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
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.
Overview

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- 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

Spot Yields on 10 Year Bonds

- Weighted
- Unweighted

01/01/1985 to 01/01/2013

Equity market measures

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Household debt

The facts
Simple model
Extensions and robustness
Conclusions and policy implications

% of GDP


11 countries
All countries

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Nominal investment-GDP ratio

- Full sample
- 11 countries

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Nominal and real capital-GDP ratios
Price of investment relative to consumption

The facts
Simple model
Extensions and robustness
Conclusions and policy implications

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Stylised facts - industrialised world before the crisis

- Real interest rates were falling for two decades before the crisis.
- Household debt levels rose, and remain high.
- Nominal investment rates and capital-output ratios fell.
- The relative price of investment fell.
Explanations for low real rates in industrialised countries

- Demographics
- Inequality
- Emerging markets’ surplus savings
Savings and investment 101

- ΔS (or -ΔCA), ΔI

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Savings and investment 101

\[ r \]

\[ S, I \]

\[ I_1, I_2 \]

\[ \Delta S \text{ (or } \Delta CA), \Delta I \]
Savings and investment 101

\[ r \]

\[ S_1 \]
\[ S_2 \]
\[ I_1 \]
\[ I_2 \]

\[ \Delta S \text{ (or } \Delta CA\text{), } \Delta I \]

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Effect of a fall in capital goods prices

The diagram illustrates the effect of a fall in capital goods prices on the nominal investment rate and the real interest rate. The diagram shows the relationship between the nominal investment rate (x-axis) and the real interest rate (y-axis) for different values of \( \sigma \):

- For \( \sigma < 1 \), the slope of the lines indicates a decrease in the nominal investment rate with an increase in the real interest rate.
- For \( \sigma > 1 \), the slope of the lines indicates an increase in the nominal investment rate with a decrease in the real interest rate.

The diagram suggests that changes in capital goods prices can have significant implications for investment decisions and economic policy. 

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Secular stagnation
The price of capital goods $p$ has two opposing effects on the demand for investment and thus the real interest rate $r = \frac{1}{p} \frac{\partial Y}{\partial K} - \delta$.
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- 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.
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We assume a value of 0.7 in the baseline model, above most estimates.

We need to talk about $\sigma$. 

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Setup - households

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

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

(1)
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 $\eta$ of their lifetime labour in the first period, and $1 - \eta$ in the second period. So their budget constraints look like this:

\[ c_1 + hp_h + a_1 = \eta W \]  \hspace{1cm} (2)

\[ c_2 + a_2 = (1 - \eta)W + (1 + r)a_1 \]  \hspace{1cm} (3)

\[ c_3 = (1 + r)a_2 + hp_h \]  \hspace{1cm} (4)
Intermediate goods have a CES production function

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

Intermediates can be transformed into consumption goods at rate 1, or capital goods at rate \( \pi \) capital goods per intermediate

\[ c = Y_c \]  (6)

\[ I = \pi Y_I \]  (7)

So the aggregate resource constraint is

\[ Y = Y_c + Y_I = C + p_K I \]  (8)

where \( p_K = \pi^{-1} \) is the key exogenous technological parameter in the model
Supply of housing (viz land) is fixed

\[ h = \bar{h} \] (9)

Asset market clears

\[ a_1 + a_2 = p_K K \] (10)
Results - baseline setup, real interest rates

![Graph showing the relative price of capital goods and annualised ex-ante interest rate over time. The graph compares anticipated and unanticipated scenarios.](image-url)
Results - baseline setup, investment, debt and house prices
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 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 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

\[ \frac{\Pi}{Y} = \frac{\Pi}{K_p} \frac{K_p}{K} \]

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

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- 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
  - Mismeasured capital-output ratio - intangibles?
  - MPK vs r in financial markets - corporate taxes, physical depreciation, marginal vs average returns
Econometric evidence - approach

- Modelling the world economy with 20-year time periods results in few datapoints
- 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 $\Delta x_i = \alpha + \beta \Delta p_i + u_i$
### Table: Coefficient on $p$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Closed</th>
<th>Open</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal investment rate</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>HH debt/GDP</td>
<td>-</td>
<td>?</td>
<td>-</td>
</tr>
<tr>
<td>Real house prices</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Current account/GDP</td>
<td>n/a</td>
<td>-</td>
<td>?</td>
</tr>
</tbody>
</table>
Sensitivity analysis

- Results go through a fortiori without housing
- Effect stronger with inelastic utility function
- Results go through with bequests
- Heterogeneous bequest motive - increased wealth inequality
- Effects reversed with highly elastic production function
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

- Dividend yield
- Earnings yield

Back to rates

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US AAA corporate yield spreads to 10 year Treasuries
Bequests

Add bequests to the utility function

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

(11)

\[ c_1 + h p_h + S_1 = \eta W \]  

(12)

\[ c'_2 + S'_2 = (1 - \eta) W + (1 + r) S_1 + b \]  

(13)

\[ c''_3 + b' = (1 + r'') S'_2 + h p_h \]  

(14)
**Results - bequests**

**Graphs:**
- **Relative price of capital vs. Annualised interest rate**
- **Net debt of young vs. annual GDP**
- **Nominal investment-GDP vs. Housing wealth-annual GDP**

**Lines:**
- **Baseline**
- **No debt**
- **Binding debt limit**

**Key points:**
- These graphs illustrate the impact of different debt scenarios on economic indicators such as interest rates, net debt, and investment versus housing wealth.

**Context:**
- This section likely provides insights into the economic models used to analyze bequests and their implications on various economic metrics.
Results - bequests

- Relative price of capital goods
- Annualised ex-ante interest rate
- Net debt of young/annual GDP
- Nominal investment/GDP
- Housing wealth/annual GDP
- Profit share in GDP
- Consumption index

Back to presentation

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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

Chart 1: Relative price of capital goods over time for different age groups.
- Young: Consumption of the young
- Middle-aged: Consumption of the middle-aged
- Retired: Consumption of the retired
- Total wealth: Total wealth/GDP ratio

Chosen parameters for bequest motive:
- Parameterisation of heterogeneity

Econometric results:
- Results show significant impacts of bequests on economic outcomes.

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Results - $\sigma = 1.3$
Results - no housing

- Annualised ex-ante interest rate
- Nominal investment–GDP
- Housing wealth–annual GDP
- Net debt of young/GDP

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Results - inelastic utility

- Annualised ex-ante interest rate
- Nominal investment-GDP
- Housing wealth-annual GDP
- Net debt of young/GDP

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We need to talk about $\sigma$

- Results of this model require that the elasticity of substitution between capital and labour $\sigma < 1$
- When $\sigma$ 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 $\sigma$ 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 $\sigma$ well below unity
### Table: Two ways to estimate $\sigma$: labour share and investment rate

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Labour share</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Robust regression</td>
<td>OLS</td>
<td>Robust regression</td>
<td>OLS</td>
</tr>
<tr>
<td>Relative price of investment</td>
<td>Coefficient</td>
<td>0.210**</td>
<td>-0.032</td>
<td>0.455***</td>
</tr>
<tr>
<td></td>
<td>standard error</td>
<td>[0.09]</td>
<td>[0.11]</td>
<td>[0.16]</td>
</tr>
<tr>
<td>Implied value of sigma</td>
<td>Observations</td>
<td>57</td>
<td>57</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>Central</td>
<td>1.21</td>
<td>0.97</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>lower bound of CI</td>
<td>1.03</td>
<td>0.75</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>upper bound of CI</td>
<td>1.39</td>
<td>1.19</td>
<td>0.87</td>
</tr>
</tbody>
</table>
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

\[
Y = \left[ \mu M^{\frac{\theta-1}{\theta}} + (1 - \mu) \left[ \left( 1 - \alpha \right) L^{\frac{\sigma-1}{\sigma}} + \alpha K^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \right]^{\frac{\theta-1}{\theta}} \frac{\theta}{\theta-1}
\]
Labour share and investment both increasing in $\rho$
### Table: Estimates of the elasticity of substitution $\sigma$

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Panel</th>
<th>Time trends</th>
<th>Panel</th>
<th>Time trends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimator</td>
<td>FE</td>
<td>OLS</td>
<td>Robust</td>
<td>FE</td>
</tr>
<tr>
<td>RHS source</td>
<td>PWT</td>
<td>WDI</td>
<td>PWT</td>
<td>WDI</td>
</tr>
<tr>
<td>Log($p$)</td>
<td>0.491*** [0.04]</td>
<td>1.121*** [0.21]</td>
<td>0.776*** [0.17]</td>
<td>0.290*** [0.04]</td>
</tr>
<tr>
<td>$\hat{\sigma}$</td>
<td>0.509</td>
<td>-0.121</td>
<td>0.224</td>
<td>0.71</td>
</tr>
<tr>
<td>$\hat{\sigma}_H$</td>
<td>0.589</td>
<td>0.299</td>
<td>0.564</td>
<td>0.79</td>
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<tr>
<td>$\hat{\sigma}_L$</td>
<td>0.429</td>
<td>-0.541</td>
<td>-0.116</td>
<td>0.63</td>
</tr>
<tr>
<td>N</td>
<td>1632</td>
<td>54</td>
<td>54</td>
<td>1643</td>
</tr>
<tr>
<td>no. of countries</td>
<td>99</td>
<td>100</td>
<td></td>
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</table>
### Table: Regression of household debt on relative price of capital

<table>
<thead>
<tr>
<th>Left-hand side variable</th>
<th>Household debt/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dataset</td>
</tr>
<tr>
<td></td>
<td>Estimator</td>
</tr>
<tr>
<td></td>
<td>RHS source</td>
</tr>
<tr>
<td>log(p)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>535</td>
</tr>
<tr>
<td>no. of countries</td>
<td>21</td>
</tr>
</tbody>
</table>
# Real house prices

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

<table>
<thead>
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<th>Left-hand side variable</th>
<th>Real house prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dataset</td>
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<td>Estimator</td>
<td>FE</td>
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<tr>
<td>RHS source</td>
<td>PWT</td>
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<tr>
<td>log(p)</td>
<td>-1.082***</td>
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<tr>
<td>[0.10]</td>
<td>[0.89]</td>
</tr>
<tr>
<td>N</td>
<td>535</td>
</tr>
<tr>
<td>no. of countries</td>
<td>21</td>
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</table>

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## Current account balance

### Table: Regression of current account on relative price of capital

<table>
<thead>
<tr>
<th>Left-hand side variable</th>
<th>Current account/GDP</th>
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<tbody>
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<td></td>
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<tr>
<td></td>
<td>Estimator</td>
</tr>
<tr>
<td></td>
<td>RHS source</td>
</tr>
<tr>
<td>log(p)</td>
<td>-0.055***</td>
</tr>
<tr>
<td></td>
<td>[0.01]</td>
</tr>
<tr>
<td>N</td>
<td>1004</td>
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<tr>
<td>no. of countries</td>
<td>50</td>
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</table>