 2 is positive and statistically significant at the 10% level, it supports the supply-leading theory that financial development has a separate and distinct impact on GDP growth.

Country Selection

The countries included in this analysis were selected using the classification employed in IMF's 2005 World Economic Outlook report. The IMF divides the world into two major groups: advanced economies and emerging market plus developing countries. (A few countries are not included either because they are not IMF members and hence are not monitored by the IMF, or because suitable data are not available). The total number of countries classified as advanced is 29, and the number of countries classified as emerging and developing is 146. The data for this study were provided by the 2002 World Bank Economic Indicators publication which includes data from 1960 to 2000. Because of missing data, the total number of countries included in the analysis is 20 advanced countries and 70 emerging/developing as listed below.

Table 2

Emerging and Developing Countries (N=70)

Country Code	Country Name
DZA	Algeria
ATG	Antigua and Barbuda
ARG	Argentina
BGD	Bangladesh
BEN	Benin
BOL	Bolivia
BWA	Botswana
BRA	Brazil
BFA	Burkina Faso
CHL	Chile

Table 2 (continuous)

Country Code	Country Name
CHN	China
COL	Colombia
COM	Comoros
ZAR	Congo, Dem. Rep.
COG	Congo, Rep.
CRI	Costa Rica
CIV	Cote d'Ivoire
DOM	Dominican Republic
ECU	Ecuador
EGY	Egypt, Arab Rep.
ETH	Ethiopia
GAB	Gabon
GMB	Gambia, The
GHA	Ghana
GRD	Grenada
GTM	Guatemala
HND	Honduras
HUN	Hungary
IND	India
IDN	Indonesia
IRN	Iran, Islamic Rep.
JAM	Jamaica
JOR	Jordan
KEN	Kenya
LSO	Lesotho
MDG	Madagascar
MWI	Malawi
MYS	Malaysia
MLI	Mali
MRT	Mauritania
MUS	Mauritius
MEX	Mexico
MAR	Morocco
MOZ	Mozambique
NIC	Nicaragua
NER	Niger
NGA	Nigeria
PAK	Pakistan
PAN	Panama
PNG	Papua New Guinea
PRY	Paraguay
PER	Peru
PHL	Philippines

Table 2 (continuous)

Country Code	Country Name
RWA	Rwanda
SEN	Senegal
ZAF	South Africa
LKA	Sri Lanka
LCA	St. Lucia
VCT	St. Vincent and the Grenadines
SWZ	Swaziland
SYR	Syrian Arab Republic
THA	Thailand
TGO	Togo
TTO	Trinidad and Tobago
TUN	Tunisia
UGA	Uganda
URY	Uruguay
VEN	Venezuela, RB
ZMB	Zambia
ZWE	Zimbabwe

Table 3

Advanced Countries (N=20)

Country Code	Country Name
Large Countries:	
CAN	Canada
FRA	France
JPN	Japan
USA	United States
ITA	Italy
DEU	Germany
Remaining Advanced countries	
AUS	Australia
BEL	Belgium
DNK	Denmark
FIN	Finland
HKG	Hong Kong, China
ISL	Iceland
IRL	Ireland
ISR	Israel
KOR	Korea, Rep.
NLD	Netherlands
NZL	New Zealand
NOR	Norway
SWE	Sweden
CHE	Switzerland

4. Empirical Results

The results will be divided into two groups for analysis: Emerging/Developing Countries and Advanced Countries.

A. Emerging/Developing Countries

Table 4 shows the descriptive statistics for each variable. The J-B statistics are all statistically significant at the 1% level, indicating that the variables follow a normal distribution. Table 5 shows the correlation matrix. All four independent variables exhibit a positive correlation with Y*, with the correlation between exports and Y* reporting the largest value (0.366).

Table 4

Descriptive Statistics – Emerging/Developing Countries

	Y*	(I/Y)	L*	F*	X*
Mean	3.140451	22.127	2.237636	4.39567	4.649967
Median	3.775847	20.55489	2.389334	5.589777	5.012837
Maximum	29.56503	69.87299	16.01232	191.7863	71.7362
Minimum	-69.71552	5.910286	-19.08459	-233.8142	-94.41759
Std. Dev.	5.041367	8.695062	1.149776	16.38991	12.05616
Skewness	-2.639092	1.434051	-3.393708	-2.088293	-0.551859
Kurtosis	36.89198	6.376353	106.8096	55.47834	10.11205
Jarque-Bera	66375.66	1107.22	610568.9	156354.3	2922.349
Probability	0	0	0	0	0
Sum	4252.171	29959.96	3029.759	5951.737	6296.055
Sum Sq. Dev.	34387.01	102292.4	1788.644	363455.2	196660
Observations	1354	1354	1354	1354	1354

Table 5

Correlation Matrix – Emerging/Developing Countries

	Y*	(I/Y)	L*	F*	X*
Y*	1	0.138222	0.173767	0.194142	0.366412
(I/Y)	0.138222	1	-0.088744	0.097879	0.051621
L*	0.173767	-0.088744	1	-0.001785	0.062629
F*	0.194142	0.097879	-0.001785	1	0.077128
X*	0.366412	0.051621	0.062629	0.077128	1

The Granger causality test results with 2-year and 4-year lags are shown in Table 6.

Table 6

Granger Causality Test Results: 4-year and 2 year lags – Emerging/Developing Countries

Lags: 4years			
Null Hypothesis:	Obs	F-Statistic	Probability
(I/Y) does not Granger Cause Y*	1088	1.0499	0.38022
Y* does not Granger Cause (I/Y)		8.25668	1.50E-06
L* does not Granger Cause Y*	1115	5.30106	0.00031
Y* does not Granger Cause L*		5.00405	0.00053
F* does not Granger Cause Y*	**1093**	**1.822**	**0.12227**
Y* does not Granger Cause F*		**17.213**	**1.10E-13**
X* does not Granger Cause Y*	1109	4.46832	0.00138
Y* does not Granger Cause X*		5.96463	9.50E-05

Lags: 2 years			
Null Hypothesis:	Obs	F-Statistic	Probability
(I/Y) does not Granger Cause Y*	1230	0.49304	0.61089
Y* does not Granger Cause (I/Y)		23.0736	1.50E-10
L* does not Granger Cause Y*	1255	13.1174	2.30E-06
Y* does not Granger Cause L*		9.91524	5.30E-05
F* does not Granger Cause Y*	**1236**	**1.2696**	**0.28131**
Y* does not Granger Cause F*		**26.405**	**5.90E-12**
X* does not Granger Cause Y*	1249	10.1994	4.00E-05
Y* does not Granger Cause X*		14.2847	7.40E-07

The results of both Granger causality models reveal that growth in output (Y*) increases the portion of real investment for a given level of production (I/Y). That is, increases in output and income provide the kind of investment environment that encourages a greater level of savings and investment. Both population, as a proxy for labor, and the level of exports demonstrate bi-directional causality with output Y*. Thus, as the amount of labor and the level of exports increase, not surprisingly the level of output increases. Alternatively, as the level of output and income increases there is a greater incentive to enter the labor force and the level of exports begins to rise. As measured by the F-statistic, the strongest evidence of Grange causality is found between output (Y*) and our measure of FSD (F*), where F-values of 17.2 and 26.4 are reported in the 4-year and 2-year lag models, respectively. In contrast to the Odedokun model, both tests arrive at the conclusion that Granger causality runs from economic development to FSD at the 1% significance level; evidence of a "demand-following" relationship. The evidence of a reverse causation (i.e., supply following relationship) is much weaker, with an F-value of only 1.88 and 1.27 in the 4-year and 2-year lag models, respectively.

Multiple Regression Estimates of the Odedokum Model

While Granger causality tests are enlightening, univariate models are generally less powerful than multivariate models since they cannot control the potential influence of other explanatory variables. By including appropriate control variables into the regression, the model can eliminate omitted variable bias in the estimation process. Tables 7 and 8 show the result of a multivariate regression model using both a unified and fixed-effects model specification. The fixed effects model is more flexible and allows the intercept (fixed effects) to vary by country.

In Table 7, the DW statistic in 2.0 is after correcting for serial correlation with a one-year autoregressive lag adjustment. Hence, the model and the coefficient estimates are free of serial correlation which is a concern with the parameter estimates provided by Odedokun. The adjusted R-square is 22%, which is close to the result in Odedokun's 1996 study. All independent variables are significant at the 1% level with the expected positive sign. In terms of their respective t-values, the level of exports is the clearly the most significant variable with a t-value of 12.1, compared to the next most significant variable, labor growth, with an F-value of 7.7. Close behind is our measure of FSD (F*) with a value of 6.2 and a regression coefficient of 0.047.

Table 7

Multivariate Regression Model – Emerging/Developing Countries (Panel data estimate)

Dependent Variable: Y*				
Method: Panel Least Squares				
Date: 05/03/05 Time: 13:38				
Sample (adjusted): 1982 2000				
Cross-sections included: 70				
Total panel (unbalanced) observations: 1280				
Convergence achieved after 9 iterations				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-1.33246	0.477714	-2.789251	0.0054
L*	0.889897	0.115227	7.722963	0.00E+00
I/Y	0.078723	0.016407	4.798217	0.00E+00
X*	0.129369	0.010619	12.18328	0.00E+00
F*	0.046913	0.007592	6.178915	0.00E+00
AR(1)	0.105267	0.027816	3.784373	0.0002
R-squared	0.220343	Mean dependent var		3.192496
Adjusted R-squared	0.217283	S.D. dependent var		5.026633
S.E. of regression	4.447127	Akaike info criterion		5.82707
Sum squared resid	25195.81	Schwarz criterion		5.851232
Log likelihood	-3723.33	F-statistic		72.01044
Durbin-Watson stat	2.031624	Prob(F-statistic)		0.00E+00

For comparison purposes the respective regression coefficients and the associated t-values in parentheses from the Odedokun study are: (1) coefficient on L*: 0.13 (1.6); (2) coefficient on (I/Y): 0.108 (6.0); (3) coefficient on X*: 0.102 (15.7); and (4) coefficient on F*: 0.125 (12.9). Thus, one noteworthy difference in the reported results is the fact that labor has become a more significant factor in the production function, although its marginal impact (regression coefficient) is essentially unchanged. The level of significance associated with the proportion of investment to income

(I/Y) is similar although the regression coefficient is considerably smaller by a factor of about 7. The impact and significance of the level of exports is quite similar in both size and significance. Most important, while still highly significant, the impact of FSD as measured by M3 has become smaller in size (0.047 vs. 0.125) and statistically weaker (t-values of 6.2 vs. 12.9).

The results presented in Table 8 using the fixed-effects model are generally similar. The adjusted R-square is slightly larger (27.1% vs. 22%) although the overall F-value is smaller (7.9 vs. 72.0). Once again both the level of exports and labor growth play the dominant role in the model, although the level of FSD once again plays an important role in the model. The regression coefficient on F* declines slightly from 0.047 to 0.034, as does its respective t-value (6.2 vs. 4.6).

Single Country Estimates

Finally, the model is estimated separately for each country which allows the intercept and the slope coefficients to fluctuate. Following Odedokun's approach, instead of reporting 70 separate regression equations (one per country), Table 9 summarizes the overall result for the F* coefficient only. As before each equation is adjusted for autocorrelation. (Note that the corresponding percentages in the Odedokun study are provided in bold print).

Table 8

Fixed Effects Multivariate Regression Model – Emerging/Developing Countries

Dependent Variable: Y*				
Method: Panel Least Squares				
Date: 05/03/05 Time: 13:40				
Sample (adjusted): 1981 2000				
Cross-sections included: 70				
Total panel (unbalanced) observations: 1354				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.849524	0.589618	-3.136816	0.0017
L*	1.590914	0.145715	10.918	0
I/Y	0.032701	0.022651	1.443709	0.1491
X*	0.11984	0.010172	11.7816	0
F*	0.033956	0.007349	4.620758	0
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.311028	Mean dependent var		3.140451
Adjusted R-squared	0.271735	S.D. dependent var		5.041367
S.E. of regression	4.302225	Akaike info criterion		5.809244
Sum squared resid	23691.69	Schwarz criterion		6.09403
Log likelihood	-3858.858	F-statistic		7.915616
Durbin-Watson stat	2.003153	Prob(F-statistic)		0

Table 9

Percentage of Coefficients on F* which are Statistically Significant and Positive – Emerging/Developing Countries

	Number of countries	Percentage of Countries
Financial development coefficient significant at the 10% level	21	21/70=30% **vs. 53.5%**
Financial development coefficient positive	46	46/70=66% **vs. 85.8%**
Financial development coefficient positive and significant at the 10% level	18	18/70=26% **vs. 49.3%**

The results of the single equation estimates appear to suggest that the impact of FSD is less pervasive than in the earlier study. Perhaps over time the level of FSD has become more uniform as the level of international trades has increased, promoting the globalization of the financial markets. Thus, this evidence of a reduced emphasis on a "supply-leading" relationship may reflect a changing role for FSD in the economic development process. And, as suggested by the Granger causality tests, at some point in the economic growth cycle, the driving force turns into a "demand-following" relationships, as increased economic growth leads to higher income and education levels, which in turn generates greater demands for more sophisticated financial and risk management services.

B. Advanced Countries Results

Table 10 shows the descriptive statistics for each variable. Once again, the J-B statistics are all statistically significant at the 1% level, indicating that the variables follow a normal distribution. Table 11 shows the correlation matrix. Our measure of FSDS (F*) shows a modest positive correlation with Y* (.273), as is true for the variables, L* and I/Y. On the other hand, X* shows a much stronger positive correlation (0.504).

Table 10

Univariate Descriptive for Advanced countries

	Y*	L*	(I/Y)	F*	X*
Mean	2.872224405	0.778492605	21.45469526	4.11229032	5.61977637
Median	2.893666821	0.65959543	20.52461156	3.61194838	5.36346139
Maximum	10.42272544	6.017008781	36.88480045	69.1187152	23.8775855
Minimum	-6.92359393	-0.602257431	14.40222254	-49.948365	-9.3689905
Std. Dev.	2.586204679	0.683079989	4.5547669	8.60028645	5.03229205
Skewness	-0.02053736	2.117834985	1.136783369	0.54434398	0.35785594
Kurtosis	4.430904911	13.59519783	4.208519445	18.4464532	3.89899011
Jarque-Bera	28.85922865	1833.637567	93.36721824	3376.87572	18.5960097
Probability	5.41E-07	0	0	0	9.16E-05
Sum	970.8118489	263.1305004	7251.686998	1389.95413	1899.48441
Sum Sq. Dev.	2254.009215	157.2436173	6991.368809	24926.1804	8534.17562
Observations	338	338	338	338	338

Table 11

Correlation Matrix for Advanced countries

	Y*	(I/Y)	L*	F*	X*
Y*	1	0.268145858	0.220931573	0.27264804	0.4037649
(I/Y)	0.268145858	1	0.163837799	0.20057574	0.08743325
L*	0.220931573	0.163837799	1	0.1400135	0.0749068
F*	0.272648042	0.200575744	0.0.140001352	1	0.101426
X*	0.5037649	0.087344248	0.0749068	0.101426	1

The Granger causality test with 2- year and 4-year lags is shown in Table 12.

Table 12

Granger Causality Test for Advanced Countries

Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Probability
L* does not Granger Cause Y*	351	4.289859	0.014443
Y* does not Granger Cause L*		1.58701	0.206021
(I/Y) does not Granger Cause Y*	351	3.683406	0.026128
Y* does not Granger Cause (I/Y)		16.21196	1.86E-07
F* does not Granger Cause Y*	305	1.437885	0.239061
Y* does not Granger Cause F*		12.90894	4.19E-06
X* does not Granger Cause Y*	351	4.394369	0.013043
Y* does not Granger Cause X*		0.192654	0.824855

Lags: 4			
Null Hypothesis:	Obs	F-Statistic	Probability
L* does not Granger Cause Y*	311	1.486937	0.206019
Y* does not Granger Cause L*		1.207201	0.307743
(I/Y) does not Granger Cause Y*	311	3.877091	0.004355
Y* does not Granger Cause (I/Y)		9.113684	5.80E-07
F* does not Granger Cause Y*	265	0.444824	0.77613
Y* does not Granger Cause F*		5.9325	0.00014
X* does not Granger Cause Y*	311	3.234189	0.012788
Y* does not Granger Cause X*		2.551739	0.039243

The results of both Granger causality models reveal that growth in output (Y*) and I/Y are bi-directionally correlated. In both models, growth in exports (X*) influences Y* (Note: in the 4-lag model, Y* weakly impacts X). While not quite as strong as witnessed in the emerging/developing country results, changes in output (Y*) among the advanced countries have a definite causal relationship with changes in FSD as measured by F*. Once again, these results provide evidence of a "demand-following" relationship. In the 2-lag model alone, labor growth has a causal relationship with output.

Multiple Regression Estimates of the Odedokum Model

Tables 13 and 14 show the results of multivariate regression models using both unified and fixed-effects model specifications. As mentioned before, the fixed effects model is more flexible and allows the intercept (fixed effects) to vary by country. In Table 13, the DW statistic is close to 2.0 after correcting for serial correlation with a one-period auto-regression lag adjustment. Compared to the emerging/developing country results, the adjusted R-square for the advanced countries almost doubles to 41.8%. All independent variables are significant at the 1% level with the expected positive sign, with the exception of labor growth (L*). Our measure of FSD (F*) has a regression coefficient of 0.033 with a t-value of 2.7. The fixed effect results reported in Table 14 are once again all positive but considerably weaker in terms of statistical significance. The strongest results are reported for growth in exports (X*), followed by I/Y and our measure of FSD (F*) which has a smaller regression coefficient of 0.023 and t-value of 1.78. The adjusted R-square is approximately the same as reported in Table 13. In terms of their respective F-values, the level of exports is clearly the most significant variable with a t-value of 7.1.

Table 13

Multivariate Regression Model – Advanced Countries, 1980-2000

Dependent Variable: Y*				
Method: Panel Least Squares				
Date: 09/17/05 Time: 14:53				
Sample (adjusted): 1982 2000				
Cross-sections included: 20				
Total panel (unbalanced) observations: 318				
Convergence achieved after 12 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.46884	0.827765	-1.77447	0.076961
L*	0.36071	0.236608	1.524507	0.128395
(I/Y)	0.127561	0.037908	3.365071	0.000861
X*	0.223342	0.023837	9.369524	1.52E-18
F*	0.03284	0.012256	2.679583	0.007763
AR(1)	0.351451	0.054384	6.462368	3.96E-10
R-squared	0.426939	Mean dependent var		2.91554
Adjusted R-squared	0.417755	S.D. dependent var		2.605416
S.E. of regression	1.988061	Akaike info criterion		4.230885
Sum squared resid	1233.145	Schwarz criterion		4.301867
Log likelihood	-666.711	F-statistic		46.48891
Durbin-Watson stat	1.983497	Prob(F-statistic)		7.97E-36

Table 14

Fixed Effects Multivariate Regression Model – Advanced Countries (Panel data estimate)

Dependent Variable: Y*				
Method: Panel Least Squares				
Date: 09/17/05 Time: 14:54				
Sample (adjusted): 1984 2000				
Cross-sections included: 20				
Total panel (unbalanced) observations: 278				
Convergence achieved after 102 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.54151	1.617318	-0.95313	0.341441
L*	0.317978	0.407353	0.780596	0.435775
(I/Y)	0.140446	0.074821	1.877099	0.061664
X*	0.205673	0.028853	7.128353	1.08E-11
F*	0.022573	0.012671	1.78138	0.07606
AR(1)	0.383407	0.062712	6.11379	3.70E-09
AR(2)	-0.05388	0.066478	-0.81046	0.418446
AR(3)	-0.06359	0.070776	-0.8984	0.369832
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.462033	Mean dependent var		3.057577
Adjusted R-squared	0.406307	S.D. dependent var		2.569771
S.E. of regression	1.980046	Akaike info criterion		4.296194
Sum squared resid	984.0661	Schwarz criterion		4.648517
Log likelihood	-570.171	F-statistic		8.291201
Durbin-Watson stat	2.004273	Prob(F-statistic)		1.00E-21

Single Equation Model Estimates: As before, the model is estimated separately for each country. Table 15 summarizes the aggregate result for only the F* coefficient. Once again, each equation is adjusted for autocorrelation. (Note that no corresponding percentages in the Odedokun study are provided since the Odedokun sample only included less developed countries).

Table 15

Percentage of Coefficients on F* which are Statistically Significant and Positive – Advanced Countries

	Number of countries	Percentage of Countries
Financial development coefficient significant at the 10% level	3	3/20=15%
Financial development coefficient positive	16	16/20=80%
Financial development coefficient positive and significant at the 10% level	2	2/20=10%

While one must take into consideration the large difference in sample size (20 vs.70), the single equation results are considerably weaker for the advanced countries compared to the emerging/developing nations. While 80% of the countries reported a positive regression coefficient on F*, in only two out of the twenty advanced countries these coefficients were statistically significant at the 10% level (two-tail t-test).

5. Conclusions

Given that the causal relationship between changes in a country's financial sector development (FSD) and its rate of economic growth is expected to be sensitive to the country's stage of economic development, two sets of country data are analyzed: Emerging/Developing countries and Advanced countries. The results for the Emerging/Developing countries will be discussed first.

Strong evidence of Grange causality is found between output (Y*) and our measure of FSD (F*) suggesting that Granger causality runs from economic development to FSD, evidence of a "demand-following" relationship. Evidence of reverse causation, or of a possible supply-following relationship is much weaker. As a further test, this paper employs the "supply-leading" Odedokun-type production function model with both combined and fixed-effects econometric specifications. The regression coefficient on our measure of FSD (F*) is 0.047, with a high level of statistical significance (t-value of 6.2). (For comparison, the comparable regression coefficient and t-value from the Odedokun study are 0.125 and 12.9, respectively).

The Granger causality results from the Advanced country sample, while not quite as strong as witnessed in the Emerging/Developing country results, confirm that growth in output (Y*) has a definite causal relationship with growth in FSD. These results provide additional evidence of a "demand-following" relationship. On the other hand, the results of the Odedokun multivariate regression model once again finds a positive and statistically significant on F*, which suggests a supply-leading relation consistent with the results from the Emerging/Developed country analysis. Finally, the individual country equations are quite weak.

Comparing the two sets of production estimates, the average regression coefficient on F* for the Emerging/Developing countries is 0.041 (average of 0.047 and 0.034), compared to only 0.028 for the Advanced countries (average of 0.032 and 0.023). Thus, it appears that while the "supply leading" relationship is present for both groups of countries, the Emerging/Developing countries have a 50% larger relative impact (.041/.028).

While the results of the Granger causality and the Odedokun model yield mixed results, the production function multivariate approach appears to be more informative. The ability to hold other output producing variables constant allows one to estimate the marginal impact of changes in FSD. The pooled models consistently indicate a strong supply-leading relationship between FSD and aggregate output. At the same time, the results of the single equation estimates appear to suggest that the impact of FSD is less pervasive today than in the earlier Odedokun study. Perhaps over time the level of FSD has become more uniform as the level of international trades has increased, promoting the globalization of the financial markets. Thus, this evidence of a reduced emphasis on a "supply-leading" relationship may reflect a changing role for FSD in the economic development process. Thus, as suggested by the Granger causality tests, at some point in the economic growth cycle, the driving force turns into a "demand-following" relationships, as increased economic growth leads to higher income and education levels, which in turn generates greater demands for more sophisticated financial and risk management services as suggested by Allen and Santomero.

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Appendix

World Bank Economic Indicators: Data Definitions

Population growth (annual %) (SP.POP.GROW)

Annual population growth rate. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of the country of origin.

Gross fixed capital formation (constant 1995 US$) (NE.GDI.FTOT.KD)

Gross fixed capital formation (formerly gross domestic fixed investment) includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the 1993 SNA, net acquisitions of valuables are also considered capital formation. Data are in constant 1995 U.S. dollars.

Exports of goods and services (constant 1995 US$) (NE.EXP.GNFS.KD)

Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude labor and property income (formerly called factor services) as well as transfer payments. Data are in constant 1995 U.S. dollars.

Liquid liabilities (M3) as % of GDP (FS.LBL.LIQU.GD.ZS)

Liquid liabilities are also known as broad money, or M3. They are the sum of currency and deposits in the central bank (M0), plus transferable deposits and electronic currency (M1), plus time and savings deposits, foreign currency transferable deposits, certificates of deposit, and securities repurchase agreements (M2), plus travelers checks, foreign currency time deposits, commercial paper, and shares of mutual funds or market funds held by residents.

Series: GDP (constant 1995 US$) (NY.GDP.MKTP.KD)

GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 1995 U.S. dollars. Dollar figures for GDP are converted from domestic currencies using 1995 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.