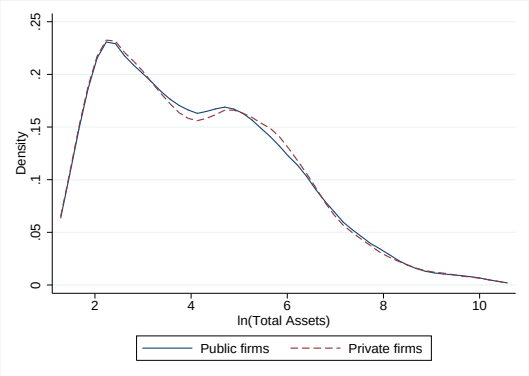
Internet Appendix for "Financial Dependence and Innovation: The Case of Public versus Private Firms"

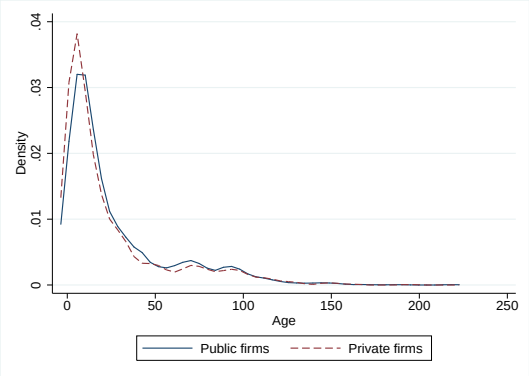
Abstract

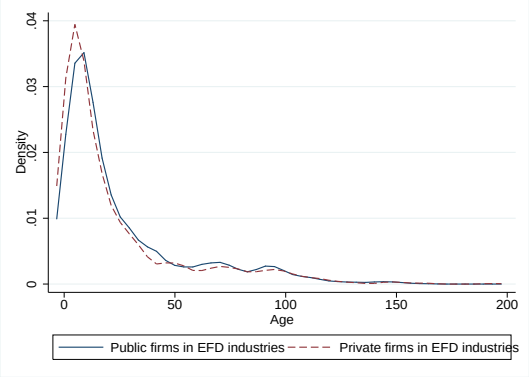
This document provides additional results that supplement to the paper "Financial Dependence and Innovation: The Case of Public versus Private Firms". Figure A.1 plots the size and age distributions of public and private firms. Table A.1 reports the results of fixed effects estimations. Table A.2 compares firm characteristics of age-year-R&D matched pairs of private and public firms in EFD and IFD industries. Table A.3 investigates difference in innovation efficiency between matched private and public firms in external finance dependent and internal finance dependent industries.

Figure A.1: Size and Age Distribution of Public and Private Firms

This figure presents the size and age distributions of the matched public and private firms in the sample, as well as in EFD and IFD industries. The graphs plot Epanechnikov kernel densities of the natural logarithm of total assets and firm age in the first sample year.







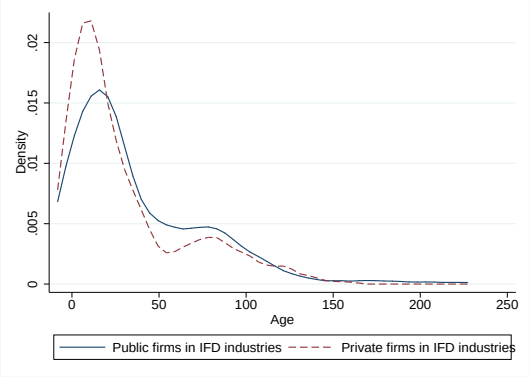


Table A.1:
Fixed Effects Estimations

This table reports estimation results using the fixed effects method. The results are based on the matched sample. The following fixed effect model is estimated: $Y_{ikt} = \alpha + \beta Public_i + \gamma X_{ikt-1} + \eta_k + \zeta_t + \varepsilon_{ikt}$, where Y_{ikt} is the measures of innovation activities: ln(R&D), number of patents, truncation-bias adjusted citations, originality, and generality; $Public_i$ is a dummy variable equal to one for public firms and zero for private firms; X_{ikt} is a set of characteristic variables that affect a firm's innovation activities, including $ln(Sales)$ (log of total revenue), $Tangible$ (tangible assets scaled by total assets), $Cash$ (total cash scaled by total assets), Age (the difference between current year and founding year), $Capex$ (capital expenditures scaled by total assets), $S.Growth$ (the first difference of natural logarithm of total revenue), ROA (EBITDA divided by total assets); η_k control for industry effects based on two-digit SIC codes; and ζ_t control for year fixed effects. The robust standard errors adjusted for heteroskedasticity are reported in the brackets. ***, **, * indicate the 1%, 5%, and 10% significant levels, respectively.

Panel A: External Finance Dependent Industries					
	ln(R&D)	Patent	Citations	Originality	Generality
Public	0.1813***	1.7080***	0.1494***	0.0289***	0.0607***
	[0.0247]	[0.2186]	[0.0193]	[0.0026]	[0.0043]

Panel B: Internal Finance Dependent Industries					
	ln(R&D)	Patent	Citations	Originality	Generality
Public	0.0409**	0.2264**	0.0061	-0.0025	0.0083
	[0.0181]	[0.0942]	[0.0199]	[0.0048]	[0.0069]

Table A.2:
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.3:
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 (ln(1 + patents/R&D)); 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. ***, **, * indicate the 1%, 5%, and 10% significant levels, respectively.

	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