



# Innovation, Adoption, Ownership, and Productivity: Evidence from Ukraine

J. David Brown, John S. Earle, Hanna  
Vakhitova, and Vitaliy Zheka

Coinvest-2010



# Outline

1. Motivation, Literature
2. Research Question
3. Hypotheses
4. Methodology
5. Data, Variables
6. Results
7. Conclusions



# Motivation, Literature

- Previous literature covers:
  - effects of ownership and corporate governance on performance
  - average returns to different types of investment
- But the literature is limited on:
  - Channels through which some owners and institutions achieve superior performance
  - How the returns to investment vary with firm characteristics
- We investigate potential link between these literatures
  - Some owners and governance arrangements may better facilitate investment choices and/or implementation
    - Through closer monitoring. Better monitoring could prevent managers from over-investing, choosing wrong projects, and implementing them poorly
    - Or, through the transfer of investment supporting organizational capital (work organization, incentive pay, centralization of decision-making)
- Some types of investment can be more sensitive to monitoring or organizational capital
  - Tangible vs intangible
  - Software IT vs hardware IT



# State vs private ownership

- State firms can be more interested in employment and other social benefits rather than value-maximization, thus less investing in labor saving projects
- State managers may also have weaker incentives to effectively implement investment projects



# Private domestic vs foreign firms

- Foreigners could introduce superior corporate governance practices and thus monitor managers more effectively.
- Foreigners may have more experience using high technology and the organizational practices that best suit it.
- Chung et al. (2003): relationship between capital or R&D expenditures and Tobin's q is stronger in firms with high analyst following and outsider board member representation (proxies for monitoring)
- Eklund et al. (2009): more positive effect in firms with smaller board of directors
- Ortega-Argiles et al. (2005): positive relationship between ownership concentration and number of patents for Spanish firms.
- Chen et al. (2008): positive relationship between R&D intensity and R&D output for Chinese firms in non-state-controlled firms
- Ho et al (2007): importance of independence of board for returns to IT investment in Taiwanese high-tech companies.
- Bloom et al. (2007): US multinationals in UK are more productive because they achieve higher IT investment productivity due to superior organizational capital.



# Research Question

- Our data allows to categorize investment in various ways, including non-technological versus R&D versus IT
- IT can be divided into software IT and hardware IT
- How do returns to the different types of investment vary according to ownership – state-owned vs. domestic private vs foreign (USA vs EU vs other foreign)?



# The context of Ukraine

- Soviet experience:
  - Low effectiveness of R&D
    - Integration between R&D and production was poor
    - Little incentive to produce innovation
    - To adopt new technology clearances from the bureaucracy and cooperation from suppliers and distributors were required
    - Managers could be punished for missing output targets but the reward for increasing productivity was small, leading to tougher plan targets in the future
- After the collapse of SU, Ukrainian firms have to build appropriate organizational capital, incentive system and implement other appropriate standards of business



# Methodology

- 1. Tobit regressions: How ownership is related to the intensity of different types of investment
  - Control variables (lagged):
    - NACE 3-digit industry market share and its square
    - Dummy for exporting firms
    - Log of capital stock
    - Industry-year dummies
    - Region (oblast) dummies

# Methodology

- 2. We estimate the productivity growth returns to different investment types using standard production function approach.
- Final equation:

$$y_{it} = \varphi_{k,it}^j (1 + DO_{it-1} + USA_{it-1} + EU_{it-1} + Other_{it-1}) * \\ * (1 + NT_{it-1} / Y_{it-1} + RD_{it-1} / Y_{it-1} + IT_{it-1} / Y_{it-1}) + \\ + \sum_s IND_s (\beta_l^s l_{it} + \beta_k^s k'_{it} + \beta_m^s m_{it}) + \sum_{s,p} \eta_{sp} IND_s YEAR_p + \tau_i$$

- Control variables: industry-year interactions, changes in log employment, log capital and log materials interacted with 25 industry dummies, log(wage/labor), machinery and non-machinery imports (dummies and levels), 3-digit-industry market share and its square
- Clustering by firm's id



# Data

- State Committee for Statistics: balance sheets, financial results statements, foreign investment, industry and region codes for 2000-2007
- State Property Committee, the State Commission on Securities and Stock Market: ownership information
- The data cover all firms in Ukraine outside of public and financial services
- The sample is restricted to NACE 10-41
- The total number of firms in the growth regressions is 52,669.
- On average, each firm is observed for about 4 years.
- The total number of firm-year observations is 169,238



# Variables

- Output – the value of gross sales in thousands of year 2000 UAH
- Capital – pre-existing tangible assets at the end of the year (depreciated value of tangible assets at the end of the year minus gross investment during the year)
- Employment – average number of registered industrial production personnel
- Materials – material cost
- Investment – non-technological, R&D, IT software, IT hardware
- Ownership – dummies for domestic, USA, EU, and other foreign ownership

# Descriptive Statistics (selected)

variable	mean	sd
Change in Log Output	-.0083494	.6562474
Change in Log Employment	-.0101691	.4926359
Change in Pre-Existing Tangible Assets	-.2227981	.5933875
Change in Log Materials	-.0073871	.8382367
Non-Technology Invest./Output	.0382348	.0999059
R&D Expenditures/Output	.0014919	.0190647
IT Expenditures/Output	.001358	.0125734
IT Software Expenditures/Output	.000211	.0037584
IT Hardware Expenditures/Output	.0011471	.0117534
Domestic Private Ownership	.8662426	
USA Ownership	.0030833	
EU Ownership	.0181277	
Other Foreign Ownership	.0093149	
Log(Wage/labor)	1.09518	.7423972

## Determinants of Firm Investment: state vs. private domestic vs. foreign

	Non-technological	R&D	IT	IT software	IT hardware
Domestic Ownership	0.041***	-0.005	0.004***	0.003***	0.003***
Foreign Ownership	0.054***	-0.018***	0.006***	0.005***	0.006***
3-digit-industry market share	-0.407***	0.212***	0.025***	0.026***	0.026***
3-digit-industry market share squared	0.457***	-0.203***	-0.047***	-0.036***	-0.047***
Exporting firm	0.010***	0.045***	0.006***	0.003***	0.007***
ln_capital	0.025***	0.029***	0.004***	0.002***	0.004***
Basic Import/Output	0.009***	-0.004**	0.000	0.000	0.000
Tech Import/Output	-0.000	-0.000	-0.000	-0.000	-0.000

## Determinants of Firm Investment: state vs. private domestic vs. USA vs. EU vs. other foreign

	Non-technological	R&D	IT	IT software	IT hardware
Domestic Ownership	0.041***	-0.005	0.004***	0.003***	0.003***
USA ownership	0.042***	0.004	0.007***	0.004***	0.007***
EU ownership	0.067***	-0.029***	0.007***	0.005***	0.007***
Other Foreign Ownership	0.034***	-0.008	0.005***	0.004***	0.004***
3-digit-industry market share	-0.408***	0.214***	0.025***	0.026***	0.026***
3-digit-industry market share squared	0.456***	-0.205***	-0.048***	-0.036***	-0.047***
Exporting firm	0.010***	0.045***	0.006***	0.003***	0.007***
Log Capital	0.025***	0.029***	0.004***	0.002***	0.004***
Basic Import/Output	0.008***	-0.004*	0.000	0.000	0.000
Tech Import/Output	-0.000	-0.000	-0.000	-0.000	-0.000

1. Returns to Investment: state vs. private domestic vs private foreign, aggregated IT

	1. OLS	2. FE	3. OLS	4. FE	5. OLS	6. FE
Non-Technology Invest./Output	0.104***	0.055*	0.043	0.059		
R&D Expenditures/Output	-0.036	-0.107	-0.118	-0.009		
IT Expenditures/Output	0.219	0.163	-0.693**	-0.695*		
Domestic Ownership	-0.028***	0.030	-0.033***	0.029	-0.033***	0.030
Foreign Ownership	-0.000	0.018	-0.010	0.014	-0.010	0.017
Log(Wage/labor)	-0.071***	-0.235***	-0.071***	-0.235***	-0.070***	-0.236***
Non-Tech*Log(Wage/Labor)	0.054***	0.086***	0.053**	0.085***	0.040*	0.090***
R&D*Log(Wage/Labor)	0.183***	0.192**	0.179**	0.182**	0.187**	0.172**
IT*Log(Wage/Labor)	0.735***	0.684**	0.696***	0.645***	0.733***	0.694***
Non-Tech*Domestic			0.067*	-0.005	0.080	-0.050
Non-Tech*Foreign			0.070	-0.001	0.118*	-0.036
R&D*Domestic			0.113	-0.115	0.107	-0.164
R&D*Foreign			0.217	-0.022	0.173	-0.094
IT*Domestic			1.003***	0.954***	0.969***	1.006**
IT*Foreign			3.349**	2.966*	1.996**	1.352*
Controls	yes	yes	yes	yes	yes	yes
Investment*Industry					yes	yes

## 2. Returns to Investment: state vs. private domestic vs private foreign, disaggregated IT

	1.OLS	2.FE	3.OLS	4.FE	5.OLS	6.FE
Non-Technology Invest./Output	0.106***	0.055*	0.046	0.063		
R&D Expenditures/Output	-0.027	-0.105	-0.114	-0.013		
IT Software Expenditures/Output	-0.843	0.024	-2.298***	-2.025***		
IT Hardware Expenditures/Output	0.314	0.179	-0.421	-0.415		
Domestic Ownership	-0.028***	0.030	-0.033***	0.029	-0.033***	0.030
Foreign Ownership	0.000	0.018	-0.010	0.013	-0.010	0.018
Log(Wage/labor)	-0.071***	-0.235***	-0.071***	-0.235***	-0.071***	-0.236***
Non-Tech*Log(Wage/Labor)	0.053**	0.086***	0.051**	0.083***	0.039*	0.091***
R&D*Log(Wage/Labor)	0.179**	0.191**	0.176**	0.184**	0.175**	0.165**
Soft*Log(Wage/Labor)	0.961	0.414	0.999	0.618	0.754	0.140
Hard*Log(Wage/Labor)	0.739***	0.724**	0.663***	0.621***	0.715***	0.694***
Non-Tech*Domestic			0.065*	-0.008	0.076	-0.058
Non-Tech*Foreign			0.071	0.002	0.113	-0.042
R&D*Domestic			0.115	-0.117	0.103	-0.175
R&D*Foreign			0.219	-0.018	0.170	-0.107
IT Software*Domestic			1.733**	2.700***	2.269**	2.605**
IT Software*Foreign			2.383***	1.976**	3.771***	3.227***
IT Hardware*Domestic			0.808**	0.656*	0.671*	0.635
IT Hardware*Foreign			3.917**	3.566	1.738	0.898

3 (begin.). Returns to Investment: state vs. private domestic vs. USA vs. EU vs. other foreign, aggregated IT

	1.OLS	2.FE	3.OLS	4.FE	5.OLS	6.FE
Non-Technology Invest./Output	0.105***	0.054*	0.042	0.058		
R&D Expenditures/Output	-0.034	-0.107	-0.123	-0.033		
IT Expenditures/Output	0.217	0.160	-0.662**	-0.615*		
Domestic Ownership	-0.028***	0.029	-0.033***	0.030	-0.033***	0.029
USA	-0.015	0.040	0.003	0.042	-0.023	0.043
EU	0.008	0.025	-0.050*	-0.006	-0.052**	-0.007
Other Ownership	-0.014	0.001	-0.021	0.019	0.003	0.017
Non-Tech*Log(Wage/Labor)	0.054***	0.087***	0.054**	0.087***	0.041*	0.092***
R&D*Log(Wage/Labor)	0.183***	0.193**	0.183**	0.199**	0.182**	0.183**
IT*Log(Wage/Labor)	0.732***	0.678**	0.666***	0.572***	0.754***	0.706***
Log(Wage/Labor)	-0.071***	-0.236***	-0.071***	-0.235***	-0.070***	-0.236***

3 (end). Returns to Investment: state vs. private domestic vs. USA vs. EU vs. other foreign, aggregated IT

	1.OLS	2.FE	3.OLS	4.FE	5.OLS	6.FE
Non-Tech*Domestic			0.066*	-0.006	0.084*	-0.038
Non-Tech*USA			0.240	-0.052	0.260	-0.093
Non-Tech*EU			0.089	0.019	0.147*	-0.006
Non-Tech*Other Foreign Ownership			0.030	0.045	0.071	0.020
R&D*Domestic			0.114	-0.112	0.113	-0.153
R&D*USA			0.419*	0.332	0.329	0.193
R&D*EU			0.177	-0.120	0.075	-0.195
R&D*Other Foreign Ownership			0.327	0.007	0.488*	-0.000
IT*Domestic			0.994***	0.928**	0.840**	0.842**
IT*USA			6.990***	7.151***	8.992***	8.140***
IT*EU			-0.239	-0.717	-1.441*	-1.543
IT*Other Foreign Ownership			2.827***	1.721**	2.936***	1.814***

4(begin.). Returns to Investment: state vs. private domestic vs. USA vs. EU vs. other foreign, disaggregated IT

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	FE	OLS	FE	OLS	FE
Non-Technology Invest./Output	0.107***	0.054*	0.045	0.061		
R&D Expenditures/Output	-0.025	-0.105	-0.118	-0.038		
IT Software Expenditures/Output	-0.837	0.034	-2.421***	-1.921**		
IT Hardware Expenditures/Output	0.312	0.174	-0.374	-0.331		
Domestic Ownership	-0.028***	0.029	-0.033***	0.029	-0.033***	0.030
USA	-0.015	0.041	-0.052**	-0.009	0.003	0.019
EU	0.008	0.000	0.003	0.040	-0.054**	-0.009
Other Ownership	-0.013	0.025	-0.024*	0.019	-0.028*	0.042
Non-Tech*Log(Wage/Labor)	0.053**	0.087***	0.052**	0.086***	0.040*	0.093***
R&D*Log(Wage/Labor)	0.178**	0.192**	0.179**	0.201**	0.170**	0.176**
Soft*Log(Wage/Labor)	0.956	0.400	1.111	0.525	0.899	0.023
Hard*Log(Wage/Labor)	0.736***	0.718**	0.619***	0.542***	0.702***	0.673***
Log(Wage/Labor)	-0.071***	-0.236***	-0.071***	-0.235***	-0.070***	-0.236***

4(end). Returns to Investment: state vs. private domestic vs. USA vs. EU vs. other foreign, disaggregated IT

	1.OLS	2.FE	3.OLS	4.FE	5.OLS	6.FE
Non-Tech*Domestic			0.065*	-0.009	0.080	-0.047
Non-Tech*USA			0.236	-0.053	0.255	-0.099
Non-Tech*EU			0.088	0.015	0.141*	-0.019
Non-Tech*Other Foreign Ownership			0.025	0.041	0.068	0.028
R&D*Domestic			0.116	-0.113	0.107	-0.164
R&D*USA			0.418*	0.334	0.319	0.176
R&D*EU			0.177	-0.126	0.063	-0.224
R&D*Other Foreign Ownership			0.315	-0.005	0.483*	-0.021
IT Software*Domestic			1.747**	2.679***	2.338**	2.561**
IT Software*USA			18.116***	6.003	18.571***	6.242
IT Software*EU			0.838	3.710	1.548	4.890**
IT Software*Other Foreign			1.919*	1.097	2.535**	1.355
IT Hardware*Domestic			0.794**	0.628*	0.508	0.432
IT Hardware*USA			6.778***	6.923***	9.226***	8.446***
IT Hardware*EU			-0.569	-1.361*	-2.223***	-2.523***
IT Hardware*Other Foreign			6.666***	5.529*	6.904***	5.447*



# Conclusions

- This paper finds significant differences in investment volume and returns across ownership types
- The differences are most stark for IT investment, where foreign firms invest more and have higher returns than domestic private firms and state firms.
- This is inconsistent with a story that foreign firms outperform mainly by having greater access to financing, as that would predict higher volume but lower returns. Instead they appear to have a higher marginal productivity of IT capital schedule.
- The results do not support the hypothesis that foreign firms provide better monitoring. Under this hypothesis, one would expect foreign firms to achieve significantly higher returns to intangible investments like R&D and IT software, as intangible investments should be more difficult to monitor. We find that foreign firms do not achieve significantly higher returns to R&D investment, and their advantage in IT software investment is similar to their advantage with IT hardware investment.
- The foreign firm, and, especially, USA firm, edge in IT as opposed to other investment types points to the possibility of superior organizational capital, as suggested by Bloom et al. (2007) and Crespi et al.'s (2007) results on USA versus domestic firms and other foreign firms in the United Kingdom. Foreign investors bring managers who are experienced in using IT, and they introduce business models that more fully exploit the technology.
- In future research it would be desirable to collect data on organizational capital and estimate more directly its role in foreign firms' superior performance, following the work of Crespi et al. (2007) in the United Kingdom.