



UNIVERSITY *of* VAASA

Hannu Piekkola / Innodrive

COINVEST workshop

*Making the Difference: The Organization Capital*

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**INNODRIVE**

*Intangible Capital and Innovations:  
 Drivers of Growth and Location in the EU*

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**Why intangibles matter?**

It is widely recognised that intellectual assets are major determinants of the generation of innovation and thus in the enhancement of growth, employment and competitiveness. However, our knowledge of the contribution of intangibles to economic performance is still incomplete.

While firms undoubtedly are at the centre of innovation and productivity growth, their activities are hard to analyse empirically. Furthermore, at the macro-level the national accounts data on capital formation focus primarily on fixed investment and have only recently attempted to measure investment in intangibles such as software, human capital, artistic creations and the value of intellectual property rights.

**What is INNODRIVE?**

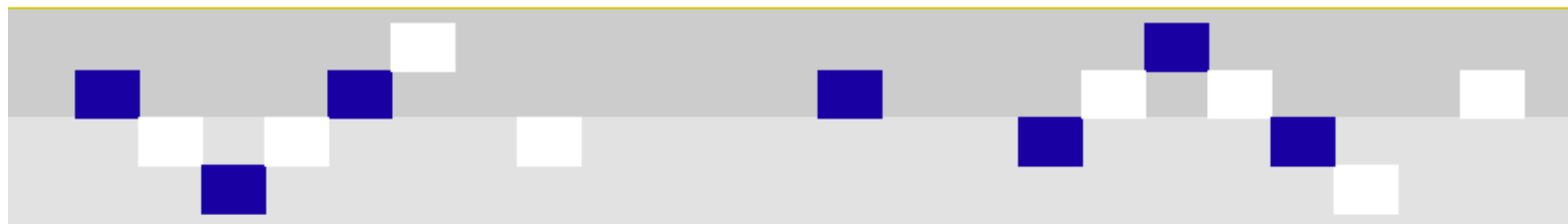
The INNODRIVE project aims at reducing our ignorance by providing new data on intangibles and new estimates of the capacity of intangible capital to generate growth.



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[www.enepr.org/inno](http://www.enepr.org/inno)  
 March 2008 - February 2011





# Value Producing Organization Capital

- Organization capital: an important missing ‘factor input’ in production function?
- The appropriate production function?
  - Hall et al. 2000 (Hall, Cummins, & Lamont, 2000))
  - Lev, B., & Radhakrishnan, S. (2003). The Measurement of Firm-Specific Organization Capital: NBER Working Papers No 9581.
  - Lev, B. & Radhakrishnan, S., (2005). The Valuation of Organization Capital
  - Corrado, C., Haltiwanger, J., & Sichel, D. (2005) eds. *Measuring Capital in the New Economy* NBER and University of Chicago Press
- What to use as instrument for measuring returns to organization capital?
  - Compensations on organization-related work OC
  - Administrative expenses or Selling, General and Administration SGA expenditures (Lev and Radhakrishnan uses firm with operation-based balance-accounts)
- How explains market values in excess of that by analysts’ forecasts?



# Methodology

1. Model the firm's output as a function of Organization capital instrument, physical capital PPE, skill-adjusted labor EMP and RND (representing other intangible assets)
2. Organization compensation OC or administration expenditures affects the total factor and asset (resource) productivities
3. Assess the returns on organization capital investment as the difference between expected sales with the organization capital and without it
4. Evaluate how measured organization capital explains market value over book value of the firms listed in stock exchange

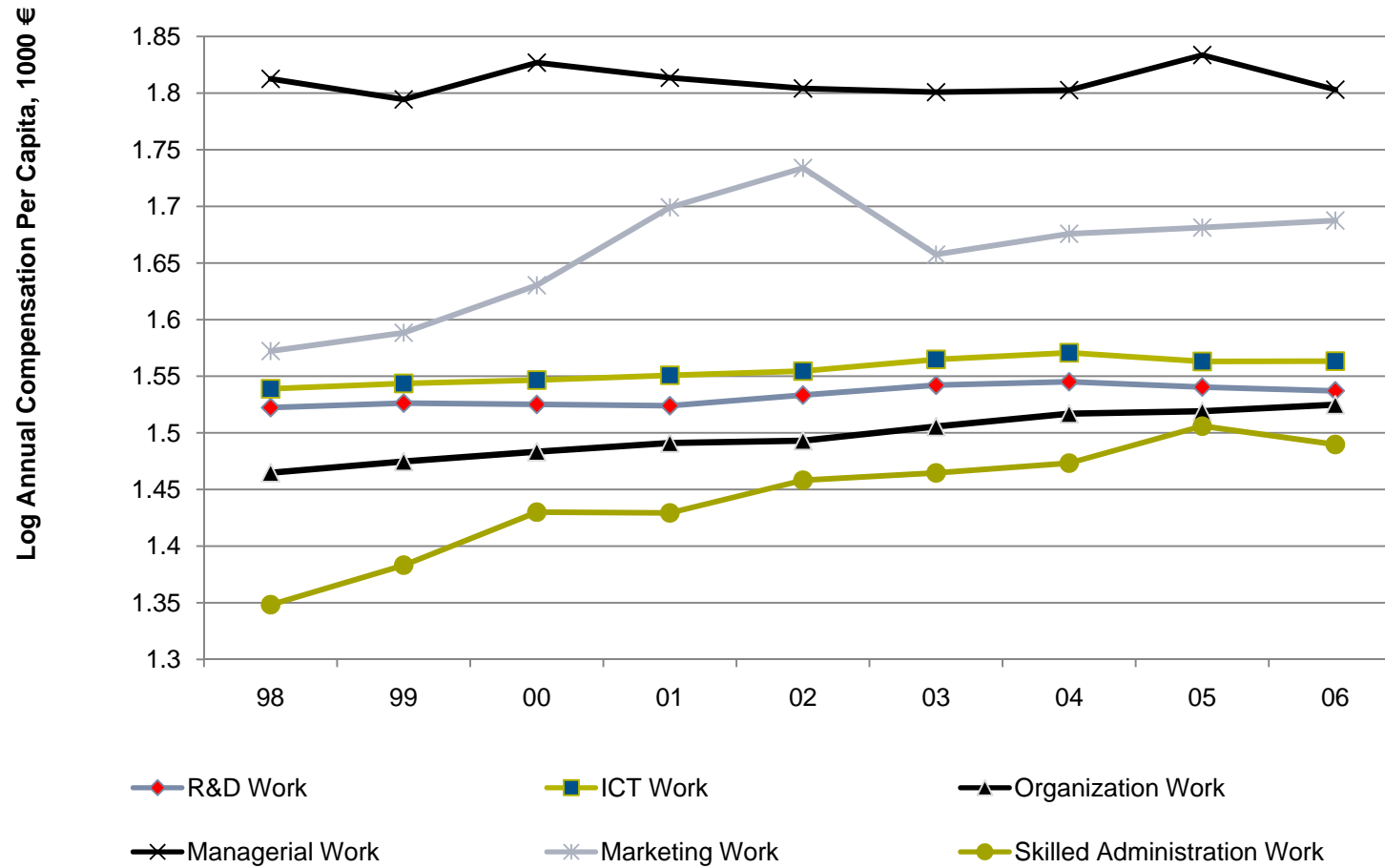


## Data Finland (Innodrive microdata also Norway, Germany, Czech Rep., Slovenia, UK)

- Employee data 7,2 million obs linked to public financial statistics data to include information on profits, value added and capital intensity (fixed assets)
  - *4 million obs and 1300 firms left, (firms with average sales below 2 million € and total assets below 0.5 million € dropped)*
  - 80 firms that report operation-based balance sheets and SGAs
- LEED data 1995-2006
  - Average sales are 78 million (in €2000 prices) and average growth 2.5%
  - Annually 250,000 employees (over half of employees before linking), one-fifth of the entire private sector workforce
  - Half of employed in manufacturing
  - 41 non-production worker occupations



Figure 1. Log of Annual Compensations Per Capita for Organization and other Intangible Capital Related Work in Finland 1997-2006





**Table 2. Summary of Organization Personnel**

Occupation	Mean Annual Wages	Stand. Dev.	Share of Work-force
Organization compensation	31.5	9.1	19.0 %
Managers	64.6	88.8	7.4 %
Marketing	46.2	99.4	5.2 %
General and Administration	28.0	30.4	6.4 %
Research and Development	34.2	7.5	9.7 %
ICT related work	36.0	8.8	3.1 %

1) OC Organization Compensation

- Compensations in selling, marketing and management occupations + 30% social security payments in 1300 firms

- 3% of sales

- Total OCs are twice to R&D compensations and fivefold to ICT compensations

2) Administrative expenses 5.5% of sales and SGA 12% of sales in the 80 firms with operation-based accounts



## Step 2. Production Function and Instrument for Organization Capital

$$SALE_{it} = b_{0it} PPE_{it}^{b1} EMP_{it}^{b2} RND_{it}^{b3} e_{it}$$

$$\log(b_{0it}) = c_{0t} + g_{01t} \log(X_{it})$$

$$b_{nt} = c_t + g_{nt} \log(X), \text{ for } n = 1, 2, 3$$

$b_{0it}$  = Total factor productivity, firm-specific and influenced by X

X = Organizational Compensations (on management, administration and management) or administration costs (part of SGA)

or



## Step 3. Measuring Organization Capital

Sales accounting for Organization Capital

$$\begin{aligned} SALE_{it}^* &= SALE_{it-1} \{ \exp \{ c_{0t} + g_{0t} \log(OC_{it} / OC_{i,t-1}) \\ &\quad + c_{1t} \log(PPE_{it} / PPE_{i,t-1}) + c_{2t} \log(EMP_{it} / EMP_{i,t-1}) \\ &\quad + c_{3t} \log(RND_{it} / RND_{i,t-1}) \} \end{aligned}$$

Sales excluding Organization Capital

$$\begin{aligned} SALE_{it}^{**} &= SALE_{it-1} \{ \exp \{ c_{0t} + c_{1t} \log(PPE_{it} / PPE_{i,t-1}) + c_{2t} \log(EMP_{it} / EMP_{i,t-1}) \\ &\quad + c_{3t} \log(RND_{it} / RND_{i,t-1}) \} \end{aligned}$$

$$OC_{it} = SALE_{it}^* - SALE_{it}^{**}$$

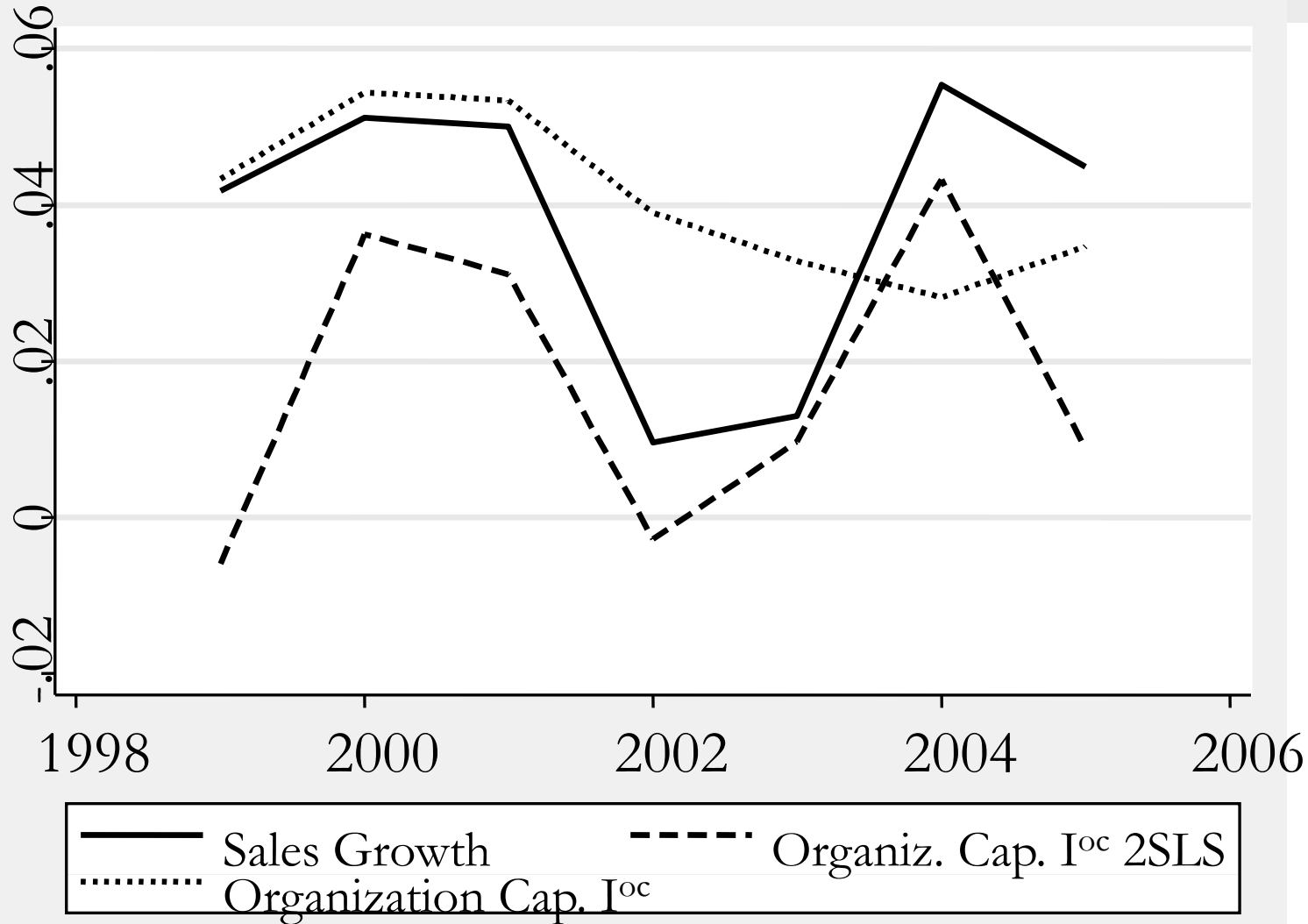


## Table Log difference estimation of sales growth (not yearly here)

	<b>OLS</b>	<b>2SLS</b>
	<b>(1)</b>	<b>(2)</b>
<b>Organization Compensation</b>	<b>0.0427***</b> <b>(3.87)</b>	<b>0.0443***</b> <b>(3.74)</b>
<b>Net Plant, Property, Equipment</b>	<b>0.171***</b> <b>(14.62)</b>	<b>0.169***</b> <b>(13.78)</b>
<b>Employment</b>	<b>0.212***</b> <b>(15.81)</b>	<b>0.220***</b> <b>(15.84)</b>
<b>R&amp;D Asset</b>	<b>0.0383*</b> <b>(2.19)</b>	<b>0.0454*</b> <b>(2.48)</b>
<b>Constant</b>	<b>0.0428</b> <b>(0.97)</b>	<b>0.0661</b> <b>(1.49)</b>
<b>Observations</b>	<b>5749</b>	<b>4979</b>
<b>R2</b>	<b>0.103</b>	<b>0.122</b>



# Organization Capital per Sales and Business Cycle



$I^{oc}$ : by three-year periods

$I^{oc}$  2SLS:

by year and by

11 industries  
using 2SLS



# Stock prices, Residual Income and Unaccounted Organization Capital

$$MV_{it} = \sum_{\tau=1}^{\infty} \frac{E_t(DIV_{it+\tau})}{(1+r_i)^\tau}, \quad \overbrace{BV_{it-1} - BV_{it-1}}^{\Delta \text{ Book Value}} = \overbrace{FE_{it} + a_{it} K_{it}^{OC}}^{\text{Earnings}_t^*} - \overbrace{DIV_{it}}^{\text{Dividends}_t^*}$$

$FE_t$  = analysts' forecast,  $a_t$  = unaccounted share of organization capital  $K^{OC}$ ,

$$K_{it+1}^{OC} = I_{it}^{OC} + (1-\delta)K_{it}^{OC} \quad \text{or} \quad K_{it}^{OC} = I_{it}^{OC} / (\delta + g_i^{OC}), \quad g_i^{OC} = \frac{K_{it+1}^{OC} - K_{it}^{OC}}{K_{it}^{OC}}$$

$$\Rightarrow \underbrace{MV_{it}}_{\text{Market Value}} = \underbrace{BV_{it} + RE_{it} + \frac{a_i}{\delta + g_i} I_{it}^{OC}}_{\text{Book Value + Residual Earnings + Unaccounted Org. Cap.}}$$

$$RE_{it} = \sum_{\tau=1}^{\infty} (1+r_i)^{-\tau} [FE_{it} - r_i BV_{it-1}]$$

(12)



## Organizational Capital and Equity Valuation

$$RE_{it} = (1 + r_{it})^{-1} (FE_{it} - r_{it} BV_{it-1}) + \\ (FE_{it+1} - r_{it} BV_{it}) (r_{it} - g_{it})^{-1} (1 + r_{it})^{-2}$$

$r_{it}$  = discount rate (bond rate+beta)

$g_{it}$  = growth of abnormal earnings

$FE_{it}$  = analysts' forecast

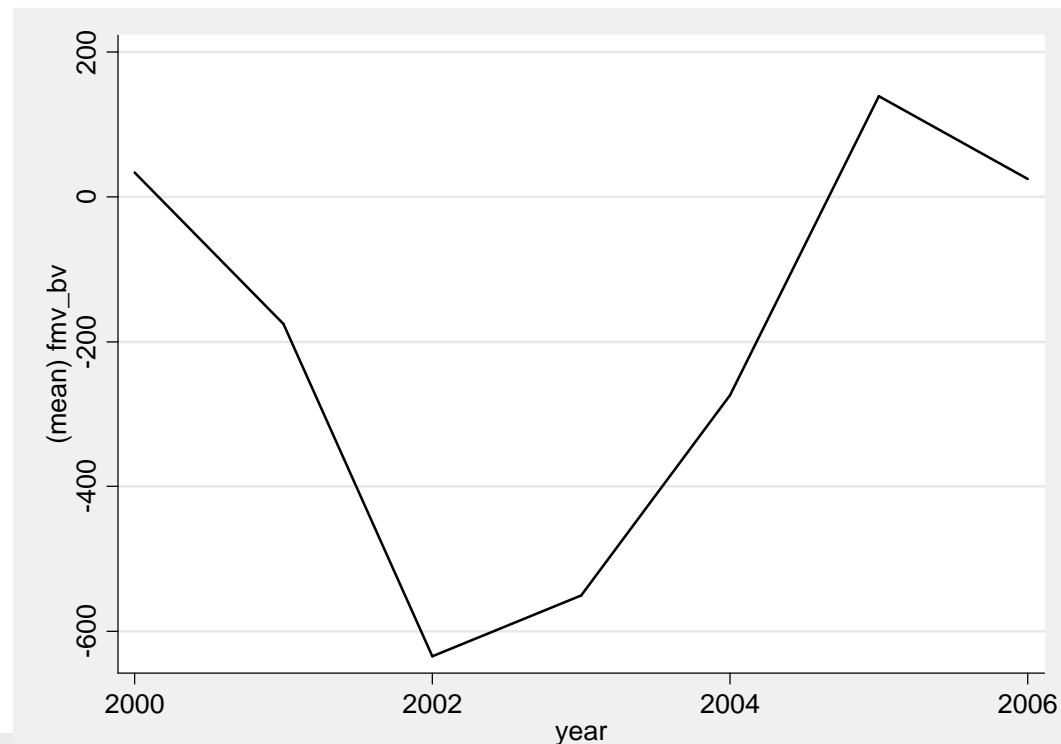


# Estimation

$$(MV_{it} - BV_{it}) / SALE_{it} = \sigma_{re} RE_{it} / SALE_{it} + \sigma_{org} I_{it}^{OC} / SALE_{it} + \sigma_{year} Year_{ijt} / SALE_{it}$$

Market Value less Book Value

Data 51 firms listed  
in Helsinki Stock  
Exchange  
1998-2006





# Organizational Capital and Equity Valuation

Variable	Mean	Standard Deviaton	Mini-mum	Median Value	Max	Obs number
Market Value - Book Value (€ million)	0.45	0.99	-3	0.41	12	328
Abnormal Earnings (€ million)	-0.35	2.2	-12	-0.43	14	328
Organization Capital OC	53035	195551	-140328	7055	2104702	328
Organization Capital OC SLS	43005	211305	-1559541	3697	2137411	328
Organization Capital OC 2SLS	0.085	0.12	-0.066	0.045	0.87	328
Organization Capital/Sales OC 2SLS	0.099	0.4	-1.1	0.023	4.6	328

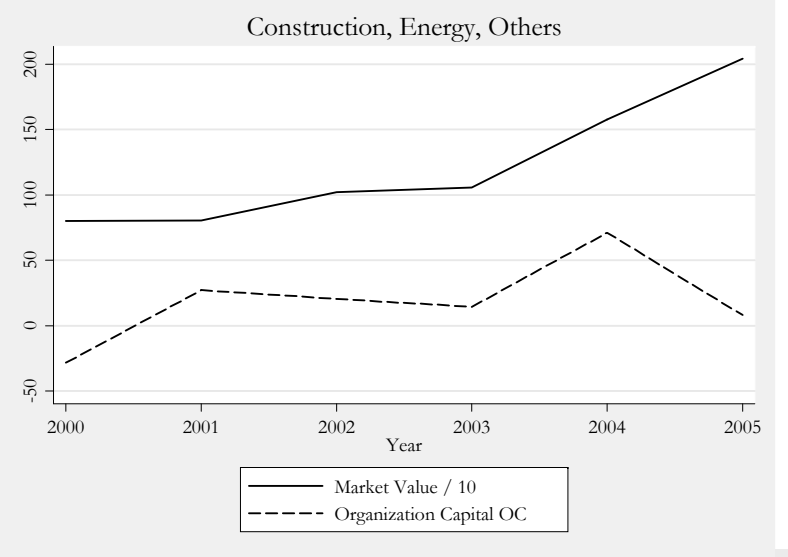
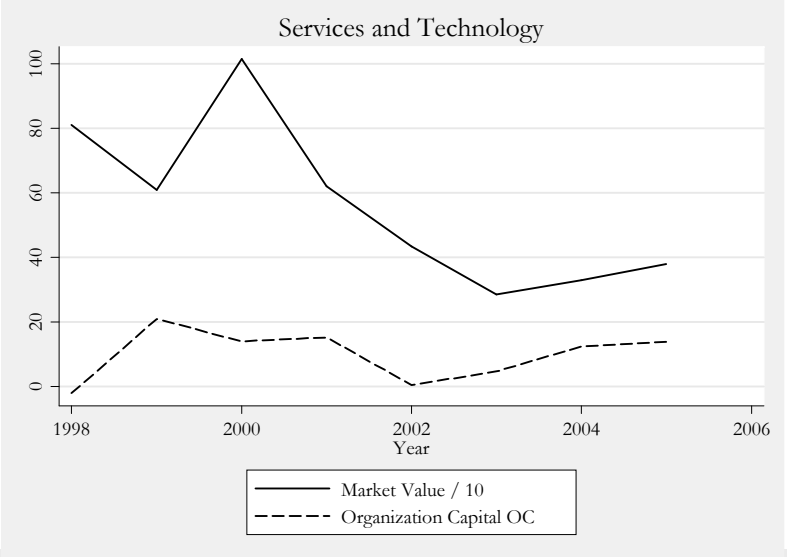
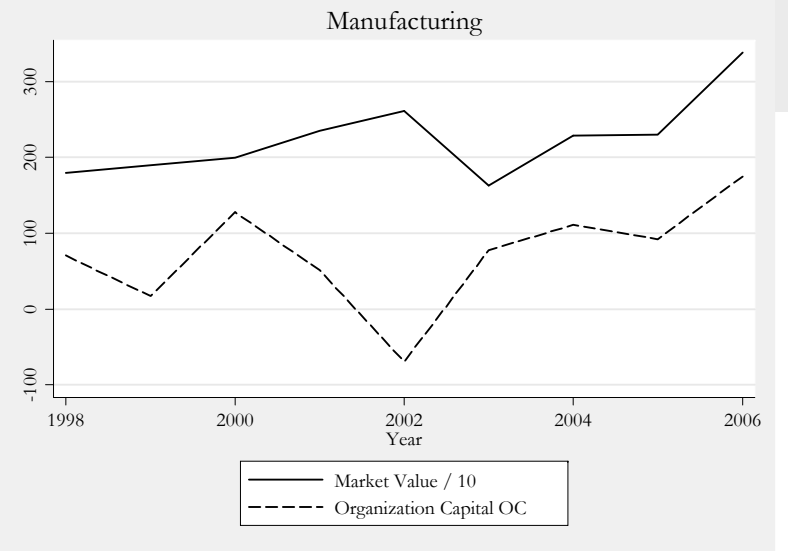
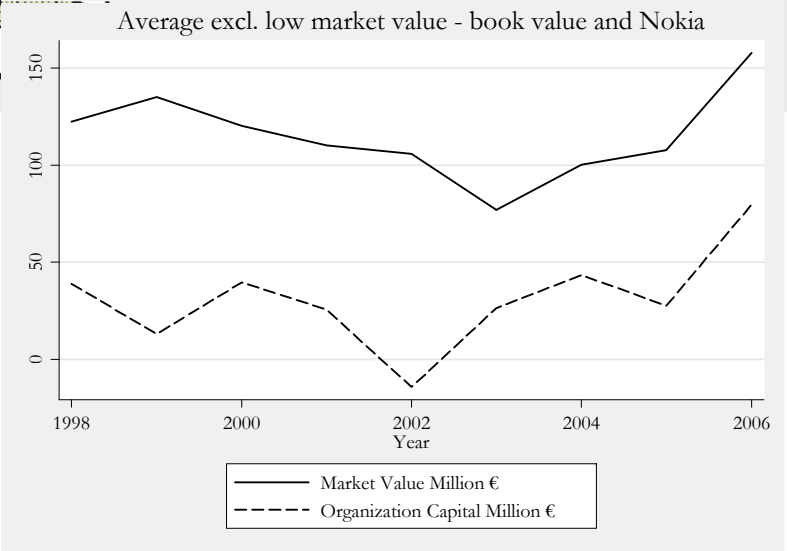


## Equity Valuation, OC instrument

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Market Value – Book Value				
				High	Medium	Low	Manu- facturin g	Services Tecnolog y
Organization Capital/Sales OC		0.735 (1.42)						
Organization Capital/Sales OC 2SLS			0.944*** (7.64)	5.018 (1.94)	1.182*** (8.31)	-0.459* (2.01)	-0.960** (2.97)	1.344*** (8.90)
Residual Earnings/Sales	0.164*** (6.82)	0.162*** (6.78)	0.128*** (5.69)	0.0803 (0.66)	0.137*** (4.16)	0.0993*** (4.00)	0.178*** (5.92)	0.0647 (1.40)
Manufacturing	-0.130 (0.88)	-0.108 (0.73)	-0.149 (1.10)	0.454 (1.73)	-0.0936 (0.48)	-0.140 (0.68)		
Service, Consumer Non- durables	0.316* (2.20)	0.345* (2.38)	0.278* (2.10)	0.526 (1.89)	0.294 (1.69)	0.0527 (0.23)		
Constant	0.381** (3.10)	0.318* (2.44)	0.323** (2.85)	0.262 (1.02)	0.272 (1.75)	-0.144 (0.69)	0.326*** (4.30)	0.563*** (6.06)
Observations	328	328	328	74	168	86	132	140
R <sup>2</sup>	0.193	0.198	0.319	0.230	0.455	0.499	0.299	0.426
Adjusted R <sup>2</sup>	0.165	0.168	0.293	0.078	0.413	0.417	0.241	0.381

Absolute *t* statistics in parentheses

# Market Value and Organization Capital in Selected Industries





# Conclusions

- Valuation using instruments
  - *Organization capital* 5% of sales and 8% in listed companies
    - Organization work expenditures better instrument, administration expenditures high correlation to sales
    - No complementarity to R&D but to tangible capital
- Equity Valuation
  - Explains unaccounted part of earnings flow
    - Potential for use in market valuation: firm-level, industry-level
  - Industry-level explains 10% of variation in market values over time
  - Services and high market value firms: 50% of total variation of stock prices can be explained, contribution at least 20%



# Table 1. Intellectual Capital (Organization, Human, Innovation, ICT)

Corrado-Hulten-Sichel (2005)	Intellectual Capital Categories	
	Van Ark (2004)	Own categories
	<i>Organization capital</i>	
1) Digitalized information	1) Engineering design	1) Managerial competence
a) Software	2) Organization design	2) Human Resource Management
b) Database	3) Construction and use of databases	3) Remuneration of innovative ideas
2) Innovation capital (R&N scientific, non-scientic.)	4) Remuneration of innovative ideas	4) Marketing, Selling
a) R&D (patents)	5) Marketing of new products	
b) Mineral exploration	6) Social capital	
c) Art, entertainment,		<i>Human capital</i>
3) Economic competence	1) Formal education	1) Formal education
a) Brand	2) Company training	2) Experience
b) Firm-specific	3) Experience	
c) Organization structure		<i>Innovation (Knowledge) capital</i>
	1) Research & development and patents	1) Research & development assets
	2) Licenses, brands, copyrights	2) Patents
	3) Other technological innovations	
	4) Mineral exploration	
		<i>ICT capital</i>
	1) Hardware	1) ICT personnel assets
	2) Telecommunication infrastructure	
	3) Software	

	<b>Occupation of Non-Production Worker</b>	<b>Organization Worker</b>	<b>R&amp;D Worker</b>	<b>IT Worker</b>
	Management	Management		
Manufacturing	R&D		x	
	R&D superior		x	
	Supply transport non-prod			
	Supply transport non-prod superior			
	Computer			x
	Computer superior			x
	Safety quality maintenance non-prod			
	Marketing purchases non-prod	Marketing		
	Marketing purchases non-prod superior	Marketing		
	Administration non-prod			
	Administration non-prod superior	Management		
	Finance admin non-prod			
	Finance admin non-prod superior			
	Personnel management non-prod	Management		
	Cleaner garbage collectors messengers			

Finland: Occupations by Confederation of Finnish Employers. The occupational codes are transformable to ISCO88 using additional information of educational-level (for qualifications) and industrial codes

Occupation Services		Organization Worker	R&D Worker	IT Worker
Services	Media			
	Computer processing services			x
	Computer processing services super			x
	Salesperson contract work services			
	Warehouse transport services			
	Maintenance gardening forest servi			
	Teacher counseling social science professionals			
	Hotel restaurants			
	Hotel restaurants superior			
	Social and personal care			
	Health sector			
	Forwarder services			
	Purchases and sales services			
	Insurance worker			
	Insurance worker superior			
	Small business manager			
	Finance services			
	Finance services superior	Management		
	Marketing services Excluded!			
	Marketing services superior	Marketing		
R&D worker services		x		
Personnel project manag serv	Administration			
Personnel project manag serv super	Management			
Administration services				
Administration services superior	Management			

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	<b>Industry</b>	<b>Nace Rev 1.1</b>	<b>Main Industry</b>
1	<b>Service, Consumer Non-Durables:</b> Food, Tobacco, Textiles, Apparel, Leather, Hotels, Entertainment, Utilities	DA, DB, DC, DL(335), DM(354), E, H	Service, Production of Non-Durables
2	<b>Consumer Durables:</b> Cars, TVs, Furniture, Household Appliances; Transportation, Toys, Sports	DM(excl. 354) DL(322-323) DN(excl. 3611-3612) I(excl. 642)	Manufacturing
3	<b>Other Manufacturing:</b> Metal, Trucks, Planes, Office Furniture, Paper	DM(351-353) DD, DE, DK, DN(3611-3612), DJ, DN	Manufacturing
4	<b>Energy,</b> Oil, Gas, and Coal Extraction and Products	DF	Mining, Construction, Others
5	<b>Chemicals</b> and Allied Products	DG(excl. 244), DH, DI	Manufacturing
6	<b>Business Equipment:</b> Computers, Software, and Electronic Equipment	DL(300,311-316, 332-335) K(721-724)	Service, Production of Non-Durables
7	<b>Telecom,</b> Telephone and Television Transmission	I(642)	Service, Production of Non-Durables
8	<b>Wholesale, Retail,</b> and Some Services, (Laundries, Repair Shops)	J,K(excl. 721-724)	Service, Production of Non-Durables
9	<b>Healthcare,</b> Medical Equipment, and Drugs	N(private), DG(244)	Service, Production of Non-Durables
10	<b>Money, Finance</b>	J,K(excl. 721-724)	Service, Production of Non-Durables
11	<b>Other: Construction, transportation,</b> Building Materials, Mining	CA, CB, F,	Construction, Others



## Table 2. Summary Table

Variable	Mean	Std	Median	Obs
Sales	78096	251363	21559	4990
Difference of log(Sales)	0.025	0.32	0.025	4990
Value Added	22733	86064	6480	4645
Sales reporting SGA	112758	116505	69043	345
Selling, General, Administration	14022	16926	7385	343
Difference of log(SGA)	0.024	0.41	0.0099	333
Selling	8802	12809	3749	345
Administration	5138	6383	2746	345
Employment	336	745	135	4990
Employees in Organization Work	41	117	14	4990
Organization Compensation	1306	3770	420	4990
Difference of log(Organisation Compensations)	0.0078	0.35	0.0087	4990
Management Compensation	643	1730	209	4990
Management personnel	14	62	4	4990
Marketing, Purchases Compensation	322	1451	78	4990
Marketing personnel	11	35	3	4990
Administration Compensation	341	1754	72	4990
Administration personnel	16	53	3.8	4990
ICT Compensation	270	1505	30	4990
ICT personnel	7.2	40	1	4990
R&D Compensation	768	3046	86	4990
R&D Asset	4394	17119	502	4990
Net Plant, Property, Equipment	3196275	1.7E+07	426085	4990
Hours per capita	1179	494	1092	4990
Hours per capita, skill adjusted	1629	804	1435	4990



## Step 1a: estimation by year

$$\begin{aligned}\log(\text{SALE}_{ikt} / \text{SALE}_{ik,t-1}) &= c_{0t} + g_{0t} \log(\text{OC}_{ikt} / \text{OC}_{ik,t-1}) \\ &+ c_{1t} \log(\text{PPE}_{ikt} / \text{PPE}_{ik,t-1}) + c_{2t} \log(\text{EMP}_{ikt} / \text{EMP}_{ik,t-1}) \\ &+ c_{3t} \log(\text{RND}_{ikt} / \text{RND}_{ik,t-1}) + \log(e_{ikt} / e_{ik,t-1})\end{aligned}$$

- Expression estimated by year t in three year spans k=t,t-1,t-2



## Step 1b: 2SLS estimation by year and industry

$$\begin{aligned}\log(\text{SALE}_{ijt} / \text{SALE}_{ij,t-1}) &= c_{0jt} + g_{0jt} \log(\text{OC}_{ijt} / \text{OC}_{ij,t-1}) \\ &+ c_{1jt} \log(\text{PPE}_{ijt} / \text{PPE}_{ij,t-1}) + c_{2jt} \log(\text{EMP}_{ijt} / \text{EMP}_{ij,t-1}) \\ &+ c_{3jt} \log(\text{RND}_{ijt} / \text{RND}_{ij,t-1}) + \log(e_{ijt} / e_{ij,t-1})\end{aligned}$$

$$\begin{aligned}\log(\text{OC}_{ijt} / \text{OC}_{ij,t-1}) &= b_{0jt} + b_{1jt} \log(\text{OC}_{ij,t-1} / \text{OC}_{ij,t-2}) + b_{2jt} \log(\text{SALE}_{ij,t-1} / \text{SALE}_{ij,t-2}) \\ &+ b_{3jt} \text{Region}_{ijt} + b_{4jt} \log(\text{PPE}_{ijt} / \text{PPE}_{ij,t-1}) + b_{5jt} \log(\text{EMP}_{ijt} / \text{EMP}_{ij,t-1}) \\ &+ b_{6jt} \log(\text{RND}_{ijt} / \text{RND}_{ij,t-1}) + \log(u_{ijt} / u_{ij,t-1})\end{aligned}$$

- 2SLS estimated by year  $t$  and industry  $j$ ,  $t = 1998, \dots, 2006$



# Step 1. Mean from Yearly Estimates

## 1998-2006

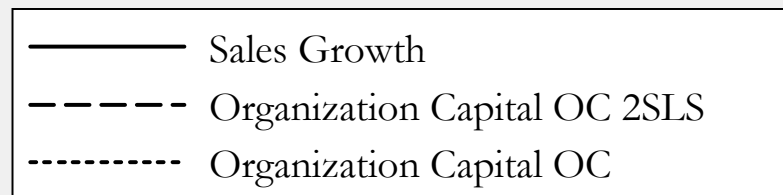
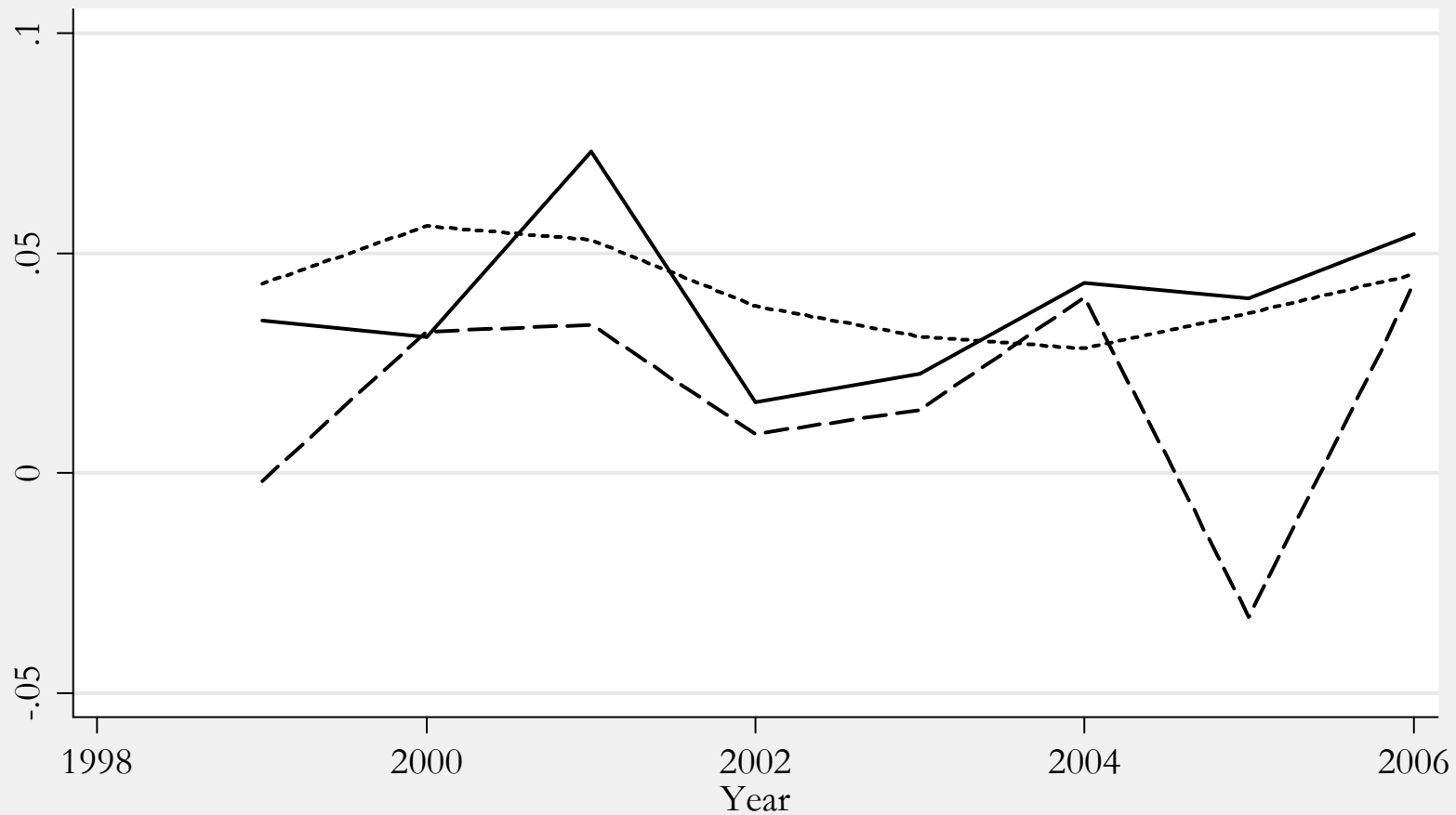
Panel Mean Estimate	(1) OC	(2) OC 2SLS	(3) SGA 2SLS
Organization Instrument	0.026	0.035	0.350
Average t-value over years (and industries)	( 2.13)	( 1.12)	( 6.55)
Standard deviation over years	0.023	0.092	0.537
Net Plant, Property, Equipment	0.143	0.187	0.239
Average t-value over years (and industries)	( 9.45)	( 1.85)	( 3.74)
Standard deviation over years	0.021	0.124	0.539
Employment	0.206	0.310	0.140
Average t-value over years (and industries)	( 11.6)	( 2.36)	( 2.99)
Standard deviation over years	0.034	0.156	0.412
R&D Asset	0.048	0.355	-0.129
Average t-value over years (and industries)	( 1.8)	( .84)	( 2.2)
Standard deviation over years	0.019	1.586	0.597
Constant	0.042	0.035	0.054
Average t-value over years (and industries)	( 7.02)	( 1.54)	( 2.45)
Standard deviation over years	0.009	0.031	0.064

OC spans over years; OC 2SLS spans over 11 industries and SGA 2SLS spans over 3 industries (1 service and non-durables, 2 manufacturing, 3 minings, construction other).

Table shows the average coefficient and t-statistics the average over the years (and industries in 2SLS) and the standard deviation is calculated from the annual estimates.



# Organization Capital per Sales in Services and Production of Non-Durables





# Organization Capital , Globalization, ICT personnel

	Organization Capital OC	Organization Capital OC 2SLS	Organization Capital ISO 2SLS
Foreign employment	0.120*** (11.48)	0.122*** (7.34)	0.0376 (0.75)
2-3 plants	0.153*** (4.03)	0.183** (3.09)	-0.0331 (0.14)
4 or more plants	0.117 (1.77)	0.308** (2.92)	-0.108 (0.25)
Listed Firm	-0.0789 (0.44)	0.0692 (0.29)	-1.304 (1.15)
Performance-Related-Pay Scheme	0.527*** (16.87)	0.474*** (9.82)	0.199 (0.85)
IT-Assets	0.220*** (43.54)	0.194*** (24.75)	0.313*** (6.5)
Firm Age	0.136*** (5.25)	0.186*** (4.68)	0.332 (1.58)
Market Share	0.0209*** (17.93)	0.0228*** (12.47)	0.00253 (0.37)
Constant	4.846*** (28.59)	4.162*** (19.28)	4.225*** (3.91)
Observations	5220	3705	208
$R^2$	0.491	0.373	0.365