Capital Deepening and Regional Inequality: An Empirical Analysis

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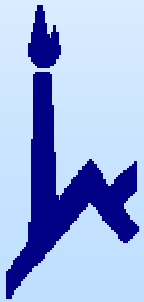

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The Motivation

- No data published on regional capital stocks in Israel (or anywhere)
- Researchers try and construct data using '*apportionist*' and '*direct*' methods that are often problematic
- This paper :
  - Introduces new hybrid method
  - Presents first time estimates of capital stock and capital per worker
  - Present a validation test of our estimates by looking at the relationship of capital deepening on regional wages.

Creating Capital Stock Series- the Problems

- *Apportioning* regional capital stock by wages, employment invested is problematic: impossible to test hypotheses about role of capital deepening on regional inequality when the data are constructed under the very hypotheses to be tested.
- *Direct* method = *perpetual inventory method*. Data on regional investment anchored to regional capital stock in base year, allowing for depreciation. Problems:
  - Absence of regional price deflators for investment
  - Absence of data on regional capital stock for base year
  - Absence of regional rates for capital depreciation

A *Direct Method* for measuring the physical stock of *plant* (perpetual inventory method):

$$P_{jt} = P_{jt-1} + C_{jt-1} - D_{jt-1} \qquad (1)$$

P_{jt} =floor-space for plant in region j at the start of year t

C_{jt} = non residential building completions in region j at time t

D = net demolitions

Anchor year =2005, CBS GIS data including building heights.

We assume D= proportion of the existing stock of plant,

i.e. $D_{jt} = \delta_j P_{jt-1}$

Criterion for selecting D:

$$\Delta \ln P_t = \Delta \ln K_{pt} + e_t \qquad (2)$$

where $P_t = \sum_{j=1}^{N} P_{jt}$

K_p = national capital stock invested in plant constant prices.

A *Semi Direct Method* for Measuring Capital Stock for *Machinery and Equipment*

Apportioning national capital stock in machinery to the regions using the formula:

$$K_{mjt} = P_{jt}\, \pi_t\, \rho_t \qquad (3)$$

K_p = national capital stocks for plant

K_m = national capital stocks for machinery

$\pi_t = K_{pt}/P_t$ = implicit price per square meter of plant

ρ = ratio of machinery (K_m) to plant (K_p) (ie space-intensity of a unit of machinery)

Fig 1: Regional Divisions

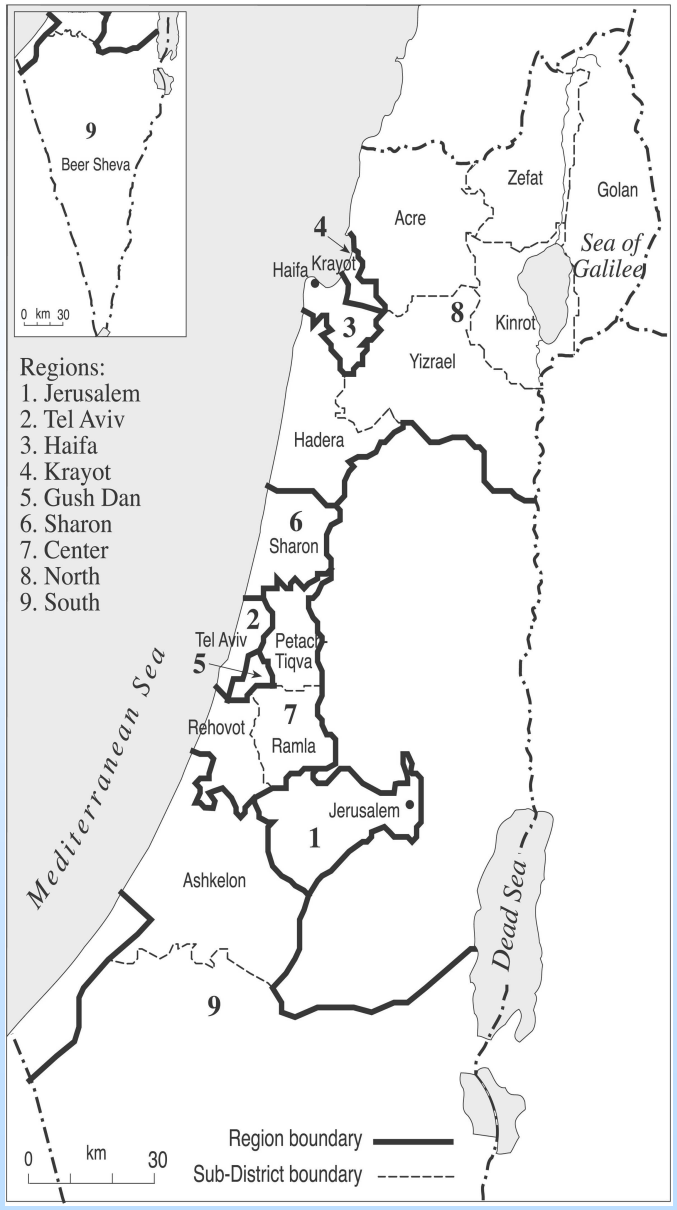


Fig 2: Regional Capital Stocks for Plant (logs, square meters)

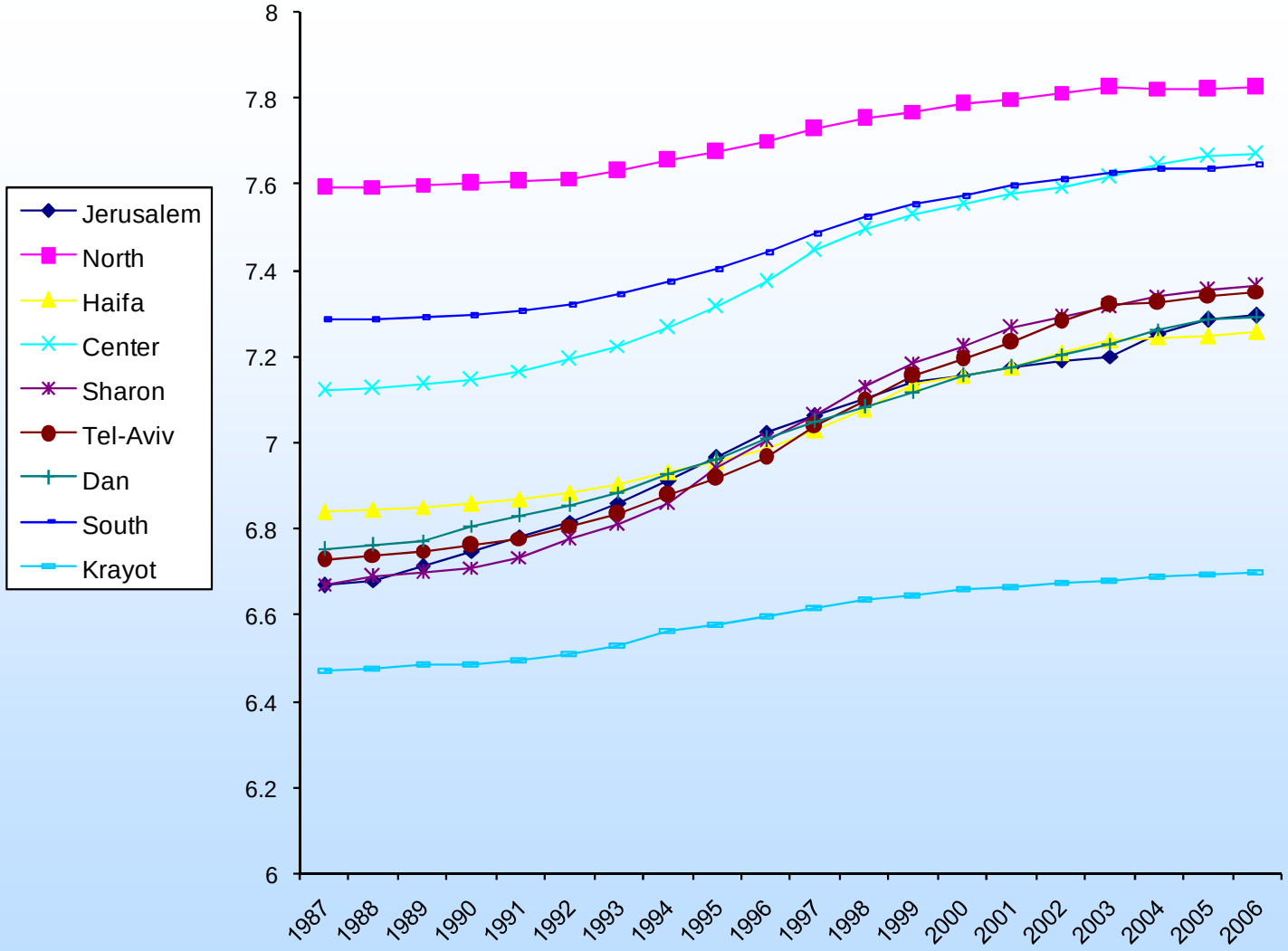


Fig 3: Machinery-Plant Ratio (ρ) and the Real Price of Plant (π) in Israel

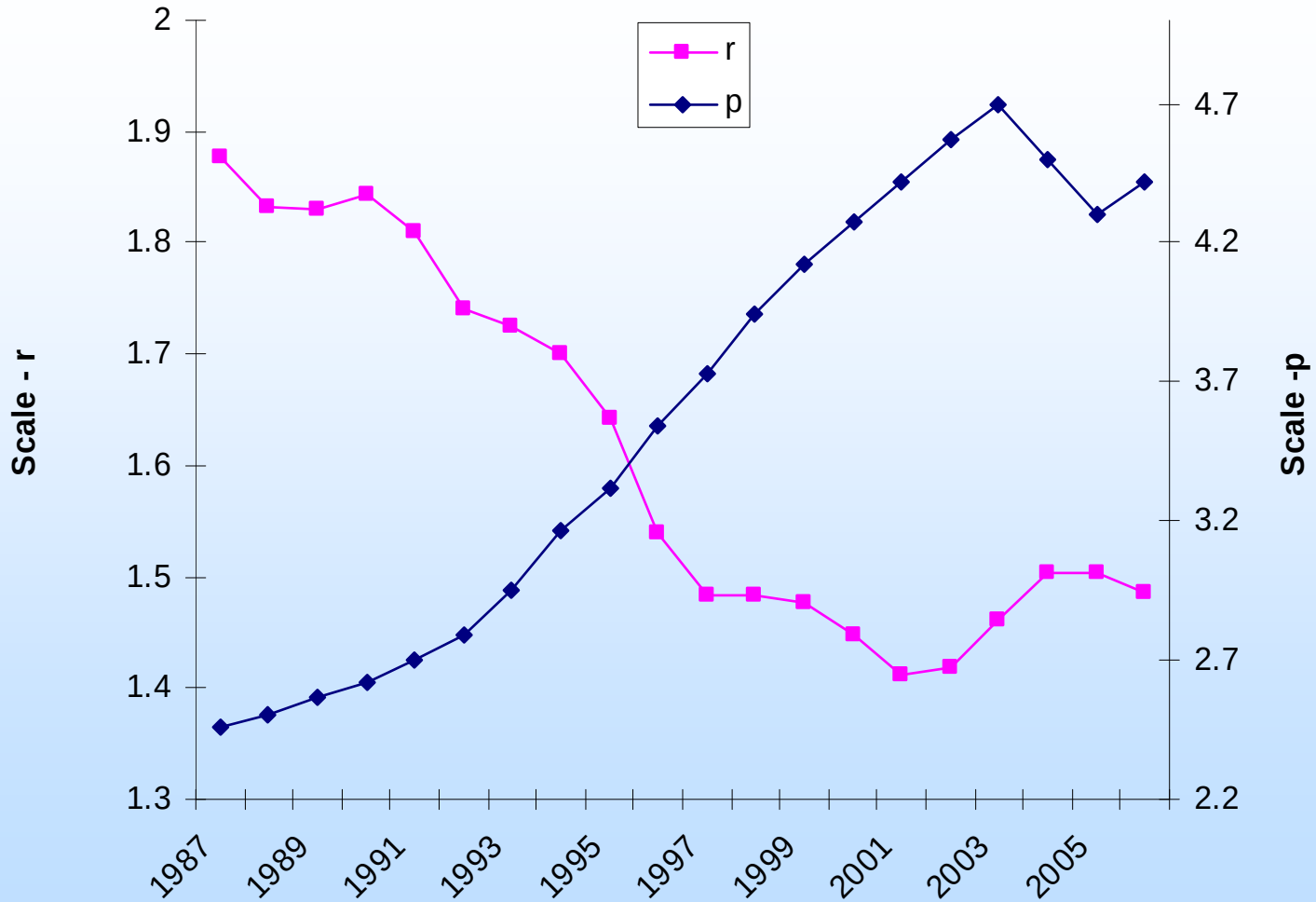


Fig 4: Regional Convergence in Capital-Labor Ratios (logs), 1987-2006

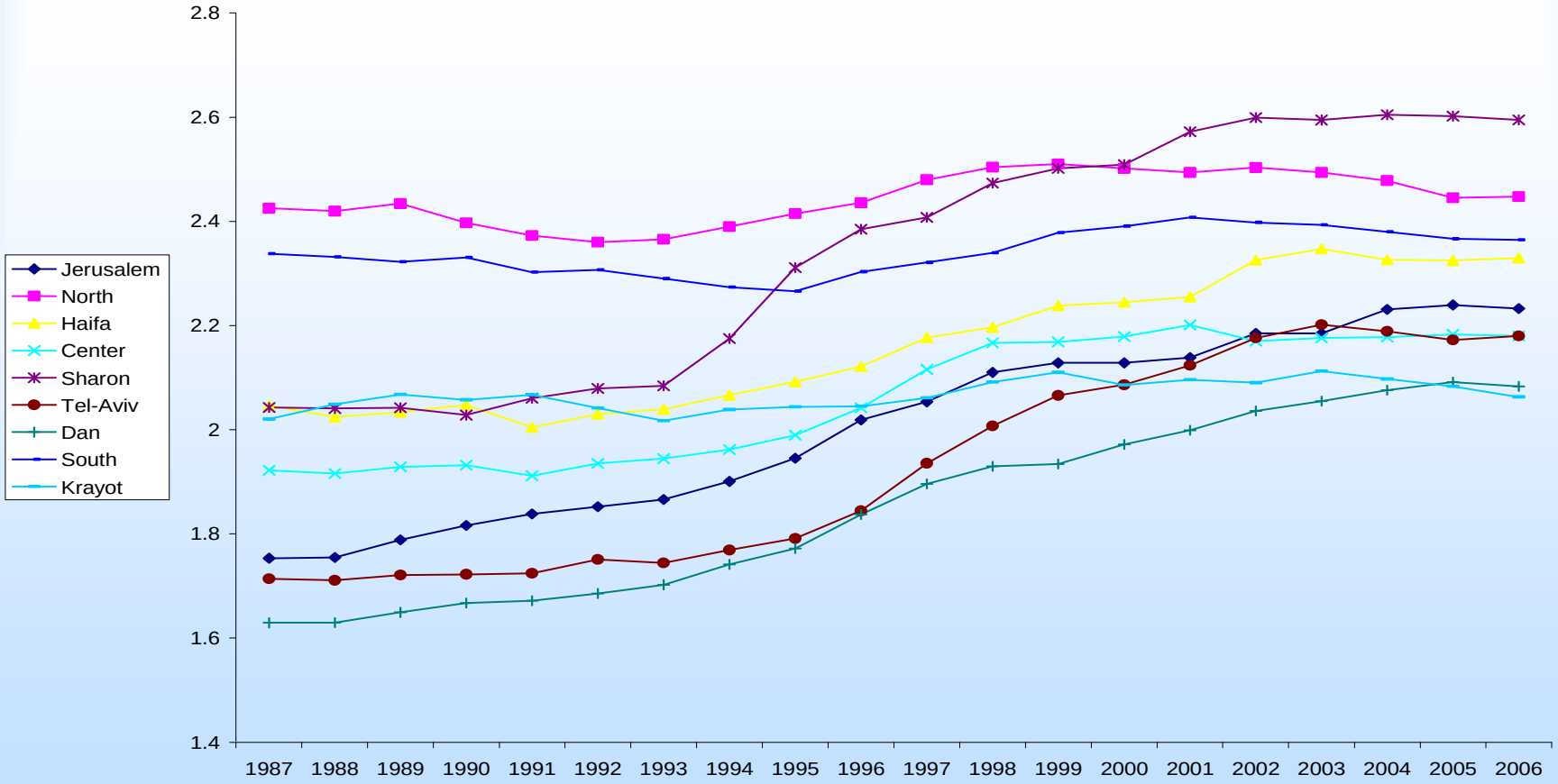


Fig 5: Regional non-residential land prices (industrial, office and commercial); Israel Land Authority Tenders 1987-2005 (m^2 in 1991 Shekel prices)

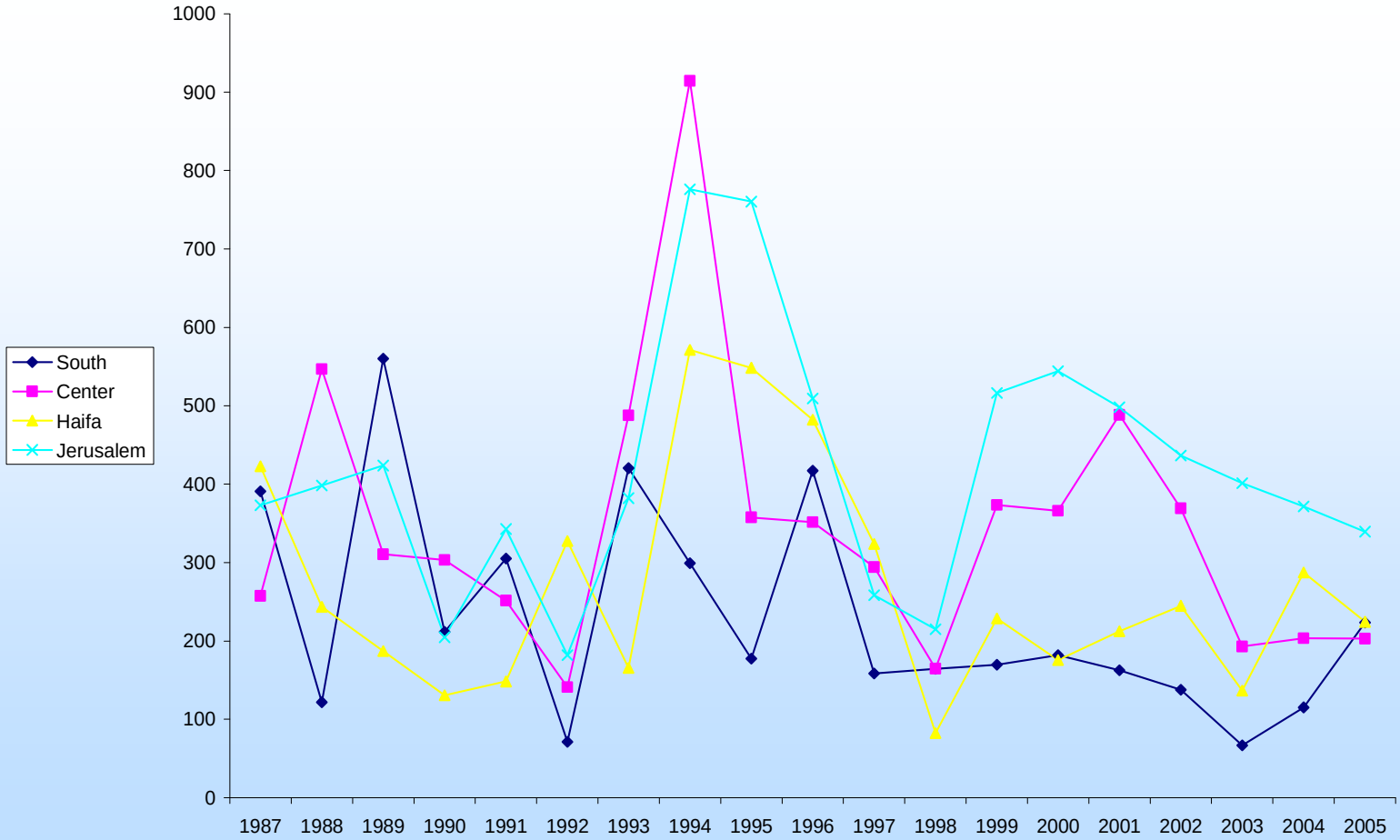
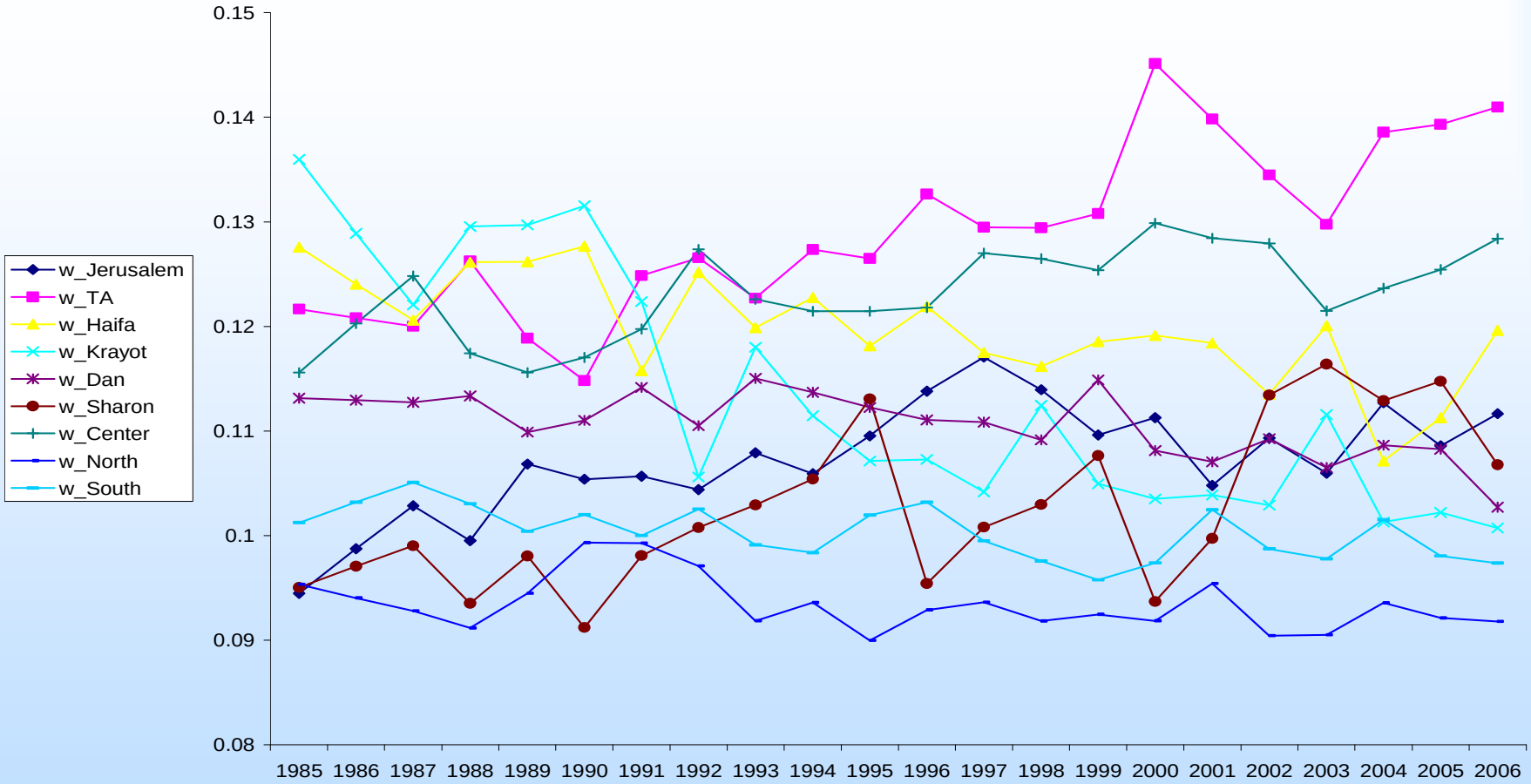


Figure 6: Validation using Relative Regional Wages



Estimating the Effect of Capital Deepening on Regional Wages

$$\ln w_{jt} = \alpha_j + \delta_t + \gamma \ln k_{jt} + \sum_{k=1}^{K} \theta_k x_{kjt} + u_{jt} \qquad (5)$$

w = regional wages deflated by national consumer prices

k = capital-labor ratio

x's = set of regional demographic or "Mincer" controls (regional averages for schooling, age, gender etc) that are hypothesized to determine wages apart from k.

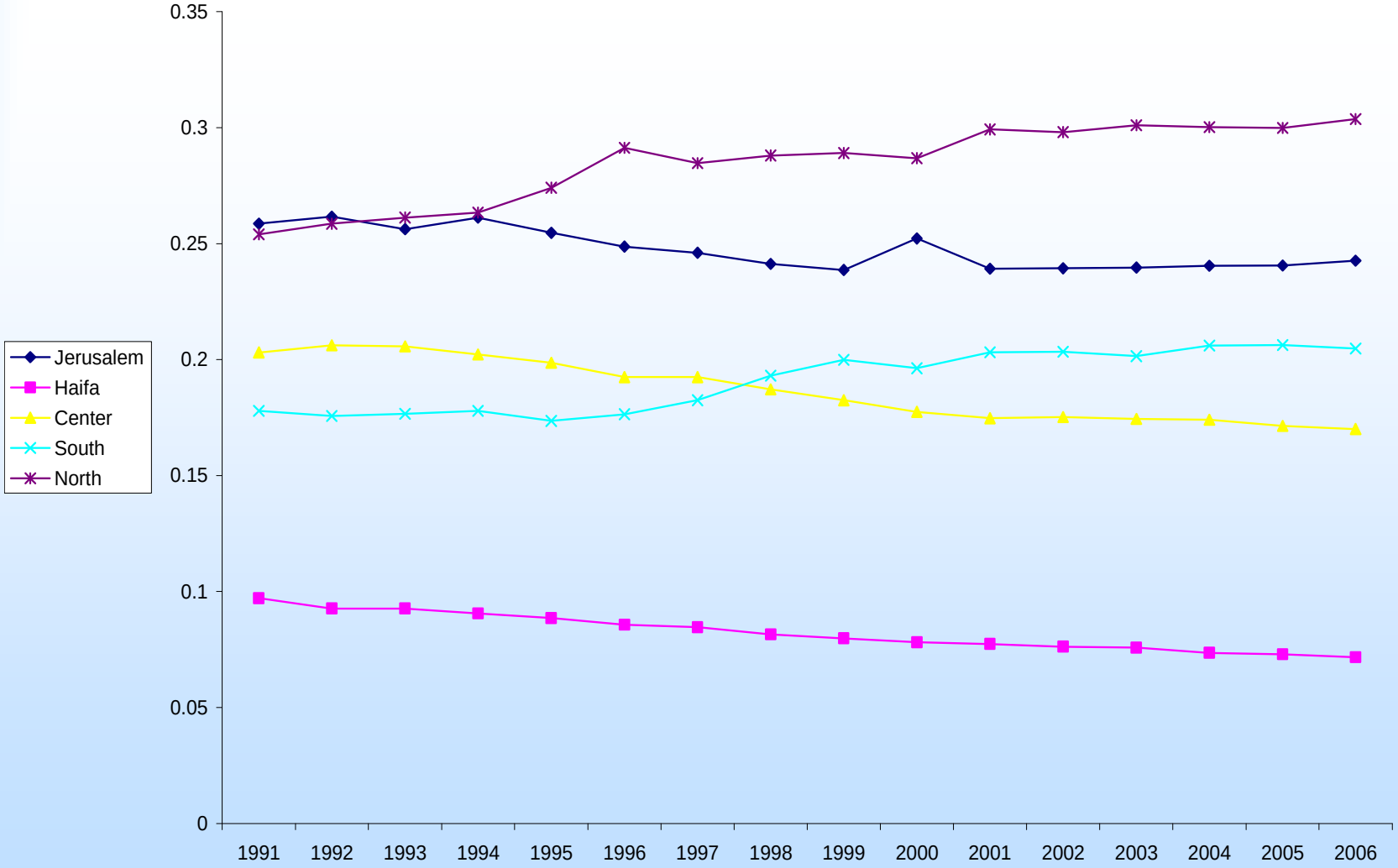
Equation (5) is estimated using panel data econometrics: the α and δ coefficients are two-way fixed effects for the nine regions and twenty years of data.

Panel Unit Root Tests (non stationary data)

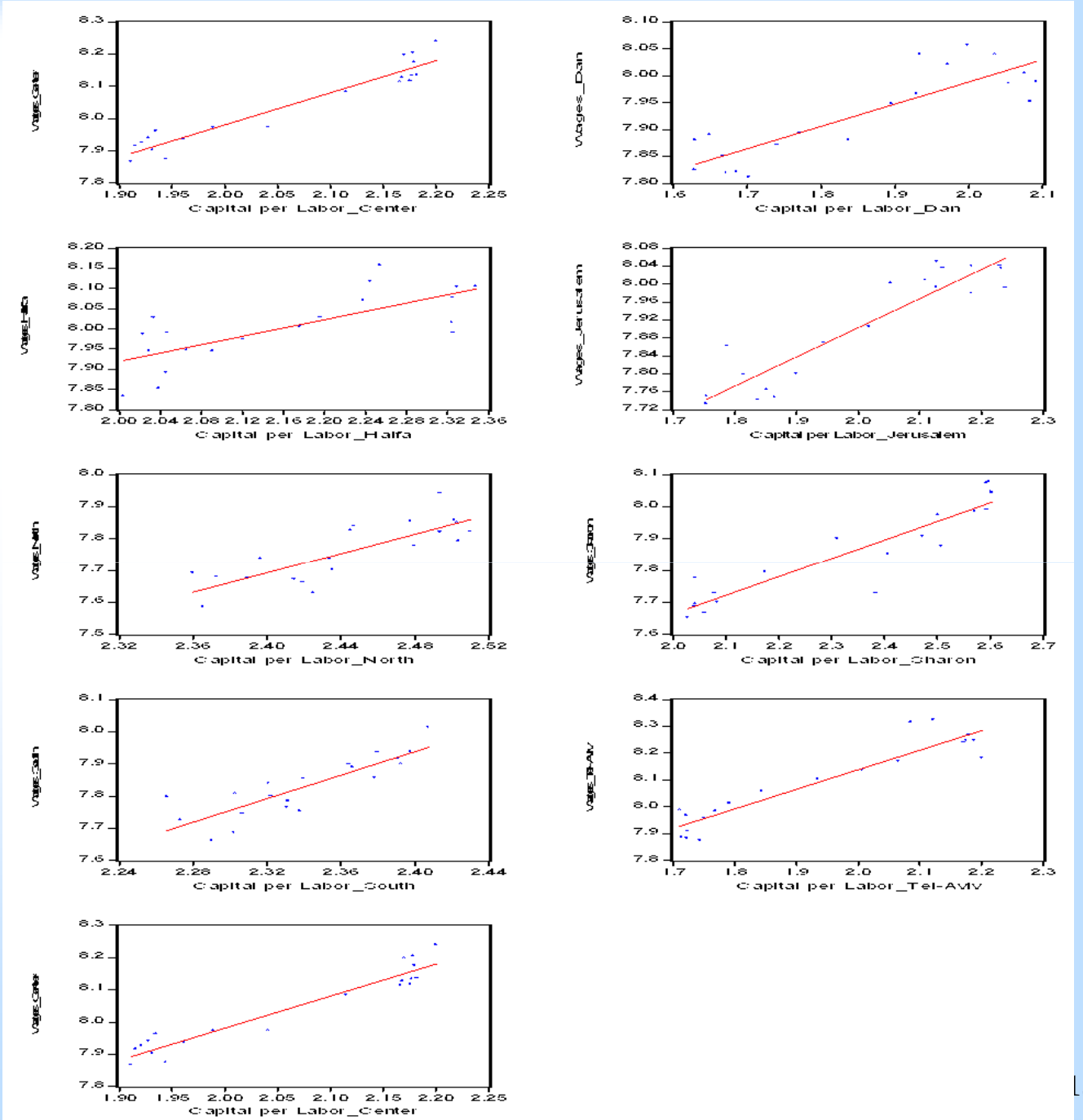
	IPS		CIPS	
	d = 0	**d = 1**	**d = 0**	**d = 1**
Ln*w*	-1.392	-4.834	-1.257	-4.077
Ln*k*	-0.644	-2.789	-1.205	-2.708
Schooling	-1.518	-6.067	-1.410	-4.702
Age	-3.015	-6.030	-2.755	-5.124
Males	-4.049	-7.106	-3.525	-6.088
Non_Jews	-3.151	-6.505	-2.952	-6.064
Immigrants	-2.049	-4.904	-2.384	-5.227

Notes: IPS is the heterogeneous unit root test due to Im et al (2003) and CIPS is its common factor counterpart due to Pesaran (2006). Schooling = average years of education. Age = average age. Males = percent males in population. Non-Jews = percent non-Jews in population. Immigrants = percent of immigrants (less than 10 years in Israel) in population.

Fig 7: Regional Shares of Human Capital



Wages and Capital-Labor Ratios by Region



Panel Cointegration Tests for Regional Wages

Model	1	2	3
Lnk	0.107 (0.021)	0.25-0.45	0.3769
Schooling	0.13 (0.005)	0.103 (0.0097)	0.0983 (0.00996)
Age	0.35 (0.155)	0.408 (0.173)	0.36327 (0.1756)
Age^2	-0.0043 (0.0019)	-0.0049 (0.0021)	-0.004 (0.0021)
Males	0.0022 (0.0013)	-0.0031 (0.0013)	-0.002 (0.0013)
Non-Jews	-0.0023 (0.00028)	0.00264 (0.0043)	0.0021 (0.0004)
Immigrants	-0.0015 (0.00048)	-0.00045 (0.00023)	-0.0004 (0.0004)
Fixed effects	No	No	Yes
Standard Error	0.064	0.05	0.049
R^2	0.998	0.999	0.969
t-bar	-0.9	-1.67	-1.8
Pedroni	-0.95	-1.48	-1.61

Notes: Dependent variable is lnw. Estimated by EGLS with SUR cross-section dependence. Standard errors of parameters in parentheses. Estimation period 1991-2006. t-bar is the average ADF statistic of the residuals. Pedroni is the Phillips-Perron cointegration test statistic suggested by Pedroni (2004) for panel data.

Decomposing Regional Wage Inequality

Use Model 1 to decompose regional wage inequality.

The decomposition due to equation (5) is:

$$\text{var}(\ln w)_t = \gamma^2 \,\text{var}(\ln k)_t + \sum_{k=1}^{K} \theta_k^2 \,\text{var}(x_k)_t + c_t + \text{var}(\hat{u})_t \qquad (6)$$

$$c = 2\sum_{k=1}^{K} \gamma\theta_k \,\text{cov}(\ln k x_k) + \sum_{j}^{K}\sum_{h}^{K} \theta_k \theta_h \,\text{cov}(x_k x_h) \qquad (7)$$

Decomposing Regional Inequality

Variance	1991	2006
Lnk	0.00065621	0.000352
Schooling	0.012436751	0.0074308
Age	0.091168376	0.091360
Age-squared	0.087859542	0.095657
Males	6.82691E-06	3.63226E-06
Non-Jews	0.000848695	0.00072
Immigrants	2.61073E-05	3.70551E-05
Residual	0.0112	0.0054
Covariance	-0.196	-0.182
Regional Wage	0.0091	0.0192

Conclusions

- We use direct method for calculating capital stock for plant
- We use apportionist , plant-based method for machinery
- We relate capital-labor ratios to regional wages and see ‘inverted’ convergence.
- We use panel cointegration to estimate regional wage functions in terms of capital deepening and human-capital deepening
- We find regional wages have not sigma-converged because some determinants of wages (human capital) have been sigma-divergent.