PUBLIC CAPITAL SKILL-COMPLEMENTARITY AND INEQUALITY

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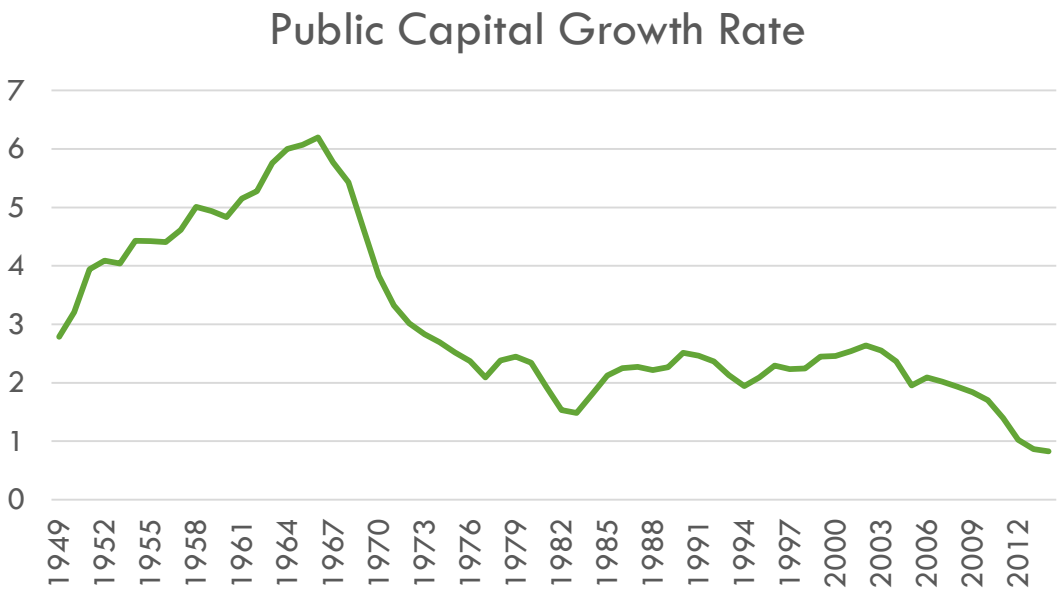
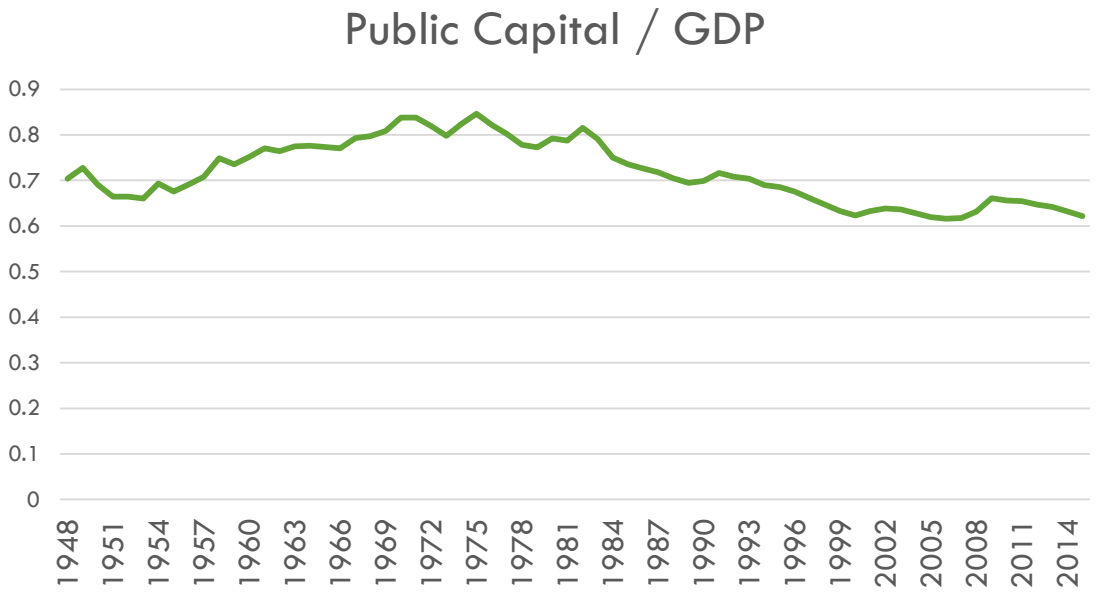
INTRODUCTION

There has been a decrease in the relative public capital stock.

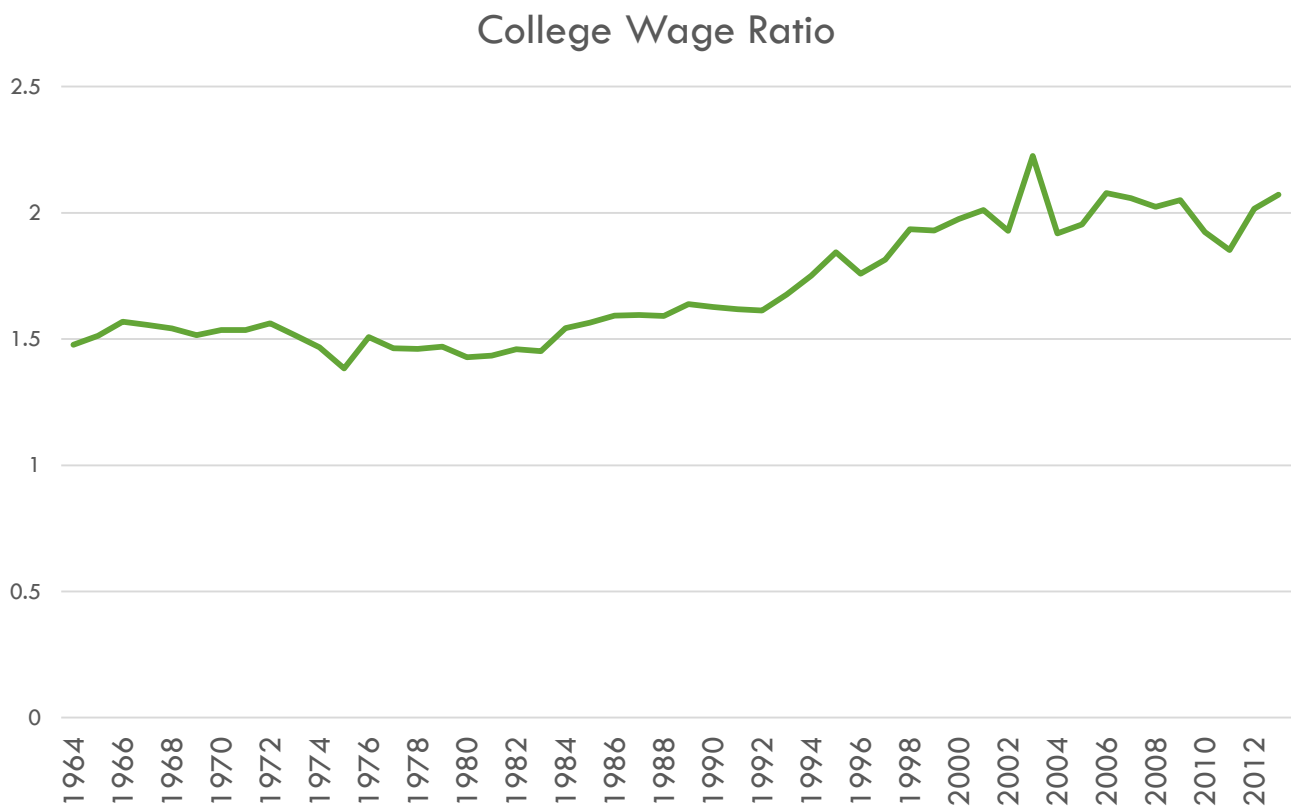


Note: Public capital is net military assets and constant cost.



Note: Public capital and GDP are constant cost. Public Capital is net military assets.

Likewise, there has been an increase in the skilled wage gap.



Source: Current Population Survey

HYPOTHESIS

- Public capital complements low-skilled labor more than high-skilled labor.
- Ex: bridges & truck drivers, water treatment & laborers (Flint, MI).
- Decreases in relative public capital increases $\frac{MPL_s}{MPL_u}$.
- This explains some of the increase in wage inequality.

LABOR COMPLEMENTARITY WITH PUBLIC CAPITAL – MIXED RESULTS

	Nadiri & Mamuneas (1996)	Cohen & Paul (2004)	
		Intra-state	Inter-state
manufacturing and services	Substitute	Complement	Complement
non-manufacturing industries.	Complement	Substitute	Complement

We are the first to study public capital complementarity with skilled labor.

(PRIVATE) CAPITAL-SKILL HYPOTHESIS

- Griliches (1969) first to show capital complements skilled labor while substituting unskilled labor.
- Krusell, Ohanian, Ríos-Rull, & Violante (2000) -- KORV
- Estimate a nested CES production function
- $Y = k_s^{\alpha}\left[\mu n^{\theta} + (1-\mu)\left(\lambda k_e^{\rho} + (1-\lambda)s^{\rho}\right)^{\frac{\theta}{\rho}}\right]^{\frac{1-\alpha}{\sigma}}$.
- The elasticity of substitutions between k_e and n is $\sigma_{k_e n} = \sigma_{sn} = \frac{1}{1-\theta}$.
- Additionally, $\sigma_{k_e s} = \frac{1}{1-\rho}$.
- Capital-skill complementary requires that $\sigma_{k_e n} > \sigma_{k_e s}$.

KORV (2000) RESULTS

- Capital-skill complementarity:

$$.401 = \sigma > \rho = -.495.$$
$$1.67 = \sigma_{k_e n} > \sigma_{k_e s} = .67$$

- Holding k_e at constant 1975 levels, the wage premium only increases by 8%, rather than 18%.

MODEL

$$Y = At\left[a\left[b\left[cK^{\theta} + (1-c)N^{\theta}\right]^{\frac{\rho}{\theta}} + (1-b)G^{\rho}\right]^{\frac{\nu}{\rho}} + (1-a)S^{\nu}\right]^{\frac{1}{\nu}},$$

- Three-layer nested CES production function
- Y – *Private Output*
- K – *Private Capital Services*
- G – *Public Capital*
- N – *Unskilled Labor*
- S – *Skilled Labor*

CES requires some of the six elasticities of substitution to be equal to each other.

I determine which model to use by AIC.

	(((G,K)S)N)	(((G,K)N)S)	(((G,S)N)K)	(((G,S)K)N)	(((K,S)G)N)	(((K,S)N)G)	(((G,N)S)K)	(((G,N)K)S)	((K,N)S)G)	((K,N)G)S)	(((N,S)G)K)	(((N,S)K)G)
σ_{GK}	*	*	#	§	§	#	#	§	#	§	#	#
σ_{GS}	§	#	*	*	§	#	§	#	#	#	§	#
σ_{KS}	§	#	#	§	*	*	#	#	§	#	#	§
σ_{GN}	#	§	§	#	#	#	*	*	#	§	§	#
σ_{KN}	#	§	#	#	#	§	#	§	*	*	#	§
σ_{SN}	#	#	§	#	#	§	§	#	§	#	*	*

Note: #, *, and § represent elasticities that are equal to each other.

ESTIMATION

Following Duffy, Papageorgiou, & Pérez-Sebastian (2004),

I employ non-linear least squares.

Total factor productivity, A, is represented by a time trend

Standard errors are Newey-West correcting for autocorrelation.

S.E. for σ are calculated using the Delta Method.

Partial equilibrium production function.

- Reduces the number of parameters substantially.
- We have a small sample (50 observations)

PROBLEMS

Labor quality per hour is unobservable. KORV (2000) simulate efficiency units.

$s_t \equiv \varphi_{st} h_{st}$

h_{st} is number of hours worked

φ_{st} is human capital or skill-specific technology level

Follows the stochastic process

$\varphi_t = \varphi_0 + \gamma t + \omega_t$

For a nonlinear latent process, OVKR (1998) find Simulated Pseudo-MLE is superior.

P-MLE relies on first and second moments of data. Robust to incorrectly specified likelihood function.

DATA

Public Capital

- BEA Standard Fixed Asset Tables

Private Output and Private Capital

- BLS Multifactor Productivity Series.

Labor input

- Consumer Population Survey (CPS) accessed through IPUMS (Flood, King, Ruggles, & Warren, 2015).

- Skilled Labor is defined as “completed four years of college.”

MODEL SELECTION

Four of the combinations assume $\sigma_{G,N} = \sigma_{G,S}$.

Model	AIC	BIC
1	518.1	531.5
2	515.5	523.1
3	685.6	691.3
4	362.4	368.1
5	285.0	290.8
6	283.8	291.5
7	273.3*	279.0*
8	273.5	279.3

RESULTS

	$[((K,N)\,G)\,S]$	$[((G,N)\,K)\,S]$
σ_{GS}	1.46	3.07
	(0.377)	(1.068)
σ_{GN}	0.42	0.30
	(0.078)	(0.229)

Public Capital complements unskilled labor more than skilled labor

ROBUSTNESS

$\sigma_{GS} > \sigma_{NS}$ in six out of eight model selections

In three of these, the difference is greater than the respective 95% confidence regions of the point estimates.

WHERE TO NEXT – VARYING INPUT TYPES

- Public Capital
  - Transportation, Utilities, Government Buildings
- Labor
  - Different education thresholds.
  - Split labor by occupation or industry.
    - Orak (2017) “Capital-Task Complementarity”
  - Gender

WHERE TO NEXT - ESTIMATION

- Simulated P-MLE
  - Match model with labor share, wage ratio, and no arbitrage condition
- Simple general equilibrium model

WHERE TO NEXT – HUMAN CAPITAL AGGREGATION

- Jones (2014) calculates a generalized aggregator subsuming the linear method; such as in KORV (2000).
- Linear aggregation assumes perfect substitution between different levels of human capital.
- Jones allows for scarcity effect $\frac{\partial MPL_u}{\partial L_u} < 0.$
- complementary effect $\frac{\partial MPL_u}{\partial L_s} > 0.$