Financial architecture and the sources of growth

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The Development of Securities Markets

Trends, Risks and Policies

Università Bocconi 27 February 2015

Agenda

- Motivation and literature review
- Model and data
- Empirical results
- Conclusion

Financial development and growth
vs
Financial Structure and Technological Change

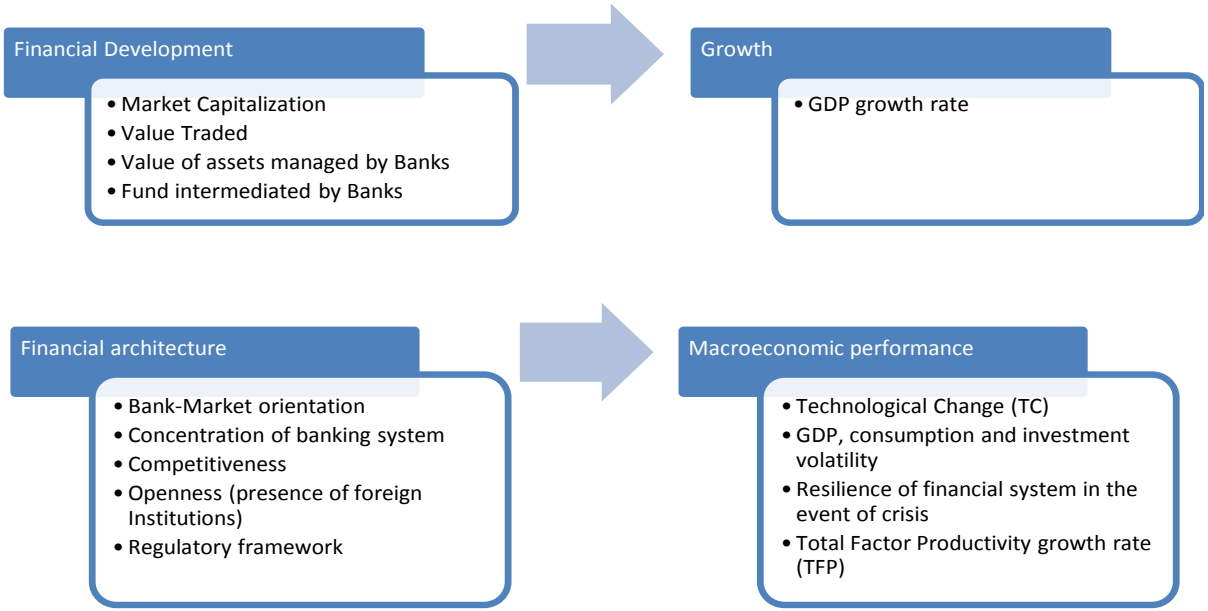
- Two alternative views about finance growth nexus: **capital accumulation** vs **technological change**
- **Capital accumulation hypothesis**: better financial sector influence growth primarily by raising domestic savings rates and attracting foreign capital
- **Technological change hypothesis**: financial sector alters the path of economic progress by affecting the allocation of savings and not necessarily by altering the rate of savings
- **Our question**: does financial sector affect economic development primarily by influencing technological change?

Financial development and growth
vs
Financial Structure and Technological Change

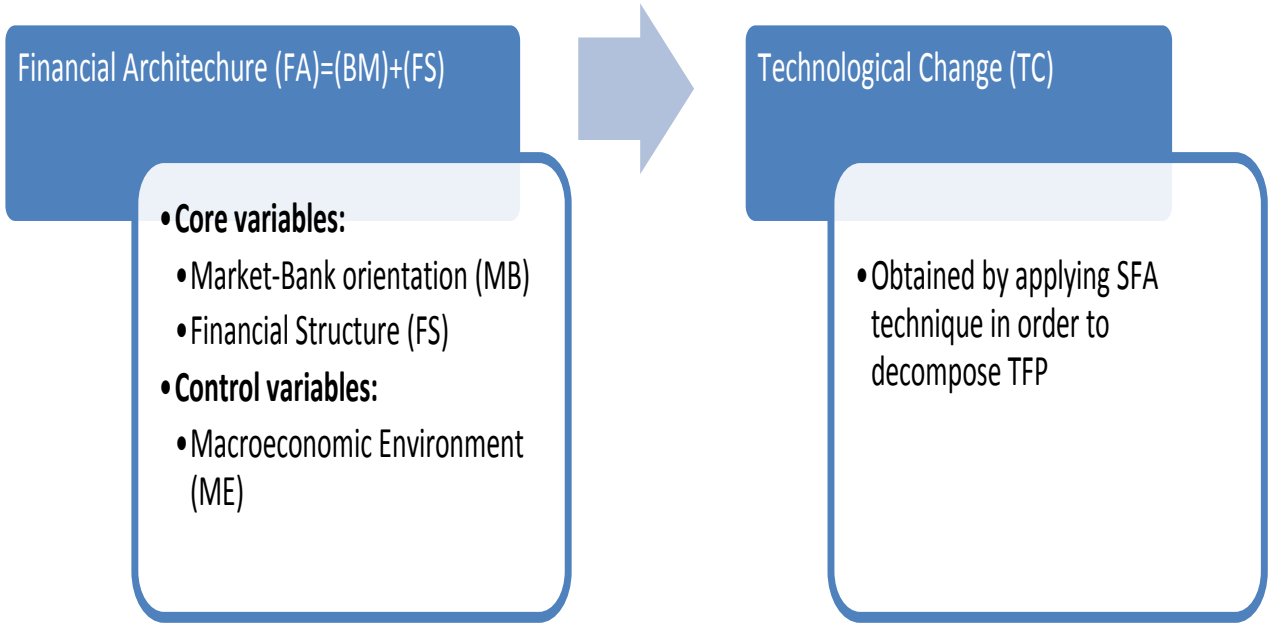
- Financial system promote technological change by
  - Reducing the costs of information
  - Identifying the best projects
- Which **features** of financial system are best suited to promote technological change?
- We try to get new empirical evidence on the relationship between the features of a country's financial system (FA, financial architecture) and the rate of technological change (TC)
- Our approach is able to soften the classic endogeneity problem which affects relevant literature

Literature review

Finance-Growth Nexus



Testing the impact of financial architecture on technological change



Financial architecture (1)

Core variables

Market-Bank orientation

- index of the degree of stock market orientation of a financial system based on three indices that measure the relative (i) size, (ii) activity and (iii) efficiency of the securities markets with respect to the banking sector
- Reflects the principal component of these three variables
- by construction higher values of MB indicate a more market-oriented financial system

- Data: We build on aggregate cross-country data by Global Financial Development Database

Financial architecture (2)

Core variables

Financial structure

- Foreign banks among total banks
- Bank concentration
- Bank lending-deposit spread
- Stock price volatility
- Number of listed companies
- Bank capitalization

Control variables

Macroeconomic environment

- Real GDP per capita
- Output gap
- General government total expenditure
- Trade openness growth

Estimating and decomposing TFP: stochastic frontier analysis (1)

- Stochastic Frontier Analysis (SFA), looking at output growth from the perspective of a frontier of production possibilities, allows us to distinguish the 2 elements of productivity (TFP) growth:
  - Technological change/progress: measures shifts of the production frontier over time
  - Efficiency change: measures the movement of a country towards or away from the frontier

- Only OECD countries because SFA assumes a common production technology frontier
- Our sample contains data for 27 OECD countries during the 1996-2010 period

Estimating and decomposing TFP: stochastic frontier analysis (2)

- To obtain technological change we estimate a translog production function where the dependent variable (y_{it}) is the log of real GDP and the independent variables are the log of labour force and physical capital (x_{jit})

- $y_{it} = \alpha_0 + \sum_j \beta_j x_{jit} + \beta_t t + \frac{1}{2}\sum_j \sum_k \beta_{jk} x_{jit} x_{kit} + \frac{1}{2}\beta_{tt} t^2 + \sum_j \beta_{jt} x_{jit} t + v_{it} - u_{it}$

- $u_{it} = \gamma' z_{it} + \varepsilon_{it}$

- $TC = \beta_t + \beta_{tt} t + \sum_j \beta_{jt} x_{jit}$

Estimating and decomposing TFP: stochastic frontier analysis (3)

- Inefficiency (u_{it}) is not identically distributed but depends on a series of explanatory variables (z_i):
    - Human capital, proxied by education level (OECD)
    - Institutional variables built on World Bank indicators (government effectiveness, regulatory quality and rule of law, political stability, voice and accountability, control of corruption)

Production function estimation results

	Model 1		Model 2		Model 3		Model 4	
	coefficient	*t* ratio	coefficient	*t* ratio	coefficient	*t* ratio	coefficient	*t* ratio
Production Frontier								
Constant	-9.27	-4.03	-8.59	-3.88	-9.21	-3.90	-14.28	-14.34
Labour	-1.14	-2.29	-1.06	-2.05	-1.16	-2.14	-5.28	-5.82
Capital	2.70	6.07	2.58	5.90	2.70	5.71	5.07	9.99
Time	-0.27	-5.17	-0.27	-5.05	-0.27	-4.80	-0.58	-0.63
Labor2	-0.05	-0.80	-0.04	-0.66	-0.05	-0.79	-0.64	-1.52
Capital2	-0.16	-3.62	-0.15	-3.39	-0.16	-3.37	-0.48	-5.20
Time2	0.00	-2.14	0.00	-3.89	0.00	-2.13		
Labour*Capital	0.11	2.14	0.10	1.91	0.11	2.00	0.57	2.94
Capital*Time	0.02	4.93	0.02	4.73	0.02	4.41	0.05	0.70
Labour*Time	-0.02	-4.12	-0.02	-3.83	-0.02	-3.58	-0.05	-0.87
Inefficiency model								
Constant	1.45	5.78	1.53	6.93	1.46	5.79	0.32	0.32
Tertiary edu	-0.04	-6.88	-0.04	-7.75	-0.04	-6.42	-0.01	-0.10
Voice and Accountability	-0.30	-1.42	-0.35	-1.80	-0.30	-1.43	0.16	0.16
Political Stability			-0.24	-0.27	0.06	0.10	-0.02	-0.02
Government effectiveness	-1.05	-4.97	-1.15	-6.02	-1.05	-5.28	-0.33	-0.35
Regulatory Quality	-0.17	-0.96	-0.21	-0.96	-0.17	-0.93	-0.20	-0.20
Rule of Law	-0.82	-3.49	-1.04	-4.73	-0.79	-3.17	-0.28	-0.29
Control of Corruption			0.38	1.55			-0.25	-0.26
σ^2	0.13	6.99	0.15	8.82	0.13	6.53	0.17	0.37
γ	0.93	63.21	0.94	80.55	0.93	61.61	0.93	12.40
Number of observations	405		405		405		405	
Log-likelihood	159.77		160.93		159.89		56.30	

Production frontier: almost all coefficients significant with expected sign

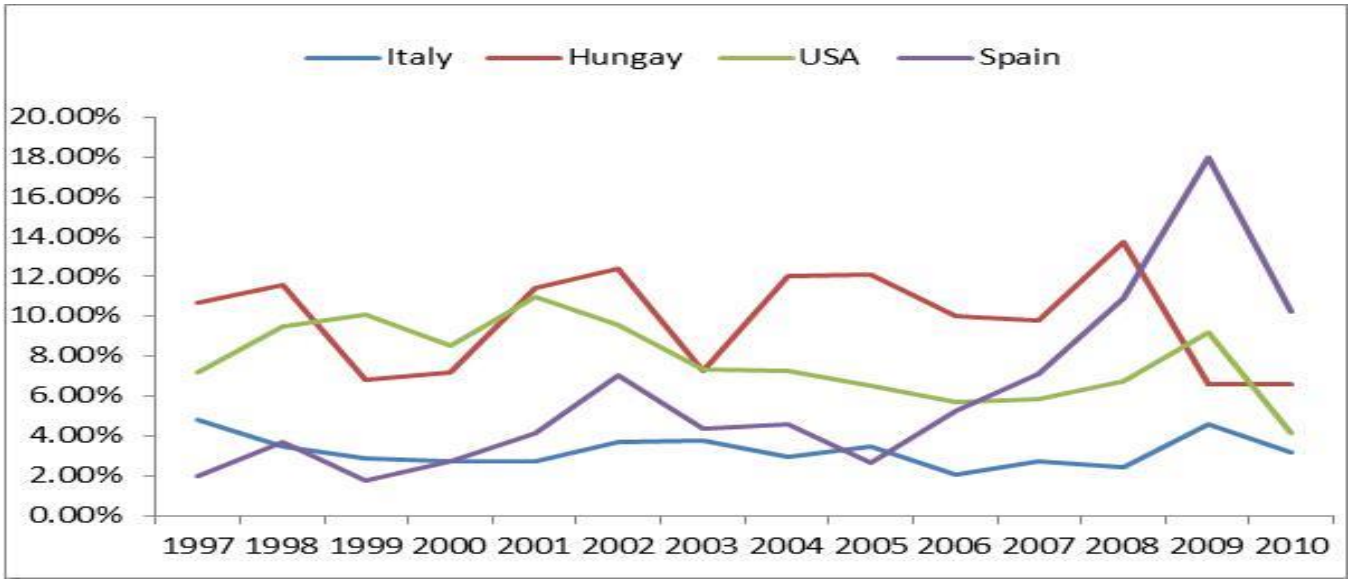
Inefficiency model: human capital expected significant negative sign; institutional variables confirm governance relevance

Technological change estimates

	Italy	France	Germany	Spain	Norway	USA	Hungary
1996	1.84	1.78	1.87	1.04	1.43	1.87	-2.24
1997	1.88	1.82	1.95	1.06	1.43	1.95	-2.13
1998	1.92	1.84	2.01	1.10	1.53	2.04	-2.01
1999	1.95	1.87	2.09	1.11	1.60	2.14	-1.95
2000	1.97	1.90	2.16	1.14	1.66	2.23	-1.87
2001	2.00	1.94	2.22	1.18	1.64	2.34	-1.76
2002	2.04	1.98	2.29	1.25	1.69	2.43	-1.63
2003	2.08	2.04	2.35	1.30	1.73	2.50	-1.56
2004	2.11	2.09	2.39	1.34	1.79	2.58	-1.44
2005	2.14	2.15	2.41	1.37	1.86	2.64	-1.32
2006	2.16	2.19	2.42	1.42	1.95	2.70	-1.22
2007	2.19	2.24	2.43	1.49	1.99	2.76	-1.12
2008	2.21	2.29	2.46	1.60	2.02	2.83	-0.99
2009	2.26	2.38	2.49	1.78	2.09	2.92	-0.92
2010	2.29	2.44	2.52	1.88	2.17	2.96	-0.85

Germany, USA and Italy are the country with best technological change - which represents the shift of a country's frontier - in the 90s: ranging from1.84 for Italy and 1.87 for Germany and USA. Italy performs well until the early 2000s, then it significantly slowed down and was overtaken by other countries

Annual variation of technological change



Important not only the level but the dynamics of technological change providing useful insights on the speed of catching up in certain countries and the prevailing stagnation path for others

Efficiency scores

	Italy	France	Germany	Spain	Norway	USA	Hungary
1996	88.53	92.10	92.35	89.48	97.77	95.63	62.09
1997	88.33	92.02	92.13	89.17	97.79	96.61	63.21
1998	87.61	92.76	91.45	89.16	97.78	96.77	65.12
1999	86.85	92.77	91.21	88.67	97.78	96.82	66.11
2000	87.08	92.83	91.38	88.44	97.87	96.76	67.42
2001	86.54	92.50	91.03	87.87	97.81	96.61	69.22
2002	85.35	92.19	90.54	87.45	97.82	96.60	71.38
2003	84.04	92.01	86.68	86.62	97.79	96.60	72.98
2004	84.31	94.34	90.44	81.06	97.94	96.70	76.00
2005	83.93	92.89	90.52	80.12	97.99	96.72	78.19
2006	84.34	94.62	90.95	79.91	98.00	96.65	80.66
2007	84.78	92.67	91.33	80.01	97.96	96.63	80.92
2008	83.68	94.53	86.73	79.92	97.82	96.55	82.42
2009	80.87	91.15	88.48	79.52	97.70	95.22	78.68
2010	82.77	91.58	86.09	79.99	97.69	95.69	80.62

Note: the scores are in percentage, so 100 means that the country is on the frontier and therefore reaches a maximum efficiency.

- Efficiency scores refer to the country's ability to reach the production frontier; the changes reflect the movement a country does towards or away from the frontier
- Norway is the most efficient country followed by USA.
- Hungary shows the most impressive improvement in its efficiency score

The impact of financial architecture on technological change (1)

- To investigate the impact of financial architecture on technological change we run country fixed-effects unbalanced panel regression both in good times (2002-2007) and crisis periods (1998-2010)

$$TC_{it} = \alpha_{it} + \beta_1 MB_{it} + \beta_2 FS_{it} + \beta_3 ME_{it} + \varepsilon_{it}$$

- The 1998-2010 period includes two financial crisis – the dot-com crisis in 2001 and the big financial crisis – therefore our model implemented in the full sample cannot perform properly.
- Financial variables strongly affected by 2 different breaks caused by the crisis.

The impact of financial architecture on technological change (2)

		(1)	(2)	(3)	(4)	(5)	(6)
BM	Bank-Market orientation	0.0013** (2.34)	0.0013** (2.61)	0.0017*** (2.86)	0.0015*** (2.66)	0.0008* (1.71)	0.0014** (2.03)
FS_1	Concentration	-0.003* (-1.94)	-0.0039** (-2.60)	-0.0037** (-2.52)	-0.004*** (-2.67)	-0.0033 (-2.48)	-
FS_2	Foreign	0.0217*** (7.32)	0.0206*** (7.33)	0.0200*** (7.02)	0.0199*** (7.07)	0.0116*** (4.26)	0.0118*** (3.78)
FS_3	Volatility	-0.0091*** (-4.45)	-0.0099*** (-5.11)	-0.0100*** (-5.15)	-0.0102*** (-5.31)	-0.0080*** (-4.88)	-0.0098*** (-3.97)
FS_4	Listed companies	-	-	-	0.00004* (1.68)	0.00004 (0.120)	0.00002 (0.248)
FS_5	Lending-deposit spread	-	-	-	-	-	-0.0364* (-1.94)
FS_6	Bank capitalization	-	-	-	-	-	-0.0014*** (-3.25)
ME_1	Gdp	0.0259** (2.61)	0.0221** (2.35)	0.0266** (2.62)	0.0309*** (2.98)	-	-
ME_2	Trade openess growth	-	0.1082*** (3.75)	0.1101*** (3.82)	0.1161*** (4.03)	0.1053*** (4.29)	0.11286*** (4.40)
ME_3	Public expenditure	-	-	0.00952 (1.17)	0.0104 (1.29)	-	-
ME_4	Otuput-gap	-	-	-	-	0.0364*** (6.00)	0.0301*** (3.40)
	Costant	0.0042** (2.27)	0.0051*** (2.84)	0.0007 (0.17)	-0.0008 (-0.18)	0.0103 (5.32)	0.004 (1.64)
	Observation	132	132	132	132	126	74
	R^2	0.53	0.59	0.6	0.61	0.73	0.81

- Estimated coefficients of MB are always positive and statistically significant meaning that a more market oriented financial system spurs technological change
- Higher concentration and lending spreads – both indicators of the competition in the banking sector – are associated with lower technological changes

The impact of financial architecture on technological change (3)

- A larger share of foreign banks in positively associated with a higher technological change: two channels
  - To gain market share, financing more opaque and riskier firms characterised by innovative and high return projects
  - System more interconnected with global economies (via FDI, international trade, etc.)
- Bank capitalization is negatively associated with technological change: excessive capital regulation may hinder the financing of technological progress

The impact of financial architecture on technological change (4)

- Stock price volatility affects negatively technological progress, increasing the cost of equity
- More listed companies, well-developed domestic capital market - positively associated with technological progress
- Macroeconomic variables related to GDP and trade openness have the expected sign
- Public expenditure has unexpected negative sign, probably due to the predominance of current expenditure

Conclusions

- Policy relevance of the relation between financial structure and economic outcome
- No much theoretical and empirical work

- Our main results:
- Well-functioning domestic capital market is positively related with technological progress
- Economies with higher technological progress are characterised by:
  - more market-oriented and more competitive financial systems
  - higher presence of foreign banks
  - higher companies' propensity to go public
  - less volatile stock market