

# Lecture 7 - Marginal Product of Capital, Bubbles, OLG

## UCLA - Econ 221 - Fall 2018

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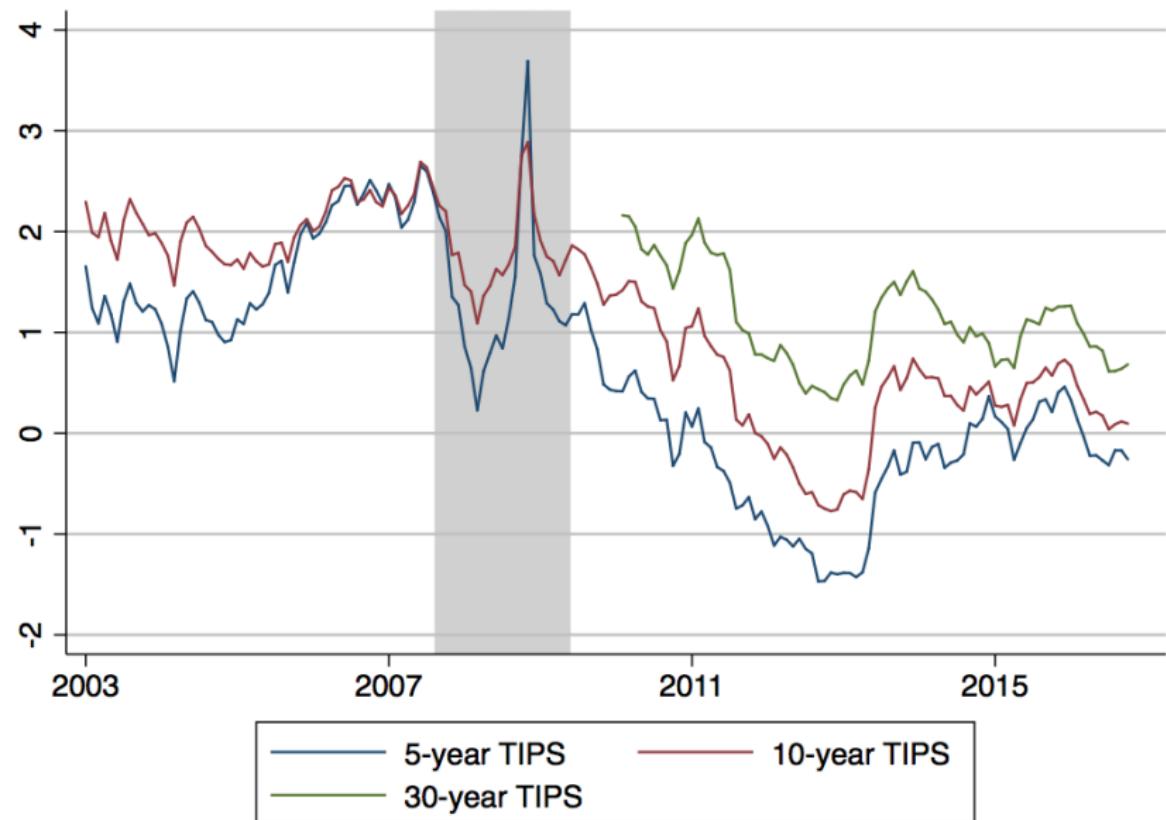
November 13, 2018

# Outline

- ① Low interest rates
- ② More interest rates
- ③ Abel et al. (1989)
- ④ Caselli and Feyrer (2007)
- ⑤ Piketty and Zucman (2014)
- ⑥ Changing nature of capital
- ⑦ Reassessing Dynamic Efficiency
- ⑧ Rognlie (2015)

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# Negative yields



# Interest rates VS growth rates

**Table 2.2**

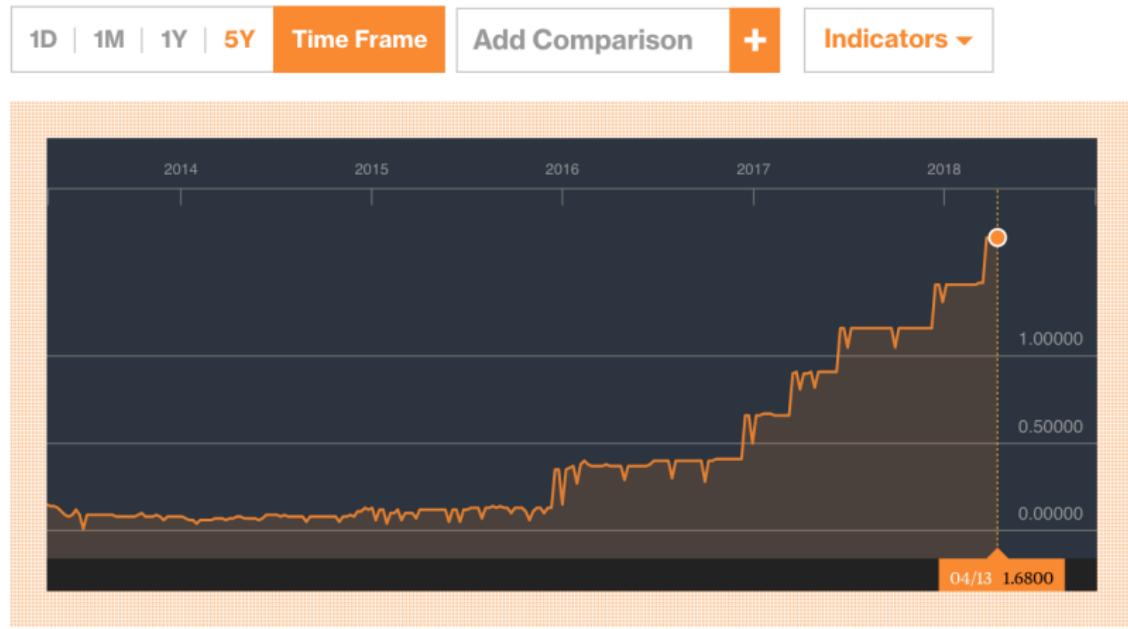
Interest rates on public debt versus growth rates

Period		Interest rate*	Nominal growth	Real growth	Inflation	Interest-growth
From	To	(1)	(2)	(3)	(4)	(5)
1792	2003	4.5%	5.2%	3.8%	1.4%	-0.6%
1792	1868	4.8%	4.9%	4.2%	0.6%	-0.1%
1869	2003	4.4%	5.3%	3.5%	1.8%	-1.0%
1792	1914	4.6%	4.3%	4.1%	0.2%	0.4%
1915	2003	4.4%	6.4%	3.4%	3.1%	-2.1%

\*The interest rate on public debt is computed as the ratio of interest payments over the average of outstanding debt at the start and the end of each year.

# Federal Funds Rate

Source: Bloomberg, Screenshot, April 14, 2018. Link



# Federal Funds Rate

Source: Bloomberg, Screenshot, April 14, 2018. Link

## Federal Reserve Rates

RATE	CURRENT	1 YEAR PRIOR
FDFD:IND <b>Fed Funds Rate</b>	1.68	0.90
FDTR:IND <b>Fed Reserve Target</b>	1.75	1.00
PRIME:IND <b>Prime Rate</b>	4.75	4.00

# US Treasury Yields

Source: Bloomberg, Screenshot, April 14, 2018. Link

## Treasury Yields

NAME	COUPON	PRICE	YIELD	1 MONTH	1 YEAR	TIME (EDT)
<b>GB3:GOV 3 Month</b>	0.00	1.72	1.75%	0	+95	4/13/2018
<b>GB6:GOV 6 Month</b>	0.00	1.91	1.95%	+2	+103	4/13/2018
<b>GB12:GOV 12 Month</b>	0.00	2.03	2.09%	+6	+108	4/13/2018
<b>GT2:GOV 2 Year</b>	2.25	99.80	2.36%	+10	+115	4/13/2018
<b>GT5:GOV 5 Year</b>	2.50	99.20	2.67%	+6	+90	4/13/2018
<b>GT10:GOV 10 Year</b>	2.75	99.34	2.83%	+1	+59	4/13/2018
<b>GT30:GOV 30 Year</b>	3.00	99.47	3.03%	-3	+14	4/13/2018

# US TIPS

Source: Bloomberg, Screenshot, April 14, 2018. Link

## Treasury Inflation Protected Securities (TIPS)

NAME	COUPON	PRICE	YIELD	1 MONTH	1 YEAR	TIME (EDT)
GTII5:GOV <b>5 Year</b>	0.13	98.45	0.52%	+6	+74	4/13/2018
GTII10:GOV <b>10 Year</b>	0.50	98.29	0.68%	-5	+37	4/13/2018
GTII20:GOV <b>20 Year</b>	3.38	134.75	0.75%	-12	+31	4/13/2018
GTII30:GOV <b>30 Year</b>	1.00	103.19	0.88%	-9	+2	4/13/2018

# US TIPS

Source: Bloomberg, Screenshot, April 14, 2018. Link

## Treasury Inflation Protected Securities (TIPS)

NAME	COUPON	PRICE	YIELD	1 MONTH	1 YEAR	TIME (EDT)
GTII5:GOV <b>5 Year</b>	0.13	98.45	0.52%	+6	+74	4/13/2018
GTII10:GOV <b>10 Year</b>	0.50	98.29	0.68%	-5	+37	4/13/2018
GTII20:GOV <b>20 Year</b>	3.38	134.75	0.75%	-12	+31	4/13/2018
GTII30:GOV <b>30 Year</b>	1.00	103.19	0.88%	-9	+2	4/13/2018

# Selected Rates (Federal Reserve)

Source: Selected Interest Rates (Daily) - H.15, April 14, 2018. Link

Federal funds (effective)	1.69	1.69	1.69	1.69	1.69	Bank prime loan	4.75	4.75	4.75	4.75	4.75
Commercial Paper						Discount window primary credit	2.25	2.25	2.25	2.25	2.25
Nonfinancial						U.S. government securities					
1-month	1.82	1.81	1.80	1.83	1.81	Treasury bills (secondary market)					
2-month	1.90	1.91	1.89	1.88	1.88	4-week	1.65	1.64	1.61	1.61	1.62
3-month	1.99	2.00	2.00	2.00	2.00	3-month	1.70	1.73	1.71	1.70	1.72
Financial						6-month	1.86	1.89	1.89	1.90	1.90
1-month	1.75	1.85	1.82	1.86	1.79	1-year	2.00	2.01	2.02	2.02	2.04
2-month	n.a.	2.06	2.00	2.01	1.90						
3-month	2.29	2.23	2.29	2.27	2.01						
Treasury (Nominal)						Treasury (Inflation indexed)					
<u>Nominal</u>						5-year	0.57	0.58	0.62	0.56	0.62
						7-year	0.66	0.67	0.70	0.63	0.69
1-month	1.68	1.67	1.63	1.64	1.65	10-year	0.70	0.71	0.72	0.68	0.70
3-month	1.73	1.76	1.74	1.73	1.75	20-year	0.83	0.83	0.84	0.80	0.82
6-month	1.91	1.93	1.93	1.95	1.95	30-year	0.92	0.92	0.92	0.88	0.90
1-year	2.06	2.08	2.09	2.09	2.11	Inflation-indexed long-term average	0.85	0.85	0.85	0.82	0.84
2-year	2.27	2.29	2.32	2.32	2.34						
3-year	2.40	2.43	2.45	2.45	2.49						
5-year	2.58	2.60	2.62	2.62	2.67						
7-year	2.70	2.72	2.74	2.72	2.78						
10-year	2.77	2.78	2.80	2.79	2.83						
20-year	2.89	2.89	2.89	2.87	2.92						
30-year	3.01	3.02	3.02	2.99	3.05						

# 10-Year Europe

Source: Bloomberg, Screenshot, April 14, 2018. Link

## Europe, Middle East & Africa

### 10-Year Government Bond Yields

COUNTRY	YIELD	1 DAY	1 MONTH	1 YEAR	TIME (EDT)
<b>Germany »</b>	0.51%	0	-8	+32	4/13/2018
<b>United Kingdom »</b>	1.43%	-2	0	+39	4/13/2018
<b>France</b>	0.74%	-1	-10	-17	4/13/2018
<b>Italy</b>	1.79%	-1	-22	-51	4/13/2018
<b>Spain</b>	1.22%	-2	-16	-46	4/13/2018
<b>Netherlands</b>	0.65%	-1	-11	+22	4/13/2018
<b>Portugal</b>	1.63%	-4	-15	-222	4/13/2018
<b>Greece</b>	4.04%	+6	-7	-250	4/13/2018
<b>Switzerland</b>	-0.04%	0	-8	+18	4/13/2018

# 10-Year Asia

Source: Bloomberg, Screenshot, April 14, 2018. Link



## Asia Pacific 10-Year Government Bond Yields

COUNTRY	YIELD	1 DAY	1 MONTH	1 YEAR	TIME (EDT)
<b>Japan »</b>	0.03%	+0	-1	+3	4/13/2018
<b>Australia »</b>	2.73%	+7	0	+26	4/13/2018
<b>New Zealand</b>	2.81%	+4	-10	-11	4/13/2018
<b>Hong Kong</b>	1.83%	+3	-6	--	4/13/2018
<b>Singapore</b>	2.36%	+1	-2	+26	4/13/2018
<b>South Korea</b>	2.60%	+3	--	+42	4/13/2018
<b>India</b>	7.44%	-5	-24	+62	4/13/2018

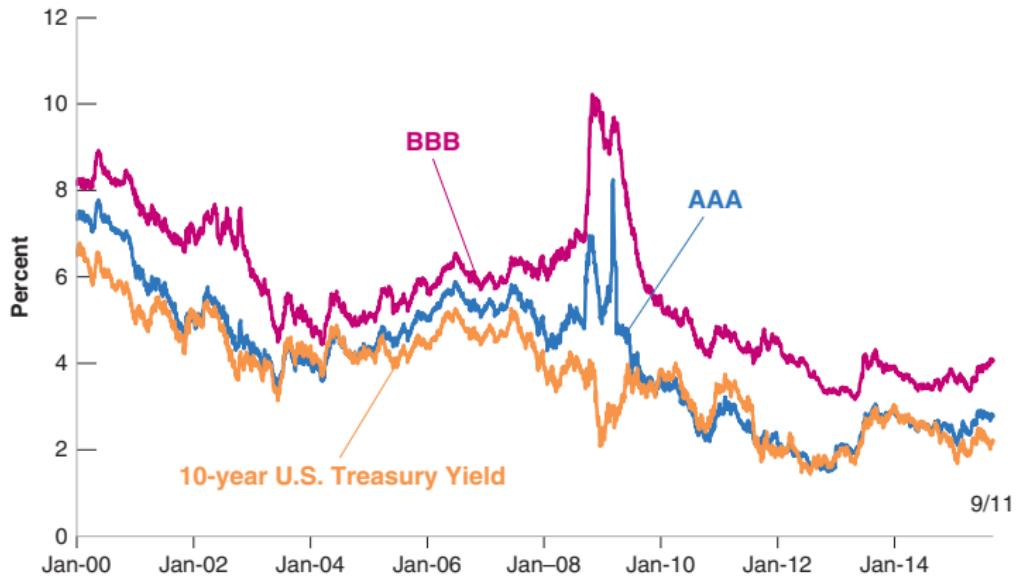
# Japan Government Bonds Yields

Source: Bloomberg, Screenshot, April 14, 2018. Link

## Government Bond Yields

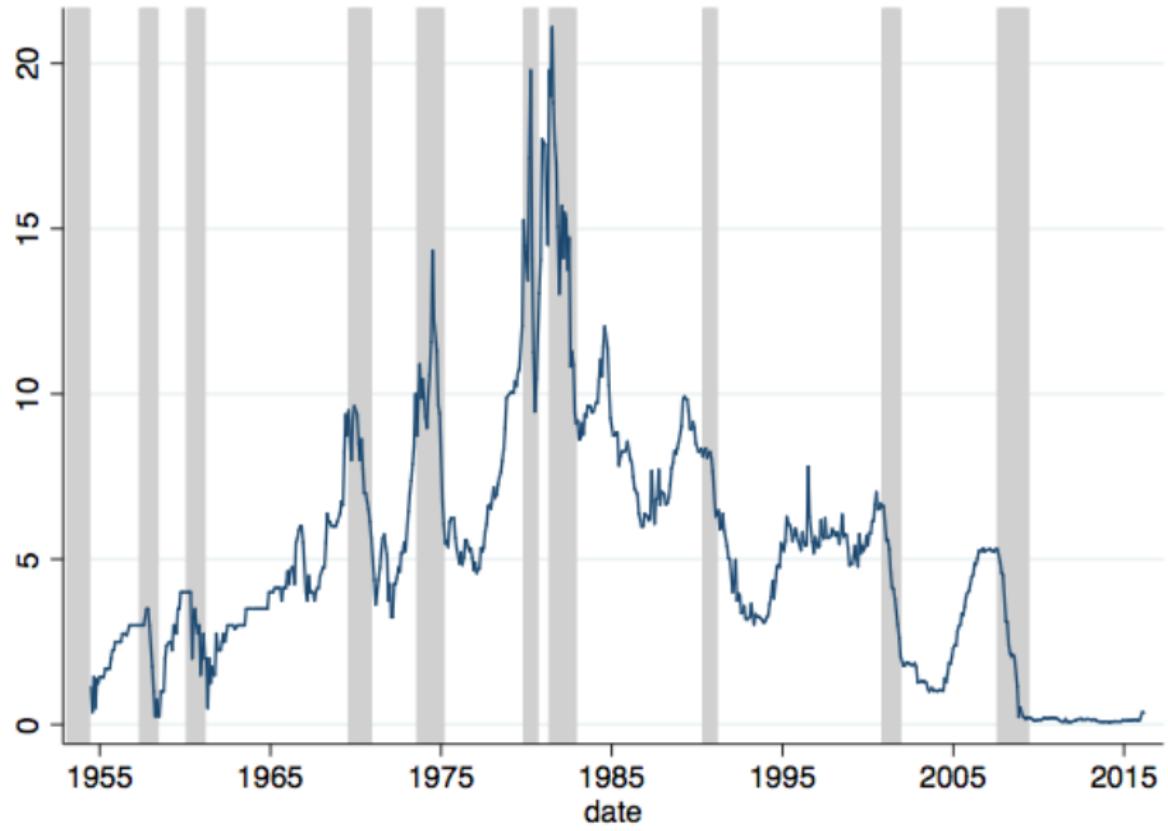
NAME	COUPON	PRICE	YIELD	1 DAY	1 MONTH	1 YEAR	TIME (EDT)
GTJPY2Y:GOV <b>JGB 2 Year Yield</b>	0.10	100.52	-0.16%	0	-1	+7	4/13/2018
GTJPY5Y:GOV <b>JGB 5 Year Yield</b>	0.10	101.05	-0.12%	+0	-1	+7	4/13/2018
GTJPY10Y:GOV <b>JGB 10 Year Yield</b>	0.10	100.67	0.03%	+0	-1	+3	4/13/2018
GTJPY20Y:GOV <b>JGB 20 Year Yield</b>	0.50	100.05	0.49%	-1	-3	-6	4/13/2018
GTJPY30Y:GOV <b>JGB 30 Year Yield</b>	0.80	102.65	0.69%	-1	-6	-7	4/13/2018

# Not just Treasury Yields actually

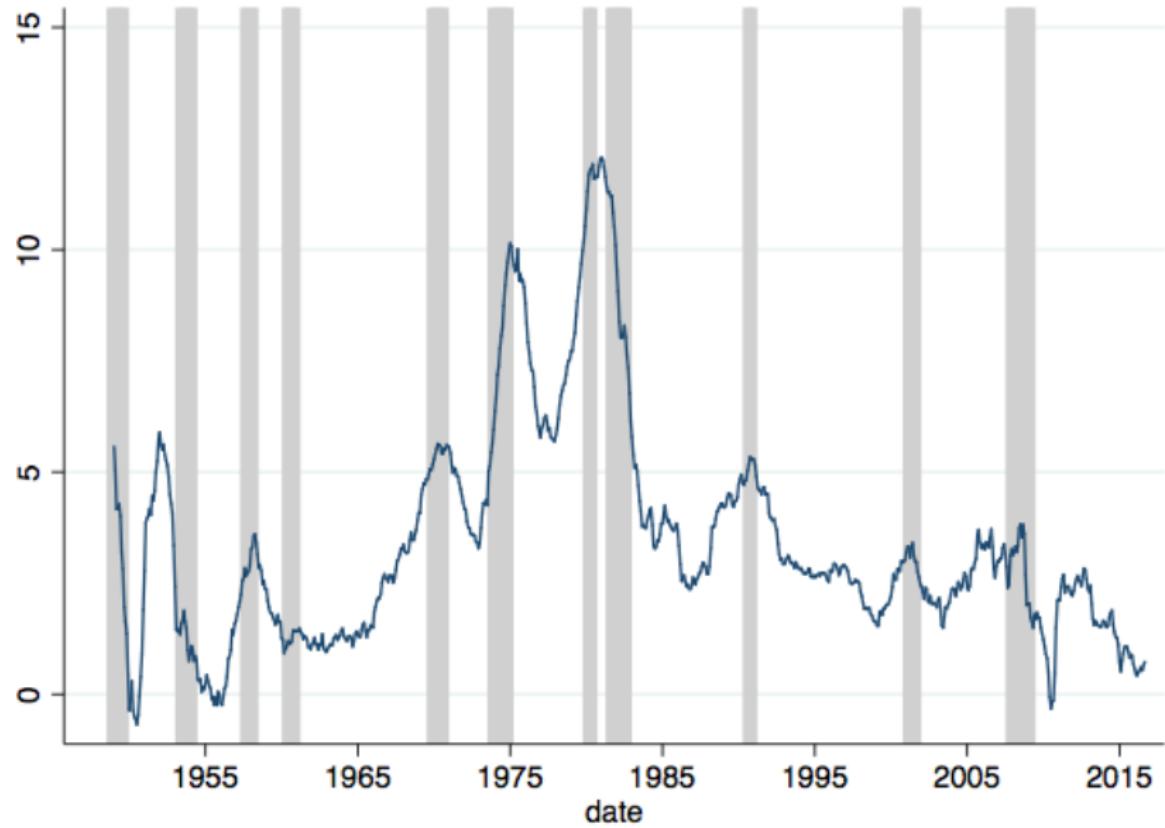


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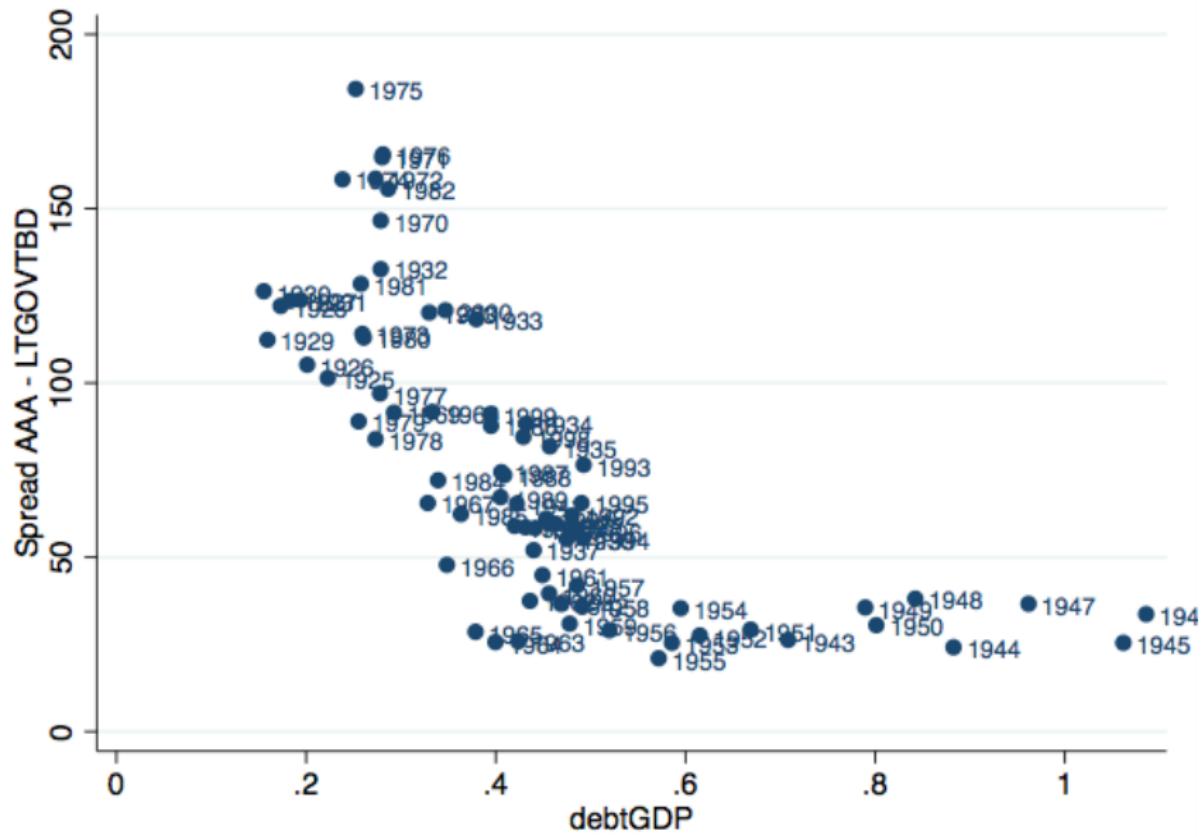
# Fed Funds Rate (Monthly)



## 2-year inflation

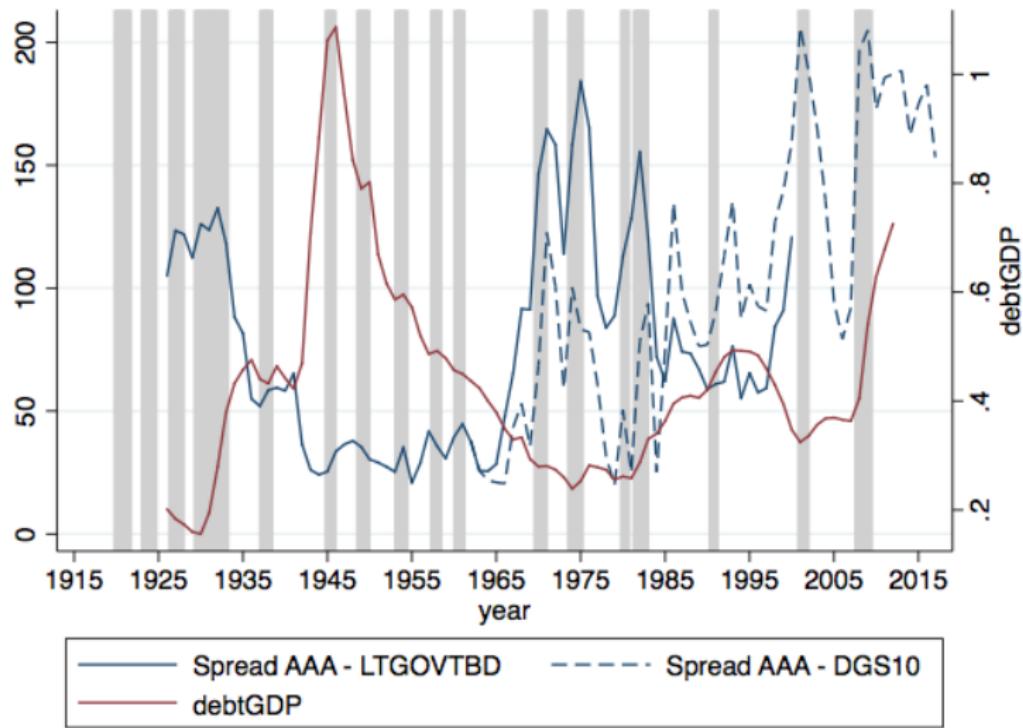


# Krishnamurthy - Vissing-Jorgensen

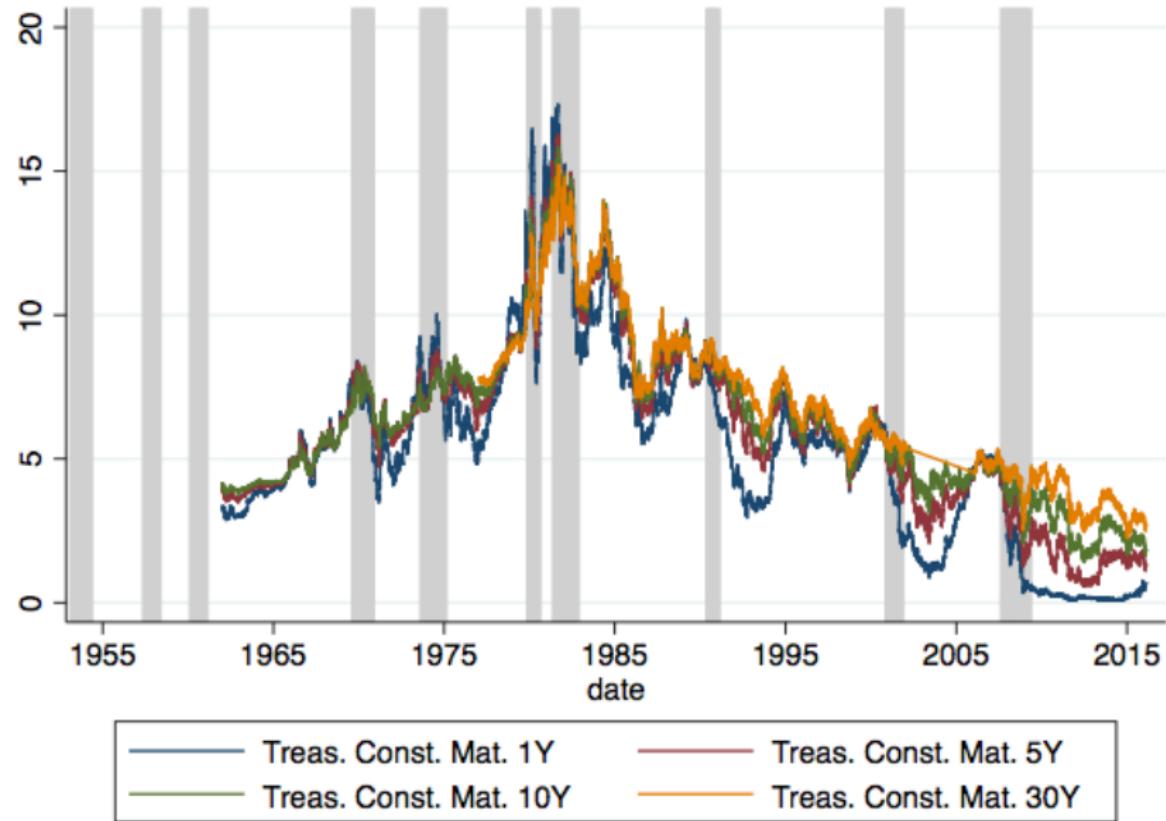


# A time effect?

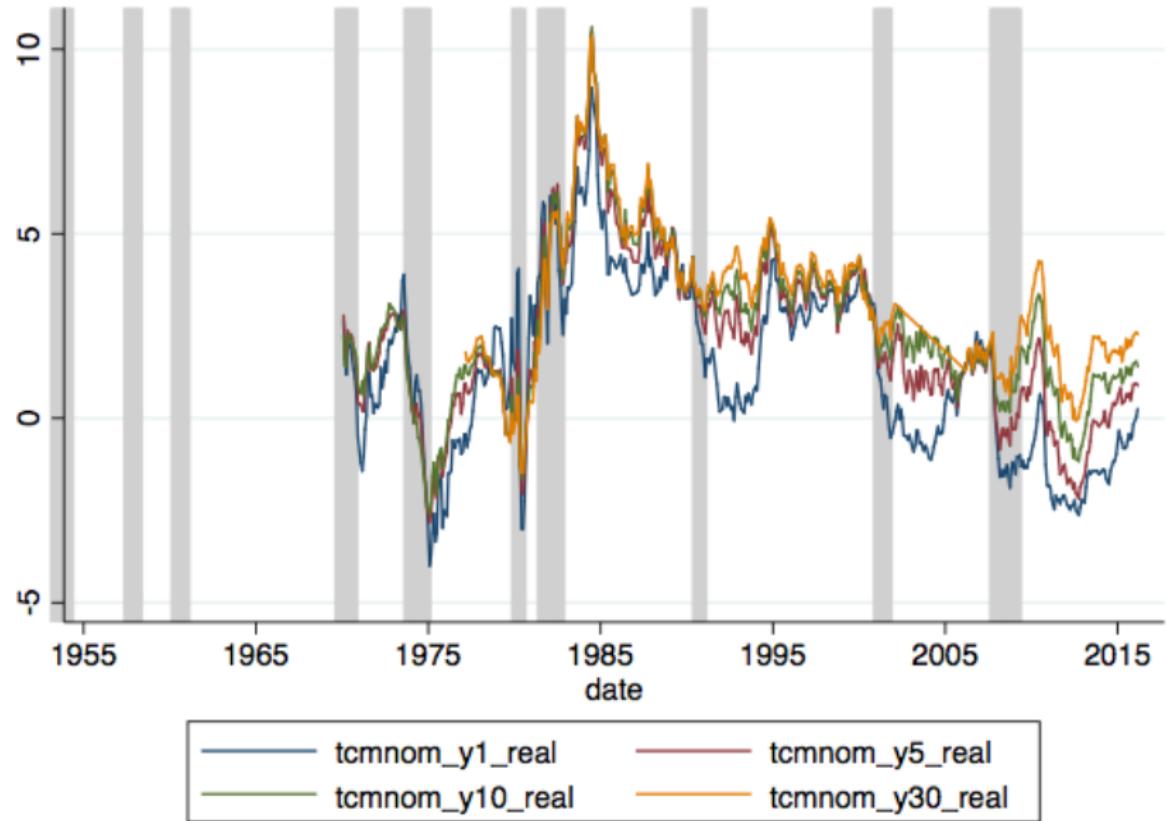
Krishnamurthy - Vissing-Jorgensen: a time effect?



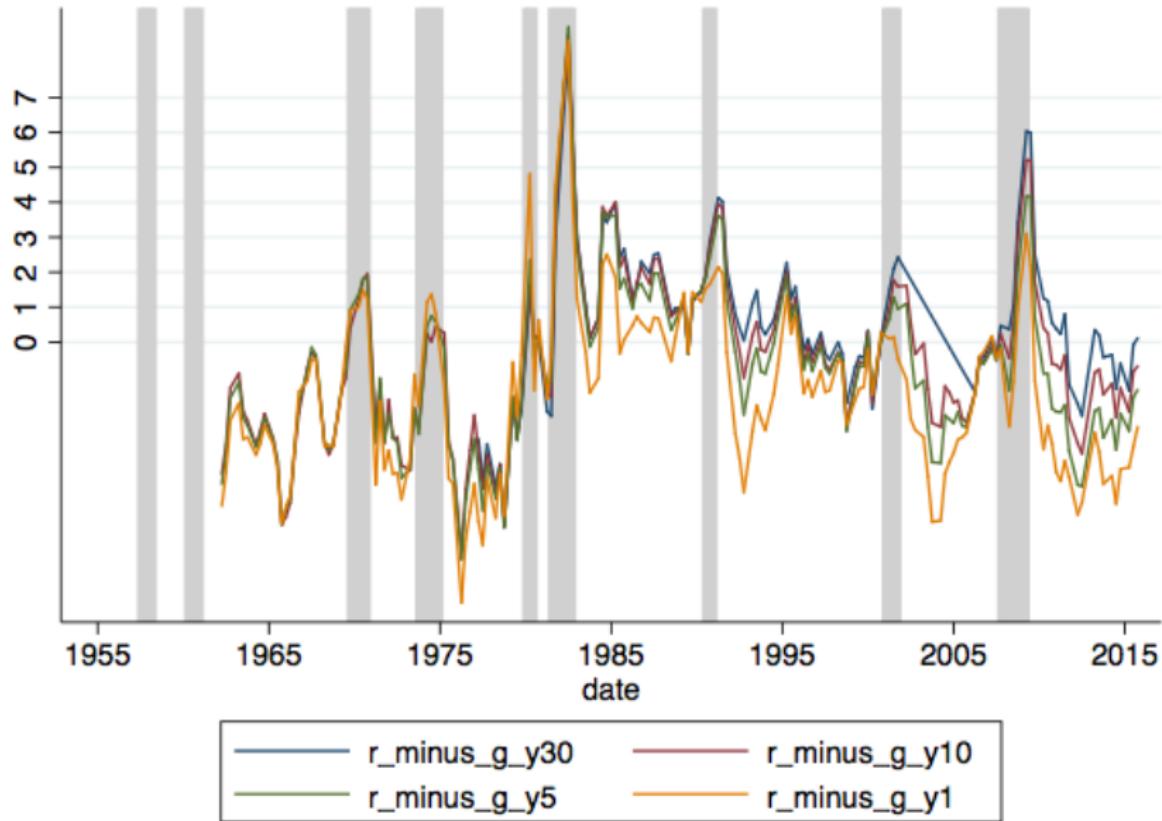
# Treasury Rates



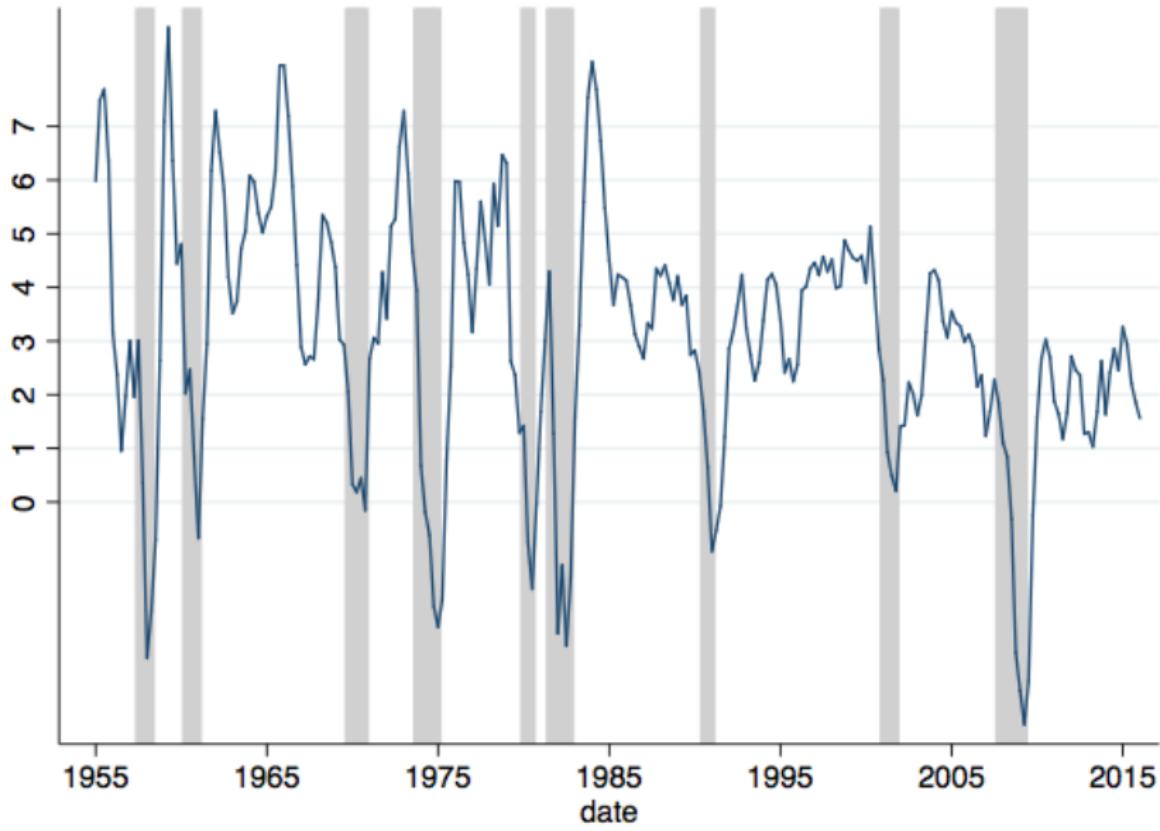
# Real Treasury Rates



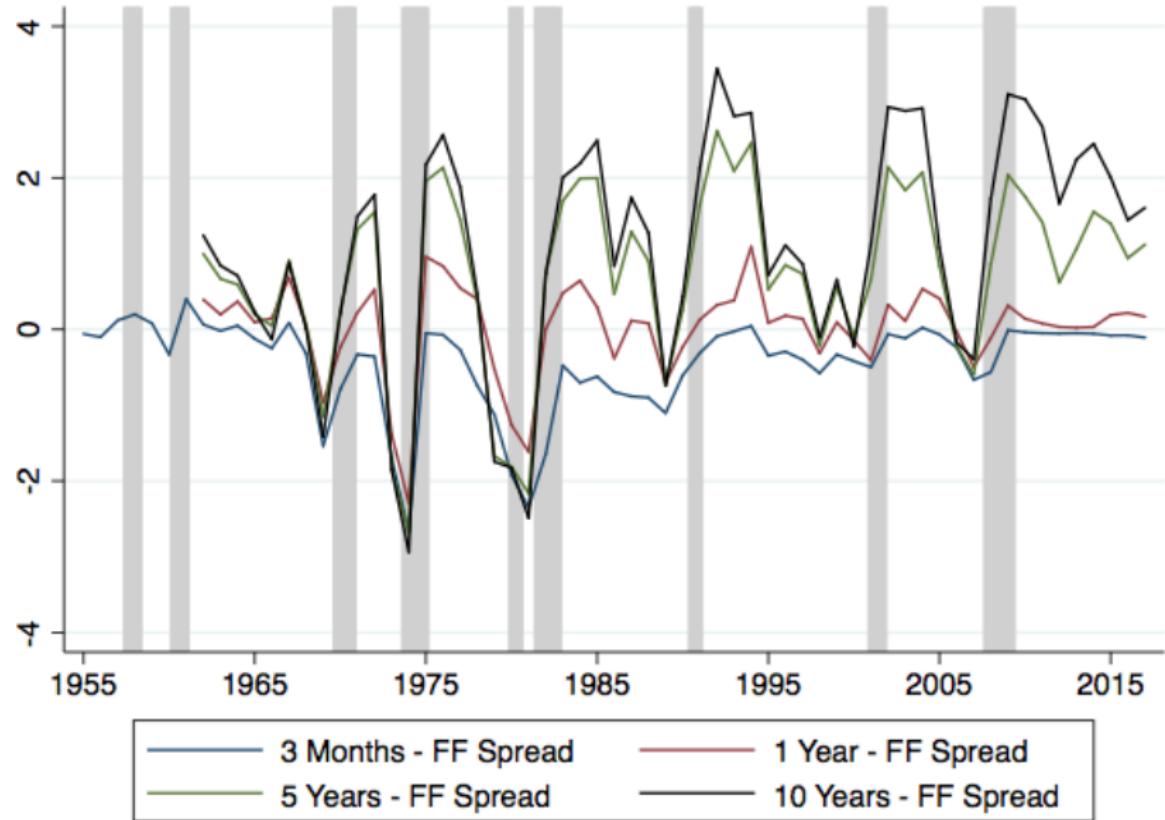
# r minus g



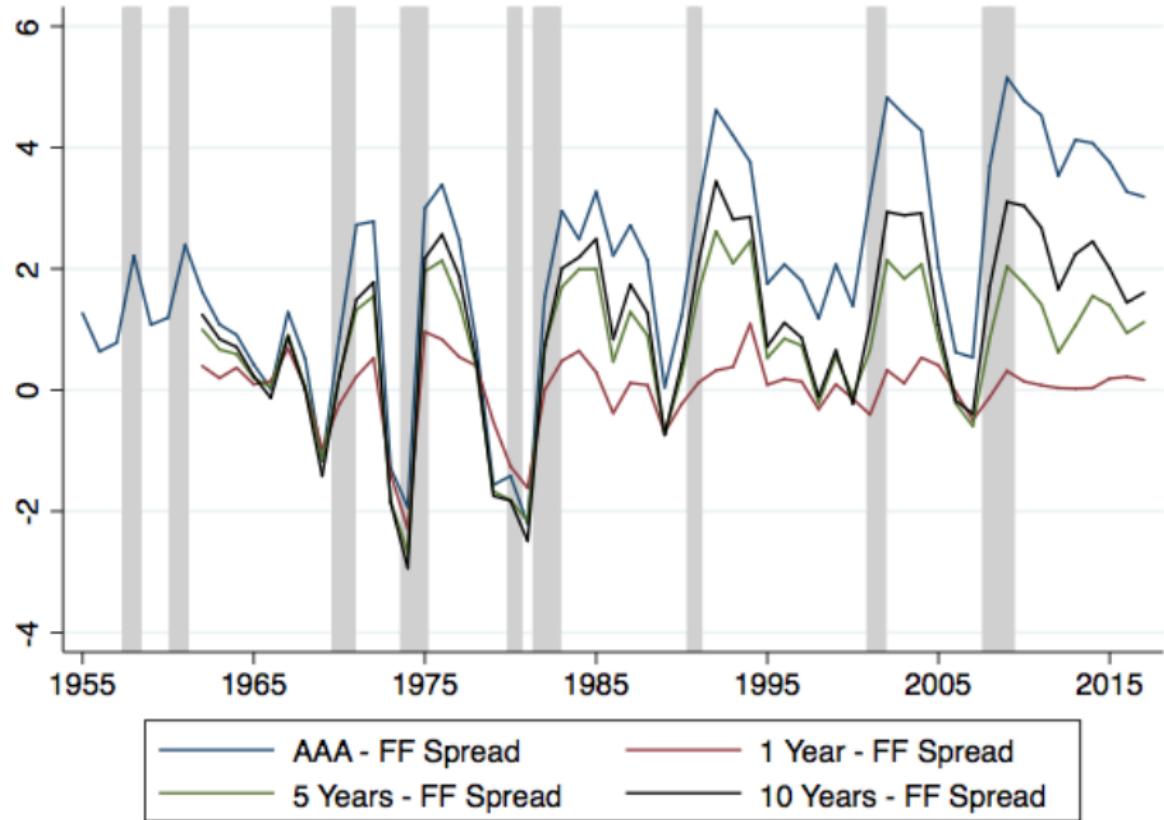
# Growth



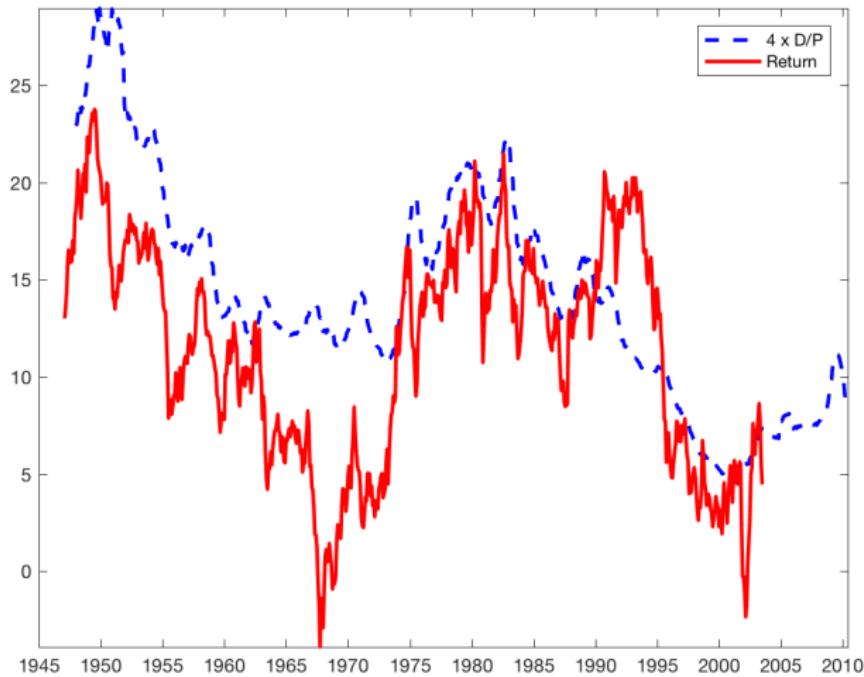
# Spreads



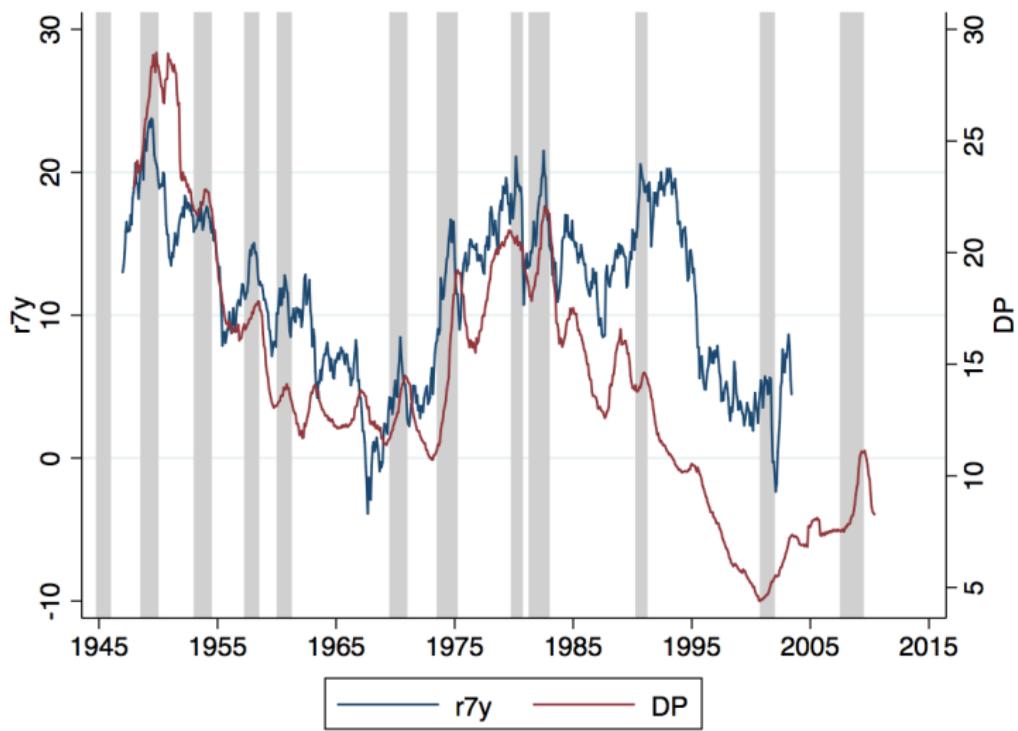
# Spreads



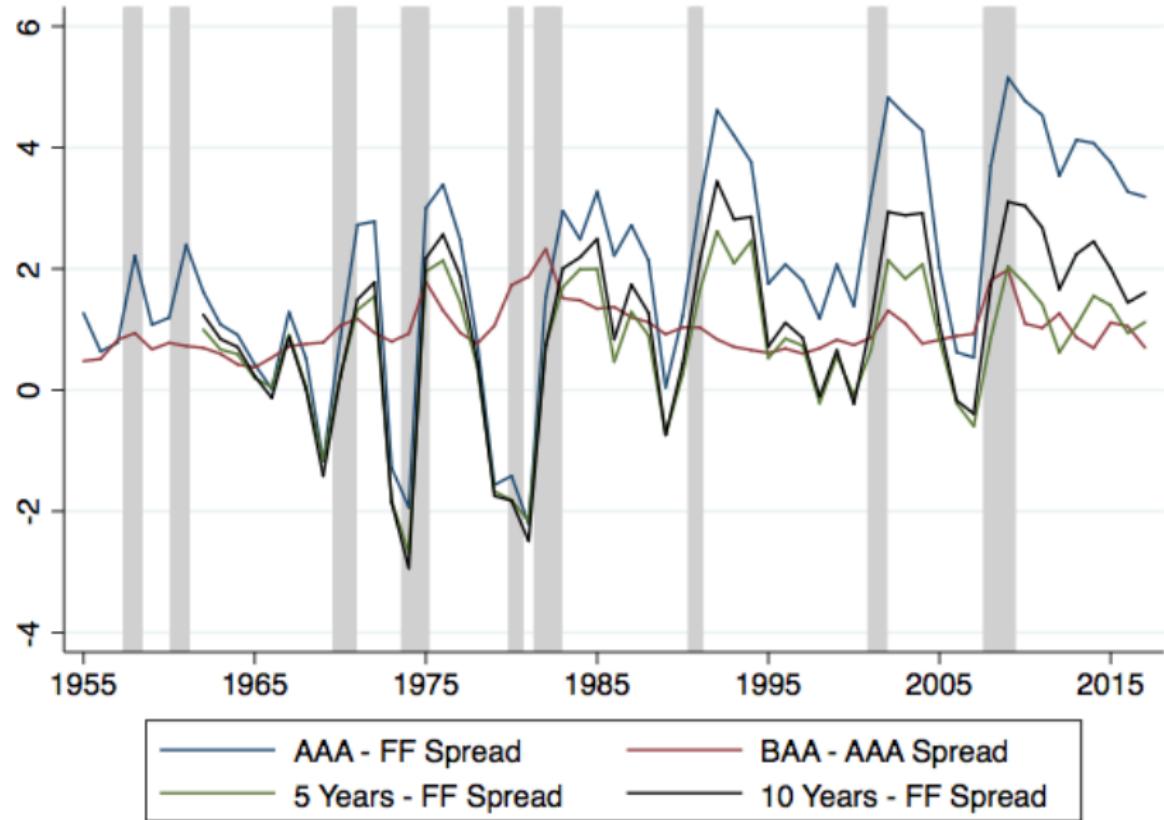
# Stock Market



# Stock Market



# Spreads



# S&P 500 Return Distribution

	daily	monthly	yearly	10year	30year
<b>nobs</b>	23786.00	1081.00	91.00	10.00	4.00
<b>mean</b>	0.00	0.01	0.12	1.58	11.79
<b>sd</b>	0.01	0.05	0.20	1.20	8.10
<b>skewness</b>	-0.03	0.37	-0.42	0.36	-0.95
<b>kurtosis</b>	19.69	12.66	3.03	1.84	2.21
<b>min</b>	-0.19	-0.29	-0.46	0.00	0.00
<b>max</b>	0.17	0.41	0.53	3.56	18.47
<b>p50</b>	0.00	0.01	0.14	1.32	14.35

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## Simplified model

- Very simplified version of Abel et al. (1989).
- Cobb-Douglas:  $Y_t = A_t K_t^\alpha N_t^\beta L_t^\gamma$ ,  $K_t = I_{t-1}$  capital (full depreciation),  $N_t = \bar{N}$  employment,  $L_t = \bar{L}$  land.
- Firm solves:

$$\max_{K_t, N_t, L_t} A_t K_t^\alpha N_t^\beta L_t^\gamma - r_t^K K_t - w_t N_t - r_t^L L_t.$$

- Income approach:

$$\begin{aligned} A_t K_t^\alpha N_t^\beta L_t^\gamma &= \text{Cap. Inc} + w_t N_t \\ &= r_t^K K_t + r_t^L L_t + \Pi_{\text{pure}} + w_t N_t. \end{aligned}$$

- Conditions:

Dynamic Efficiency:  $\exists \epsilon > 0, \quad \forall t > t_0, \quad r_t^K K_t \geq (1 + \epsilon) I_t$

## Simplified model

- Assume :

$$\exists \epsilon > 0, \quad \forall t > t_0, \quad r_t^K I_{t-1} \leq (1 - \epsilon) I_t.$$

- $dC_{t_0} > 0$ , financed by  $dK_{t_0+1} = dI_{t_0} = -dC_{t_0}$ . To maintain  $dC_{t_0+1} = 0$ , there must be a reduction in investment in  $t_0 + 1$ :

$$dI_{t_0+1} \leq \frac{\partial Y_{t_0+1}}{\partial K_{t_0+1}} dI_{t_0} = r_t^K dI_{t_0} \quad \Rightarrow \quad \frac{dI_{t_0+1}}{I_{t_0+1}} \leq \frac{r_{t_0+1}^K I_{t_0}}{I_{t_0+1}} \frac{dI_{t_0}}{I_{t_0}}$$

- Similarly, investment must decrease in all future periods to maintain  $dC_t = 0$ :

$$\forall t > t_0, \quad \frac{dI_t}{I_t} \leq \left( \prod_{\tau=t_0+1}^t \frac{r_\tau^K I_{\tau-1}}{I_\tau} \right) \frac{dI_{t_0}}{I_{t_0}}$$

- Pareto-improving change. Feasible, since  $\frac{r_t^K I_{t-1}}{I_t} \leq 1 - \epsilon$ .

## Simplified model

- $r_t^K K_t$  is not readily available:

$$A_t K_t^\alpha N_t^\beta L_t^\gamma = \left( A_t K_t^\alpha N_t^\beta L_t^\gamma \right)_{mix} + (Cap.Inc)_{nonmix} + (w_t N_t)_{nonmix}.$$

- In NIPA (BEA data),  $r_t^K K_t$  can be inferred:

$$r_t^K K_t = f \left( \left( A_t K_t^\alpha N_t^\beta L_t^\gamma \right)_{mix} \right) + \left( Cap.Inc - r_t^L L_t - \Pi_{pure} \right)_{nonmix}.$$

- $f(x) = 1/3x$ . 1/3 of mixed income is capital income.
- Cap Inc = Gross capital income = profit + rental income + interest income + private CCA.
- $r_t^L L_t$ : 25% of assets = 5% of GDP.  $\Pi_{pure} = 0$ .

TABLE 1  
*Gross profit and investment: the United States economy (percent)*

Year	Gross profit		Gross investment		<i>D</i> GNP	<i>D</i> V
	GNP	GNP	GNP	V		
1929	32.6	16.1	16.5	—	—	—
1930	31.7	11.6	20.1	—	—	—
1931	28.6	7.7	20.9	—	—	—
1932	26.4	1.9	24.5	—	—	—
1933	24.6	2.9	21.8	—	—	—
1934	26.1	5.3	20.8	—	—	—
1935	27.1	9.1	18.0	—	—	—
1936	26.4	10.5	15.9	—	—	—
1937	26.9	13.3	13.6	—	—	—
1938	26.5	7.8	18.6	—	—	—
1939	26.7	10.4	16.3	—	—	—
1940	28.2	13.3	14.9	—	—	—
1941	29.4	14.6	14.8	—	—	—
1942	29.0	6.5	22.6	—	—	—
1943	27.2	3.2	24.0	—	—	—
1944	25.2	3.6	21.5	—	—	—
1945	24.2	5.3	17.9	—	—	—
1946	24.0	14.8	9.2	—	—	—
1947	25.6	14.9	10.8	—	—	—
1948	27.8	18.0	9.8	—	—	—
1949	27.3	14.0	13.3	—	—	—
1950	28.4	19.1	9.3	—	—	—
1951	28.0	18.1	9.9	—	—	—
1952	26.9	15.2	11.7	3.9	—	—
1953	26.4	14.8	11.6	4.0	—	—
1954	26.9	14.5	12.4	4.1	—	—
1955	28.2	17.2	11.0	3.7	—	—
1956	27.6	17.0	10.6	3.4	—	—
1957	27.4	15.8	11.6	3.8	—	—
1958	27.0	13.9	13.1	4.1	—	—
1959	27.8	16.2	11.6	3.8	—	—
1960	27.1	15.2	11.9	3.9	—	—
1961	27.1	14.4	12.7	4.2	—	—
1962	27.4	15.2	12.1	4.1	—	—
1963	27.6	15.3	12.3	4.2	—	—
1964	27.7	15.3	12.4	4.3	—	—
1965	28.2	16.5	11.8	4.2	—	—
1966	27.8	16.7	11.1	4.0	—	—
1967	27.2	15.4	11.8	4.2	—	—
1968	26.6	15.3	11.3	4.0	—	—
1969	25.7	15.9	9.8	3.5	—	—
1970	24.6	14.7	9.9	3.5	—	—
1971	25.2	15.6	9.6	3.4	—	—
1972	25.6	16.7	8.9	3.1	—	—
1973	25.6	17.6	8.1	2.8	—	—
1974	25.1	16.3	8.8	2.8	—	—
1975	26.2	13.7	12.4	3.9	—	—
1976	26.4	15.6	10.8	3.4	—	—
1977	27.1	17.3	9.9	3.1	—	—
1978	27.6	18.5	9.1	2.7	—	—
1979	27.6	18.1	9.5	2.8	—	—
1980	27.4	16.0	11.4	3.2	—	—
1981	28.1	16.9	11.2	3.2	—	—
1982	27.7	14.1	13.6	3.9	—	—
1983	28.4	14.7	13.7	4.0	—	—
1984	28.5	17.6	10.9	3.3	—	—
1985	28.0	16.5	11.5	3.6	—	—

Source. NIPA. Capital Cash Flow is calculated as national income plus capital consumption allowances less employee compensation and 67% of proprietors' income which is imputed to labour. This imputation is discussed in Christensen (1971).

TABLE 2

*Gross profit and investment: the U.S. nonfinancial corporate sector (percent)*

Year	Gross profit	Gross investment	$\frac{D}{V}$
	$V$	$V$	
1953	29.1	14.7	13.6
1954	28.7	13.3	14.3
1955	25.1	13.3	10.2
1956	21.0	12.3	7.0
1957	19.4	10.8	7.5
1958	20.6	9.6	10.0
1959	18.2	9.8	7.6
1960	16.7	9.2	6.3
1961	16.9	8.9	7.5
1962	15.5	8.9	6.9
1963	18.0	9.8	8.0
1964	17.1	9.5	7.3
1965	17.5	10.5	6.9
1966	17.4	11.7	5.9
1967	18.4	11.6	6.9
1968	16.1	9.7	6.2
1969	14.6	9.5	5.7
1970	15.5	9.9	5.6
1971	16.9	10.4	6.8
1972	16.7	10.2	6.5
1973	17.7	11.4	5.7
1974	23.9	15.6	5.5
1975	31.5	15.4	14.4
1976	29.7	17.4	10.3
1977	30.0	17.6	9.6
1978	34.3	21.4	9.9
1979	35.7	21.9	12.4
1980	31.7	18.9	10.2
1981	26.6	16.9	7.1
1982	25.3	15.1	7.9
1983	23.5	14.1	9.3
1984	23.4	17.3	6.7
1985	22.1	15.9	8.5

TABLE 3  
*Dynamic efficiency in different countries*

Year	Difference of gross profit and investment as a percentage of GNP					
	England	France	Germany	Italy	Canada	Japan
1960	11.8	18.2	12.4	22.1	12.7	17.6
1961	10.6	17.4	10.9	21.0	14.0	9.5
1962	11.5	16.2	10.0	19.9	14.0	14.6
1963	12.1	15.3	10.7	17.8	14.4	13.7
1964	8.8	12.9	9.2	19.1	12.8	12.4
1965	9.4	13.6	8.5	22.9	9.4	15.2
1966	8.7	12.9	9.9	24.1	8.3	15.4
1967	8.3	13.5	13.7	22.5	9.4	14.2
1968	7.7	13.6	13.5	23.1	10.7	12.9
1969	8.3	11.9	10.3	22.1	9.4	12.1
1970	7.5	11.8	7.8	18.9	10.5	11.6
1971	8.9	12.3	7.5	19.1	8.9	11.2
1972	10.4	12.0	2.7	19.9	9.2	11.4
1973	7.8	10.9	7.9	15.4	9.4	8.1
1974	4.4	8.7	10.0	12.2	8.2	5.2
1975	6.0	10.9	12.4	16.6	9.0	6.8
1976	5.5	8.9	11.5	13.5	7.5	7.8
1977	9.1	9.9	11.9	14.6	7.9	7.8
1978	9.6	11.0	12.1	16.4	10.5	8.9
1979	8.4	10.0	9.8	16.7	10.5	7.2
1980	10.1	8.3	8.4	12.9	12.4	7.5
1981	11.9	10.4	10.8	15.1	9.3	7.3
1982	12.9	9.8	13.1	16.5	12.9	8.1
1983	13.2	11.7	13.6	17.1	15.3	9.4
1984	13.9	12.9	13.8	17.3	17.3	9.4

*Source.* OECD. These data are in some cases not adjusted for the labour income of proprietors. As discussed by Sachs (1979), this approximation is quite innocuous. For the United States, the adjustment is equal to about 4% of GNP.

- 1 Low interest rates
- 2 More interest rates
- 3 Abel et al. (1989)
- 4 Caselli and Feyrer (2007)
- 5 Piketty and Zucman (2014)
- 6 Changing nature of capital
- 7 Reassessing Dynamic Efficiency
- 8 Rognlie (2015)

# Different types of wealth

TABLE I  
PROPORTION OF DIFFERENT TYPES OF WEALTH IN TOTAL WEALTH IN 2000

Variable	Mean	St dev	Median	Weighted mean*	Corr w/ log(GDP)**
Subsoil resources	10.5	16.4	1.5	7.0	-0.13
Timber	1.7	2.6	0.8	0.9	-0.34
Other forest	2.2	5.4	1.1	0.3	-0.49
Cropland	11.4	15.2	5.1	3.2	-0.73
Pasture	4.5	5.4	2.7	1.9	-0.00
Protected areas	1.9	2.5	0.3	1.4	0.01
Urban land	13.1	4.6	13.5	16.5	0.70
Reproducible capital	54.8	19.2	56.3	68.6	0.70

\* Weighted by the total value of the capital stock.

\*\* GDP is per worker.

Source: Authors calculations using data from World Bank [2006].

# Different types of wealth

TABLE II  
DATA AND IMPLIED ESTIMATES OF THE MPK

Country	wbcode	$y$	$k$	$\alpha_w$	$\alpha_k$	$P_g/P_k$	MPKN	MPMKN	MPKL	MPMPL
Australia	AUS	46,436	118,831	0.32	0.18	1.07	0.13	0.13	0.07	0.08
Austria	AUT	45,822	105,769	0.30	0.22	1.06	0.10	0.11	0.07	0.08
Burundi	BDI	1,226	1,084	0.25	0.03	0.30	0.28	0.08	0.03	0.01
Belgium	BEL	50,600	141,919	0.26	0.20	1.15	0.09	0.11	0.07	0.08
Bolivia	BOL	6,705	7,091	0.33	0.08	0.60	0.31	0.19	0.08	0.05
Botswana	BWA	18,043	27,219	0.55	0.35	0.66	0.36	0.24	0.22	0.14
Canada	CAN	45,304	122,326	0.32	0.16	1.26	0.12	0.15	0.06	0.07
Switzerland	CHE	44,152	158,504	0.24	0.18	1.29	0.07	0.09	0.05	0.07
Chile	CHL	23,244	36,651	0.41	0.16	0.90	0.26	0.24	0.10	0.09
Cote d'Ivoire	CIV	4,966	3,870	0.22	0.06	0.41	0.41	0.17	0.08	0.03
Congo	COG	3,517	5,645	0.51	0.17	0.23	0.33	0.07	0.11	0.02
Colombia	COL	12,178	15,251	0.35	0.12	0.66	0.28	0.19	0.10	0.06
Costa Rica	CRI	13,209	23,117	0.27	0.11	0.54	0.16	0.08	0.06	0.03
Denmark	DNK	45,147	122,320	0.29	0.20	1.13	0.11	0.12	0.08	0.08
Algeria	DZA	15,053	29,651	0.30	0.13	0.47	0.20	0.08	0.06	0.03
Ecuador	ECU	13,664	25,251	0.55	0.08	0.84	0.28	0.23	0.04	0.03
Egypt	EGY	12,670	7,973	0.23	0.10	0.30	0.37	0.11	0.16	0.05
Spain	ESP	39,034	110,024	0.33	0.24	1.06	0.12	0.12	0.09	0.09
Finland	FIN	39,611	124,131	0.29	0.20	1.23	0.09	0.11	0.06	0.08
France	FRA	45,162	134,979	0.26	0.19	1.20	0.09	0.10	0.06	0.08
United Kingdom	GBR	40,620	87,778	0.25	0.18	1.07	0.12	0.12	0.08	0.09
Greece	GRC	31,329	88,186	0.21	0.15	1.03	0.07	0.08	0.05	0.05
Hong Kong	HKG	51,678	114,351	0.43	0.00	0.19	0.18			
Ireland	IRL	47,977	85,131	0.27	0.18	1.05	0.15	0.16	0.10	0.11
Israel	ISR	43,795	108,886	0.36	0.22	1.25	0.12	0.15	0.09	0.11
Italy	ITA	51,060	139,031	0.29	0.21	1.08	0.11	0.11	0.08	0.08
Jamaica	JAM	7,692	17,766	0.40	0.26	0.60	0.17	0.10	0.11	0.07
Jordan	JOR	16,221	25,783	0.36	0.25	0.55	0.23	0.12	0.16	0.09
Japan	JPN	37,962	132,955	0.32	0.26	1.12	0.09	0.10	0.07	0.08
Republic of Korea	KOR	34,382	98,055	0.35	0.27	1.09	0.12	0.13	0.09	0.10
Sri Lanka	LKA	7,699	8,765	0.22	0.14	0.47	0.19	0.09	0.12	0.06
Morocco	MAR	11,987	15,709	0.42	0.23	0.49	0.32	0.16	0.18	0.09
Mexico	MEX	21,441	44,211	0.45	0.25	0.73	0.22	0.16	0.12	0.09
Mauritius	MUS	26,110	29,834	0.43	0.33	0.42	0.38	0.16	0.29	0.12
Malaysia	MYA	26,113	52,856	0.34	0.16	0.81	0.17	0.14	0.08	0.06
Netherlands	NLD	45,940	122,467	0.33	0.24	1.03	0.12	0.13	0.09	0.09
Norway	NOR	50,275	161,986	0.39	0.22	1.14	0.12	0.14	0.07	0.08
New Zealand	NZL	37,566	95,965	0.33	0.12	1.04	0.13	0.13	0.05	0.05
Panama	PAN	15,313	31,405	0.27	0.15	0.87	0.13	0.11	0.07	0.06
Peru	PER	10,240	22,856	0.44	0.22	0.89	0.20	0.18	0.10	0.09
Philippines	PHL	7,801	12,961	0.41	0.21	0.68	0.25	0.17	0.13	0.09
Portugal	PRT	30,086	71,045	0.28	0.20	0.97	0.12	0.12	0.09	0.08
Paraguay	PRY	12,197	14,376	0.51	0.19	0.53	0.43	0.23	0.16	0.08
Singapore	SGP	43,161	135,341	0.47	0.38	1.19	0.15	0.18	0.12	0.14
El Salvador	SLV	13,574	11,606	0.42	0.28	0.51	0.49	0.25	0.32	0.17
Sweden	SWE	40,125	109,414	0.23	0.16	1.19	0.08	0.10	0.06	0.07

# Capital per Worker

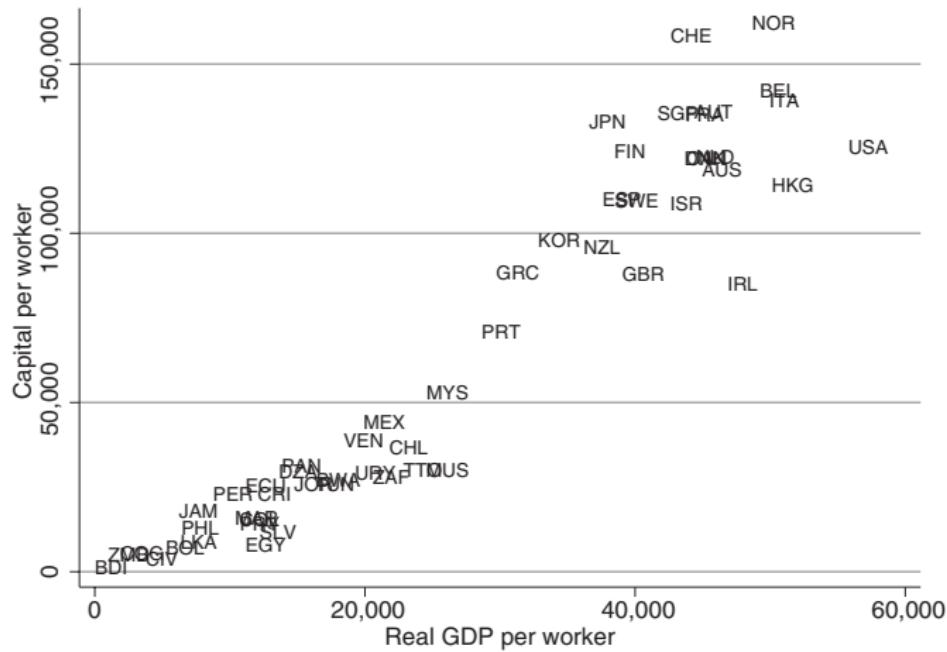


FIGURE I  
Capital per Worker

Source: Penn World Tables 6.1.

# Relative Prices

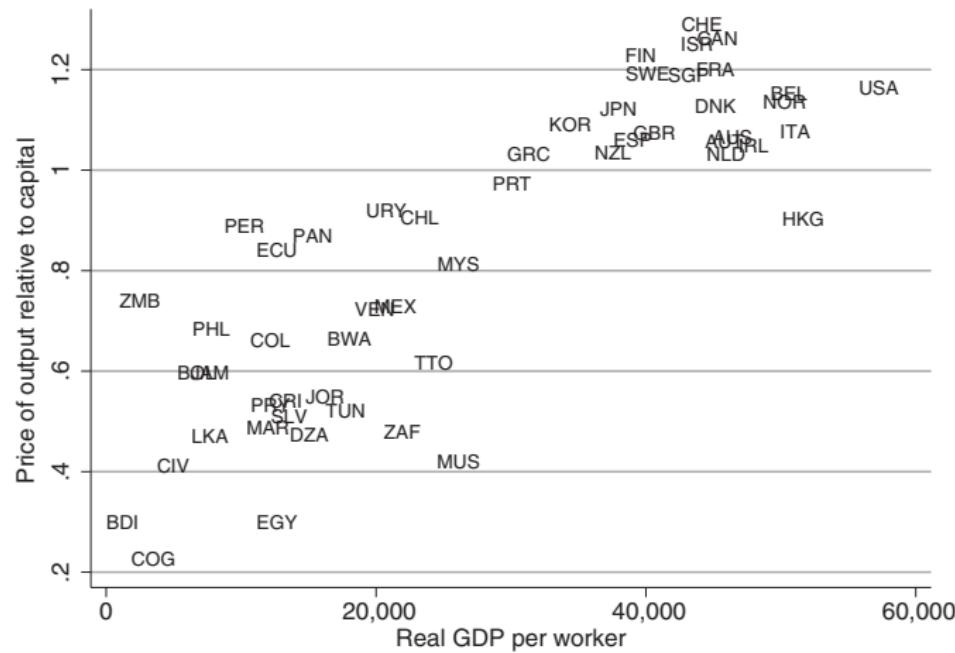


FIGURE II  
Relative Prices

Source: Penn World Tables 6.1.

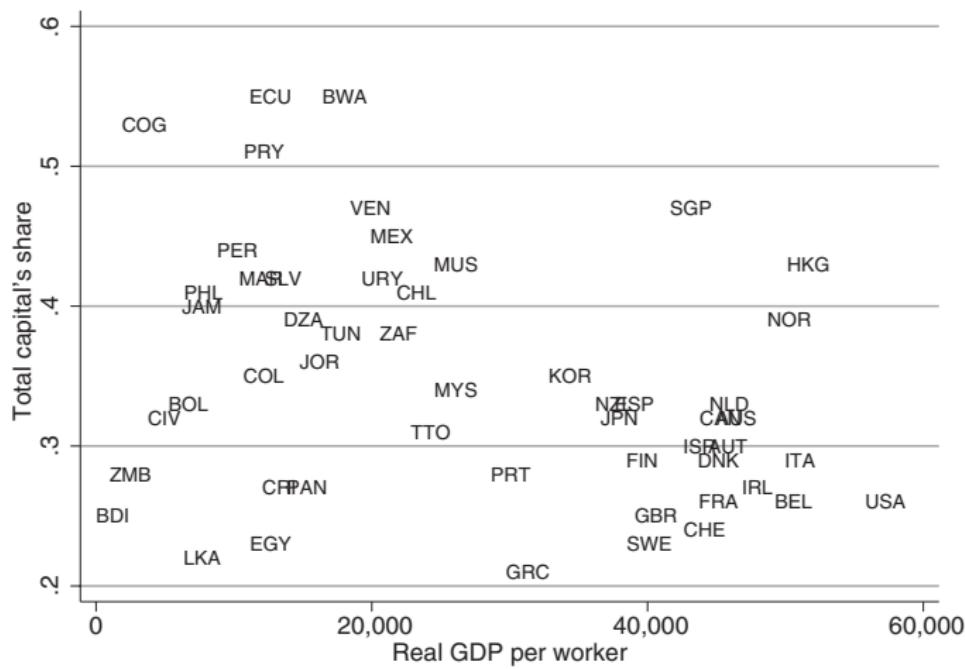


FIGURE III  
Total Capital's Share of Income

Source: Penn World Tables 6.1, Bernanke and Gurkaynak [2001].

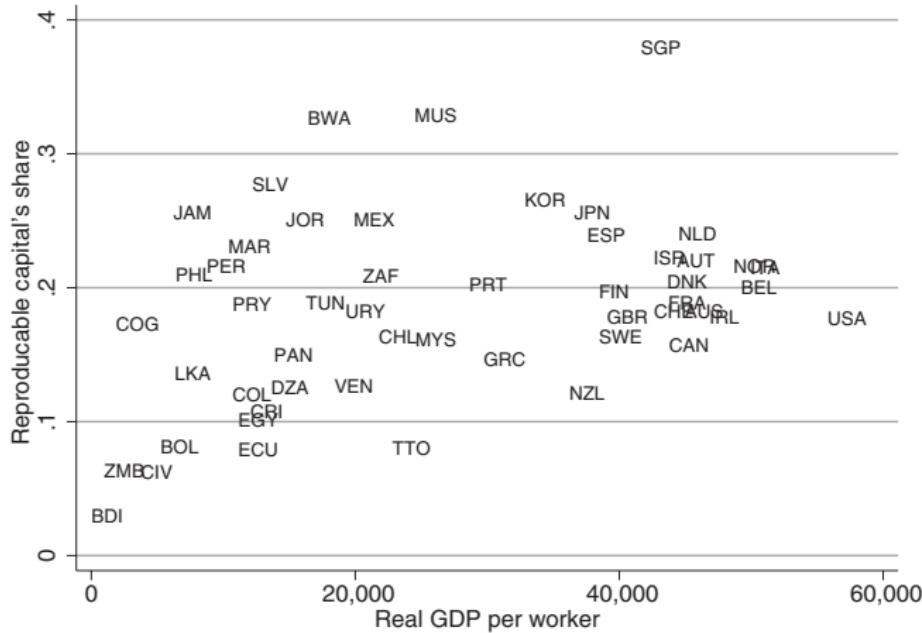


FIGURE IV  
Reproducible Capital's Share of Income

*Source:* Penn World Tables 6.1, Bernanke and Gurkaynak [2001], World Bank [2006], author's calculations.

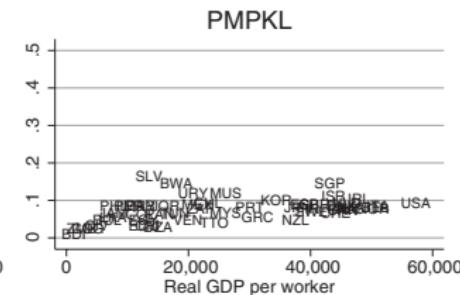
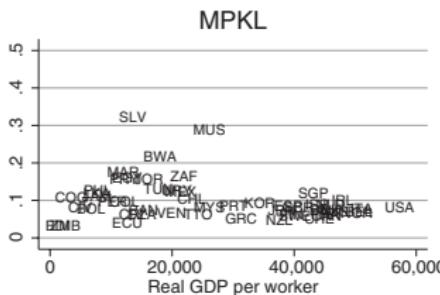
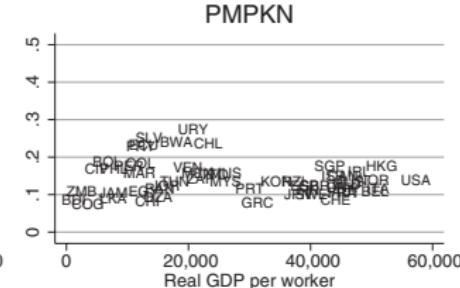
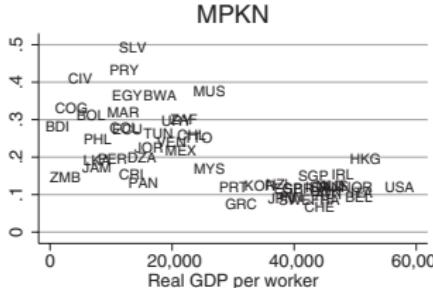


FIGURE V  
The Marginal Product of Capital

*MPKN*, naive estimate; *MPKL*, after correction for natural-capital; *PMPKN*, after correction for price differences; *PMPKL*, after both corrections.

Source: Heston, Summers, and Aten [2004], Bernanke and Gürkaynak [2001], World Bank [2006], and authors' calculations.

TABLE III  
AVERAGE RETURN TO CAPITAL IN POOR AND RICH COUNTRIES

	Rich countries	Poor countries
MPKN	11.4	27.2
	(2.7)	(9.0)
MPKL	7.5	11.9
	(1.7)	(6.9)
PMPKN	12.6	15.7
	(2.5)	(5.5)
PMPKL	8.4	6.9
	(1.9)	(3.7)

MPKN, naive estimate; MPKL, after correction for natural-capital; PMPKN, after correction for price differences; PMPKL, after both corrections; Rich (Poor), GDP at least as large (smaller than) Portugal. Standard deviations in parentheses.

Source: Authors' calculations.

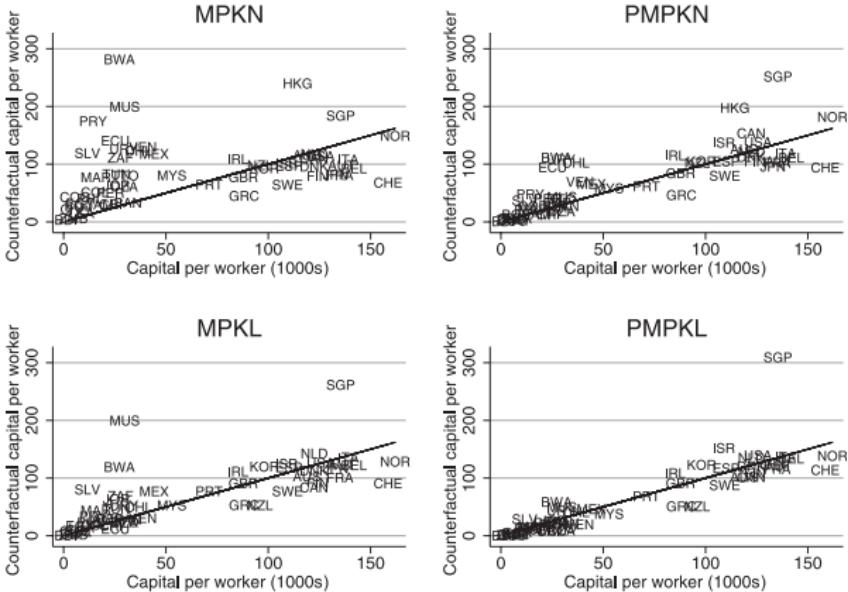


FIGURE VI

Counterfactual Capital per Worker with Equalized Returns to Capital

MPKN, naive estimate; MPKL, after correction for natural-capital; PMPKN, after correction for price differences; PMPKL, after both corrections.

Source: Heston, Summers, and Aten [2004], Bernanke and Gertler [2001], World Bank [2006], and authors' calculations.

TABLE IV  
AVERAGE CHANGES IN EQUILIBRIUM CAPITAL STOCKS UNDER MPK EQUALIZATION

	Unweighted		Weighted by population	
	Rich countries	Poor countries	Rich countries	Poor countries
MPKN	-12.9%	274.5%	-19.3%	205.8%
MPKL	-6.2%	86.6%	-5.6%	59.3%
PMPKN	0.1%	71.8%	-4.9%	52.0%
PMPKL	0.6%	-10.6%	1.4%	-14.5%

MPKN, naive estimate; MPKL, after correction for natural-capital; PMPKN, after correction for price differences; PMPKL, after both corrections; Rich (Poor), GDP at least as large (smaller than) Portugal.

*Source:* Authors' calculations.

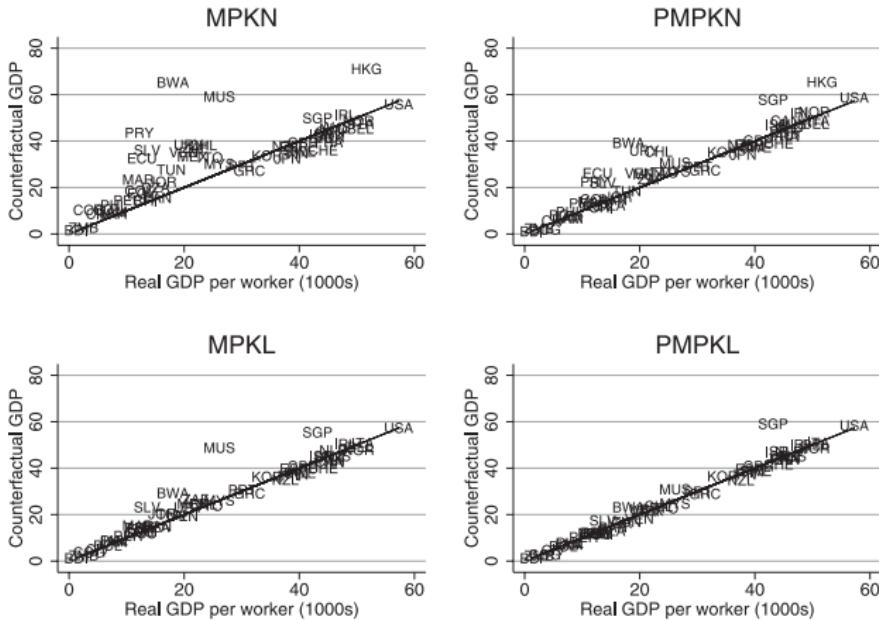


FIGURE VII

Counterfactual Output with Equalized Returns to Capital

MPKN, naive estimate; MPKL, after correction for natural-capital; PMPKN, after correction for price differences; PMPKL, after both corrections.

Source: Heston, Summers, and Aten [2004], Bernanke and Gurkaynak [2001], World Bank [2006], and authors' calculations.

**TABLE V**  
**AVERAGE CHANGES IN EQUILIBRIUM OUTPUT PER WORKER UNDER MPK**  
**EQUALIZATION**

	Unweighted		Weighted by population	
	Rich countries	Poor countries	Rich countries	Poor countries
MPKN	-3.0%	76.7%	-5.5%	58.2%
MPKL	-0.7%	16.8%	-1.0%	10.4%
PMPKN	1.1%	24.7%	-1.0%	17.4%
PMPKL	0.7%	0.0%	0.4%	-2.4%

MPKN, naive estimate; MPKL, after correction for natural-capital; PMPKN, after correction for price differences; PMPKL, after both corrections; Rich (Poor), GDP at least as large (smaller than) Portugal.

Standard deviations in parentheses.

Source: Authors' calculations.

TABLE VI  
WORLD OUTPUT GAIN FROM MPK EQUALIZATION

	No price adjustment	With price adjustment
No natural-capital adjustment	2.9%	1.4%
With natural-capital adjustments	0.6%	0.1%

*Source:* Authors' calculations.

TABLE VII  
COUNTERFACTUAL MPK UNDER MPK EQUALIZATION

	No price adjustment	With price adjustment
No natural-capital adjustment	12.7%	12.8%
With natural-capital adjustments	8.0%	8.6%

*Source:* Authors' calculations.

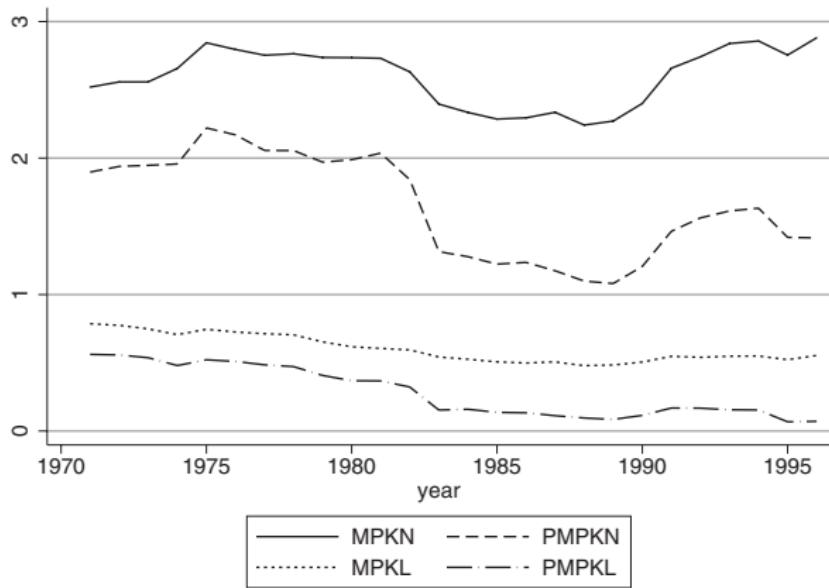


FIGURE VIII

The Dead Weight Loss of MPK Differentials (percent of world GDP)

MPKN, naive estimate; MPKL, after correction for natural-capital; PMPKN, after correction for price differences; PMPKL, after both corrections. Source: Heston, Summers, and Aten [2004], Bernanke and Gertler [2001], World Bank [2006], and authors' calculations.

- 1 Low interest rates
- 2 More interest rates
- 3 Abel et al. (1989)
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# Piketty and Zucman (2014)

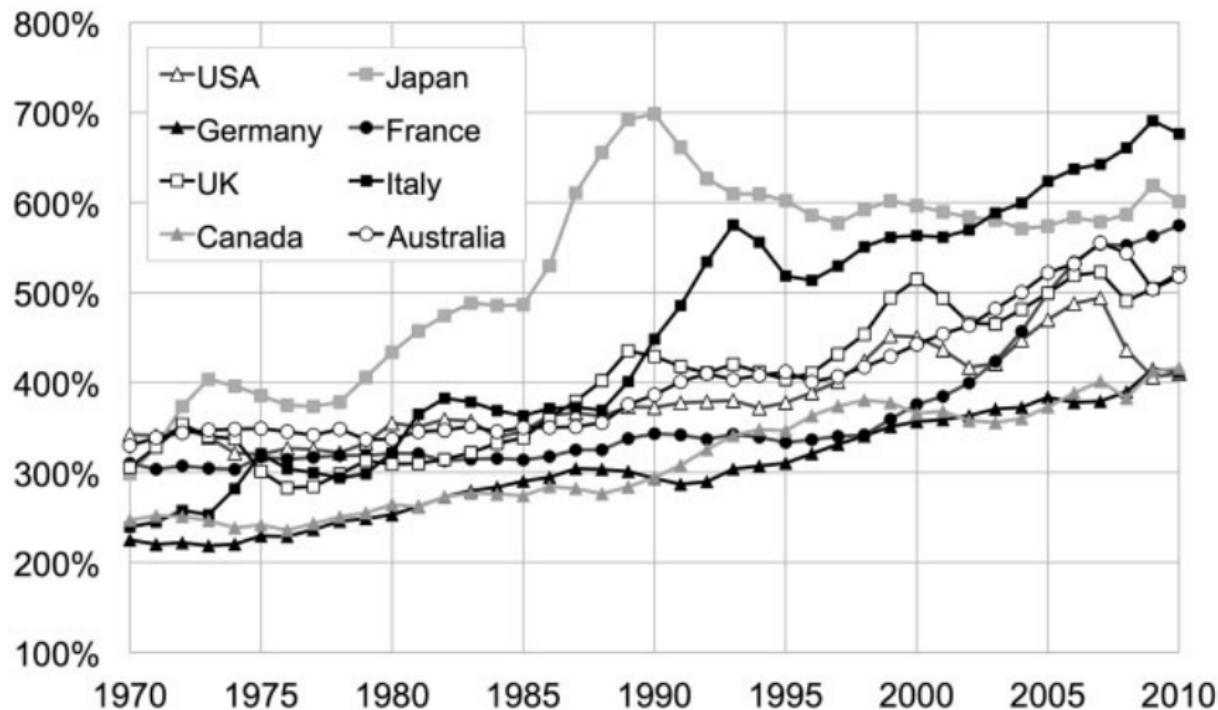


FIGURE I

Private Wealth-National Income Ratios, 1970–2010

# Piketty and Zucman (2014)

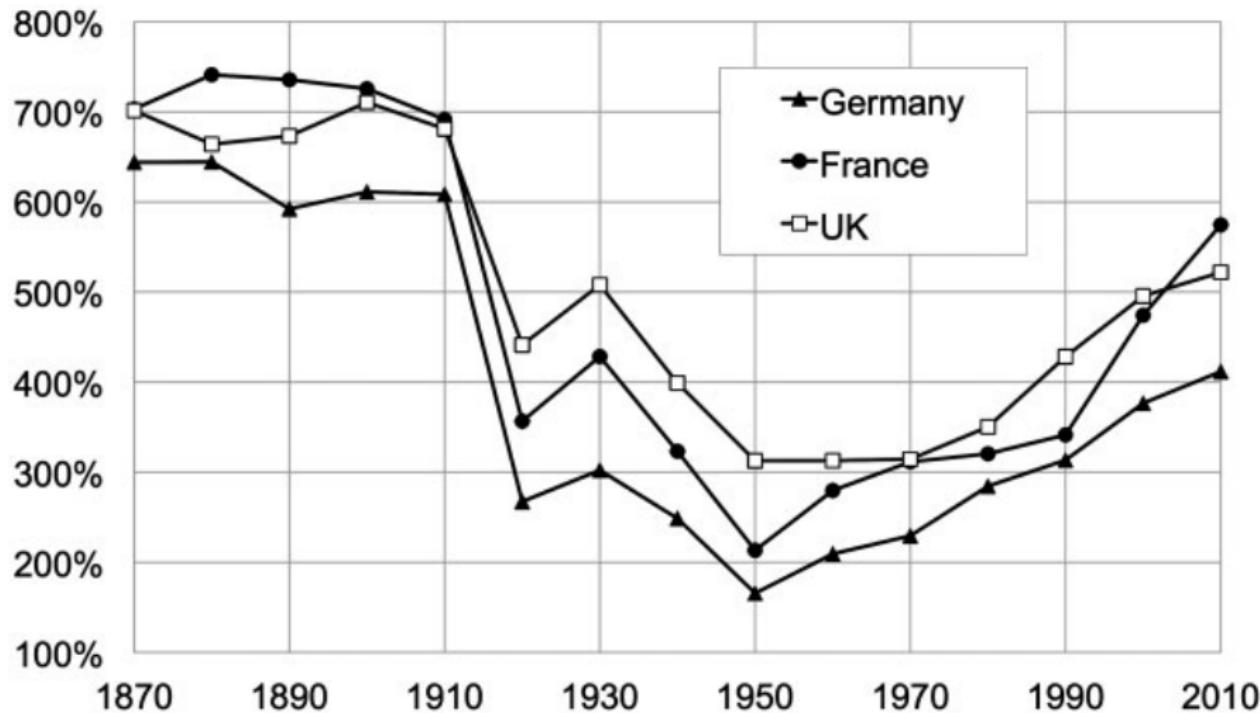


FIGURE II

Private Wealth-National Income Ratios in Europe, 1870–2010

## Piketty and Zucman (2014)

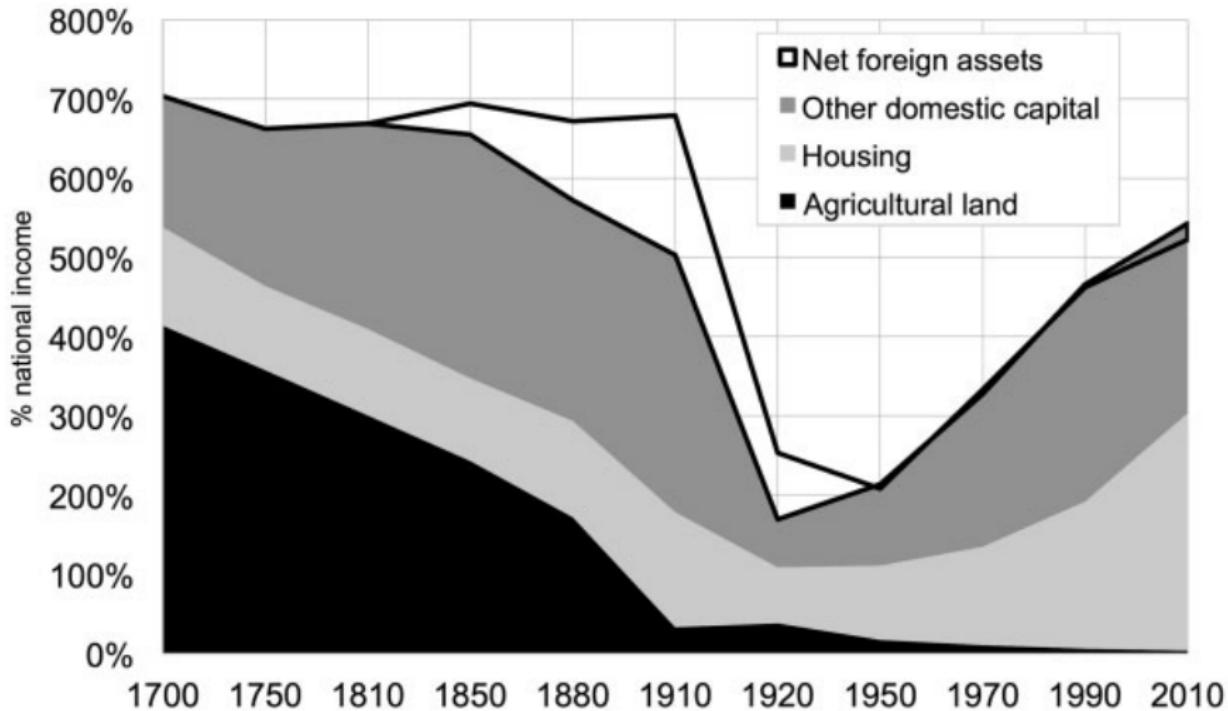


FIGURE III

The Changing Nature of National Wealth: United Kingdom, 1700–2010

## Piketty and Zucman (2014)

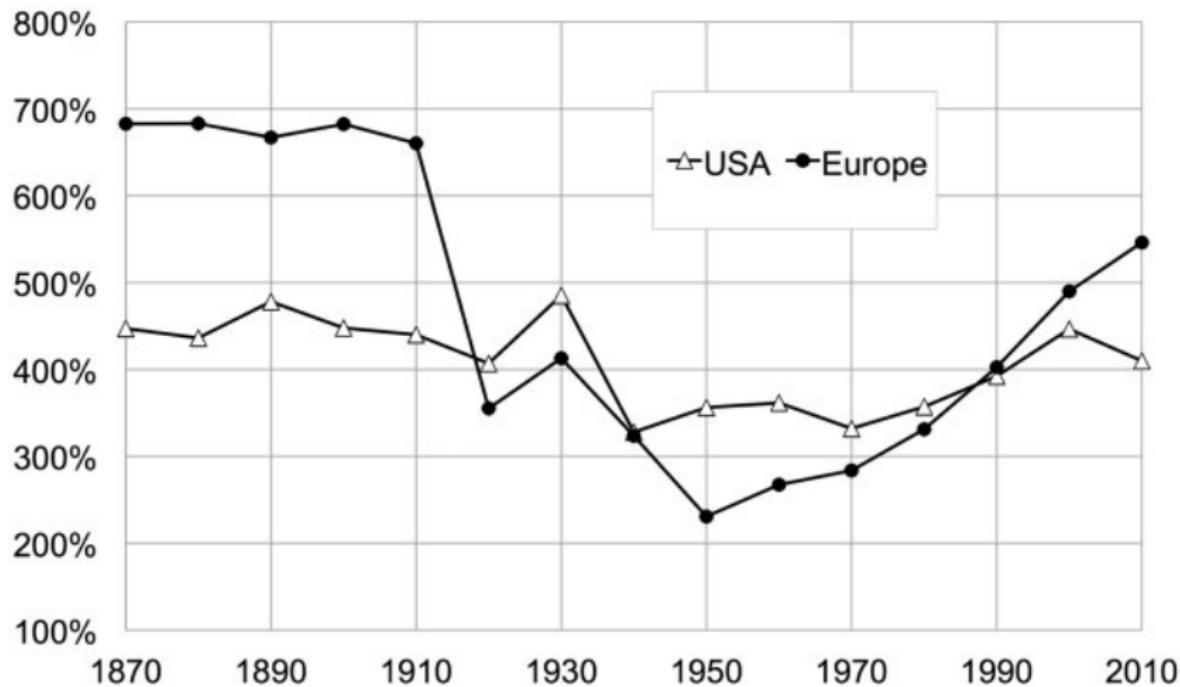
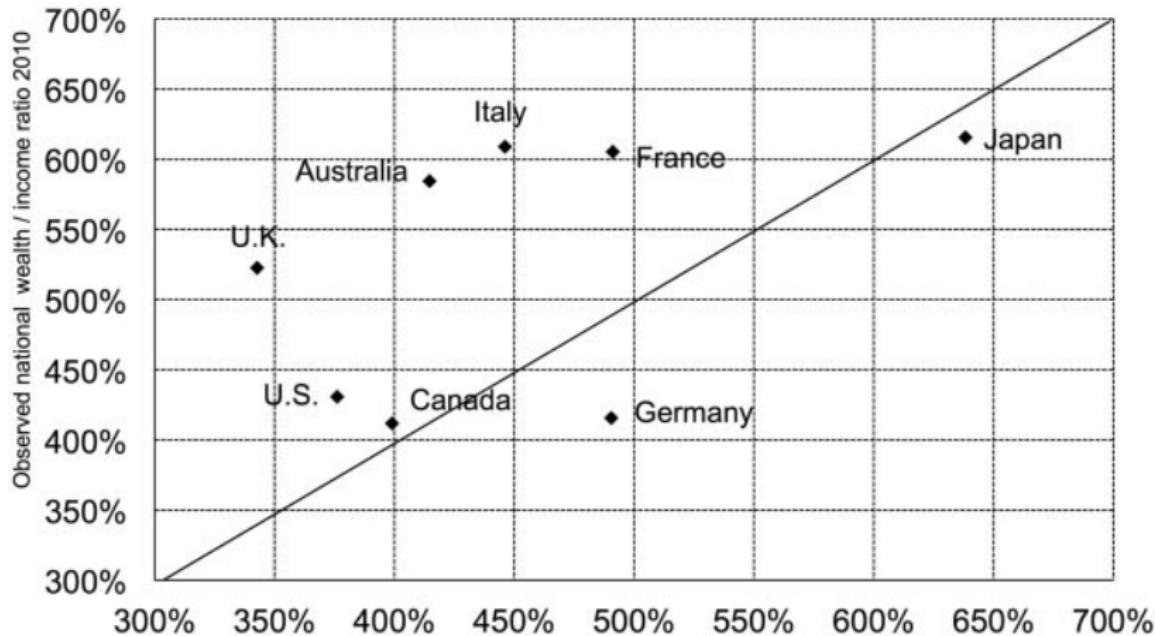


FIGURE IV

Private Wealth-National Income Ratios, 1870–2010: Europe versus United States

# Piketty and Zucman (2014)



Predicted national wealth/income ratio 2010 (on the basis of 1970 initial wealth  
and 1970–2010 cumulated saving flows) (additive decomposition, incl. R&D)

FIGURE VII

Observed versus Predicted National Wealth-National Income Ratios (2010)

# Piketty and Zucman (2014)

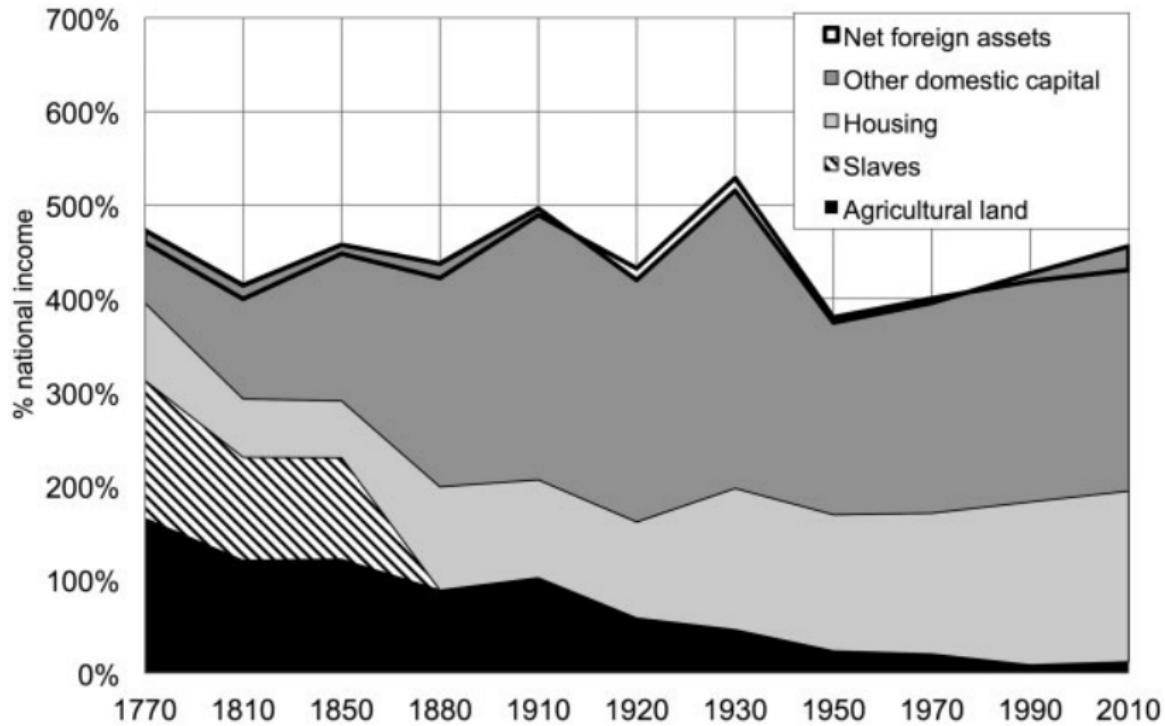


FIGURE X

The Changing Nature of Wealth: United States, 1770–2010

# Piketty and Zucman (2014)

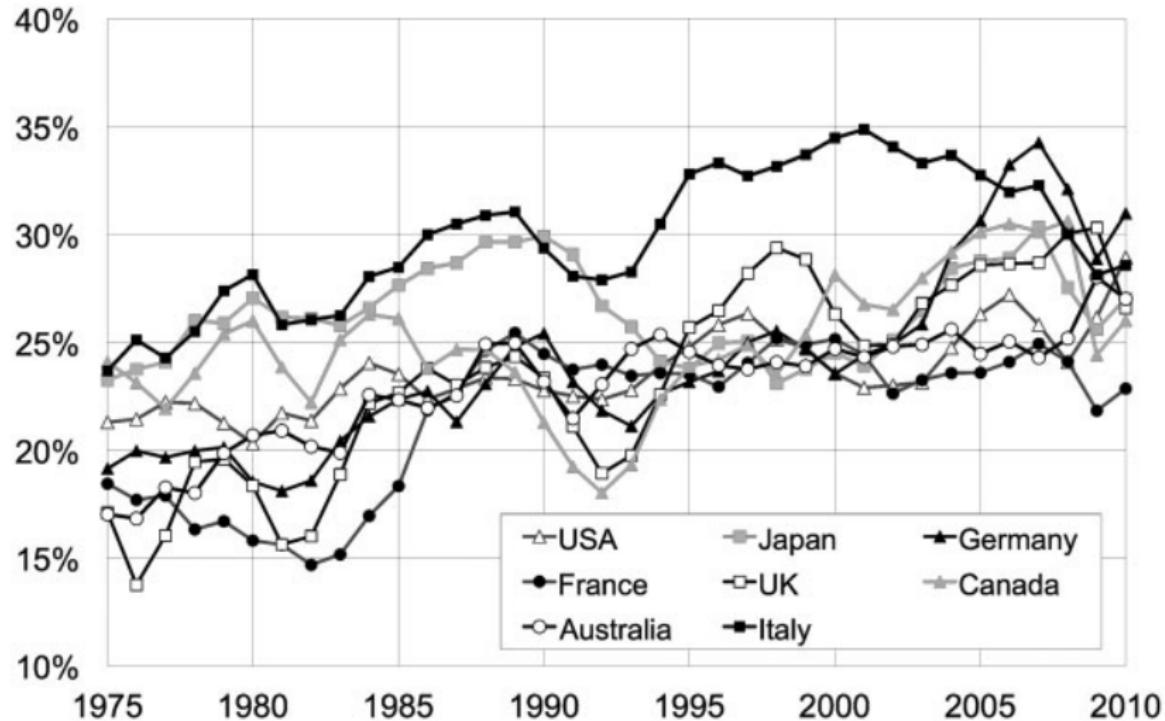


FIGURE XII

Capital Shares in Factor-Price National Income, 1975–2010

# Piketty and Zucman (2014)

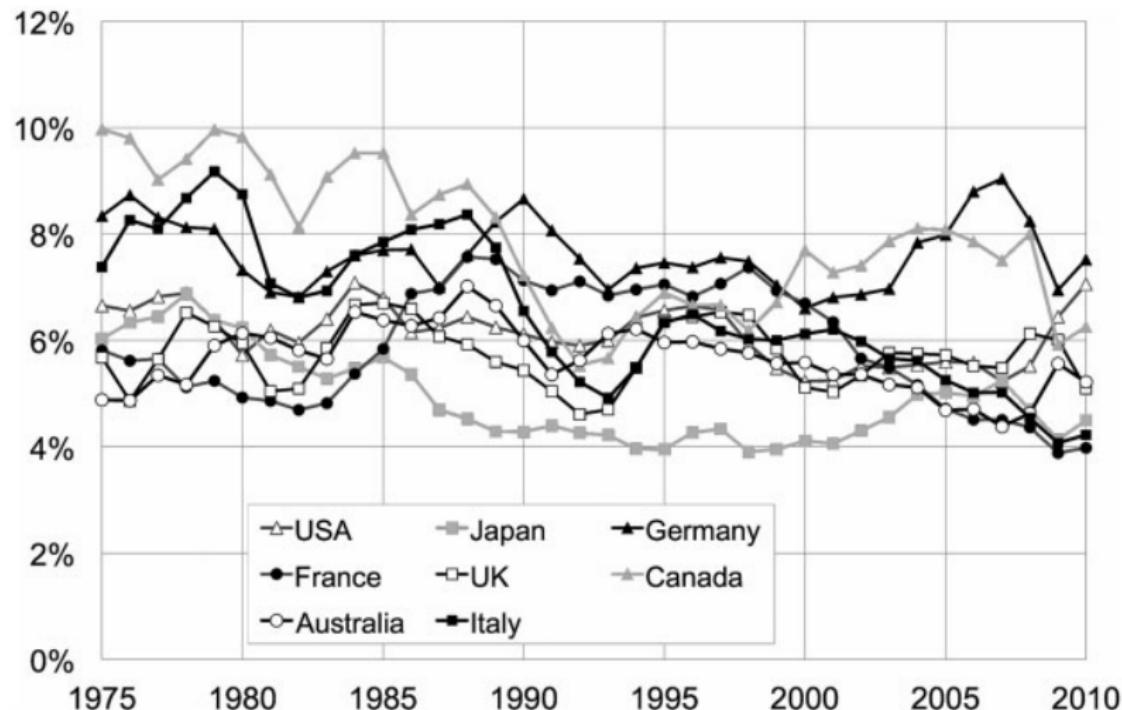
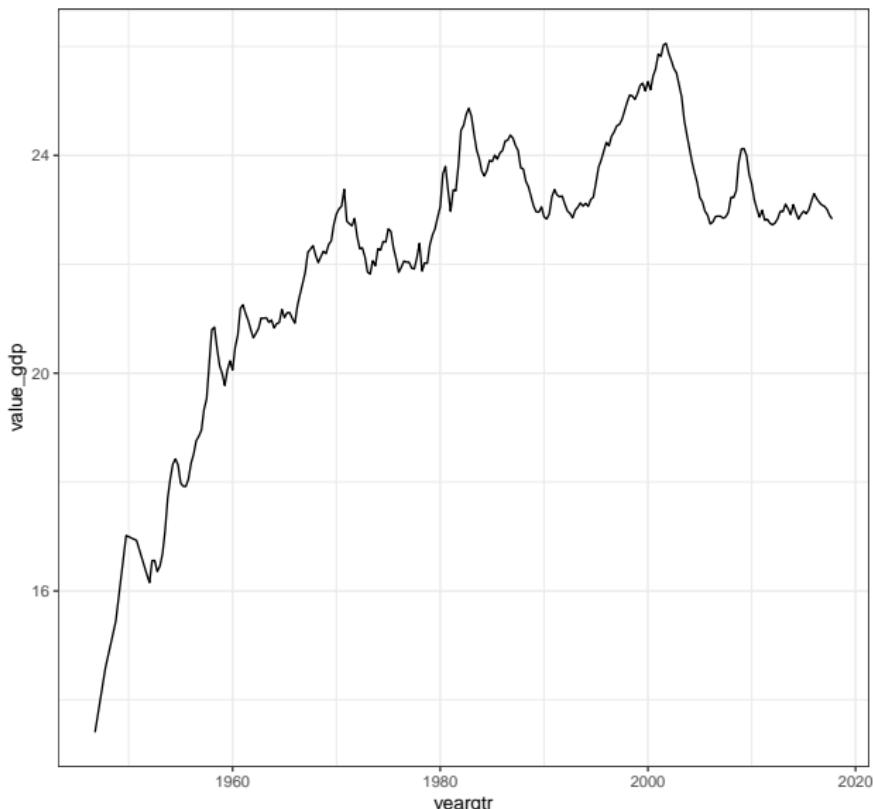


FIGURE XIII  
Average Return on Private Wealth, 1975–2010

- 1 Low interest rates
- 2 More interest rates
- 3 Abel et al. (1989)
- 4 Caselli and Feyrer (2007)
- 5 Piketty and Zucman (2014)
- 6 Changing nature of capital
- 7 Reassessing Dynamic Efficiency
- 8 Rognlie (2015)

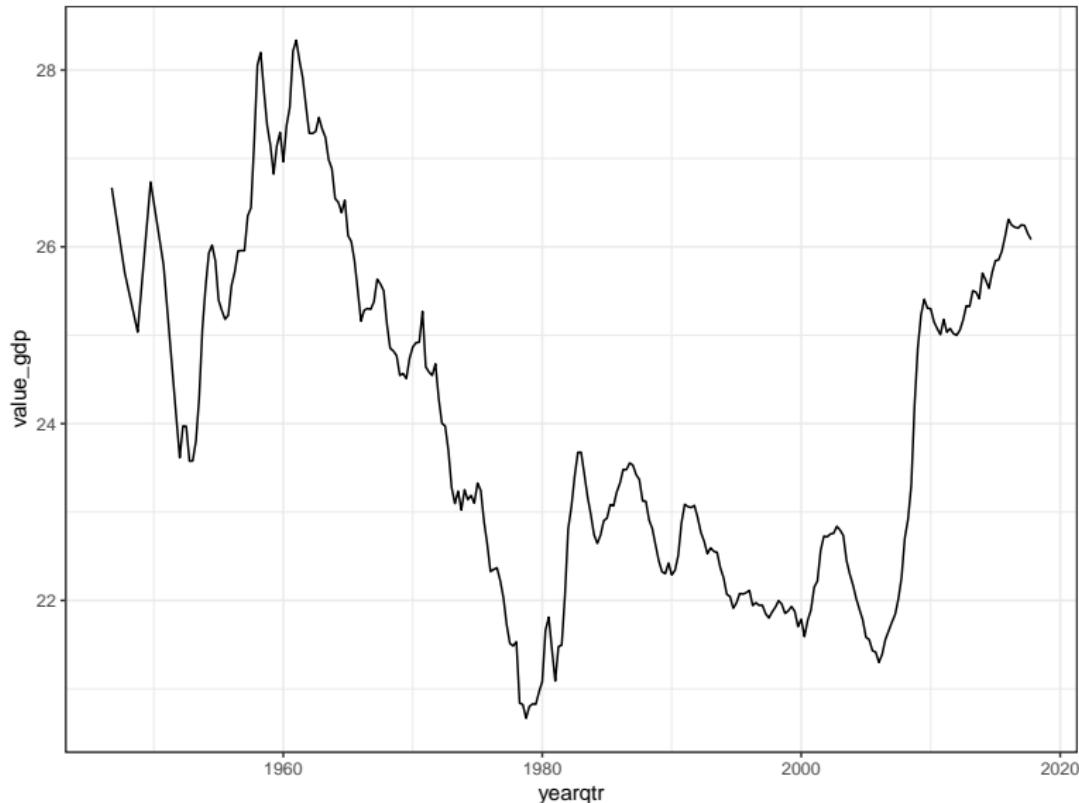
# Non Residential Equipment - historical

Nonfinancial corporate business; nonresidential equipment, historical cost basis  
Table B.103 Balance Sheet of Nonfinancial Corporate Business, Line 48  
Millions of dollars; not seasonally adjusted



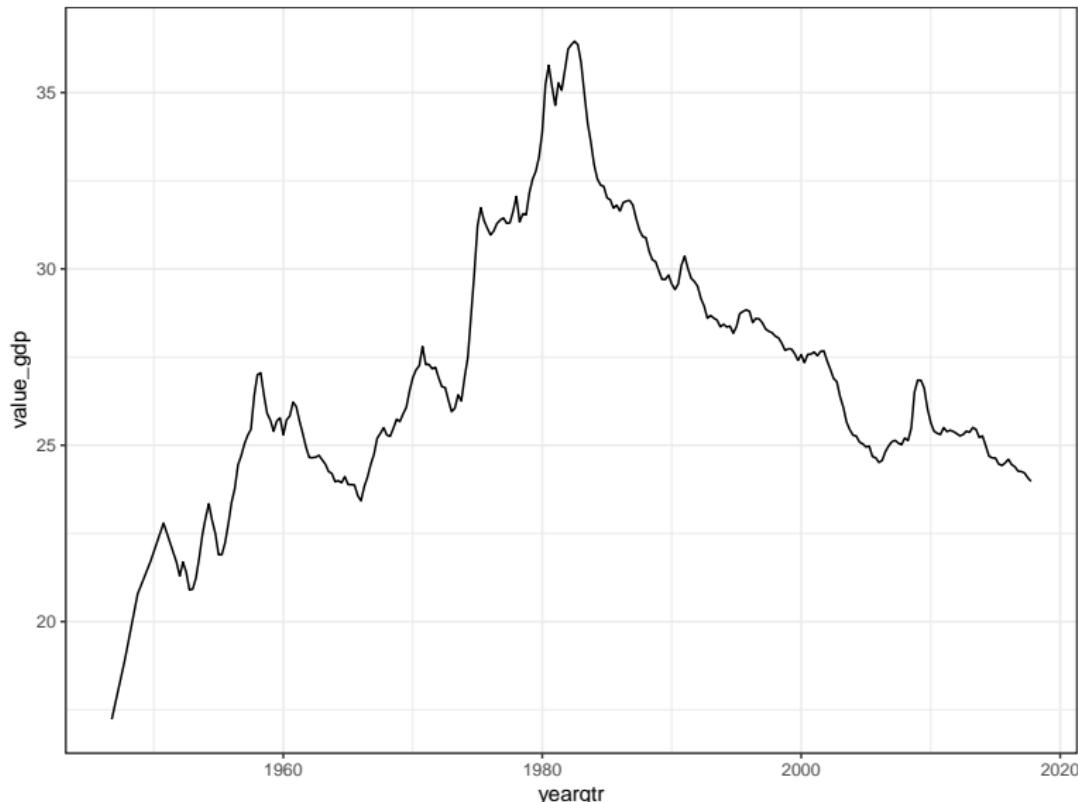
# Structures

Nonfinancial corporate business; nonresidential structures, historical cost basis  
Table B.103 Balance Sheet of Nonfinancial Corporate Business, Line 53  
Millions of dollars; not seasonally adjusted



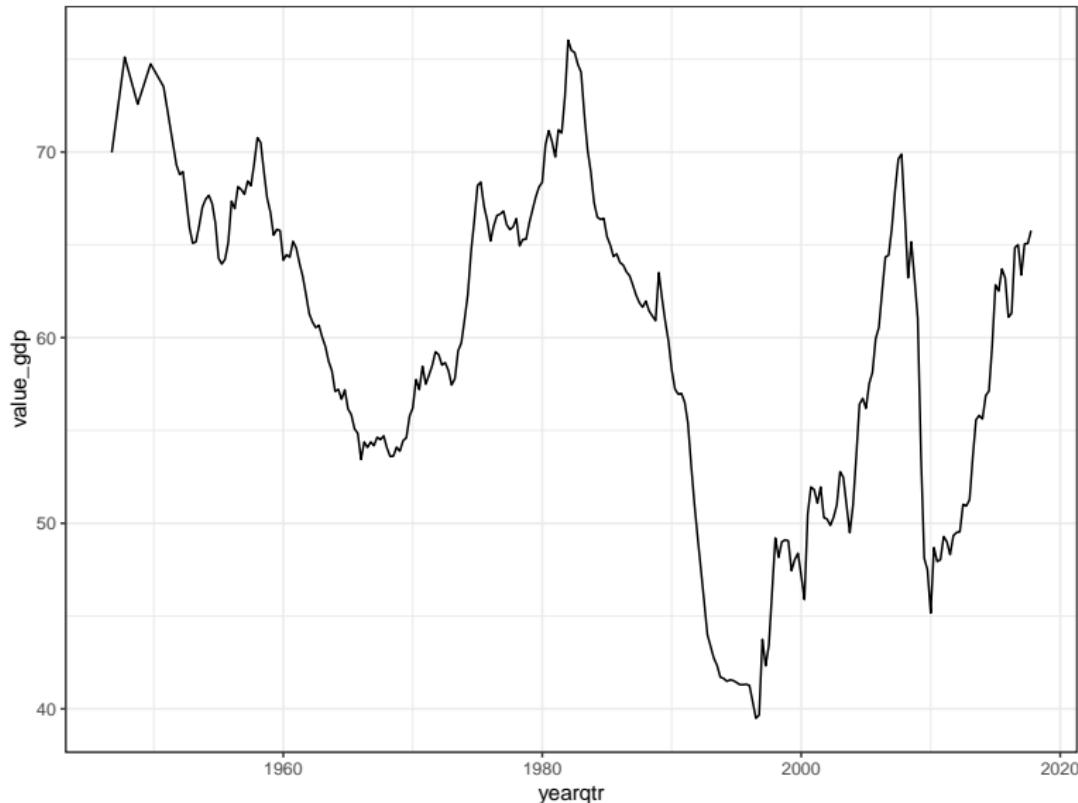
# Equipment - current

Nonfinancial corporate business; equipment, current cost basis  
Table B.103 Balance Sheet of Nonfinancial Corporate Business, Line 4  
Millions of dollars; not seasonally adjusted



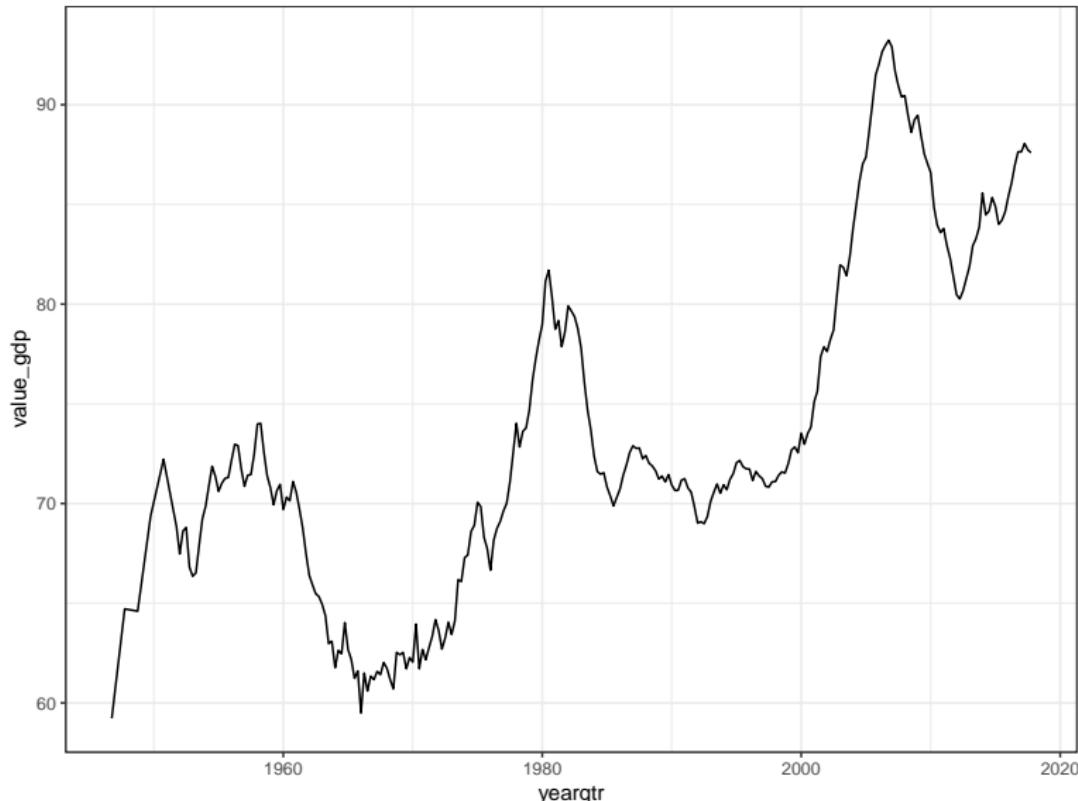
# Real estate at market value

Nonfinancial corporate business; real estate at market value  
Table B.103 Balance Sheet of Nonfinancial Corporate Business, Line 3  
Millions of dollars; not seasonally adjusted



# Residential structures

Households and nonprofit organizations; residential structures, current cost basis  
Table B.101 Balance Sheet of Households and Nonprofit Organizations, Line 45  
Millions of dollars; not seasonally adjusted



- 1 Low interest rates
- 2 More interest rates
- 3 Abel et al. (1989)
- 4 Caselli and Feyrer (2007)
- 5 Piketty and Zucman (2014)
- 6 Changing nature of capital
- 7 Reassessing Dynamic Efficiency
- 8 Rognlie (2015)

## Dynamic Efficiency

- Dynamic efficiency is important for a series of issues: public debt, retirement systems, rational bubbles, and climate change mitigation (Stern VS Nordhaus).
- Empirical question.
- Abel et al. (1989) show sufficient conditions for dynamic Efficiency / Inefficiency, comparing capital income  $rK$  and investment  $I$ :

Dynamic *Efficiency* :  $\exists \epsilon > 0, \forall t > t_0, r_t^K K_t \geq (1 + \epsilon) I_t$

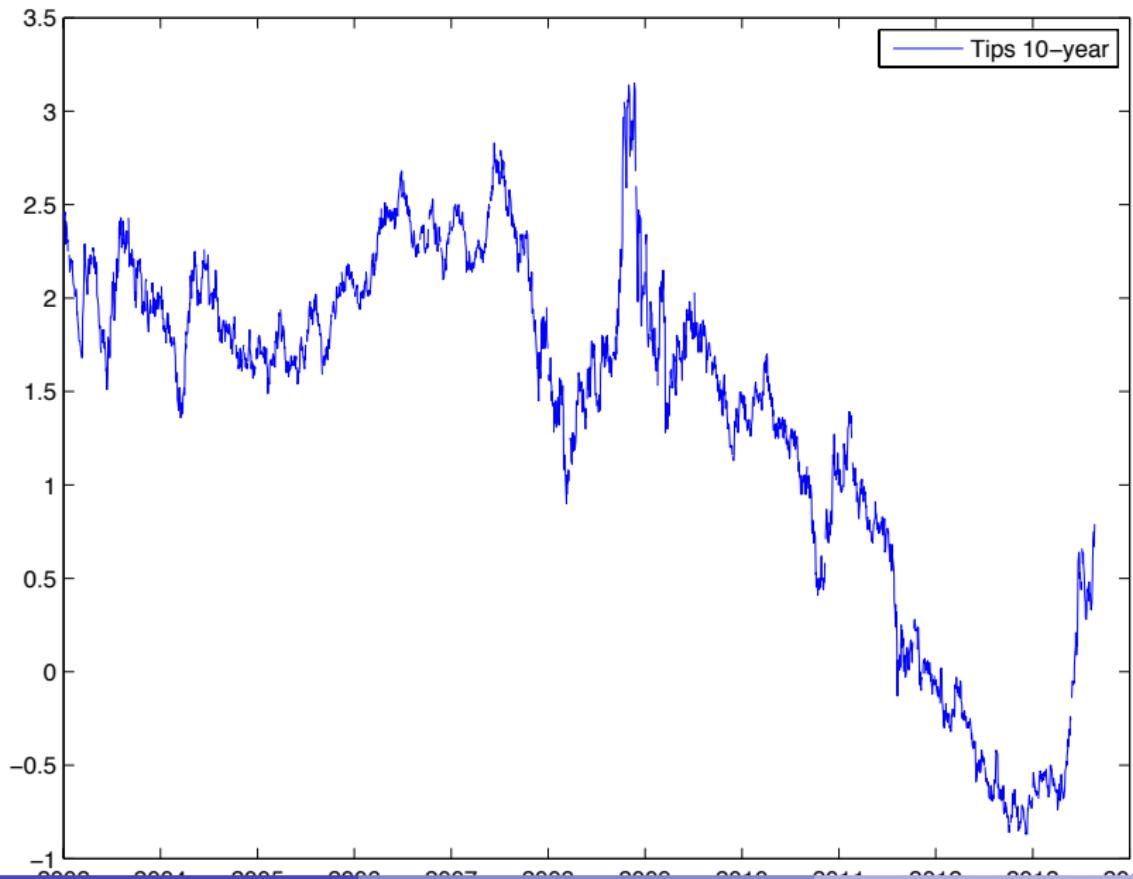
Dynamic *Inefficiency* :  $\exists \epsilon > 0, \forall t > t_0, r_t^K K_t \leq (1 - \epsilon) I_t$

- Abel et al. (1989) : United States until 1984, as well as 6 other countries satisfy  $\forall t > t_0, (rK)(t) > I(t)$ .

# Motivation

- “Savings glut”, “negative interest rates”, “search for yield”.
- Non-performing loans (subprime, Greece).
- US TIPS negative :  $\simeq -1\%$ . Before the crisis: low interest rates.
- “Firms hoard cash and don’t invest.” (e.g. Apple) “Banks do not lend.”
- $\Rightarrow$  **Too much capital?**

# TIPS



## This paper

- Using the same theoretical apparatus, but doing corrections on land rents and mixed income I find that:
  - ① Japan, and South Korea are unambiguously dynamically **inefficient**.
  - ② Australia, Canada are such that  $rK < I$  for most years.
  - ③ Dynamic inefficiency cannot be rejected for any advanced economy.
- More data: 16 countries over 40 years. Country-level data on land rents and mixed income.

## Literature

- To the best of my knowledge: nothing on flows of capital income VS investment since Abel et al. (1989).
- Recent improvements in national accounts (SNA 93) :
  - ▶ Gollin (2002) – Getting income shares right.
  - ▶ Caselli and Feyrer (2007) – The Marginal product of capital.
  - ▶ Piketty and Zucman (2014) – wealth/income in the long run.

## Dynamic Inefficiency

- Very simplified version of Abel et al. (1989).
- Cobb-Douglas:  $Y_t = A_t K_t^\alpha N_t^\beta L_t^\gamma$ ,  $K_t = I_{t-1}$  capital (full depreciation),  $N_t = \bar{N}$  employment,  $L_t = \bar{L}$  land.
- Firm solves:

$$\max_{K_t, N_t, L_t} A_t K_t^\alpha N_t^\beta L_t^\gamma - r_t^K K_t - w_t N_t - r_t^L L_t.$$

- Income approach:

$$\begin{aligned} A_t K_t^\alpha N_t^\beta L_t^\gamma &= \text{Cap. Inc} + w_t N_t \\ &= r_t^K K_t + r_t^L L_t + \Pi_{\text{pure}} + w_t N_t. \end{aligned}$$

- Conditions:

Dynamic Efficiency:  $\exists \epsilon > 0, \quad \forall t > t_0, \quad r_t^K K_t \geq (1 + \epsilon) I_t$

## Intuition for inefficiency

- Assume :

$$\exists \epsilon > 0, \quad \forall t > t_0, \quad r_t^K I_{t-1} \leq (1 - \epsilon) I_t.$$

- $dC_{t_0} > 0$ , financed by  $dK_{t_0+1} = dI_{t_0} = -dC_{t_0}$ . To maintain  $dC_{t_0+1} = 0$ , there must be a reduction in investment in  $t_0 + 1$ :

$$dI_{t_0+1} \leq \frac{\partial Y_{t_0+1}}{\partial K_{t_0+1}} dI_{t_0} = r_t^K dI_{t_0} \quad \Rightarrow \quad \frac{dI_{t_0+1}}{I_{t_0+1}} \leq \frac{r_{t_0+1}^K I_{t_0}}{I_{t_0+1}} \frac{dI_{t_0}}{I_{t_0}}$$

- Similarly, investment must decrease in all future periods to maintain  $dC_t = 0$ :

$$\forall t > t_0, \quad \frac{dI_t}{I_t} \leq \left( \prod_{\tau=t_0+1}^t \frac{r_\tau^K I_{\tau-1}}{I_\tau} \right) \frac{dI_{t_0}}{I_{t_0}}$$

- Pareto-improving change. Feasible, since  $\frac{r_t^K I_{t-1}}{I_t} \leq 1 - \epsilon$ .

## Reproducing Abel et al. (1989)

- $r_t^K K_t$  is not readily available:

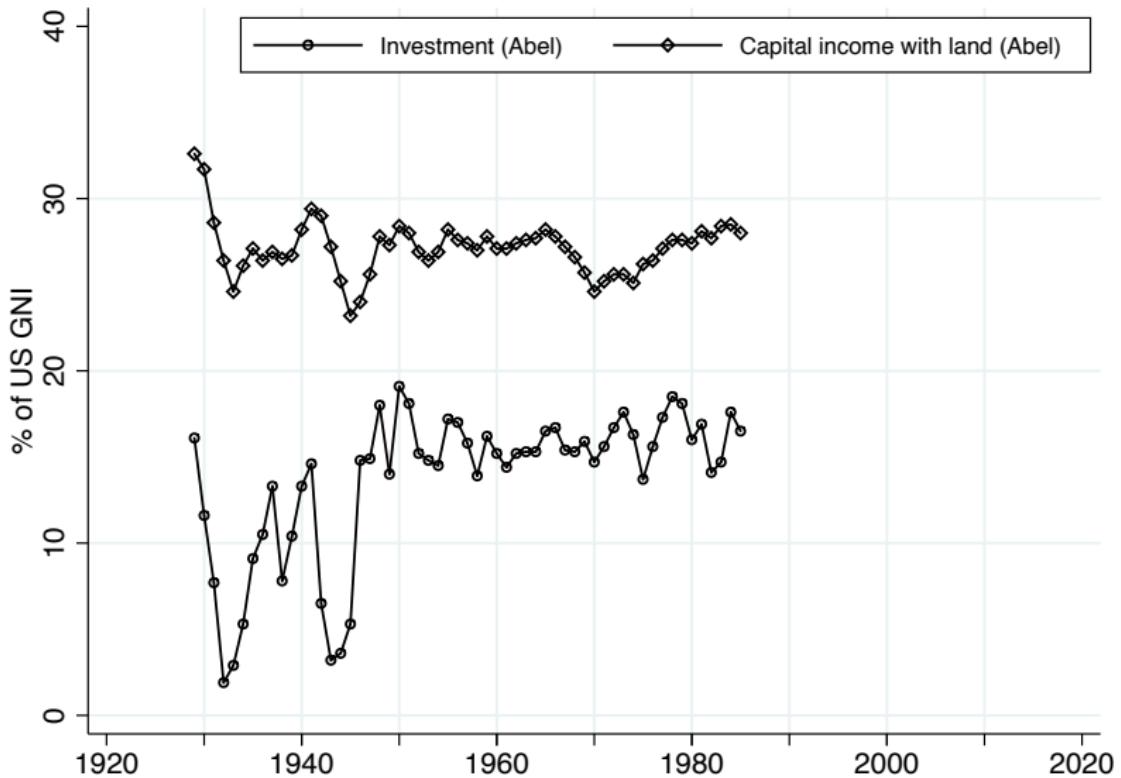
$$A_t K_t^\alpha N_t^\beta L_t^\gamma = \left( A_t K_t^\alpha N_t^\beta L_t^\gamma \right)_{mix} + (Cap.Inc)_{nonmix} + (w_t N_t)_{nonmix}$$

- In NIPA (BEA data),  $r_t^K K_t$  can be inferred:

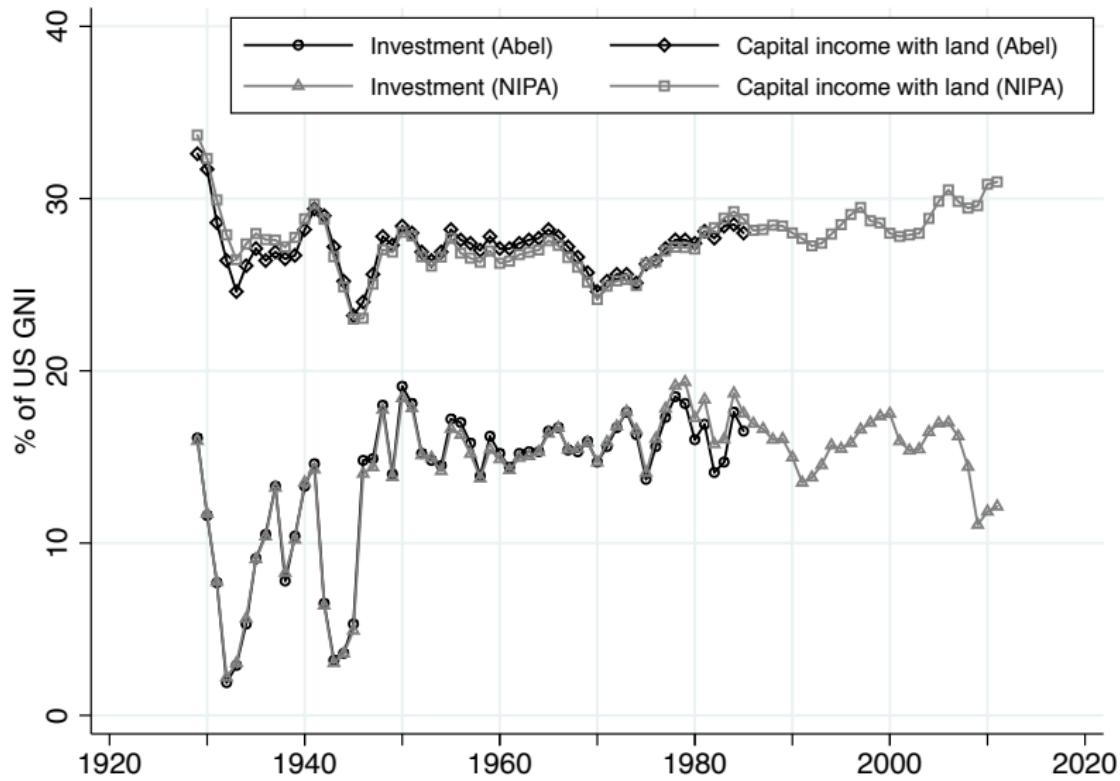
$$r_t^K K_t = f \left( \left( A_t K_t^\alpha N_t^\beta L_t^\gamma \right)_{mix} \right) + \left( Cap.Inc - r_t^L L_t - \Pi_{pure} \right)_{nonmix}$$

- $f(x) = 1/3x$ . 1/3 of mixed income is capital income.
- $Cap.Inc = Gross\ capital\ income = profit + rental\ income + interest\ income + private\ CCA$ .
- $r_t^L L_t$ : 25% of assets = 5% of GDP.  $\Pi_{pure} = 0$ .

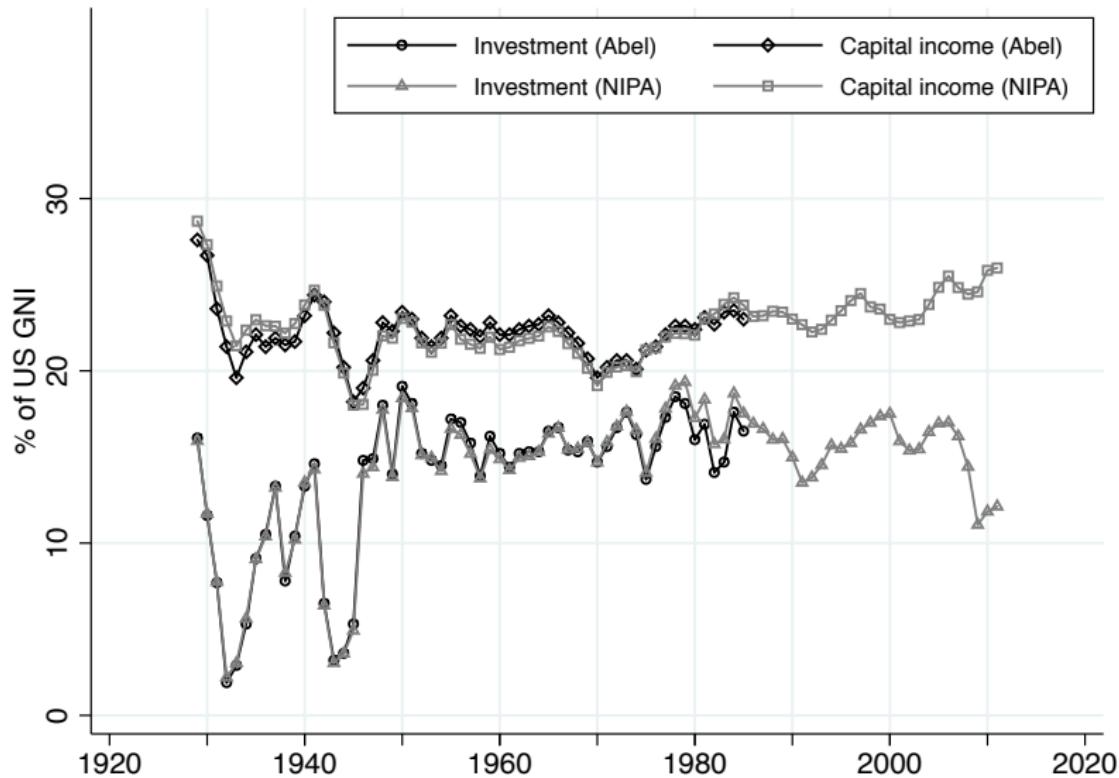
# Data from Abel et al. (1989)



## Reproducing from NIPA and updating



## Adjusting for land, according to Abel et al. (1989)

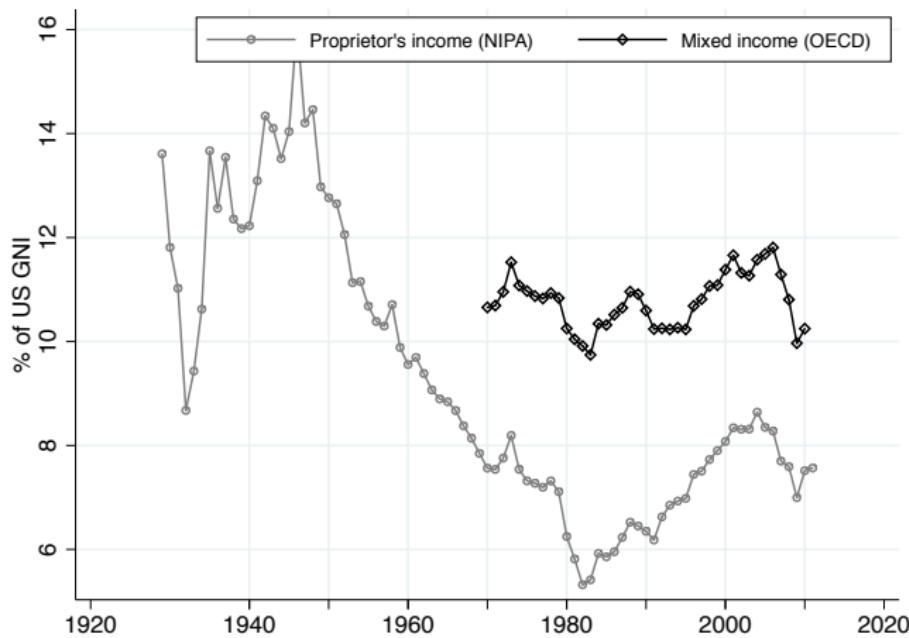


## Too sanguine about efficiency - United States

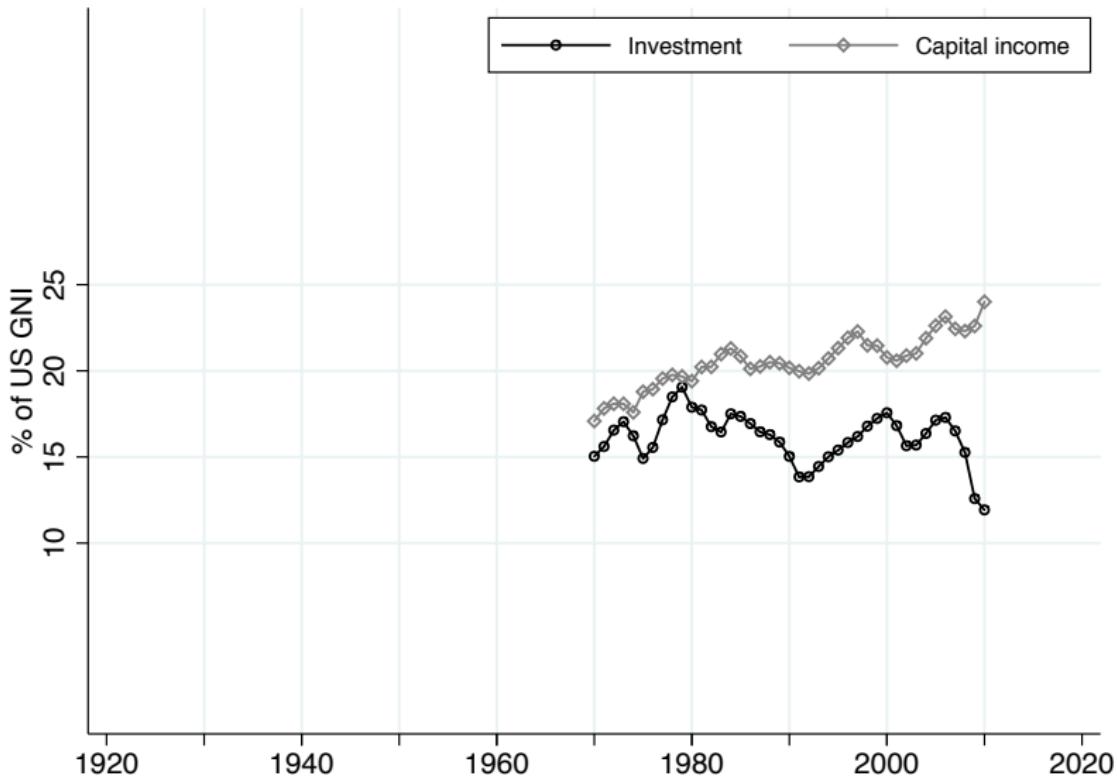
- Two corrections included here :
  - ① Correction for mixed income (NIPA's "proprietor's income" does not include all unincorporated enterprises).
  - ② Correction for land. ( $2/3$  of GDP  $\Rightarrow$  100% of GDP).
- Not quantified other reasons:
  - ▶ Conservative for mixed income :  $1/3$  being capital inc. is an upper bound. Much lower: Gollin (2002). Today: lawyers, doctors... (VS farmers before)
  - ▶ Decreasing returns to scale, monopoly rents in profit. Problem since Kuznets (1959).

## Adjusting for land, according to Abel et al. (1989)

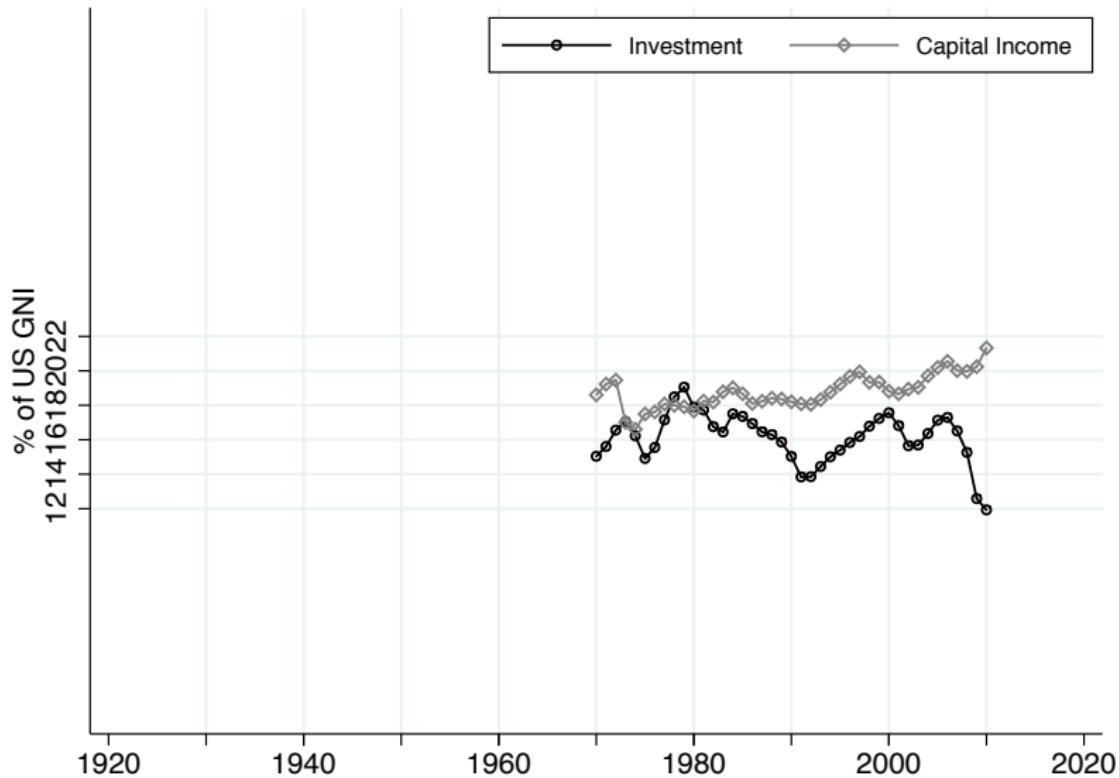
BEA: "The residual business income of unincorporated corporations that is attributable to labor and to capital has not been implemented in the NIPAs, pending a review of the sectoring of unincorporated businesses."



## Adjusting for mixed income



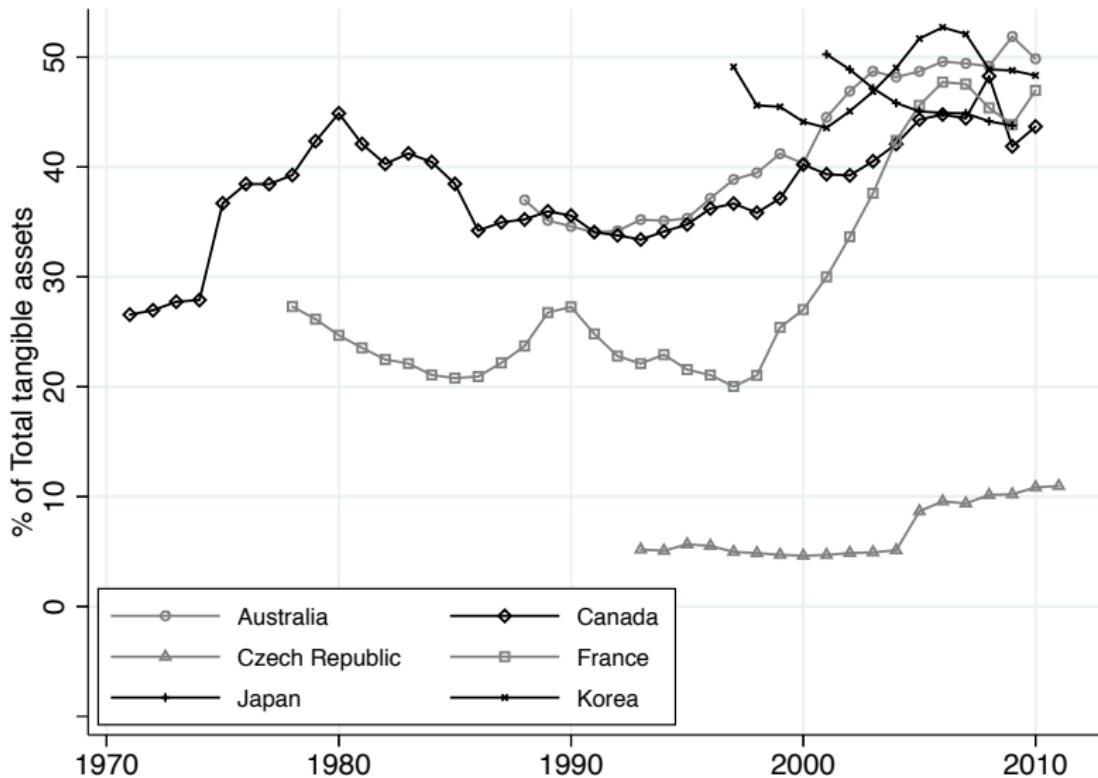
## New data on land



## Other countries

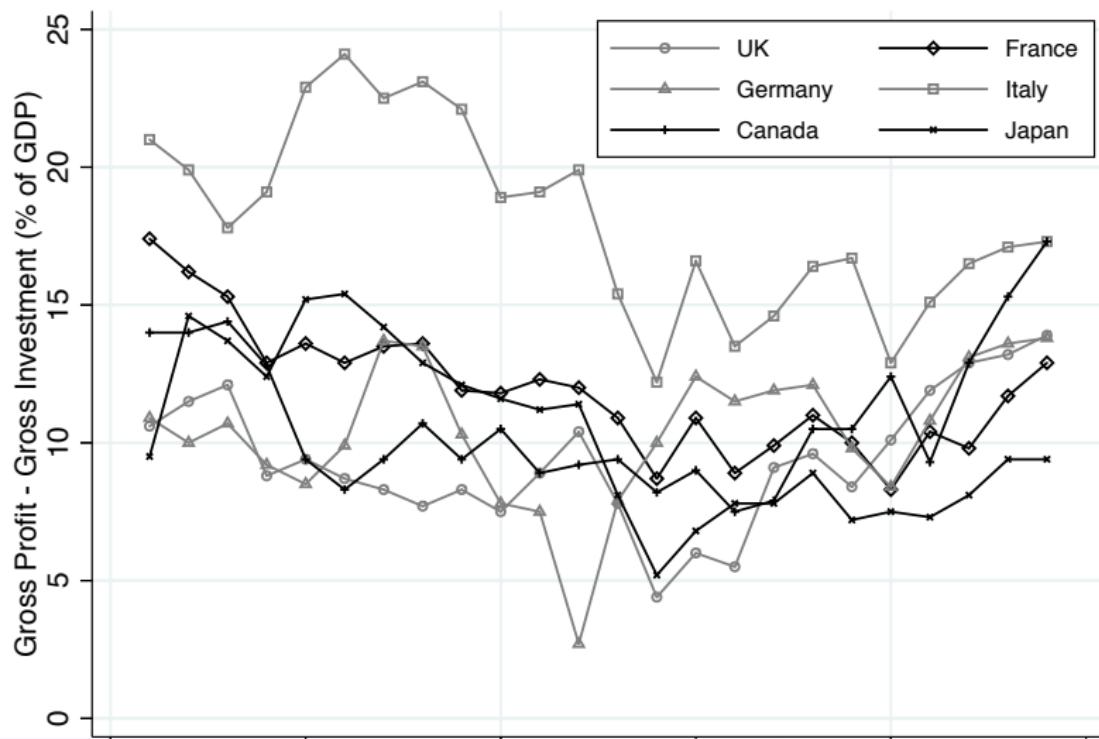
- Abel et al. (1989) : no data for land or mixed income in other countries. ⇒ took 5% of GDP for land, did not account for mixed income.
  - ▶ This paper: OECD for 6 countries. Land: residual of house prices minus replacement cost of structures. ⇒ Used value: minimum over 20-year period.
  - ▶ Supplemented by Goldsmith Balance Sheets (1985): 20 countries (1973, 1978).
  - ▶ Lowest value in 1973 or 1978 from Goldsmith for all years. Very conservative, especially for the last decade. Goldsmith underestimates relative to OECD.

# OECD Data for land

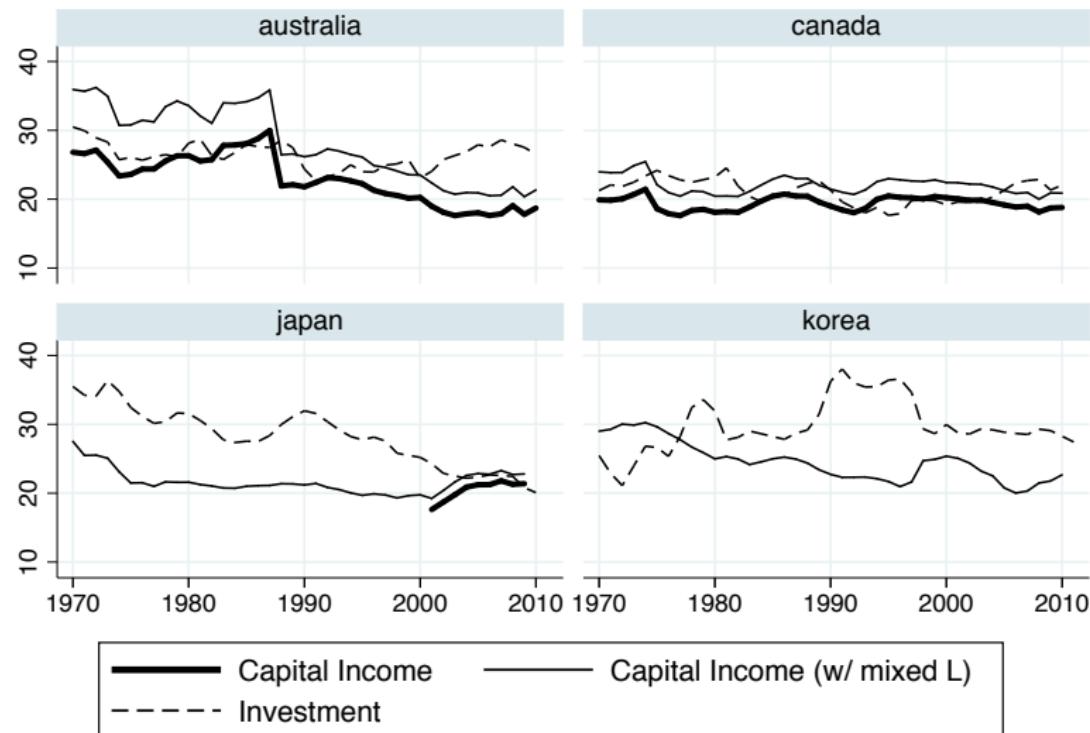


## Results of Abel et al. (1989)

- England, France, Germany, Italy, Canada, Japan.
- Give the difference between gross profit and gross investment.

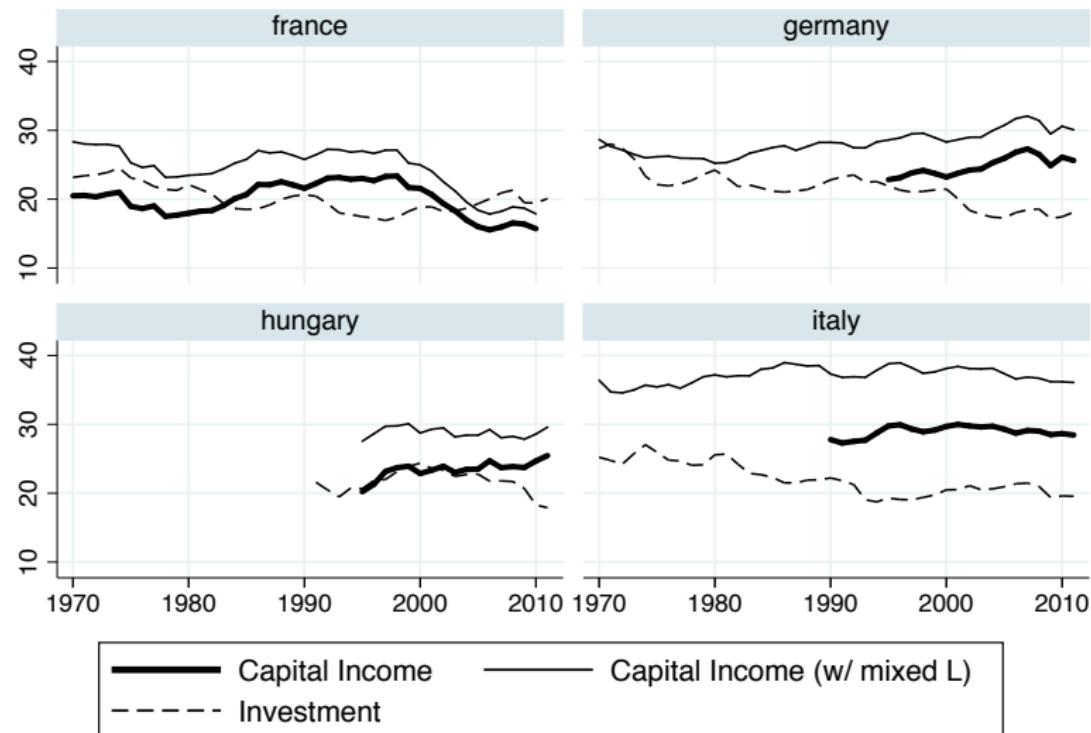


# New computations: Japan, South Korea, Australia, Canada



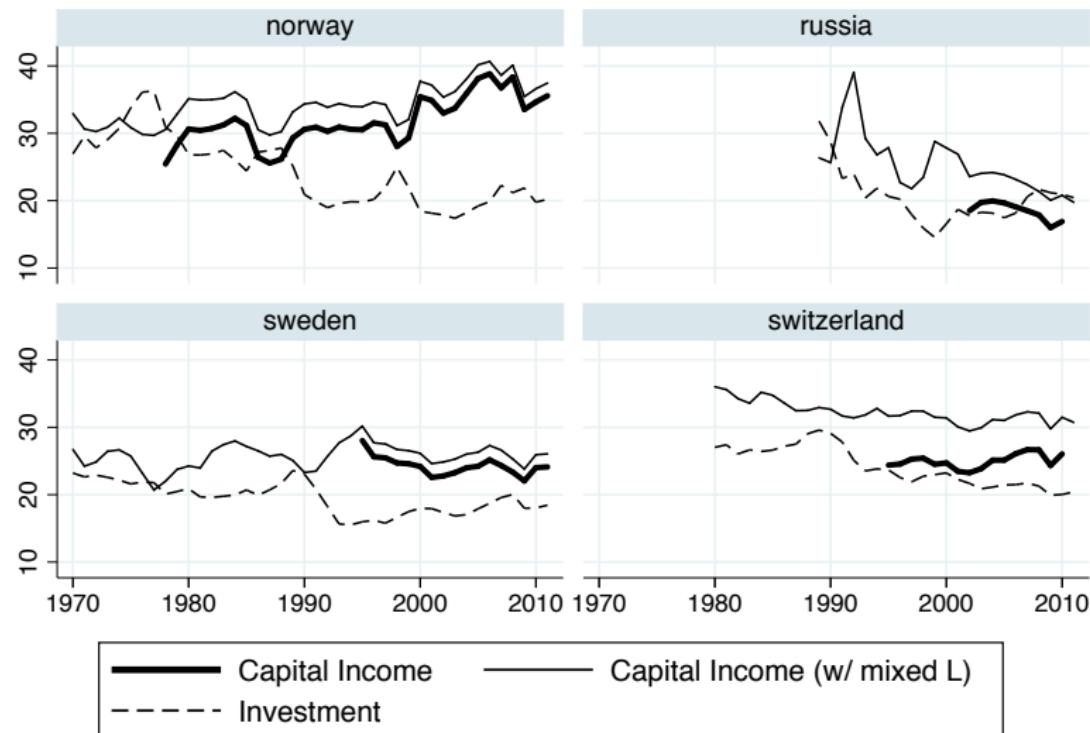
Source: OECD, Kuznets (1985), and author's calculations

# New computations: France, Germany, Hungary, Italy



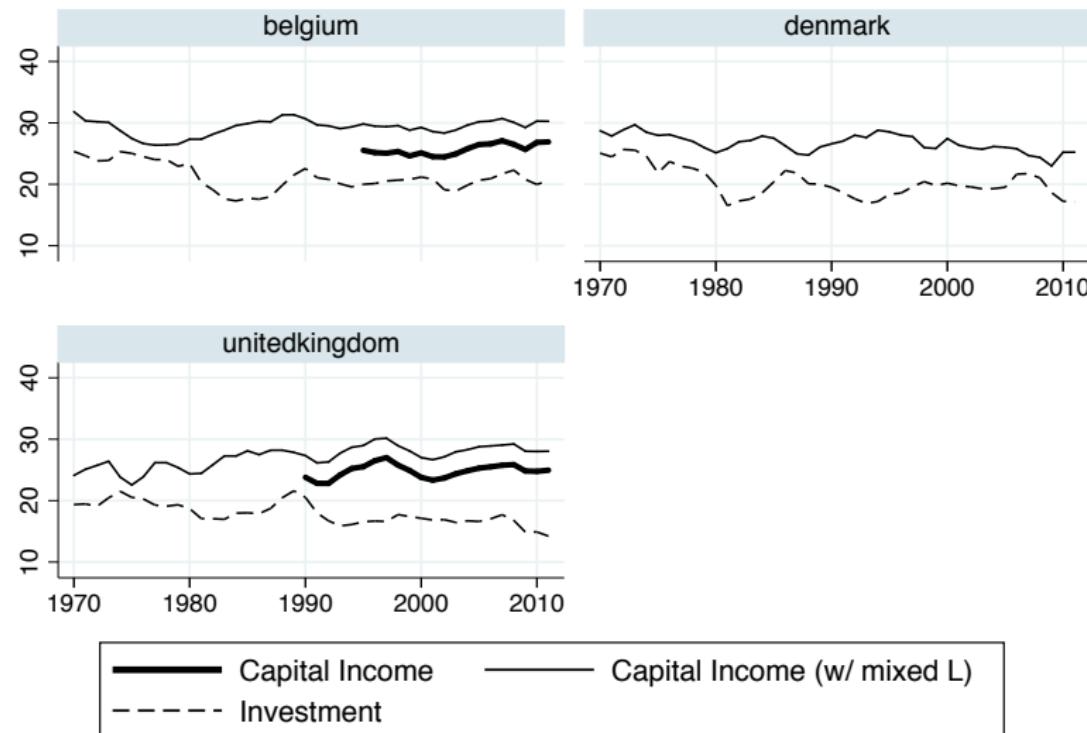
Source: OECD, Kuznets (1985), and author's calculations

# New computations: Russia, Norway, Sweden, Switzerland



Source: OECD, Kuznets (1985), and author's calculations

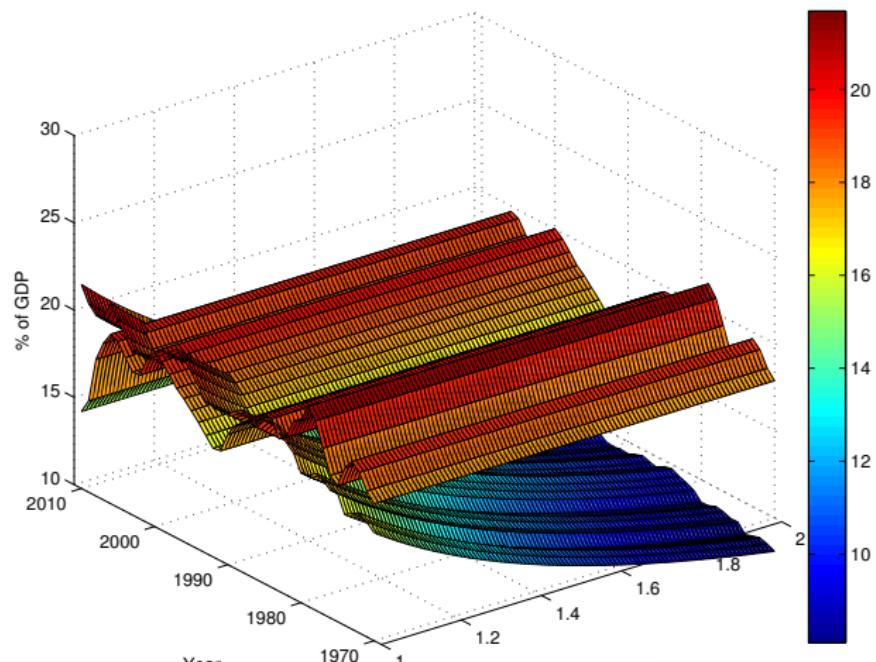
# New computations: Belgium, Denmark, United Kingdom



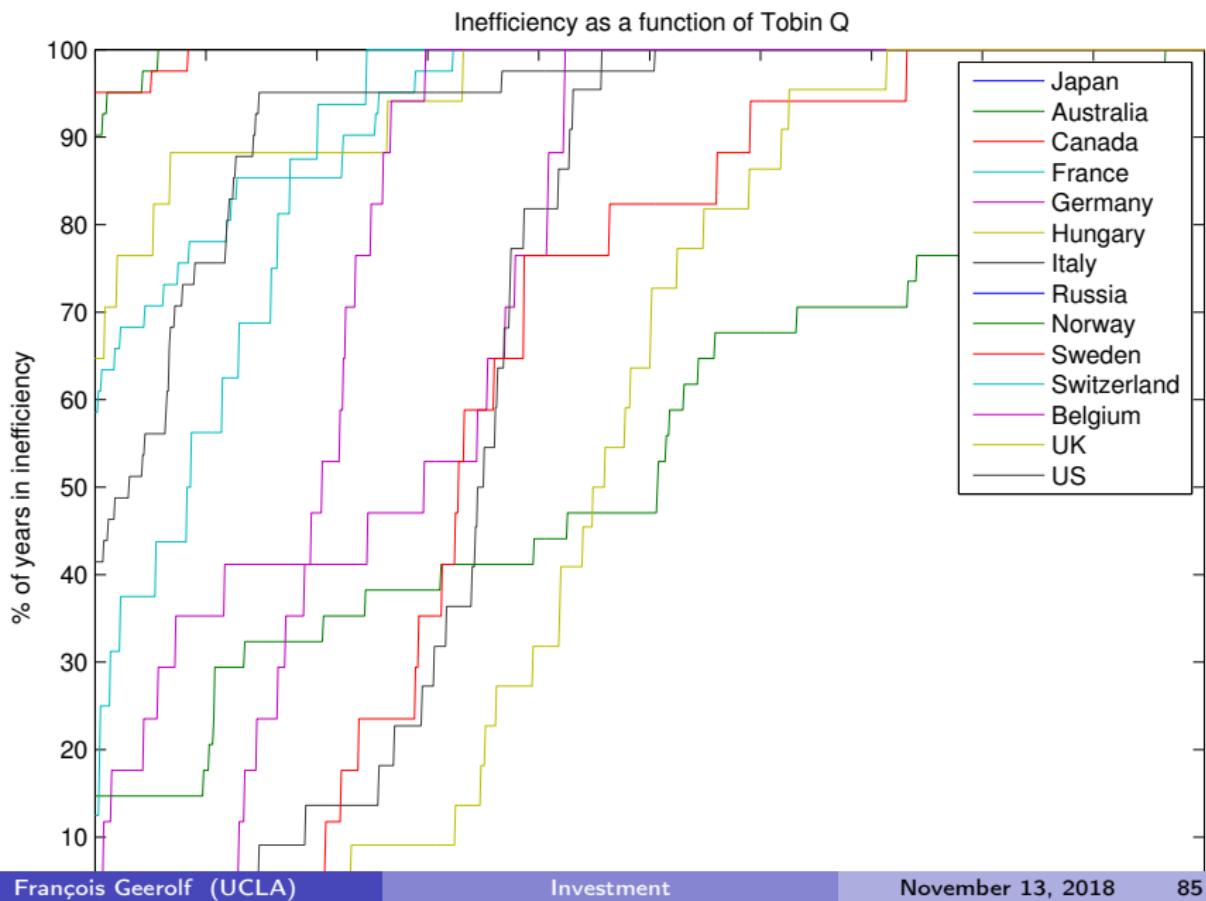
Source: OECD, Kuznets (1985), and author's calculations

## The need for Tobin's q

- Decreasing returns to scale pure profits  $\pi_t^P$  need to be taken out.  
Similarly for monopoly rents. Problem since Kuznets. Average  $q$  of  
Tobin?



# Results



## Other factors

- Go in the direction of being too sanguine about efficiency:
  - ▶ **Incidence of corporate taxation.** If borne by workers, or consumers (cf. empirical literature), then corporate taxes are not capital income. Order of magnitude:  $\simeq 2.3\%$  of GDP. Inefficiency in United States with Tobin  $q$  equal to 1.
  - ▶ **Household capital services:** monitoring financial intermediaries, picking stocks, etc.  $\simeq 2\%$  of GDP (Piketty and Saez (2011)). Most importantly: managing one's property. (choosing tenants, collecting rents...)

# Implications of dynamic inefficiency

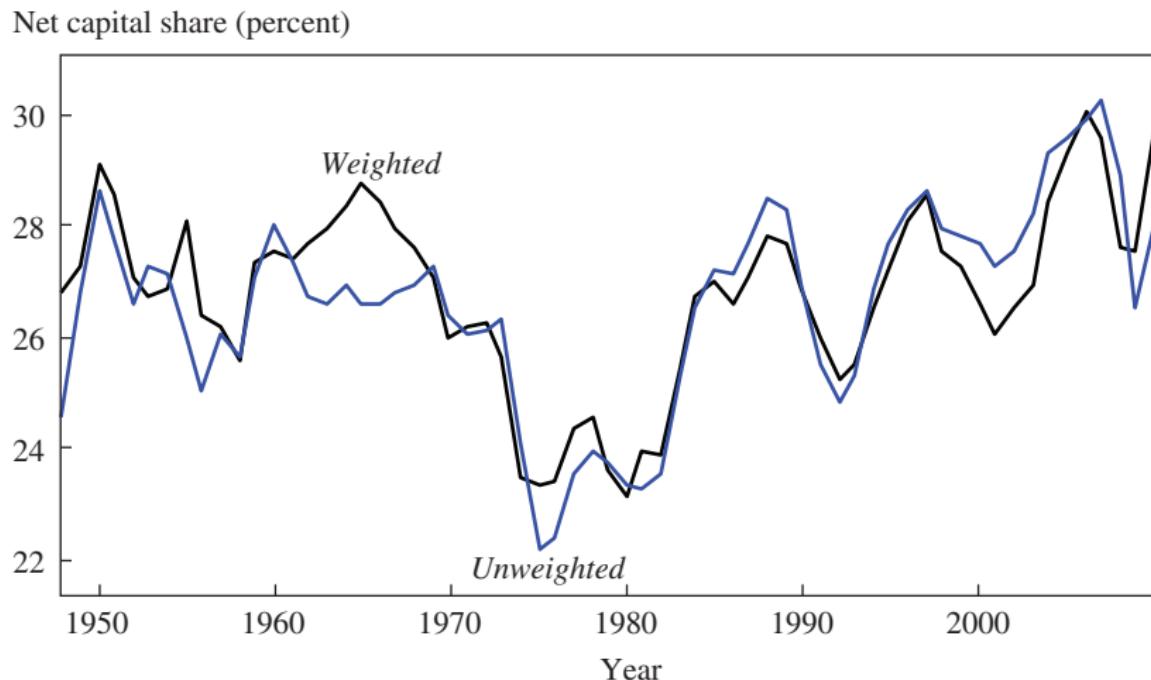
- Pareto-improving Public debt.
  - ▶ Existence of rational bubbles. Tirole (1985).
  - ▶ International debt : Hellwig and Lorenzoni (2009) solves Bulow, Rogoff (1989) (because  $W_t = +\infty$ ).
  - ▶ Environment: should we pay now for climate change? Stern ( $r^* = 1.4\%$ ) VS Nordhaus ( $r^* = 4\%$ ).

# Conclusion

- 2 corrections to Abel et al. (1989) overturn the results. Dynamic inefficiency not rejected for any advanced economy.
  - ▶ If Japan is dynamically inefficient, arbitrage argument  $\Rightarrow$  world inefficiency? how far can the external position go without Japan's fear of default?
  - ▶ Data needs : costs of managing one's property, relative wage of proprietors of unincorporated enterprises.
  - ▶ A lot more work to do.

- 1 Low interest rates
- 2 More interest rates
- 3 Abel et al. (1989)
- 4 Caselli and Feyrer (2007)
- 5 Piketty and Zucman (2014)
- 6 Changing nature of capital
- 7 Reassessing Dynamic Efficiency
- 8 Rognlie (2015)

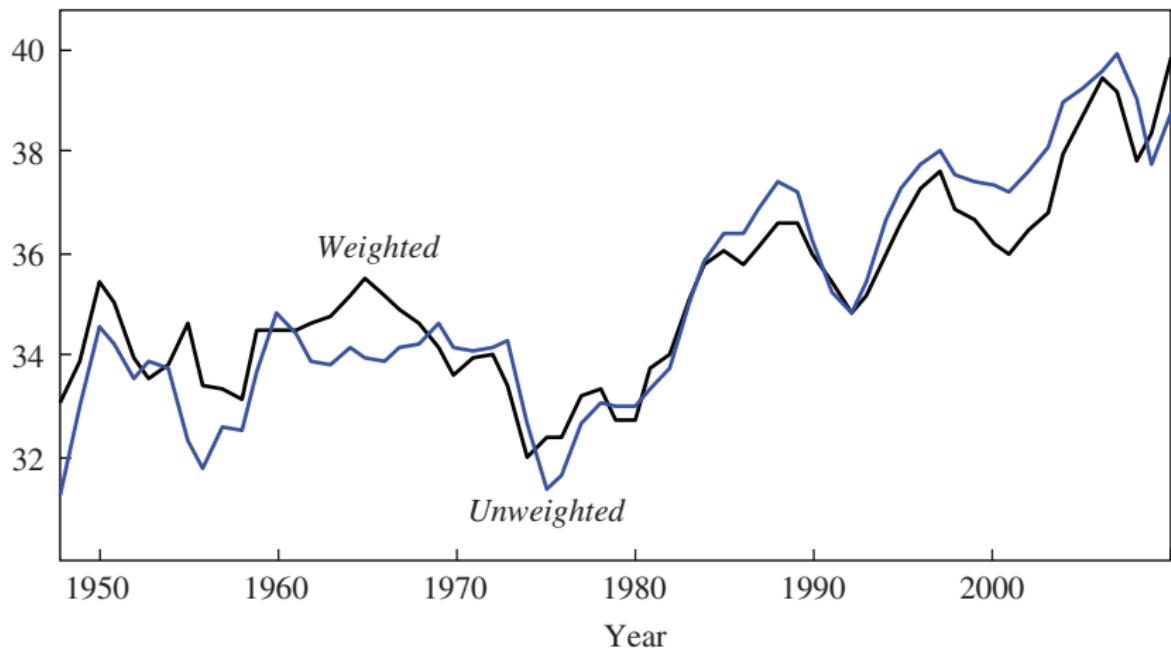
**Figure 1.** Average Net Capital Share of Private Domestic Value-Added, G7 Countries, 1950–2010



Source: Author's calculations based on national accounts; Piketty and Zucman (2014).

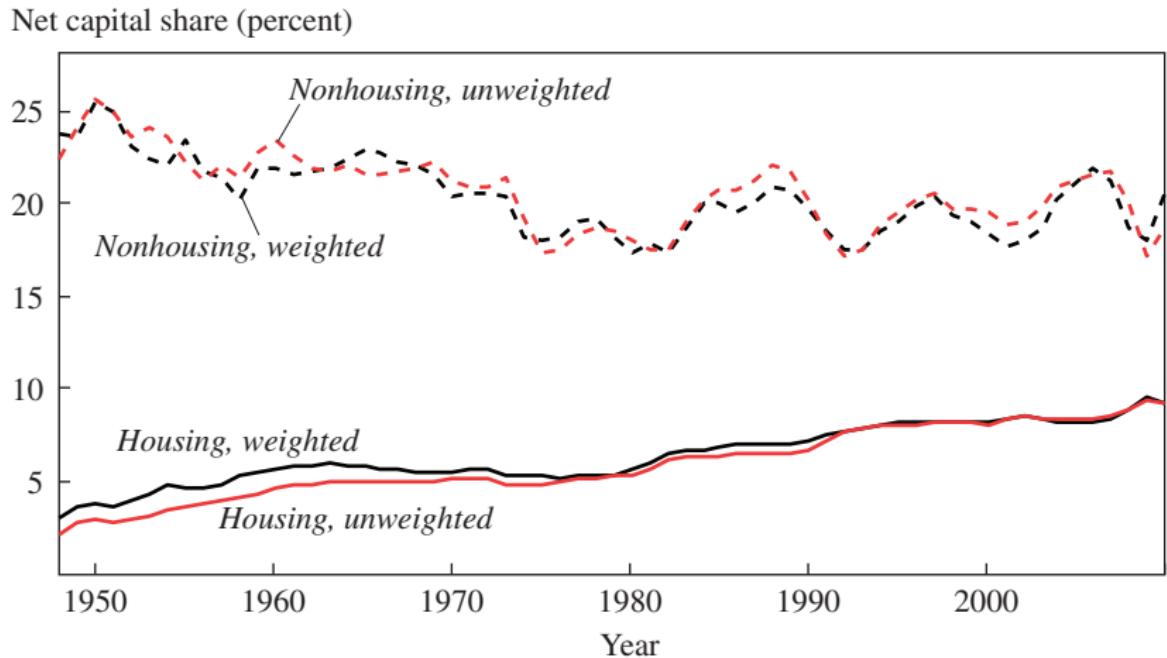
**Figure 2. Average Gross Capital Share of Private Domestic Value-Added, G7 Countries, 1950–2010**

Gross capital share (percent)



Source: Author's calculations based on national accounts; Piketty and Zucman (2014).

**Figure 3. Housing and Nonhousing Components of Average Net Capital Share of Private Domestic Value-Added, G7 Countries, 1950–2010**



Source: Author's calculations based on national accounts; Piketty and Zucman (2014).

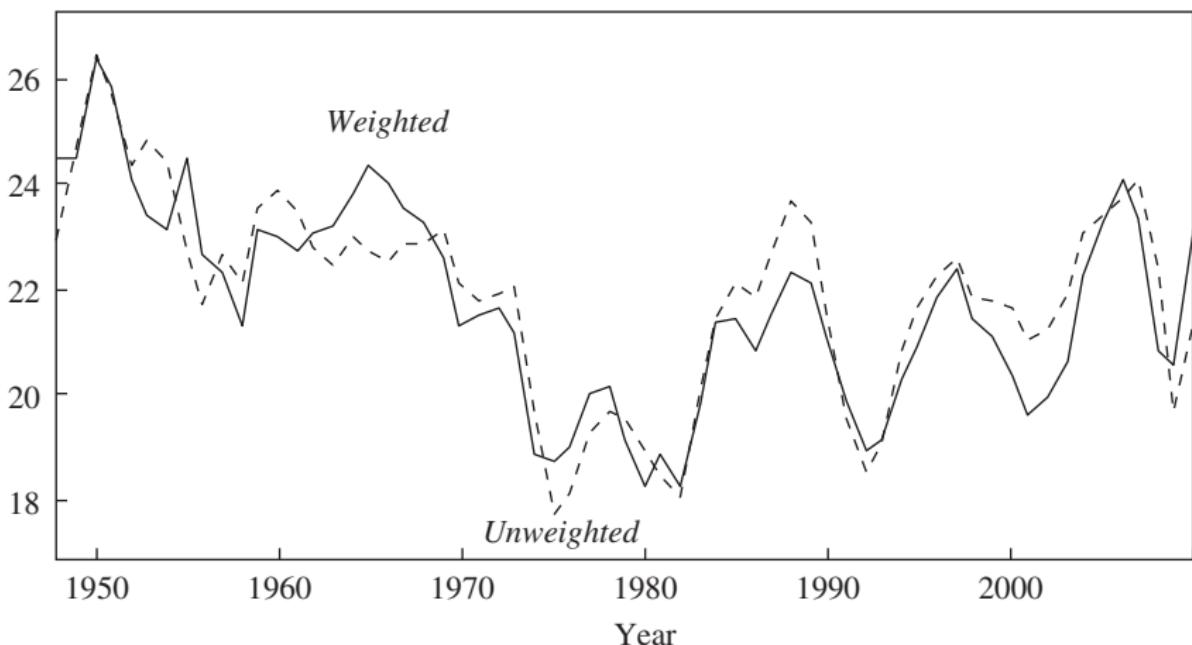
**Table 1.** Decadal Averages for the Net Capital Share of Private Domestic Value-Added,  
G7 Countries, 1950s to 2000s (Percent)

		1950s	1960s	1970s	1980s	1990s	2000s
United States	Housing	5.3	6.5	5.7	7.2	8.4	8.2
	Other	22.0	21.7	18.6	18.4	19.2	19.4
	Total	27.3	28.2	24.2	25.6	27.5	27.6
Japan	Housing		4.2	3.6	4.1	5.2	7.0
	Other		31.2	26.9	25.7	21.6	20.1
	Total		35.4	30.5	29.8	26.9	27.1
Germany	Housing					2.9	3.4
	Other					23.5	28.0
	Total					26.4	31.4
France	Housing	3.6	5.1	5.9	7.1	9.8	10.8
	Other	21.3	19.8	17.9	16.6	19.9	18.0
	Total	24.9	24.9	23.8	23.7	29.7	28.8
United Kingdom	Housing	1.2	2.1	3.8	4.6	5.8	7.3
	Other	27.2	23.9	18.3	21.6	23.2	23.4
	Total	28.4	26.0	22.1	26.2	29.0	30.7
Italy	Housing					4.3	6.4
	Other					33.9	32.5
	Total					38.2	38.9
Canada	Housing		6.6	6.6	8.1	10.4	8.6
	Other		22.5	24.0	25.8	21.2	27.2
	Total		29.1	30.6	33.8	31.6	35.8

Source: National accounts; Piketty and Zucman (2014).

**Figure 4.** Average Net Capital Shares of Corporate Sector Value-Added, G7 Countries. 1950–2010

Net capital share (percent)



Source: Author's calculations based on national accounts; Piketty and Zucman (2014).

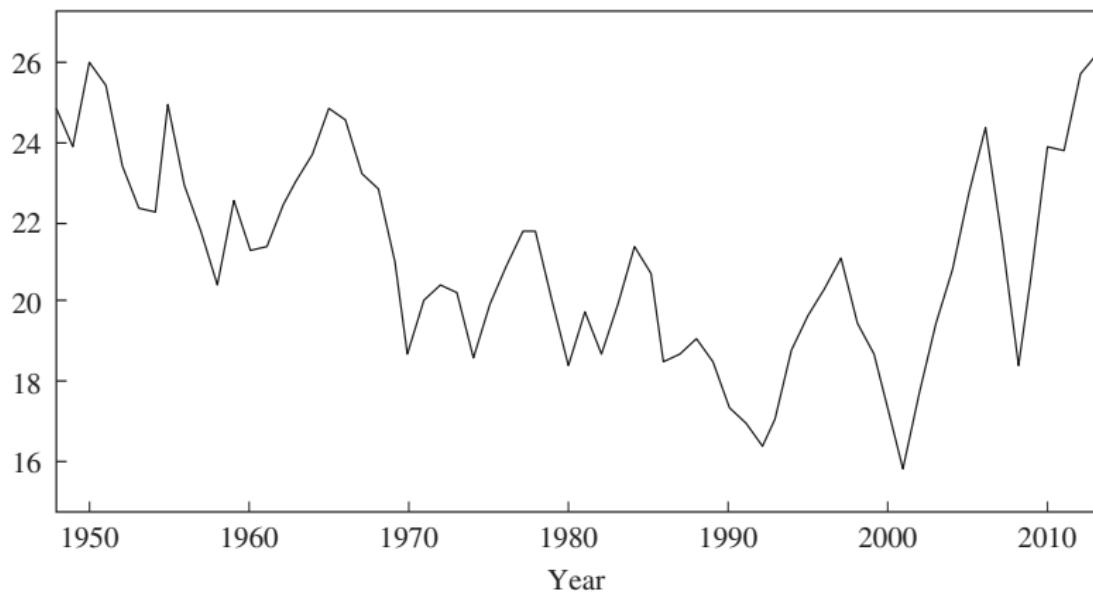
**Table 2. Decadal Averages for the Net Capital Share of Value in the Corporate Sector, G7 Countries, 1950s to 2000s (Percent)**

	1950s	1960s	1970s
United States	23.2	23.2	19.7
Germany			
France	22.1	20.9	19.0
United Kingdom	27.6	24.4	19.0
Italy			
Canada		24.5	26.1

Source: National accounts; Piketty and Zucman (2014).

**Figure 5. Net Capital Share of Corporate Sector Value-Added, United States, 1950–2010**

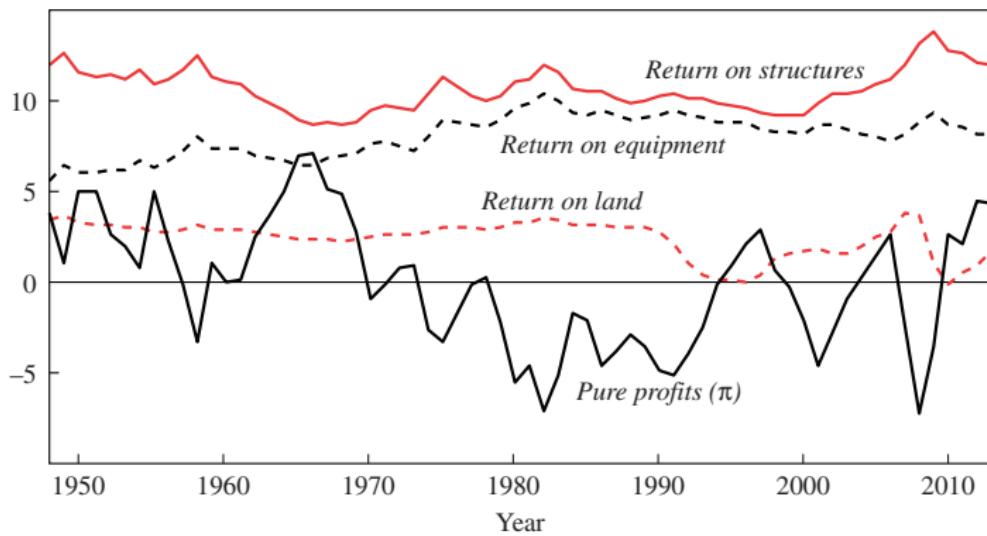
Share of net value-added (percent)



Source: National Income and Product Accounts.

**Figure 6.** Decomposition of Net Capital Share of Corporate Sector Value-Added,  
United States, 1950–2010

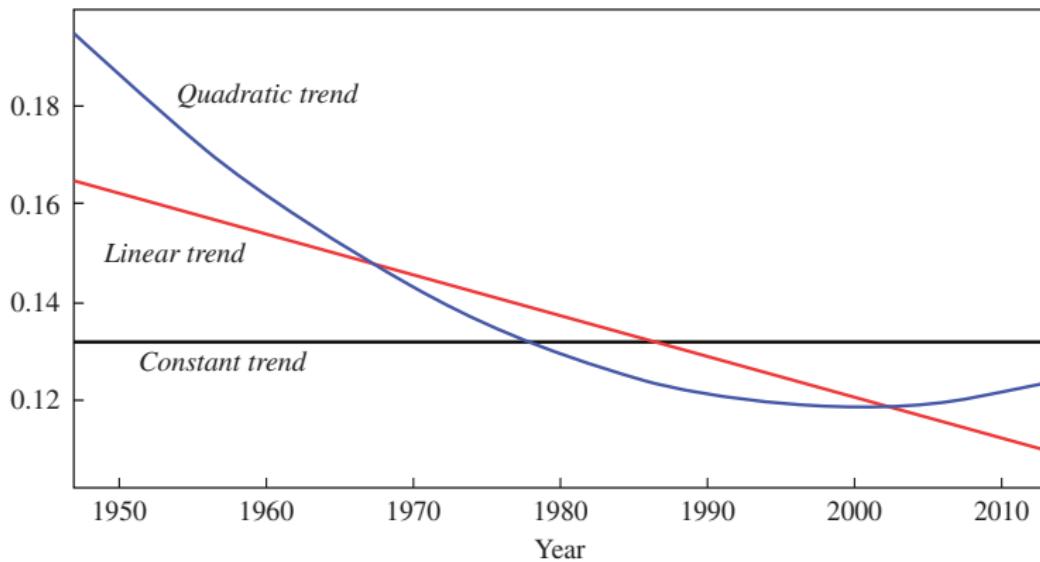
Share of net value-added (percent)



Source: Author's calculations based on National Income and Product Accounts, Financial Accounts of the United States.

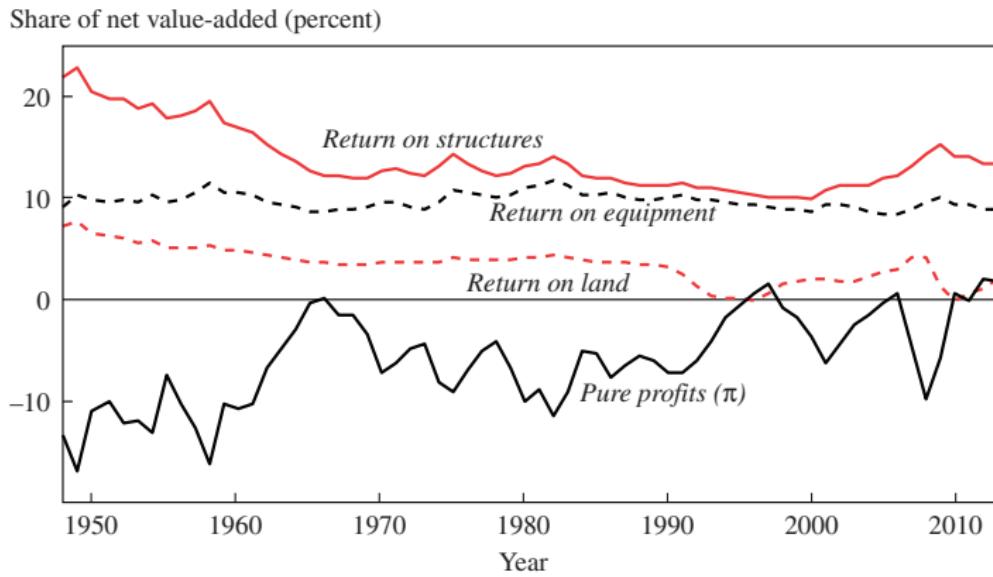
**Figure 7.** Estimated Constant, Linear, and Quadratic Time Trends for the Corporate Rate of Return  $r(t)$

Estimated corporate return  $r$  (percent)



Source: Author's calculations; see text for details.

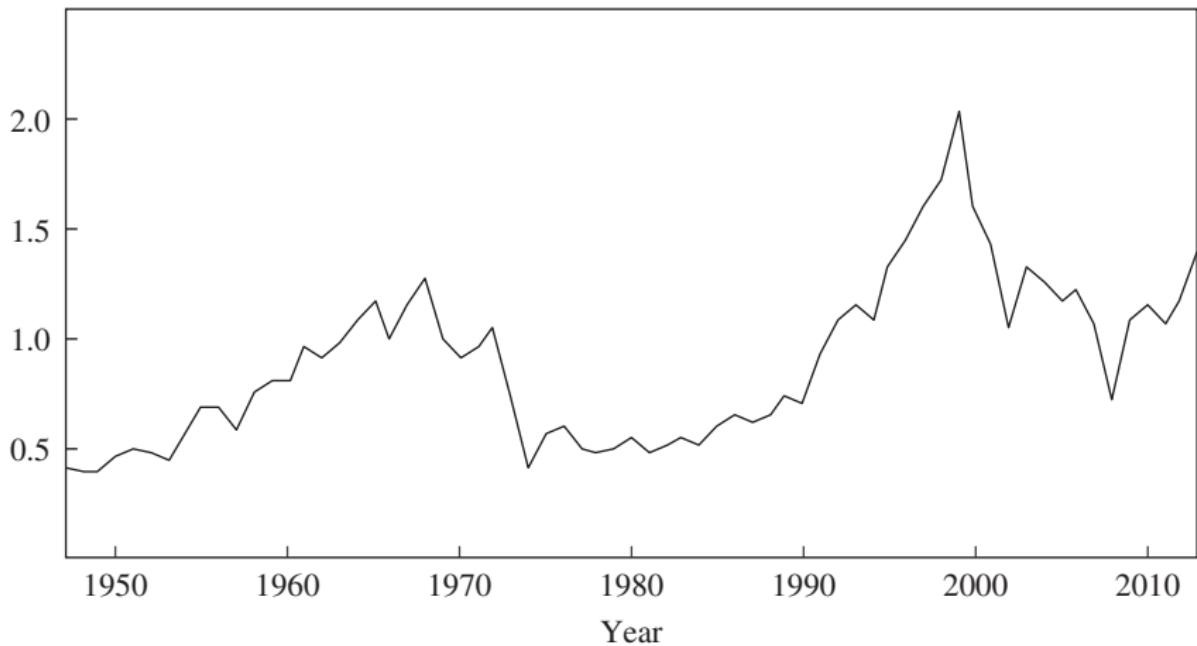
**Figure 8.** Decomposition of Net Capital Share of Corporate Sector Value-Added, Using Quadratic Trend for  $r(t)$ , United States, 1950–2010



Source: Author's calculations based on National Income and Product Accounts, Financial Accounts of the United States.

**Figure 9. Ratio of Total Market Value to the Recorded Value of Equipment, Structures, and Land, U.S. Corporate Sector, 1950–2010**

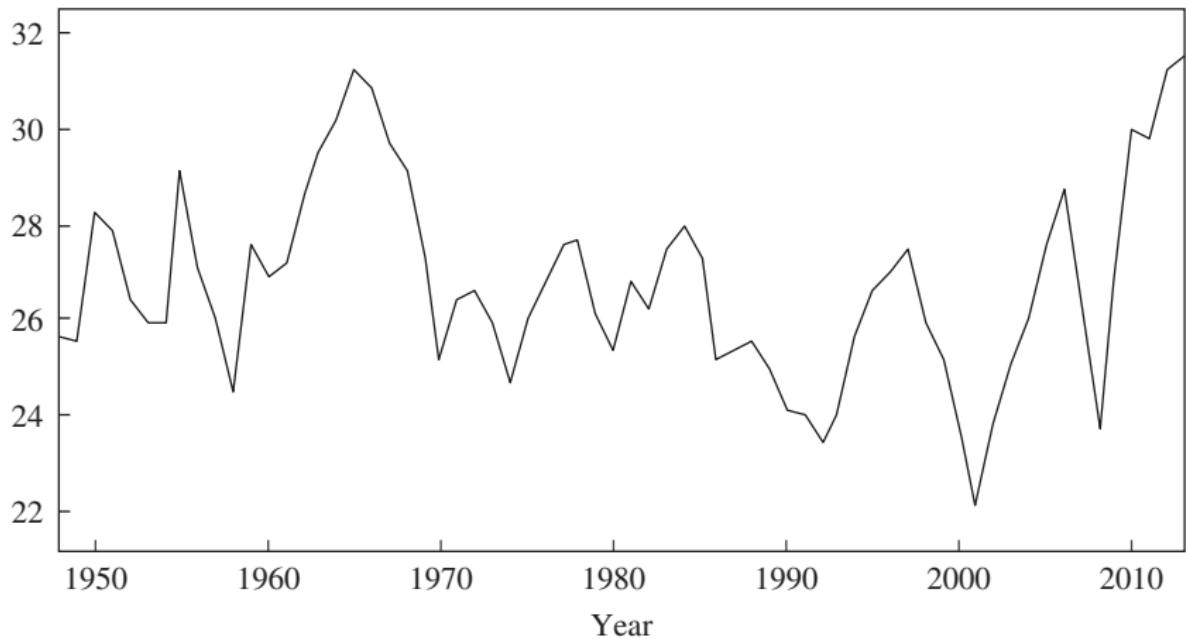
Ratio of total market value to book value



Source: Financial Accounts of the United States.

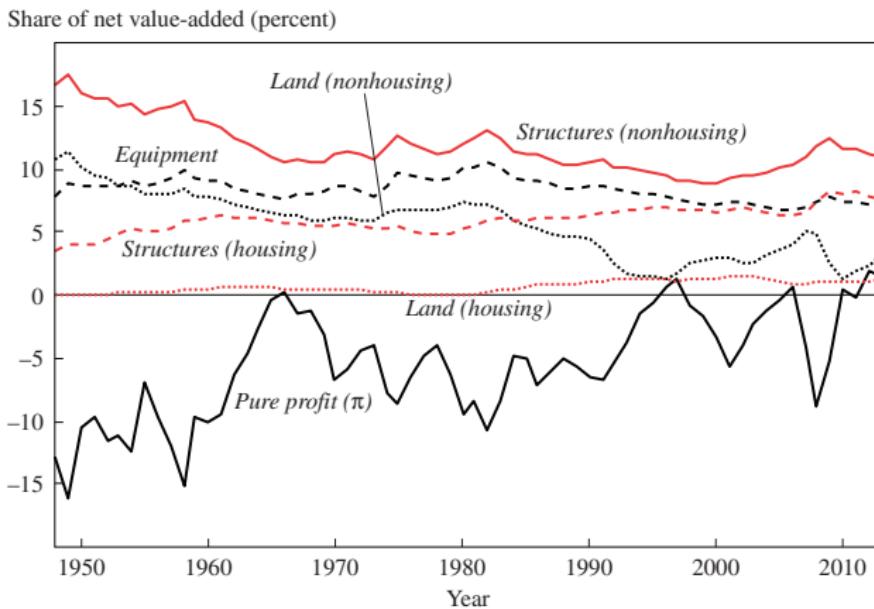
**Figure 10. Net Capital Share of Private Value-Added, United States, 1950–2010**

Share of net value-added (percent)



Source: National Income and Product Accounts.

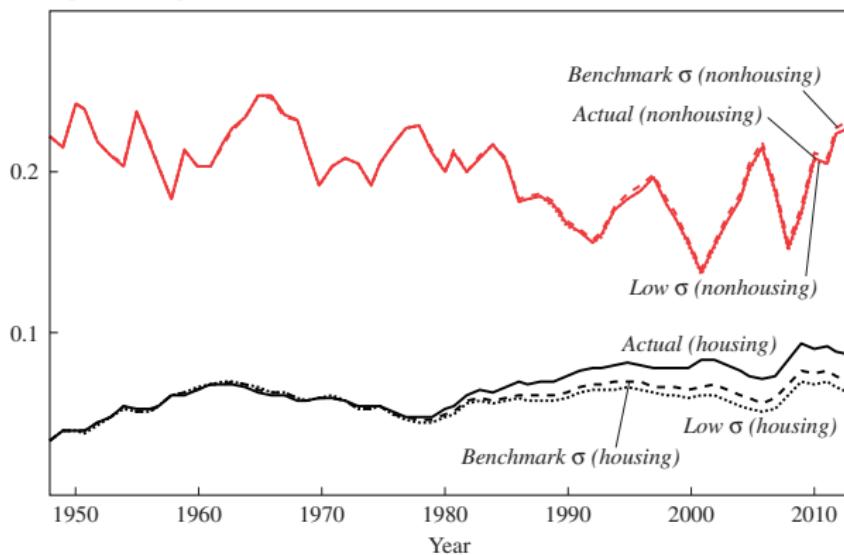
**Figure 11. Decomposition of Net Capital Share of Private Domestic Value-Added,  
United States, 1950–2010**



Source: Author's calculations based on National Income and Product Accounts, Financial Accounts of the United States.

**Figure 12.** Counterfactual Paths for the Housing and Nonhousing Components of Net Capital Share, United States, 1950–2010<sup>a</sup>

Net capital share (percent)



Source: Author's calculations; see text.

a. Assuming no change in the real price of residential structures investment and a constant ratio of the quantity of residential land to the quantity of real output.

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