Why are real interest rates so low? Secular stagnation and the relative price of capital goods

Gregory Thwaites

Bank of England and LSE

June 2015

This does not reflect the views of the Bank of England

Overview

- Over the past 30 years, the nominal investment rate and real interest rate have fallen around the industrialised world, while house prices and household debt have increased.

Overview

- Over the past 30 years, the nominal investment rate and real interest rate have fallen around the industrialised world, while house prices and household debt have increased.
- I explain these four trends with a fifth - the widespread fall in the relative price of capital goods

Overview

- Over the past 30 years, the nominal investment rate and real interest rate have fallen around the industrialised world, while house prices and household debt have increased.
- I explain these four trends with a fifth - the widespread fall in the relative price of capital goods
  - A fall in the price of capital goods reduces the resources needed for investment
  - So interest rates fall, and the money that previously went into capital investment now goes into mortgages and housing

Overview

- Over the past 30 years, the nominal investment rate and real interest rate have fallen around the industrialised world, while house prices and household debt have increased.
- I explain these four trends with a fifth - the widespread fall in the relative price of capital goods
  - A fall in the price of capital goods reduces the resources needed for investment
  - So interest rates fall, and the money that previously went into capital investment now goes into mortgages and housing
- Real interest rates will stay low even if capital goods prices have stopped falling

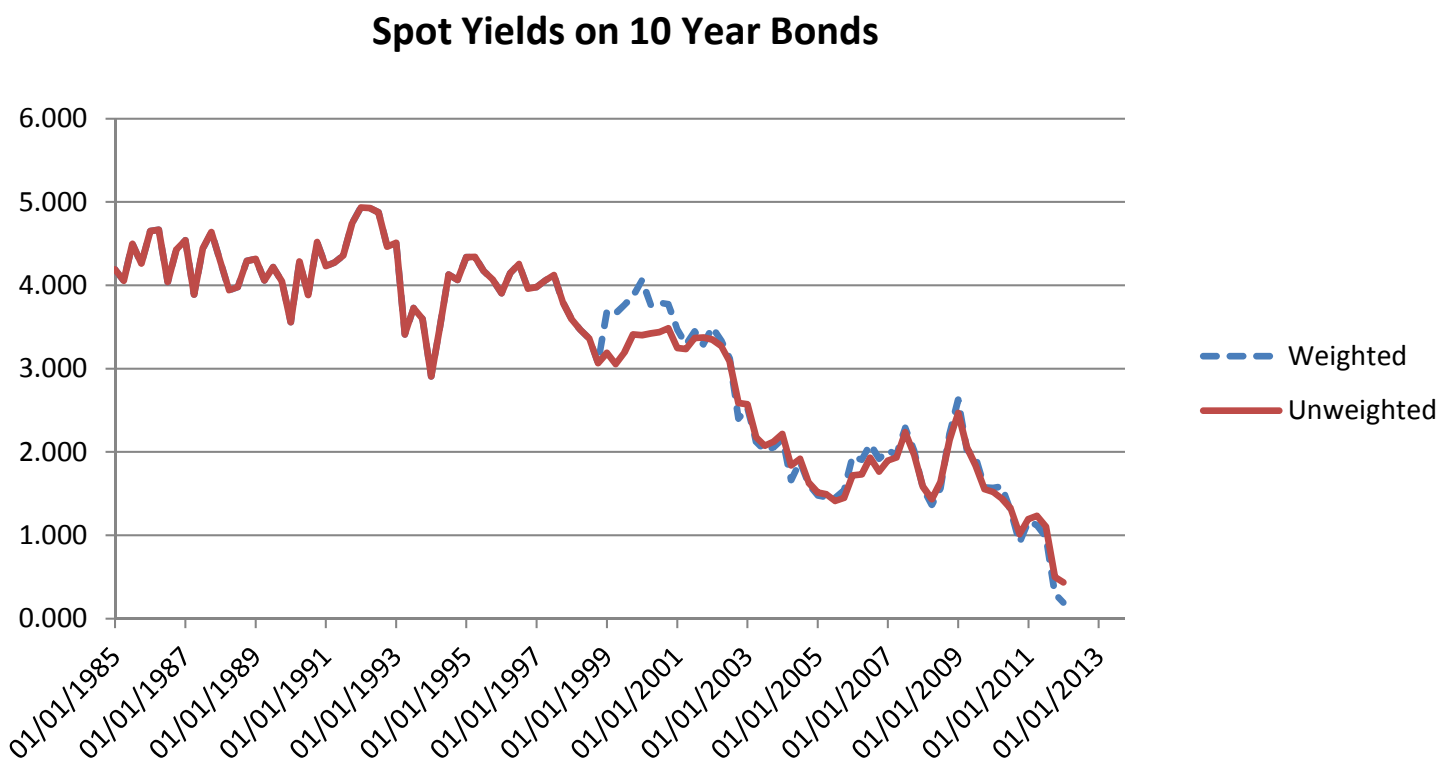
Overview

- Over the past 30 years, the nominal investment rate and real interest rate have fallen around the industrialised world, while house prices and household debt have increased.
- I explain these four trends with a fifth - the widespread fall in the relative price of capital goods
  - A fall in the price of capital goods reduces the resources needed for investment
  - So interest rates fall, and the money that previously went into capital investment now goes into mortgages and housing
- Real interest rates will stay low even if capital goods prices have stopped falling
- And preventing the accumulation of household debt would make interest rates fall further

Plan for today

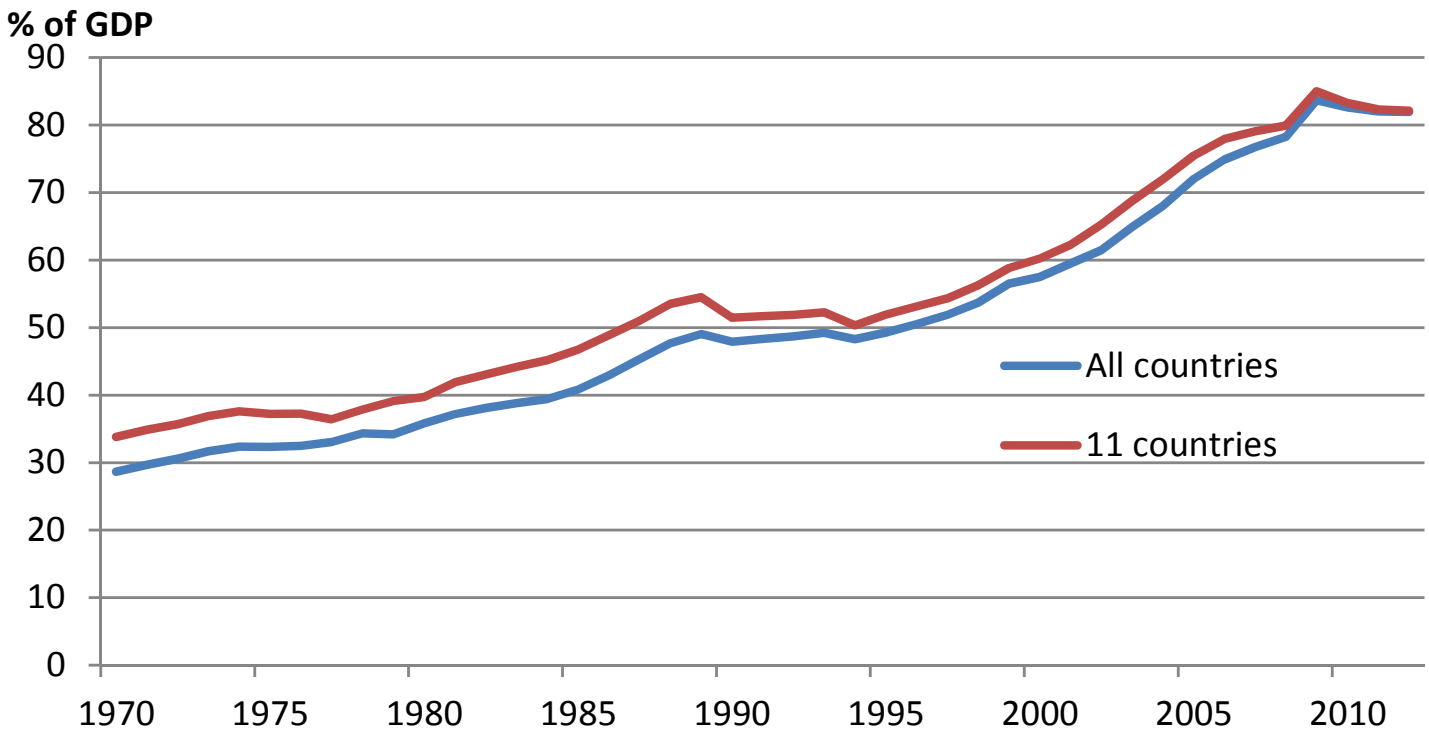
- Stylised facts
- Simplest possible heuristic model
- Results & econometric evidence
- Conclusions and policy implications

World real interest rate

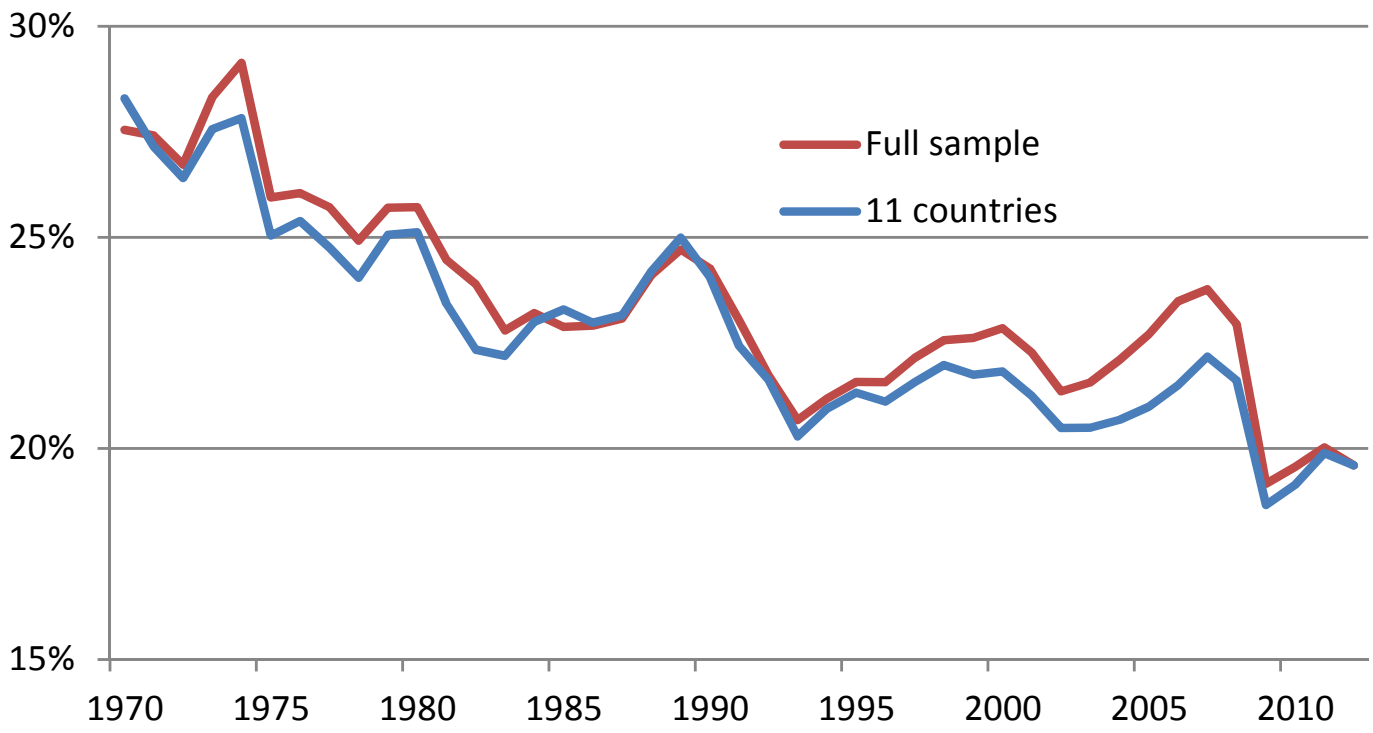


▸ Equity market measures spreads

Household debt

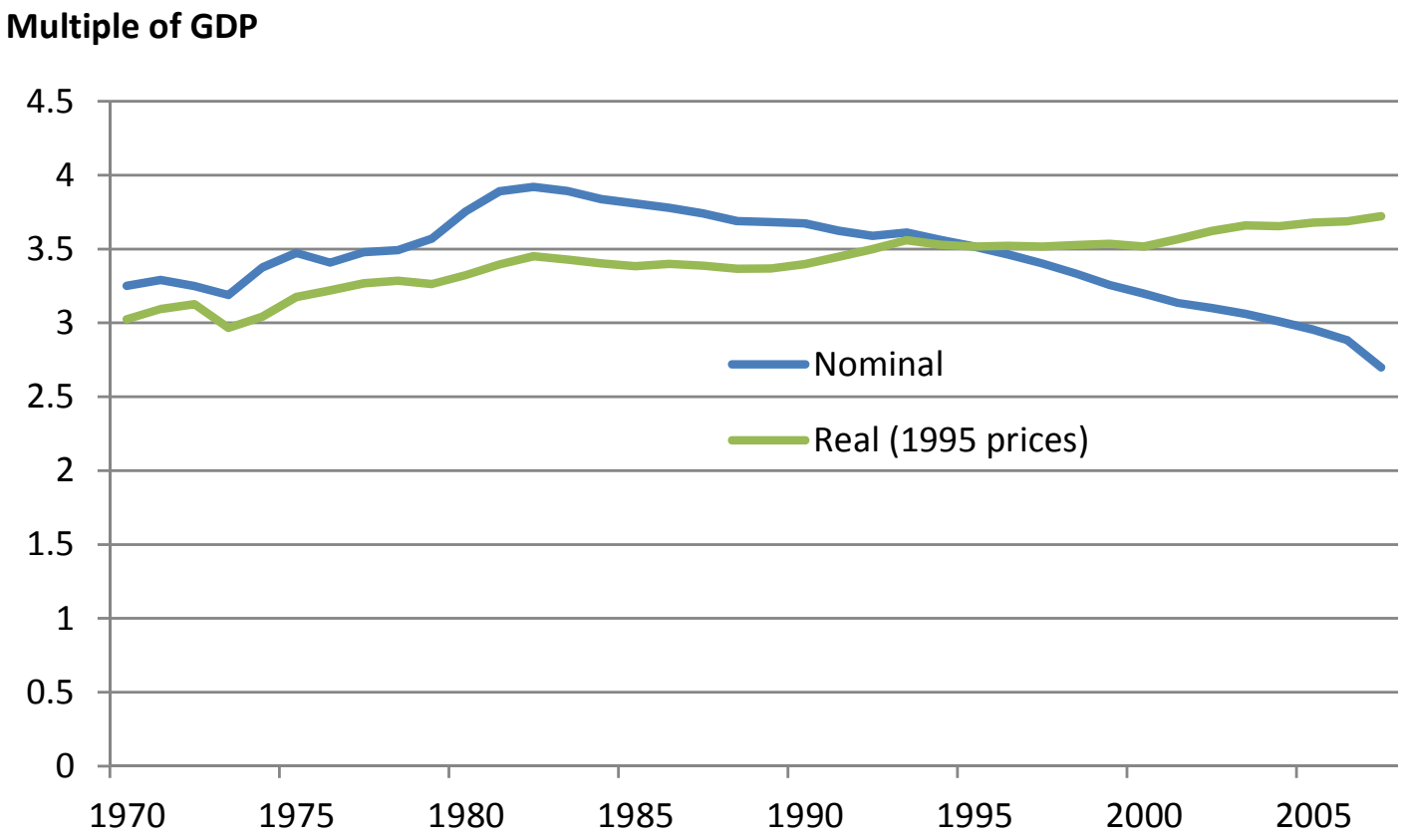


Nominal investment-GDP ratio



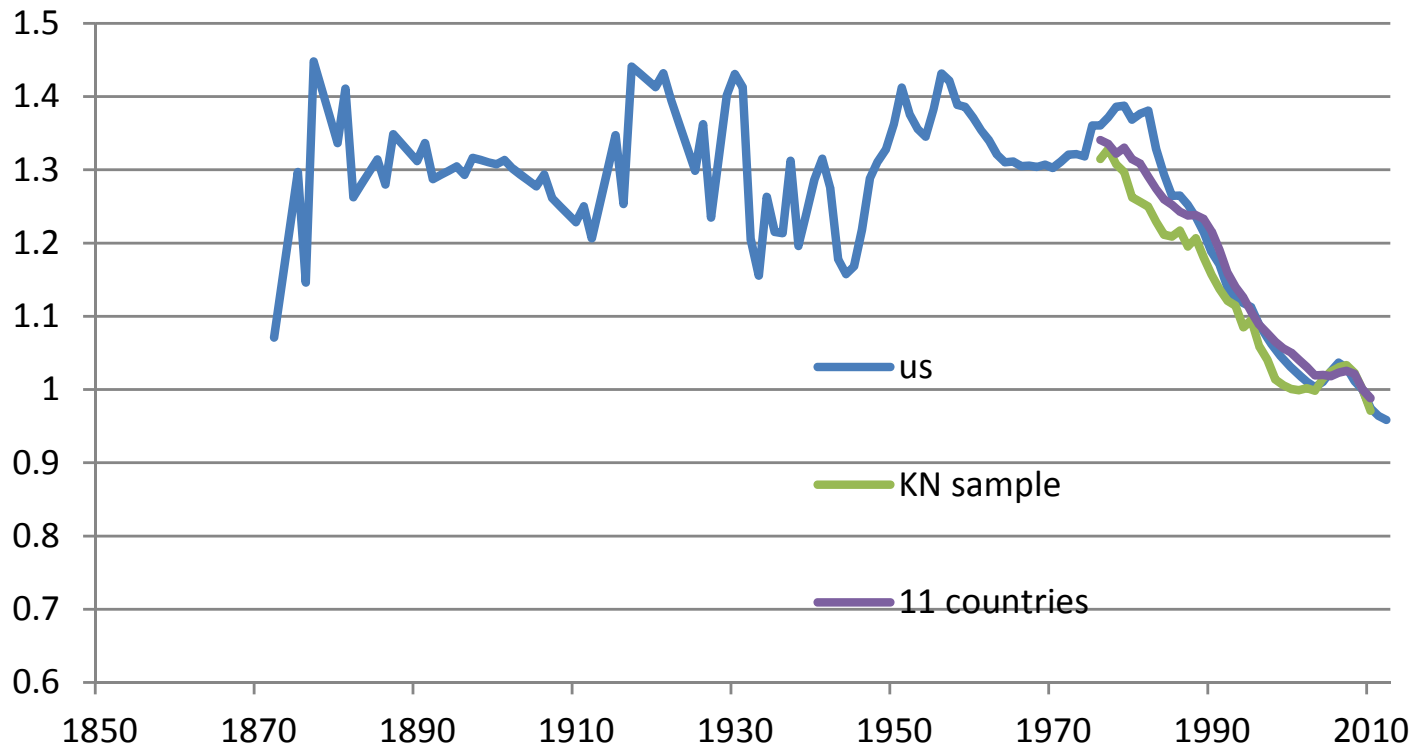
Capital stocks
presentation

Nominal and real capital-GDP ratios



investment presentation

Price of investment relative to consumption



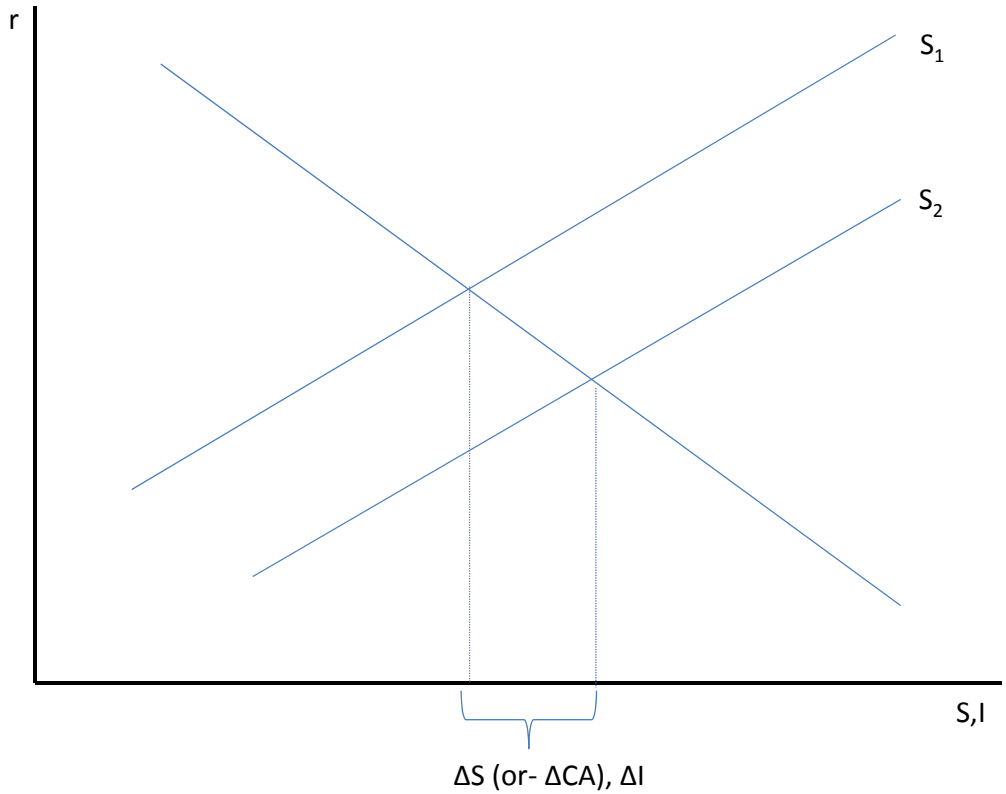
Stylised facts - industrialised world before the crisis

- Real interest rates were falling for two decades *before* the crisis ▸ rates
- Household debt levels rose, and remain high ▸ debt
- Nominal investment rates and capital-output ratios fell ▸ investment
- The relative price of investment fell ▸ relative price

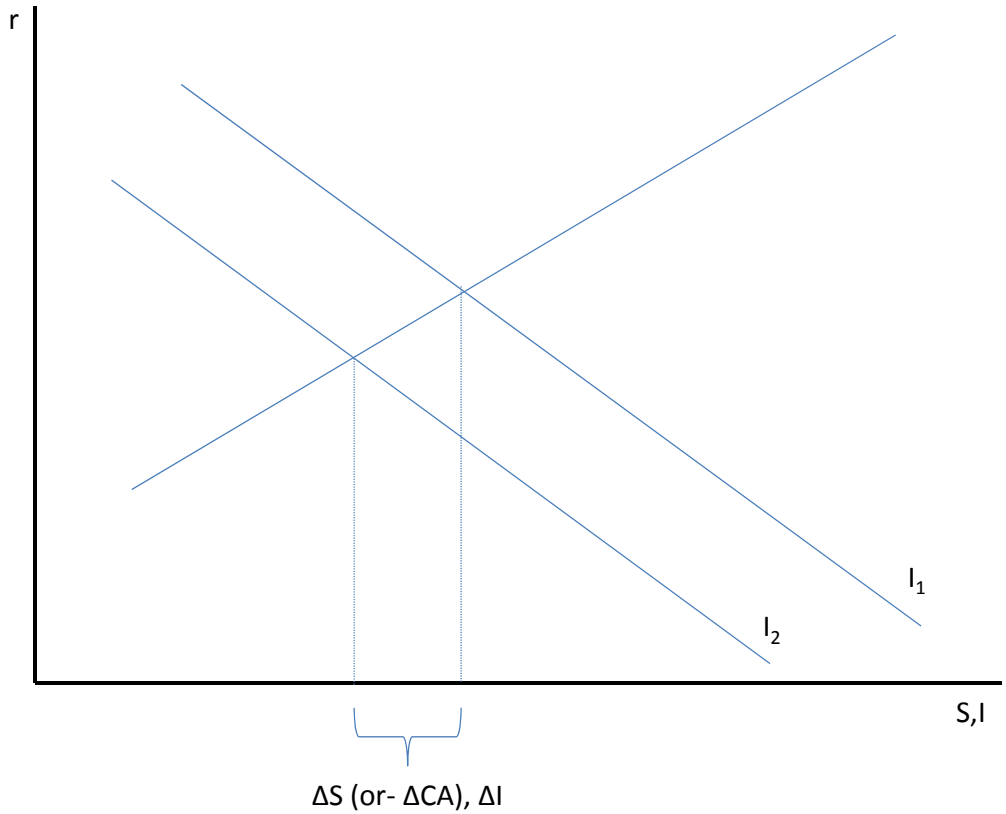
Explanations for low real rates in industrialised countries

- Demographics
- Inequality
- Emerging markets' surplus savings

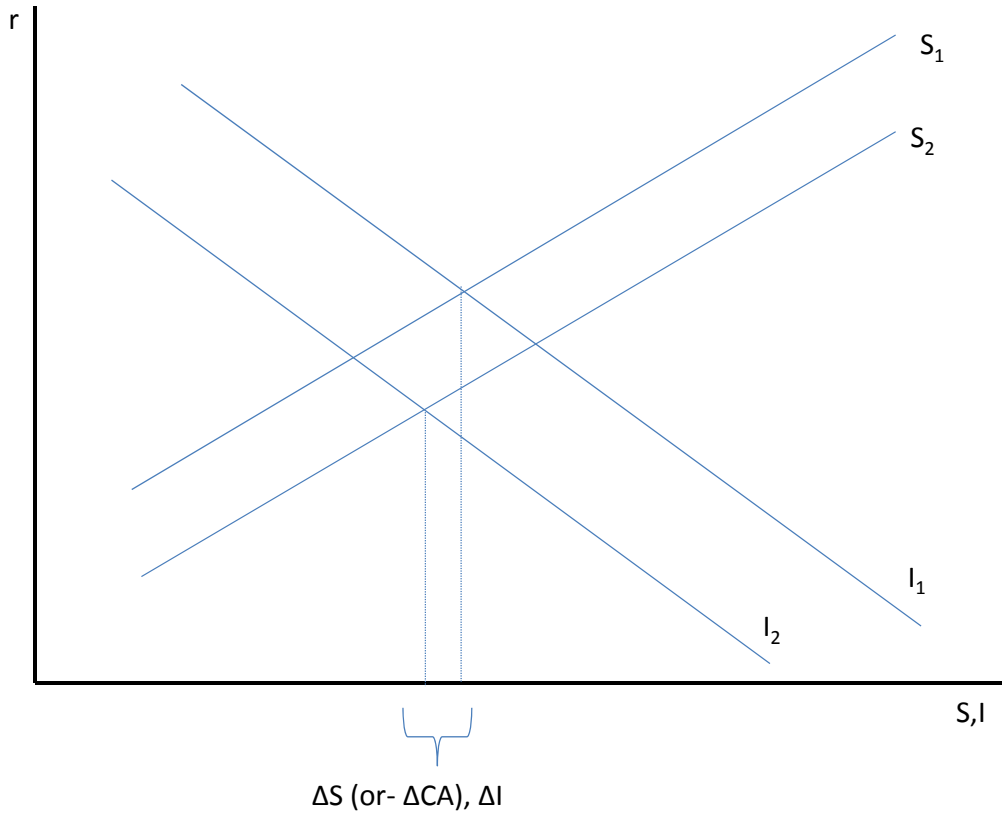
Savings and investment 101



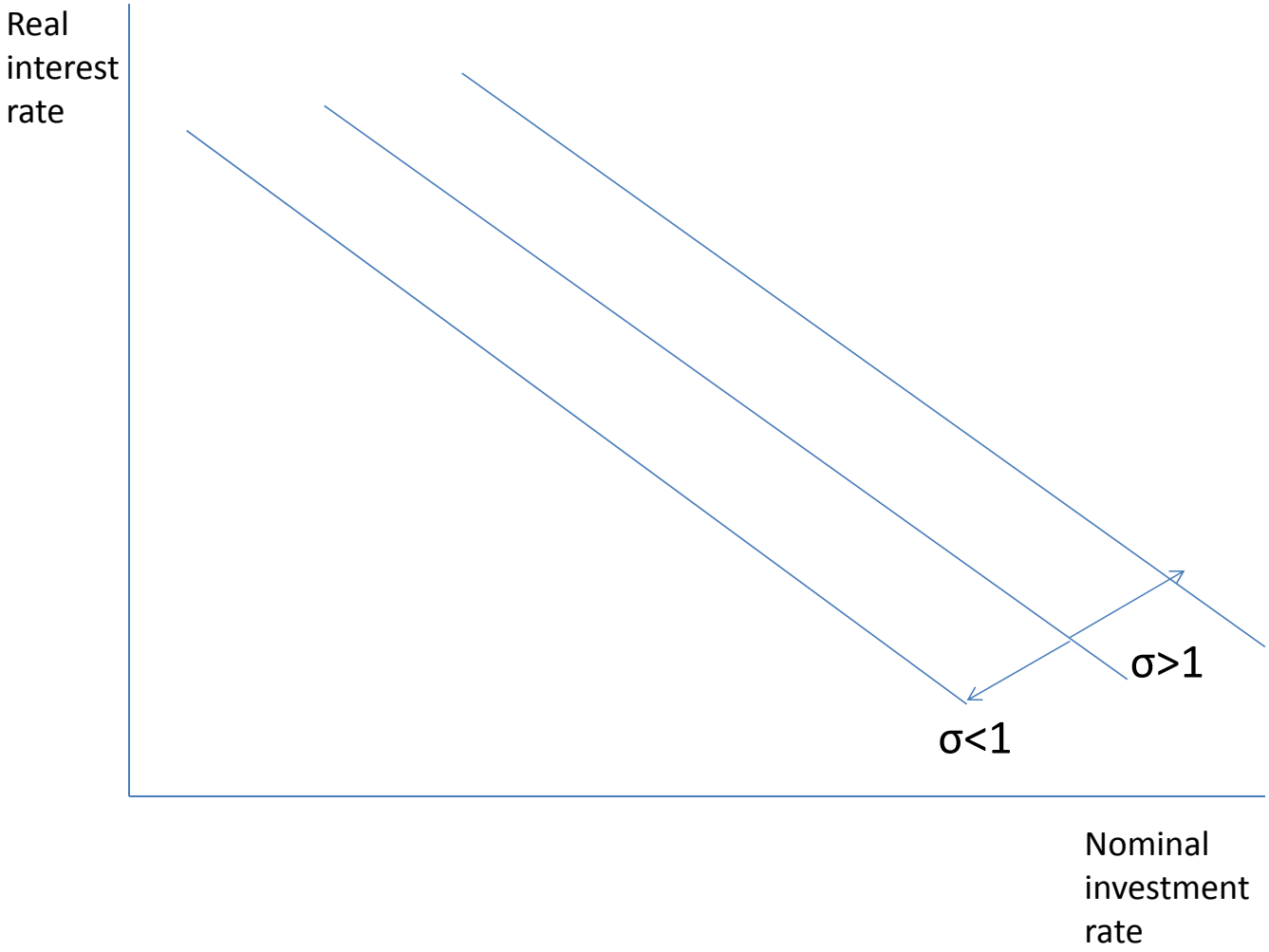
Savings and investment 101



Savings and investment 101



Effect of a fall in capital goods prices



Investment schedule, capital goods prices and σ

- The price of capital goods p has two opposing effects on the demand for investment and thus the real interest rate $r = \frac{1}{p}\frac{\partial Y}{\partial K} - \delta$

Investment schedule, capital goods prices and σ

- The price of capital goods p has two opposing effects on the demand for investment and thus the real interest rate $r = \frac{1}{p}\frac{\partial Y}{\partial K} - \delta$
  - Cheaper capital goods means you get more of them for each unit of consumption foregone
  - Increased volume of capital goods lowers the marginal product of each one

Investment schedule, capital goods prices and σ

- The price of capital goods p has two opposing effects on the demand for investment and thus the real interest rate $r = \frac{1}{p}\frac{\partial Y}{\partial K} - \delta$
  - Cheaper capital goods means you get more of them for each unit of consumption foregone
  - Increased volume of capital goods lowers the marginal product of each one
- The elasticity of substitution between capital and labour determines which of these effects predominates - critical value is unity (Cobb Douglas)

Investment schedule, capital goods prices and σ

- The price of capital goods p has two opposing effects on the demand for investment and thus the real interest rate $r = \frac{1}{p}\frac{\partial Y}{\partial K} - \delta$
  - Cheaper capital goods means you get more of them for each unit of consumption foregone
  - Increased volume of capital goods lowers the marginal product of each one
- The elasticity of substitution between capital and labour determines which of these effects predominates - critical value is unity (Cobb Douglas)
- We assume a value of 0.7 in the baseline model, above most estimates
- ▸ We need to talk about σ

Setup - households

The economy is closed. Households live for three periods and maximise a standard utility function over consumption and housing

$$U(c_1, c_2, c_3, h) = \frac{1}{1-\theta}\left(c_1^{1-\theta} + \beta_2 c_2^{1-\theta} + \beta_3 c_3^{1-\theta}\right) + \phi\frac{h^{1-\gamma}}{1-\gamma} \quad (1)$$

Setup - households cont.

- Households buy houses in the first period of life, borrowing if necessary, and sell them and consume the proceeds at the beginning of retirement. (They move in with their kids or into retirement homes).
- They supply a fraction η of their lifetime labour in the first period, and $1-\eta$ in the second period. So their budget constraints look like this

$$c_1 + hp_h + a_1 = \eta W \tag{2}$$

$$c_2 + a_2 = (1-\eta)W + (1+r)a_1 \tag{3}$$

$$c_3 = (1+r)a_2 + hp_h \tag{4}$$

Setup - firms

- Intermediate goods have a CES production function

$$Y = [(1-\alpha)L^{\frac{\sigma-1}{\sigma}} + \alpha K^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \tag{5}$$

- Intermediates can be transformed into consumption goods at rate 1, or capital goods at rate π capital goods per intermediate

$$c = Y_c \tag{6}$$

$$I = \pi Y_I \tag{7}$$

- So the aggregate resource constraint is

$$Y = Y_c + Y_I = C + p_K I \tag{8}$$

where $p_K = \pi^{-1}$ is the key exogenous technological parameter in the model

Market clearing

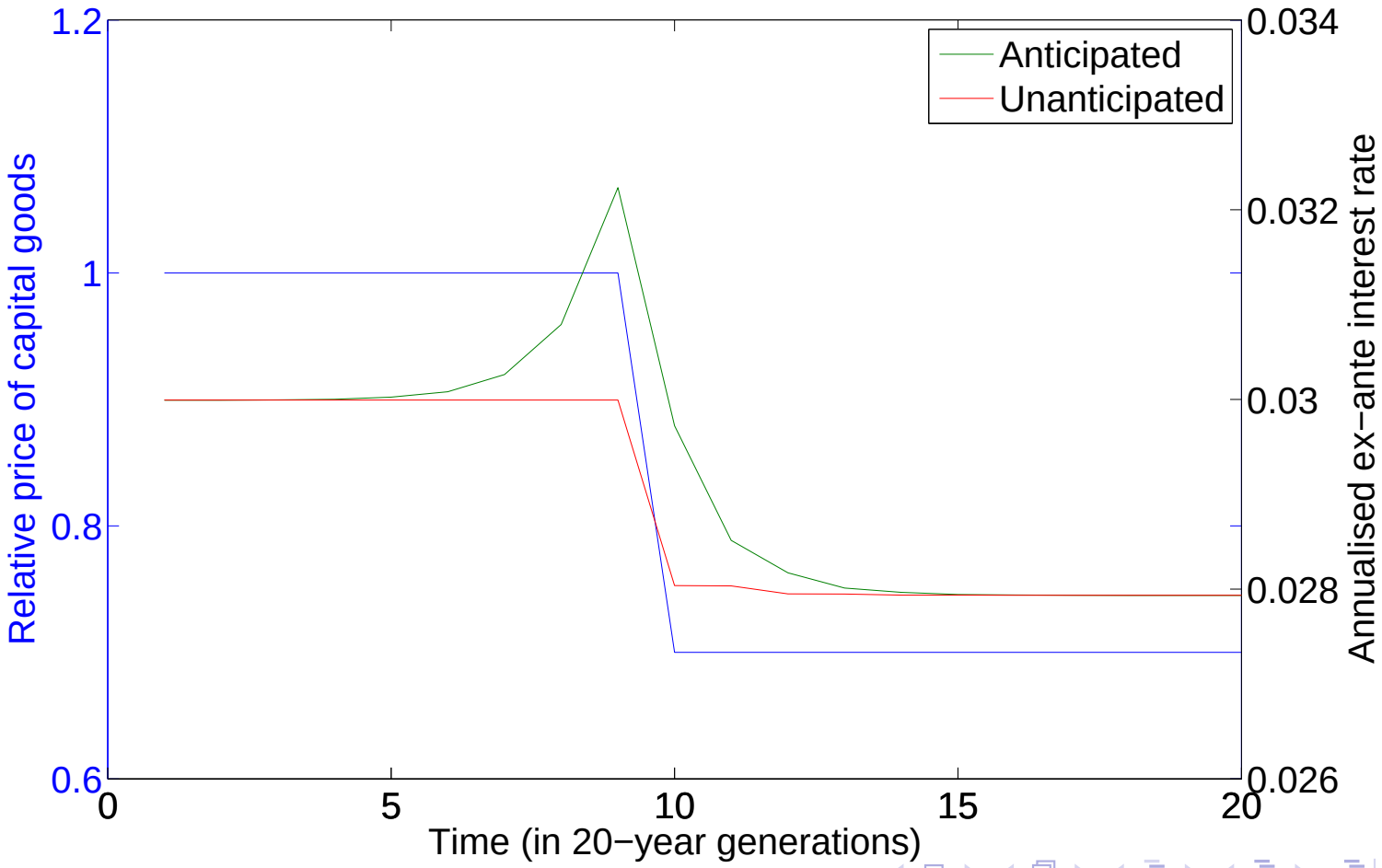
- Supply of housing (viz land) is fixed

$$h = \bar{h} \tag{9}$$

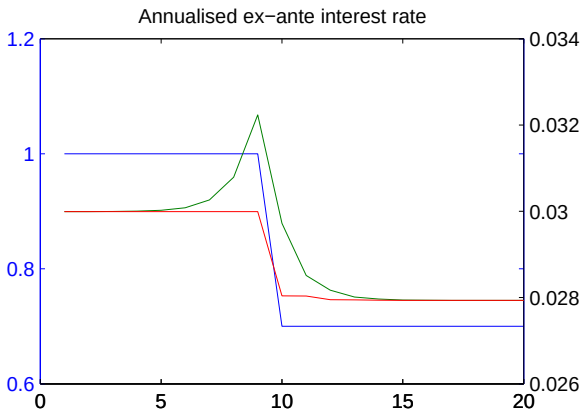
- Asset market clears

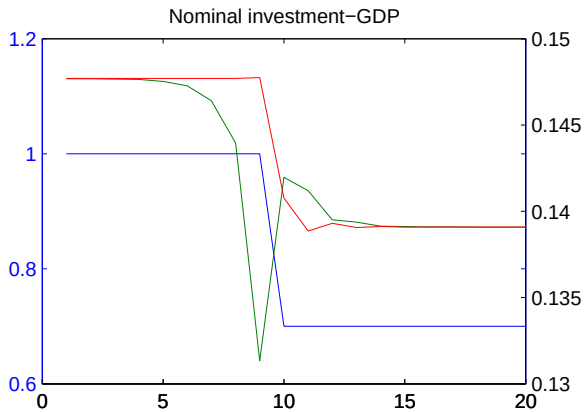
$$a_1 + a_2 = p_K K \tag{10}$$

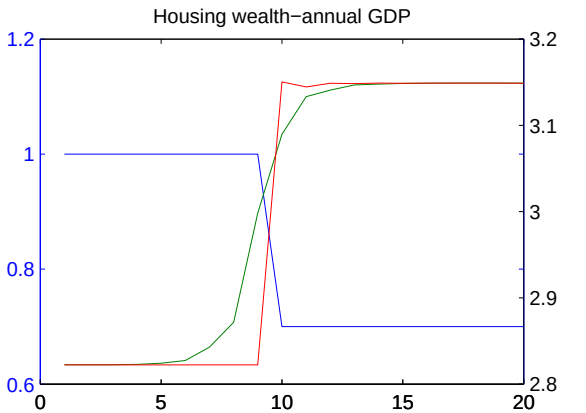
Results - baseline setup, real interest rates

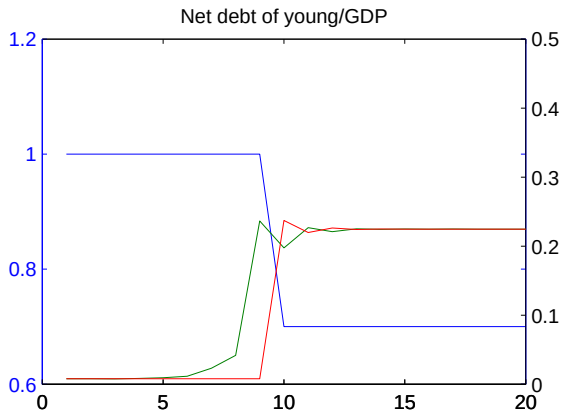


Results - baseline setup, investment, debt and house prices





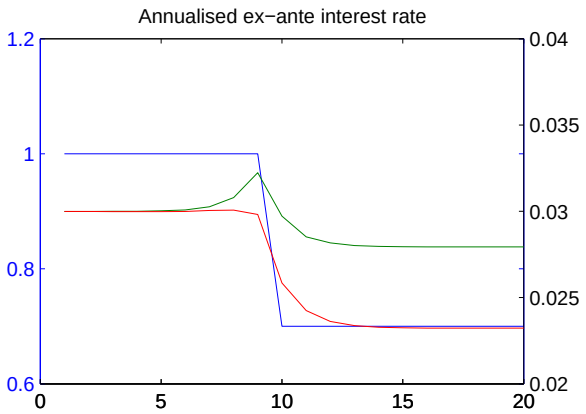


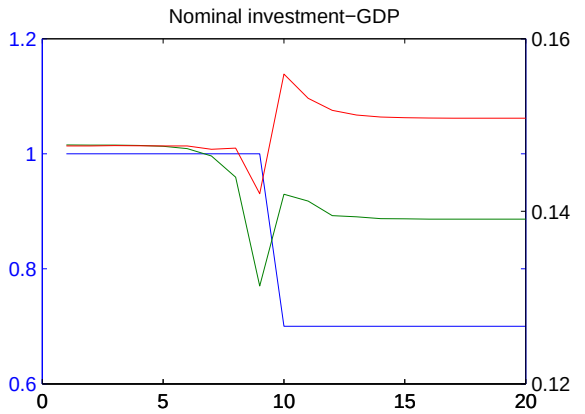


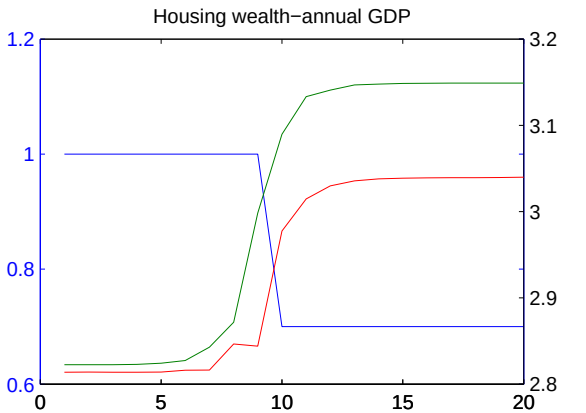
Intuition

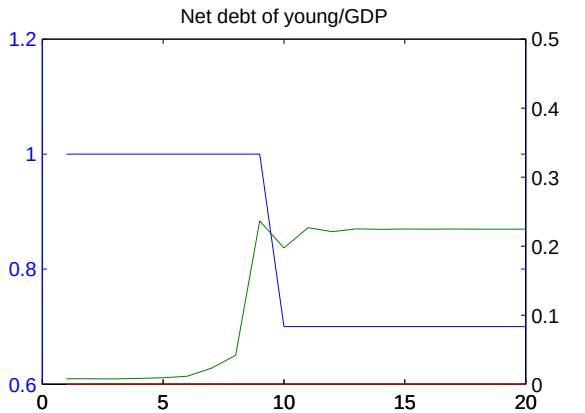
- Lower capital goods prices means each unit of savings buys more capital goods, with opposing effects on the interest rate
- With $\sigma < 1$, the interest rate falls, reducing the user cost of housing
- Housing supply is fixed, so house prices increase
- Housing is paid for early in life, so debt increases too
- Acquiring the debt claims of the young is an alternative to capital investment
- So aggregate savings and investment fall in relation to GDP

Results - no household debt

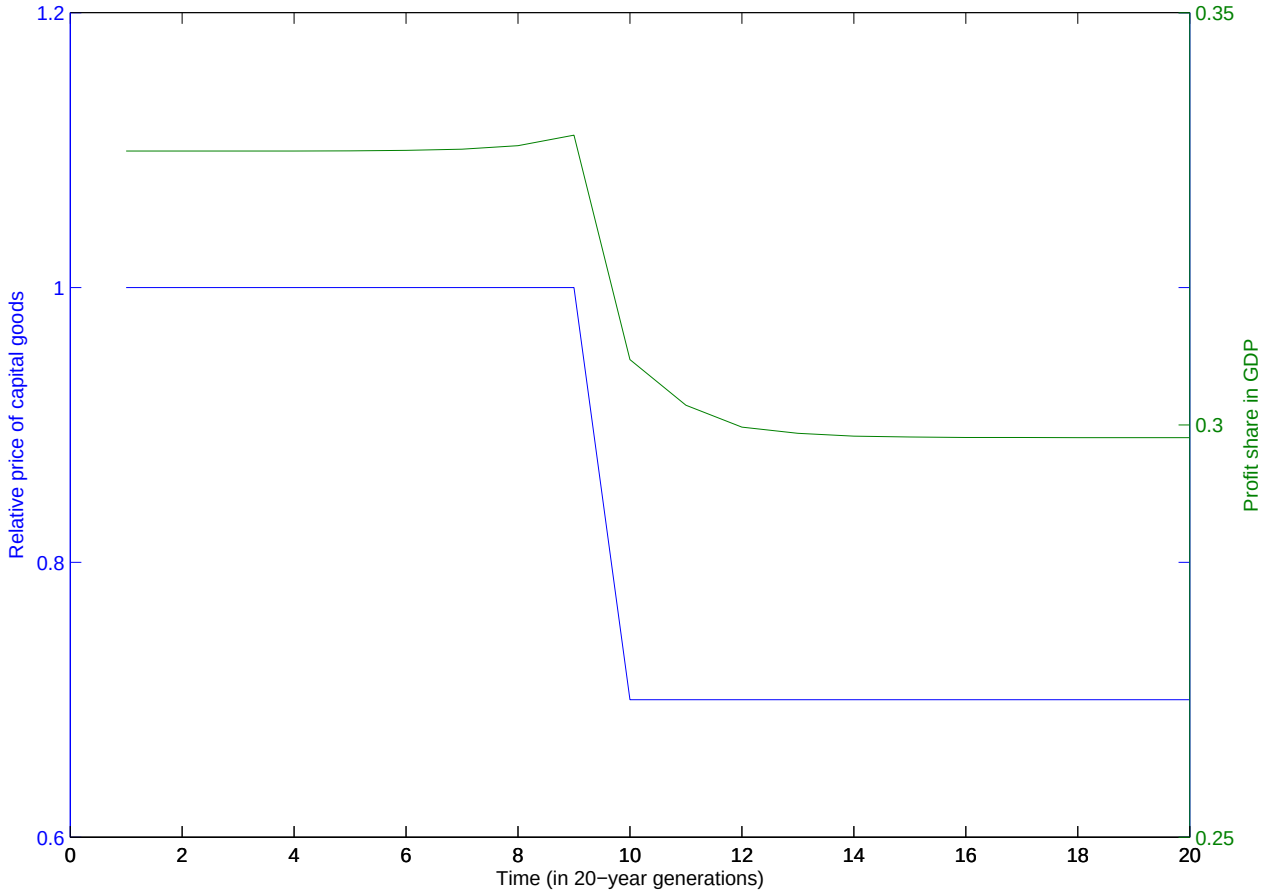








Results - baseline setup, the profit share



The profit share

- The labour share has fallen in most countries. In a simple two-factor model with no pure profits, this means the capital share rises

The profit share

- The labour share has fallen in most countries. In a simple two-factor model with no pure profits, this means the capital share rises
- Capital share equals profit rate times the capital-output ratio

$$\frac{\Pi}{Y} = \frac{\Pi}{Kp_K}\frac{Kp_K}{Y}$$

The profit share

- The labour share has fallen in most countries. In a simple two-factor model with no pure profits, this means the capital share rises
- Capital share equals profit rate times the capital-output ratio

$$\frac{\Pi}{Y} = \frac{\Pi}{Kp_K}\frac{Kp_K}{Y}$$

- But real rate and the capital-output ratio have fallen.

The profit share

- The labour share has fallen in most countries. In a simple two-factor model with no pure profits, this means the capital share rises
- Capital share equals profit rate times the capital-output ratio

$$\frac{\Pi}{Y} = \frac{\Pi}{Kp_K}\frac{Kp_K}{Y}$$

- But real rate and the capital-output ratio have fallen.
  - Profits remunerating something other than capital ▸ 3 factors
  - Mismeasured capital-output ratio - intangibles?
  - MPK vs r in financial markets - corporate taxes, physical depreciation, marginal v average returns

Econometric evidence - approach

- Modelling the world economy with 20-year time periods results in few datpoints
- Exploit cross-country dimension
- But countries are (partially) open to trade in goods and assets
- So solve an small open economy version of the model (trade in intermediates, exogenous interest rate) to generate new predictions
- Estimate $x_{it} = \alpha_i + \beta p_{it} + u_{it}$ or $\Delta x_i = \alpha + \beta \Delta p_i + u_i$

Econometric evidence - results

Table : Coefficent on p

	Prediction of model		
Variable	Closed	Open	Data
Nominal investment rate	+	+	+
HH debt/GDP	-	?	-
Real house prices	-	-	-
Current account/GDP	n/a	-	?

Sensitivity analysis

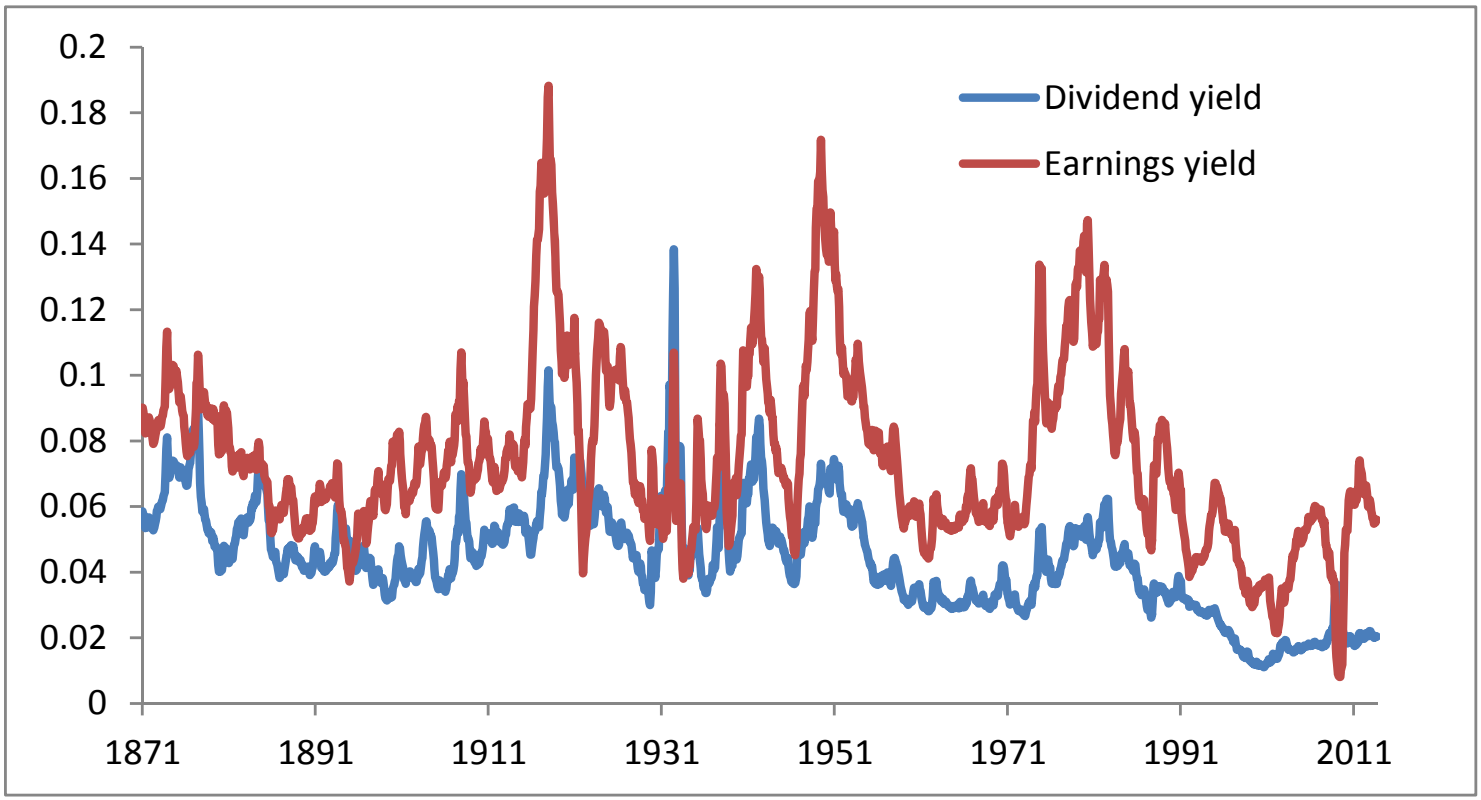
- Results go through a fortiori without housing [no housing]
- Effect stronger with inelastic utility function [inelastic utility]
- Results go through with bequests [bequests]
- Heterogeneous bequest motive - increased wealth inequality [heterogeneous agents]
- Effects reversed with highly elastic production function [elastic production]

Policy implications

- Low real rates here to stay
  - Higher inflation target to avoid the ZLB
  - Higher public debt
- So is high household debt
  - Note the side effects of macroprudential tools
  - Look for safer ways for young households to borrow

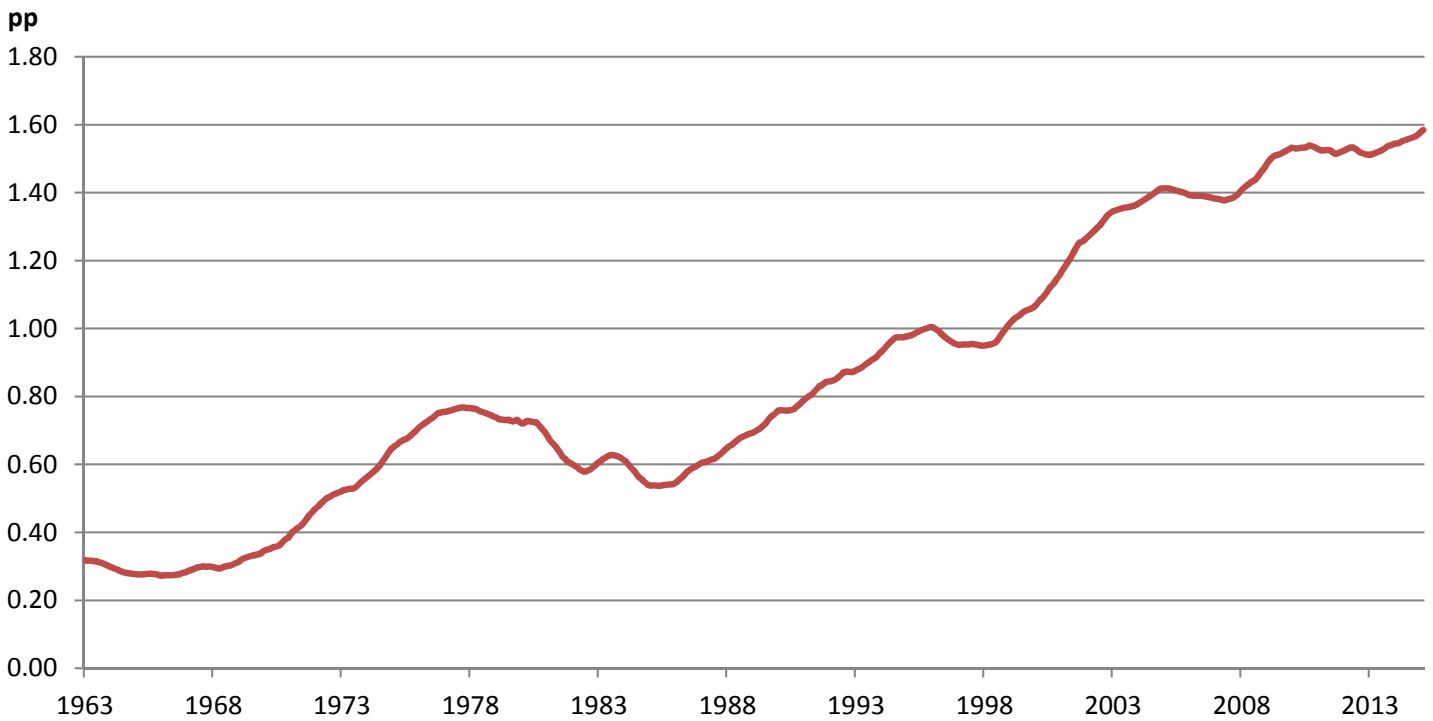
Thank you

US stock market yields



Back to rates

US AAA corporate yield spreads to 10 year Treasuries



Back to rates

Bequests

Add bequests to the utility function

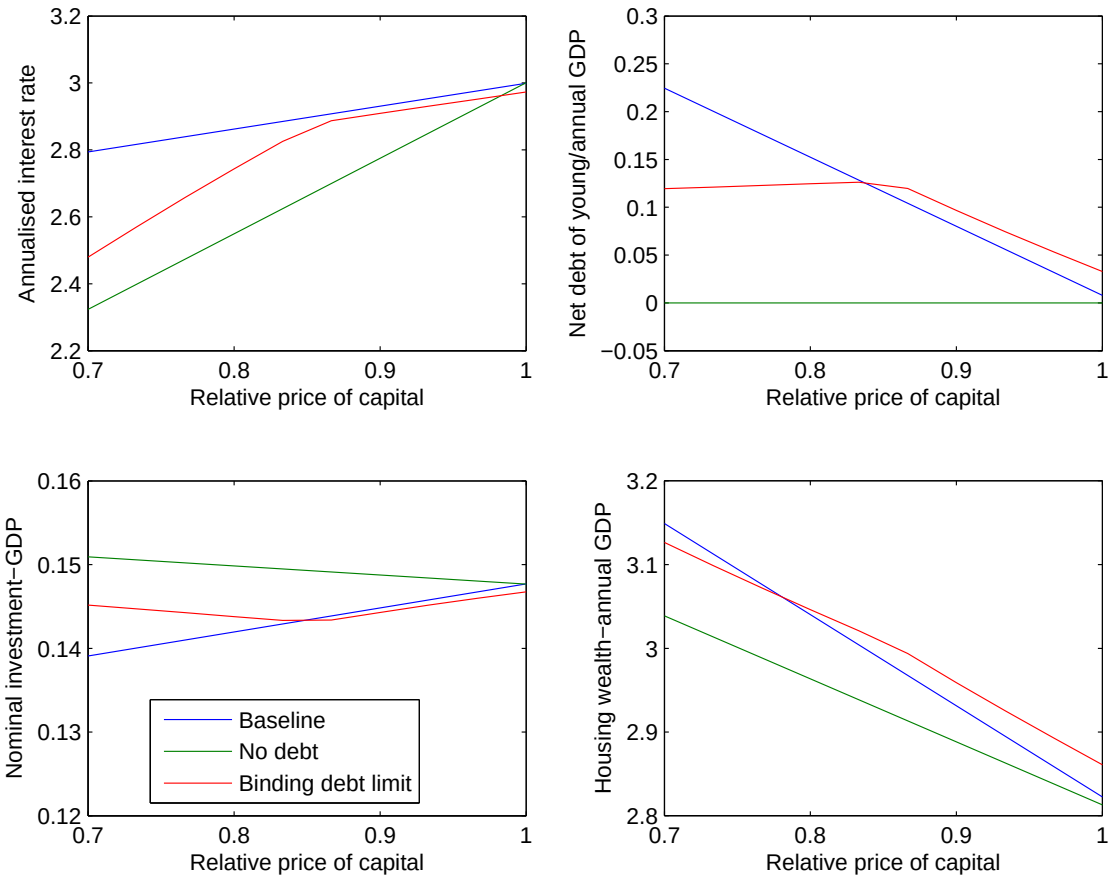
$$U = \frac{1}{1-\theta}\left(c_1^{1-\theta} + \beta_2 c_2^{'1-\theta} + \beta_3 c_3^{''1-\theta}\right) + \phi\frac{h^{1-\gamma}}{1-\gamma} + \xi\frac{b^{'1-\zeta}}{1-\zeta} \quad (11)$$

$$c_1 + hp_h + S_1 = \eta W \quad (12)$$

$$c_2^{'} + S_2^{'} = (1-\eta)W + (1+r)S_1 + b \quad (13)$$

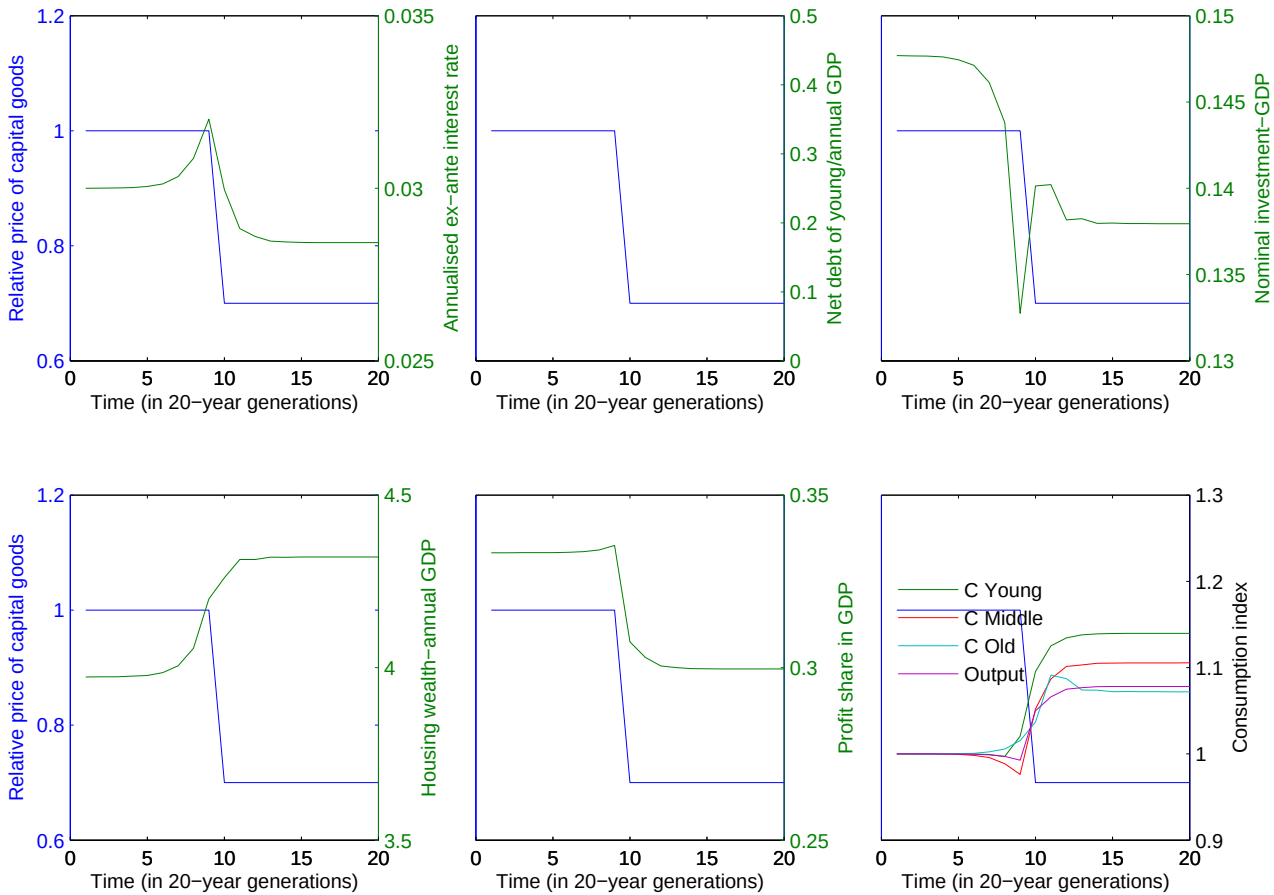
$$c_3^{''} + b^{'} = (1+r^{''})S_2^{'} + hp_h \quad (14)$$

Results - bequests



Back to presentation

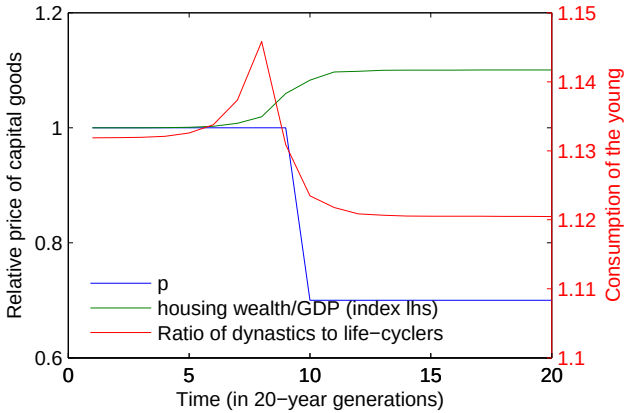
Results - bequests

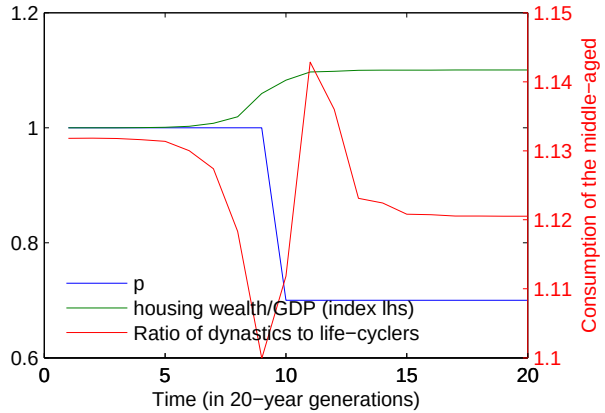


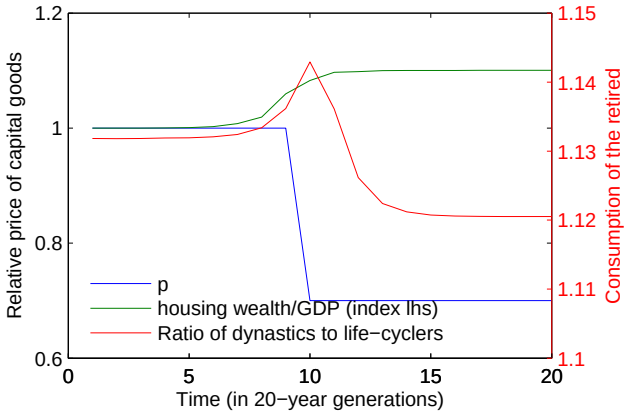
Heterogeneous bequest motive

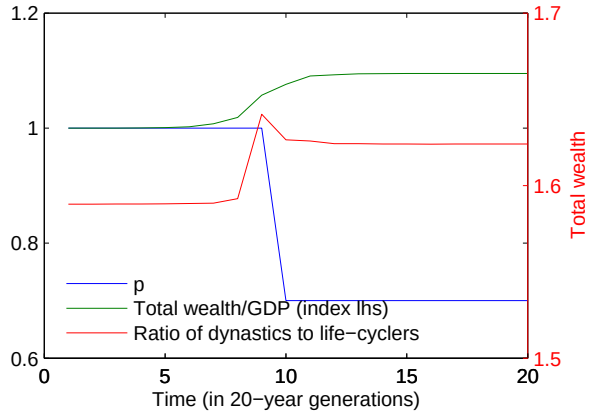
- Inherited wealth is unequally distributed
- Changes in asset prices induced by p will have distributional consequences
- To study this, divide the population into two equally-sized dynasties, one with a bequest motive as above, one without

Results - heterogeneous bequests

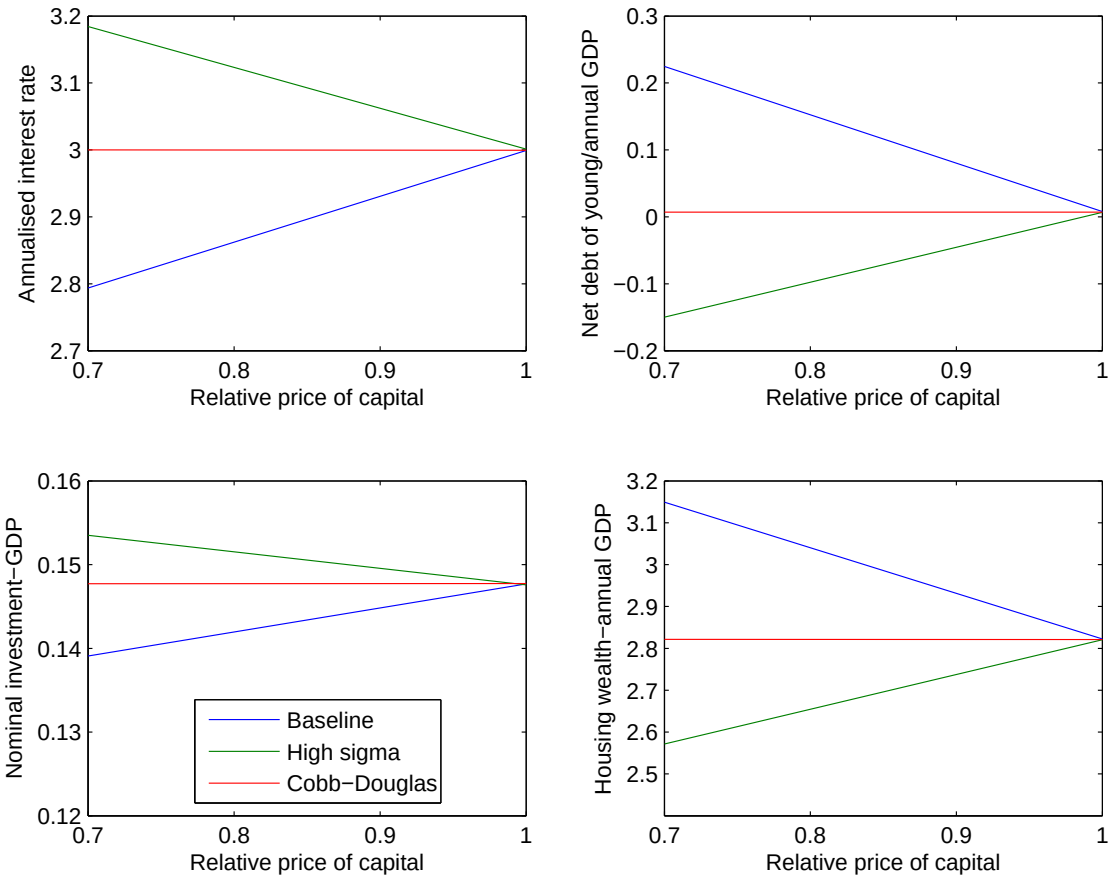




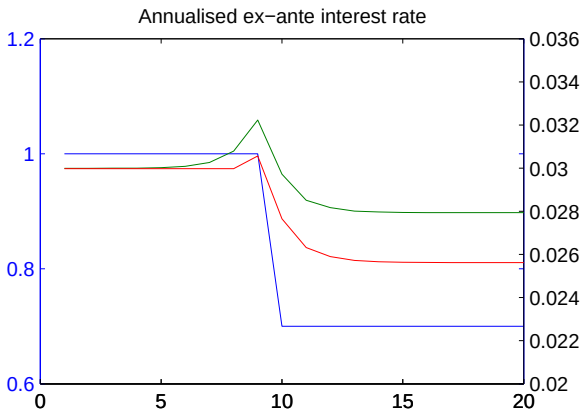


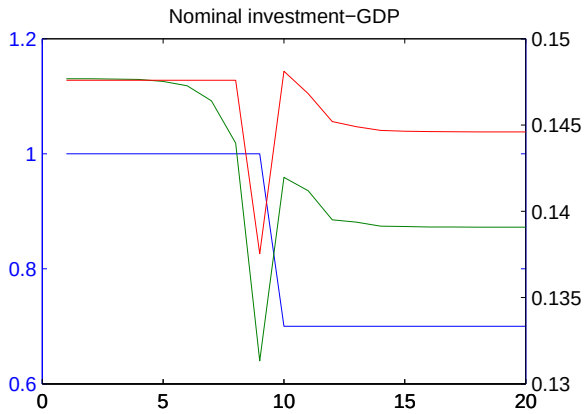


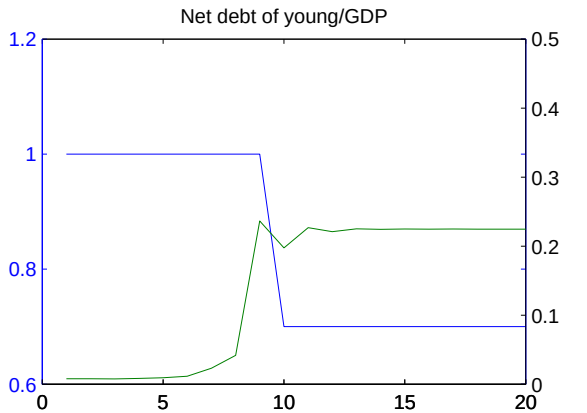
Results - $\sigma = 1.3$



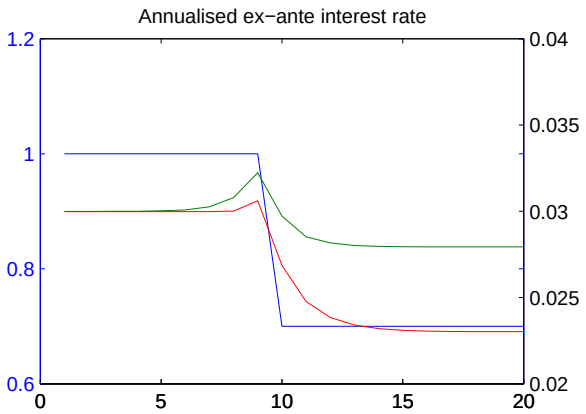
Results - no housing

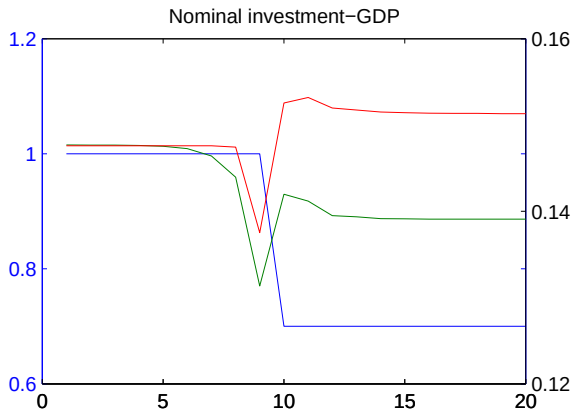


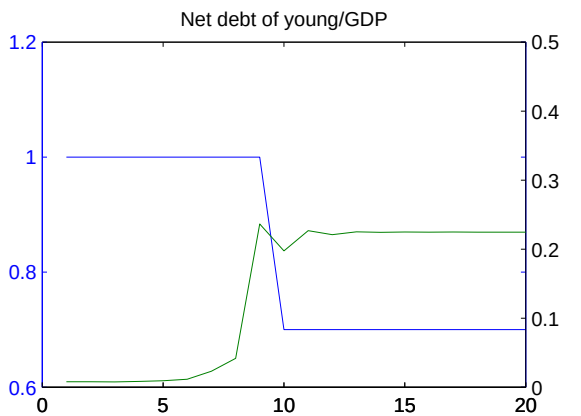




Results - inelastic utility







We need to talk about σ

- Results of this model require that the elasticity of substitution between capital and labour $\sigma < 1$
- When σ is low, it is hard to vary the production technology, so a rise in the quantity of capital goods depresses the marginal product more than proportionally
- Most estimates find σ well below unity
  - See e.g. the survey in Chirinko (2008). Median value of estimates is .5, 85th percentile is unity
  - Karabarbounis and Neiman (2014) find $\sigma = 1.3$ using corporate sector labour share
  - Other tests of Karabarbounis and Neiman's model with their data suggest σ well below unity ▸ σ econometrics

σ econometrics

Table : Two ways to estimate σ: labour share and investment rate

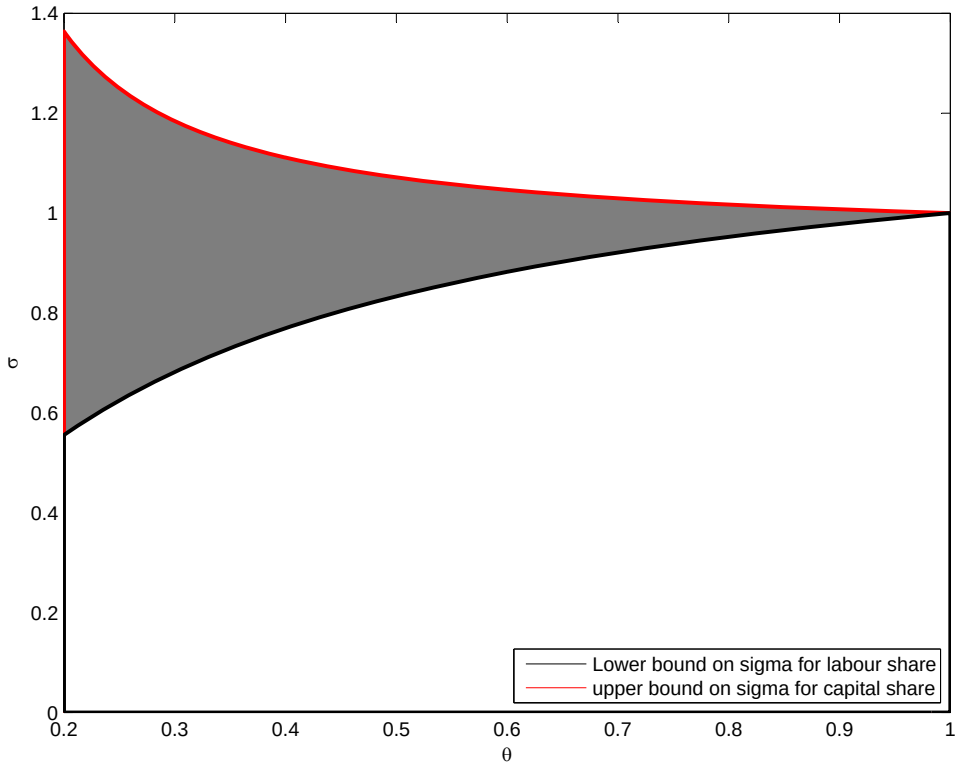
Dependent variable		Labour share		Investment rate	
		Robust regression	OLS	Robust regression	OLS
Relative price of investment	Coefficient	0.210**	-0.032	0.455***	0.592***
	standard error	[0.09]	[0.11]	[0.16]	[0.19]
Implied value of sigma	Observations	57	57	53	53
	Central	1.21	0.97	0.55	0.41
	lower bound of CI	1.03	0.75	0.23	0.03
	upper bound of CI	1.39	1.19	0.87	0.79

The profit share in a nested CES function

- Can reconcile investment rate and labour share if we add a third factor M that is paid in profits but cannot be accumulated

$$Y = \left[\mu M^{\frac{\theta-1}{\theta}} + (1-\mu) \left[\left[(1-\alpha) L^{\frac{\sigma-1}{\sigma}} + \alpha K^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \right]^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}$$

Labour share and investment both increasing in p



Investment rate

Table : Estimates of the elasticity of substitution σ

Dataset	Panel	Time trends		Panel	Time trends	
Estimator	FE	OLS	Robust	FE	OLS	Robust
RHS source		PWT			WDI	
Log(p)	0.491***	1.121***	0.776***	0.290***	0.999***	0.695***
	[0.04]	[0.21]	[0.17]	[0.04]	[0.25]	[0.16]
$\hat{\sigma}$	0.509	-0.121	0.224	0.71	0.001	0.305
$\hat{\sigma_H}$	0.589	0.299	0.564	0.79	0.501	0.625
$\hat{\sigma_L}$	0.429	-0.541	-0.116	0.63	-0.499	-0.015
N	1632	54	54	1643	52	52
no. of countries	99			100		

Back to presentation

HH debt/GDP

Table : Regression of household debt on relative price of capital

Left-hand side variable	Household debt/GDP					
Dataset	Panel	Time trends		Panel	Time trends	
Estimator	FE	OLS	Robust	FE	OLS	Robust
RHS source		PWT			WDI	
log(p)	-0.993***	0.702	-0.779***	-1.179***	0.571	-0.888***
	[0.05]	[0.65]	[0.25]	[0.07]	[0.72]	[0.30]
N	535	18	18	551	18	18
no. of countries	21			21		

Back to presentation

Real house prices

Table : Regression of real house prices on relative price of capital

Left-hand side variable	Real house prices					
Dataset	Panel	Time trends		Panel	Time trends	
Estimator	FE	OLS	Robust	FE	OLS	Robust
RHS source		PWT			WDI	
log(p)	-1.082***	0.121	-0.672	-0.976***	-0.277	-1.520**
	[0.10]	[0.89]	[0.79]	[0.12]	[0.91]	[0.65]
N	535	18	18	551	18	18
no. of countries	21			21		

Back to presentation

Current account balance

Table : Regression of current account on relative price of capital

Left-hand side variable	Current account/GDP					
Dataset	Panel	Time trends		Panel	Time trends	
Estimator	FE	OLS	Robust	FE	OLS	Robust
RHS source		PWT			WDI	
log(p)	-0.055***	0.006	0.020	-0.025**	0.025	0.028
	[0.01]	[0.05]	[0.05]	[0.01]	[0.05]	[0.05]
N	1004	35	35	992	34	34
no. of countries	50			51		

Back to presentation