Internet Appendix for "Financial Dependence and Innovation: The Case of Public versus Private Firms"

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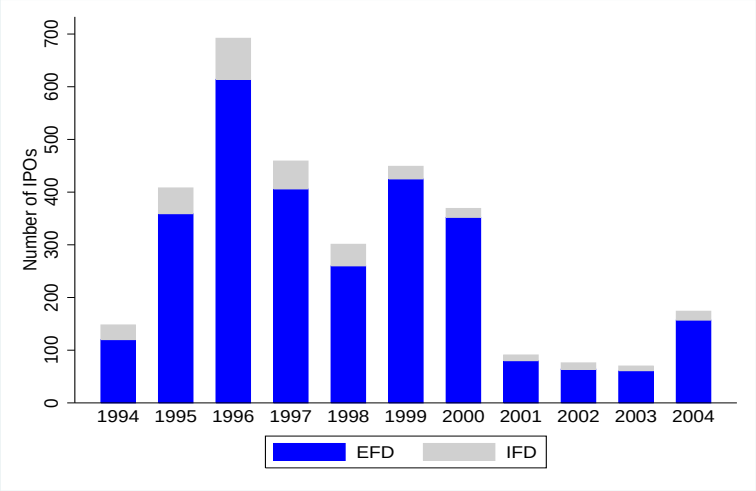
Abstract

This document provide additional results that supplement to the paper "Financial Dependence and Innovation: The Case of Public versus Private Firms". The appendix includes Figure A.1 presenting the number of IPOs across industries with different dependence on external finance and with different intensity in innovation. Table A.1 reports the results of instrumental variable estimation. Table A.2 shows the first stage estimation results of the treatment effect model. Table A.3 compares firm characteristics of age-year-R&D matched pairs of private and public firms in EFD and IFD industries. Table A.4 analyzes whether or not there is systematic difference in characteristics of firms around NASDAQ minimum listing requirement. Table A.5 investigates difference in innovation efficiency between matched private and public firms in external finance dependent and internal finance dependent industries.

Figure A.1: Number of IPOs

This figure presents the number of IPOs in external and internal finance dependent industries (top), as well as in high and low innovation intensity industries (bottom) over 1994-2004 for the sample firms. Industries with a positive (negative) value of EFD measure are regarded as external (internal) finance dependent. To construct the EFD measure, we first compute a firm's need for external finance in a year as the fraction of capital expenditure not financed through internal cash flow. The EFD measure is constructed as the time series median of industry-level external finance dependence based on the median value of the external finance needs of all firms in the two-digit SIC code industry in each year. Industries with an innovation intensity index higher (lower) than the index median value are regarded as high (low) innovation intensity industries. To construct the innovation intensity index, we first compute the time-series industry-level innovation intensity as the median number of patents for all patent-producing firms in the two-digit SIC code industries in each year. We then measure each industry's innovation intensity as its time series median during 1994-2004 and use percentile ranking of innovation intensity as the innovation intensity index.



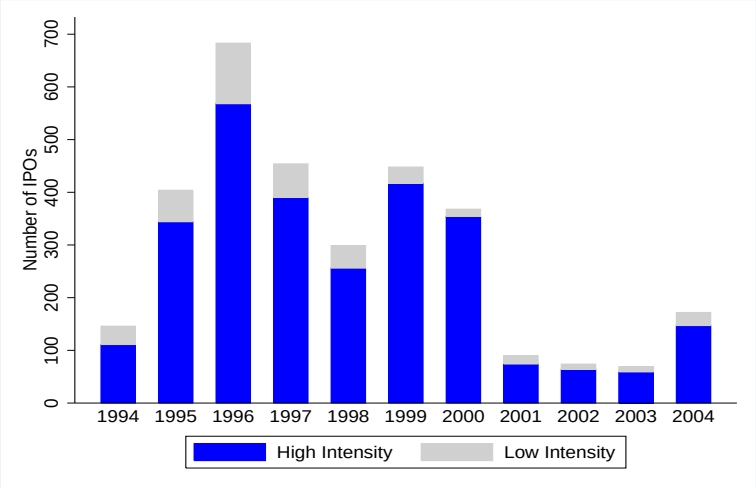


Table A.1:
Instrumental Variable Estimation

This table reports estimation results using the instrumental variable method. We use the percentage of public firms in each industry based on two-digit SIC codes in a given year as an instrument for the endogenous variable *Public*. The model is estimated using two-stage least square approach. The dependent variables are the measures of the nature of innovation activities: ln(R&D), number of patents, truncation-bias adjusted citations; $Public_i$ is a dummy variable equal to one for public firms and zero for private firms. The other control variables are a set of characteristic variables that affect a firm's innovation activities, including $ln(Sales)$ (natural logarithm of total revenue), $Tangibile$ (tangible assets scaled by total assets), $Cash$ (total cash scaled by total assets), Age (the difference between current year and founding year). We control for year fixed effects. The robust standard errors adjusted for heteroskedasticity are reported in the brackets. *** indicates the 1% significant level of the t-test; ** denotes the 5% significant level; and * denotes the 10% significant level.

	ln(R&D)	Patent	Citations	Originality	Generality
Public	2.3235***	11.5496***	0.6339***	0.2647***	0.1093***
	[0.1984]	[1.8713]	[0.1218]	[0.0293]	[0.0175]
ln(Sales)	0.1191***	1.1225***	0.0410***	0.0163***	0.0059***
	[0.0098]	[0.1404]	[0.0056]	[0.0013]	[0.0008]
Tangible	-0.0996	1.8084***	0.0139	0.0116	-0.0063
	[0.0795]	[0.5834]	[0.0402]	[0.0118]	[0.0067]
Cash	1.4457***	1.4795**	0.6433***	0.1319***	0.0804***
	[0.1141]	[0.7397]	[0.1332]	[0.0184]	[0.0121]
Age	-0.0050***	-0.0147***	-0.0002	0.0000	0.0000
	[0.0005]	[0.0056]	[0.0003]	[0.0001]	[0.0000]
Capex	-1.3526***	-3.6208	-0.3938***	-0.1380***	-0.0342
	[0.2595]	[2.4165]	[0.1459]	[0.0414]	[0.0265]
S.Growth	0.0149	-0.2248	-0.0012	0.0038	0.0038
	[0.0276]	[0.1701]	[0.0266]	[0.0044]	[0.0026]
ROA	-0.3607***	-0.2561	-0.0813	-0.0235	0.0055
	[0.0841]	[0.4801]	[0.1006]	[0.0143]	[0.0090]
Constant	-1.5231***	-13.3987***	-0.5912***	-0.2358***	-0.1190***
	[0.1571]	[1.8660]	[0.1137]	[0.0217]	[0.0127]
N	9620	9620	9,620	9,620	9,620

Table A.2:
First Stage Estimation of the Treatment Effect Model

This table reports estimation results of the first stage estimation of the treatment effect model for the matched sample, the sample of firms in external finance industries, and the sample of firms in internal finance industries. The first step estimates the probability of being public based on a firm's logarithm of total assets, capital expenditure, growth in sales, ROA, leverage, and external finance index (all firms only) from a probit model. The dependent variables $Public_i$ is a dummy variable equal to one for public firms and zero for private firms. *** indicates the 1% significant level of the t-test; ** denotes the 5% significant level; and * denotes the 10% significant level.

	All	EFD Industries	IFD Industries
Capex	0.9198***	0.9342***	0.925
	[0.2226]	[0.2323]	[0.8579]
S.Growth	-0.0493	-0.0605*	0.1367
	[0.0307]	[0.0320]	[0.1075]
ROA	-0.6064***	-0.7963***	0.4184
	[0.0941]	[0.0993]	[0.2866]
ln(A)	-0.0318***	-0.0287***	-0.0485**
	[0.0082]	[0.0088]	[0.0231]
Leverage	-1.5585***	-1.5464***	-1.7421***
	[0.0468]	[0.0505]	[0.1256]
EFD	0.2712***		
	[0.0560]		
Constant	1.3287***	1.4654***	1.3655***
	[0.0548]	[0.0531]	[0.1400]
N	9,620	8,109	1,511

Table A.3:
Firm Characteristics of Matched EFD and IFD Pairs

This table compares the means of characteristic variables for age-year-R&D matched pairs of private and public firms in EFD and IFD industries. For each industry-size matched pair of private and public firms in IFD industries, we search EFD industries for a matched pair in which the private firm has same age and similar R&D in the same year as the private firm in IFD industries. We require the absolute difference in ln(R&D) of private firms in EFD and IFD industries smaller than 0.5. $ln(Sales)$ is defined as log of total revenue. *S.Growth* is the first difference of natural logarithm of total revenue, *Tangible* is tangible (fixed) assets scaled by total assets. *Cash* is total cash scaled by total assets. *ROA* is EBITDA divided by total assets. *Age* is the difference between current year and founding year. *Capex* is capital expenditures scaled by total assets. $ln(R\&D)$ is natural logarithm of one plus research and development expenditures. *Patent* is the number of patents applied by a firm in a given year. *Citations* is citations per patent adjusted for truncation bias by dividing the number of citations by the average amount of citations in in the same year and technology class. *Originality* of patent is the Herfindahl index of cited patents and *Generality* is the Herfindahl index of citing patent. *Tangible*, *Cash*, *ROA*, and *Capex* are reported in percentage in this table. $Diff$ is the difference in means of private and public firms from the t-test. $t-stat$ is the t-statistics of t-test.

Panel A: External Finance Dependent Industries						
	ln(Sales)	S. Growth	Tangible	Cash	ROA	Age
Private	4.96	0.16	33.81	8.49	8.52	21.59
Public	4.91	0.18	32.71	15.54	6.33	34.61
Diff	-0.06	0.02	-1.10	7.04	-2.19	13.02
t-stat	-0.49	0.47	-0.84	7.16	-1.92	7.13
	Capex	ln(R&D)	Patent	Citations	Originality	Generality
Private	7.71	0.06	0.16	0.04	0.01	0.02
Public	7.95	0.35	0.78	0.25	0.05	0.07
Diff	0.24	0.29	0.62	0.21	0.04	0.05
t-stat	0.53	8.46	4.37	5.23	6.47	5.90

Panel B: Internal Finance Dependent Industries						
	ln(Sales)	S. Growth	Tangible	Cash	ROA	Age
Private	5.36	0.14	24.10	6.38	10.26	20.49
Public	5.37	0.12	20.26	9.87	8.74	37.39
Diff	0.01	-0.02	-3.85	3.49	-1.52	16.90
t-stat	0.11	-0.79	-3.58	5.07	-1.98	9.43
	Capex	ln(R&D)	Patent	Citations	Originality	Generality
Private	4.03	0.05	0.06	0.03	0.01	0.01
Public	4.31	0.10	0.48	0.06	0.02	0.03
Diff	0.29	0.05	0.42	0.03	0.01	0.02
t-stat	1.14	2.14	3.21	1.90	2.53	4.46

Table A.4:
Characteristics of Firms in the Fuzzy RD Sample

This table presents differences in characteristics of private and IPO firms near the NASDAQ minimum listing requirement of net tangible assets (normalized NTA within the interval of [-0.1, +0.1]). The forcing variable, net tangible assets, is normalized to center at zero. Characteristics of private firm in the first sample year and characteristics of public firms in the pre-IPO year are reported. $ln(Sales)$ is the log of total revenue. $Tangible$ is tangible assets scaled by total assets. $Cash$ is total cash scaled by total assets. ROA is EBITDA divided by total assets. Age is the difference between current year and founding year. $Tangible$, $Cash$, ROA are reported in percentage in this table. $Diff$ is the difference in medians of private and public firms. $p\text{-}Value$ is p-value of the Wilcoxon rank-sum test.

	ln(Sales)	Tangible	Cash	ROA	Age
Private	2.80	14.28	17.68	7.64	12.00
Public	2.88	14.44	26.78	8.49	7.00
Diff	0.08	0.16	9.10	0.85	-5.00
p-Value	0.60	0.98	0.25	0.62	0.18

Table A.5:
Innovation Efficiency

This table reports the estimation results for innovation efficiency of matched private and public firms in external finance dependent and internal finance dependent industries. We estimate the treatment effect model to address the concern that a firm's decision to go public may not be random (selection bias). The treatment effect model is estimated with a two-step approach. The first step estimates the probability of being public based on a firm's logarithm of total assets, capital expenditure, growth in sales, ROA, and leverage from a probit model. The inverse Mills ratio ($Mills$) is included in the second-step to adjust for selection bias. The dependent variable is the innovation efficiency measured as natural logarithm of one plus the ratio of number of patents to R&D expenditures. The control variables are a set of characteristic variables that affect a firm's innovation activities, including $ln(Sales)$, $Tangible$, $Cash$, Age, capital expenditure, growth in sales, and ROA. Year and industry fixed effects are controlled. In the last column, we estimate the treatment effect model with the second step model as $Y_{ikt} = \alpha + \beta Public_i + \delta EFD_{ik} + \theta Public_i \times EFD_{ik} + \gamma X_{ikt-1} + \lambda X_{ikt-1} \times EFD_{ik} + \phi Mills_i + \varepsilon_{ikt}$, where Y_{ikt} is innovation efficiency measured as the natural logarithm of one plus patents per dollar R&D investment; EFD_{ik} is an industry external finance index. X_{ikt-1} includes $ln(Sales)$, $Tangible$, $Cash$, Age, capital expenditure, growth in sales, and ROA. Industry and time effects are included. The coefficients on the control variables are not reported. Two-step consistent standard errors are reported in the brackets. *** indicates the 1% significant level of the t-test; ** denotes the 5% significant level; and * denotes the 10% significant level.

	EFD Industries	IFD Industries	All
Public	0.0490***	0.0114	0.0221*
	[0.0123]	[0.0100]	[0.0115]
EFD			0.0109
			[0.2201]
EFD×Public			0.0416***
			[0.0136]
Mills	-0.0141*	-0.0037	-0.0107*
	[0.0074]	[0.0063]	[0.0063]
N	8,109	1,511	9,620