From Shirtsleeves to Shirtsleeves in a Long Lifetime

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1 Question

To what extent are fluctuations of housing prices and aggregate production consistent with fundamental conditions of technology and finance?

How does the life-cycle of consumption and home-ownership depend upon technology and limitation of contract enforcement?

We develop an overlapping generations model of a production economy in which land and capital are combined into residential and commercial structures. Each household chooses consumption and home-ownership under collateral constraints

Idea:

Household enjoys an owned house more than a rented house

$\longrightarrow$ Hence wants to buy a house

But, the household faces a collateral constraint and therefore needs to save for a downpayment

$\longrightarrow$ Young and poor rent, rich and old own

$\longrightarrow$ First order welfare effects

Implications:

Life-cycle of home-ownership depends upon

- Technology: importance of land for production of structures

  growth rate of population and labor productivity

- Financial system

- Pension system

Change in growth rate of population and labor productivity affect both level and growth rate of housing price and aggregate quantities

Change in the level of labor productivity and required rate of return for foreigners affects level of housing price and aggregate quantities

Change in the downpayment requirement of housing has a limited effect on housing prices and aggregate output, even though it has a significant effect on the home-ownership rate

2 Model

Output is produced from labor and productive structures

$$Y_t = F(A_t N_t, Z_{Yt}) = (A_t N_t)^{1-\eta} Z_{Yt}^{\eta} \tag{1}$$

Capital and land form structures

$$Z_t = K_t^{\gamma} L^{1-\gamma} \tag{2}$$

Capital accumulation through investment

$$K_t = \lambda K_{t-1} + I_t \tag{3}$$

Continuum of workers with population size of N_t :

High productivity workers

$\uparrow \delta^m$ $\searrow 1-\omega$ $1-\sigma$

Medium productivity workers $\longrightarrow$ Retirees $\longrightarrow$ Dead

$G_N - \omega$ $\uparrow \delta^l$ $\nearrow$

$\longrightarrow$ Low Productivity workers

Preferences

$$E_0 \left[\Sigma_{t=0}^{\infty} \beta^t u(c_t, (1 - \psi I(rent)) h_t) \right] \tag{4}$$

where

$$u(c, h) = \left[\left(\frac{c}{\alpha} \right)^{\alpha} \left(\frac{h}{1 - \alpha} \right)^{1-\alpha} \right]^{1-\rho} / (1 - \rho)$$

Limited commitment

Tenant cannot precommit to take proper care of rented house $\longrightarrow$ landlords limit the freedom of the tenants $\longrightarrow$ utility discount for tenants

Potential hold-up between the owners of land and building $\longrightarrow$ must own capital and land together $\longrightarrow$ only asset traded is share of structures

Borrowers may default $\longrightarrow$ only home-owner can borrow (issue outside equity) up to collateral fraction:

$$\begin{aligned} s_t &\geq \theta h_t : \text{ for a home-owner} \\ s_t &\geq 0 : \text{ for a tenant} \end{aligned} \tag{5}$$

Flow-of-funds constraint

For a worker

$$c_t + r_t h_t + q_t s_t = (1-\tau) w_t \varepsilon_t + r_t s_t + d_t s_{t-1} \qquad (6)$$

For a retiree

$$c_t + r_t h_t + q_t s_t = b_t + r_t s_t + (d_t/\sigma) s_{t-1}$$

For the representative foreigner

$$C_t^* + q_t S_t^* = r_t S_t^* + d_t S_{t-1}^*$$

The asset demand of the foreigner

$$\begin{aligned} S_t^* &= \overline{S}^* + \xi(R_t - R_t^*), \text{ where} \\ R_t &= \frac{d_{t+1}}{q_t - r_t} \end{aligned} \qquad (7)$$

Representative firm

chooses the production plan $(Y_t, N_t, Z_{Yt}, Z_t, K_t, I_t)$ to maximize the value of the firm:

$$V_t = Y_t - w_t N_t - r_t Z_{Yt} + r_t Z_t - I_t + \frac{1}{R_t} E_t V_{t+1}$$

subject to the constraint of technology $(1, 2, 3)$.

d_t is gross dividend to the shareholder of structure from date t-1:

$$d_t Z_{t-1} = V_t$$

Market clearing

Labor

$$N_t = \int_0^{\overline{N_t}} n_t(i)di = \varepsilon^l N_t^l + \varepsilon^m N_t^m + \varepsilon^h N_t^h = N_t^l + N_t^m + N_t^h$$

Goods

$$Y_t = I_t + \int_0^{\overline{N}_t} c_t(i)di + C_t^*$$

Use of structures

$$Z_t = Z_{Yt} + \int_0^{\overline{N}_t} h_t(i)di$$

Shares of structures

$$Z_t = S_t^* + \int_0^{\overline{N}_t} s_t(i)di$$

Behavior of representative firm

$$
\begin{aligned}
w_t &= (1-\eta) Y_t / N_t \\
r_t &= \eta Y_t / Z_{Yt} \\
1 - \frac{\lambda}{R_t} &= \gamma r_t \left(L/K_t\right)^{1-\gamma} \\
V_t &= q_t Z_t - I_t
\end{aligned}
$$

Behavior of Households

Indirect utility with net worth x and shareholding s :

Tenant: $s < \theta h$

$$u^T(s,x) = \left(\frac{r}{1-\psi}\right)^{(\alpha-1)(1-\rho)} \frac{[x-(q-r)s]^{1-\rho}}{1-\rho}$$

Constrained home-owner: $s = \theta h$

$$u^C(s,x) = \left\{\left[\frac{x-(q-r+\frac{r}{\theta})s}{\alpha}\right]^{\alpha}\left[\frac{s/\theta}{1-\alpha}\right]^{1-\alpha}\right\}^{1-\rho}/(1-\rho)$$

Unconstrained home-owner: $s > \theta h$

$$u^U(s,x) = r^{(\alpha-1)(1-\rho)}\frac{[x-(q-r)s]^{1-\rho}}{1-\rho}$$

Value function for the retiree

$$
\begin{aligned}
V^r(x,\overline{A}) \;=\; Max\{ & \\
& \max_s \left[u^T(s,x) + \beta\sigma V^r(b' + (d'/\sigma)\, s, \overline{A}')\right], \\
& \max_s \left[u^C(s,x) + \beta\sigma V^r(b' + (d'/\sigma)\, s, \overline{A}')\right], \\
& \max_s \left[u^U(s,x) + \beta\sigma V^r(b' + (d'/\sigma)\, s, \overline{A}')\right]\}
\end{aligned}
$$

Value function for worker with low productivity

$$V^l(x, \overline{A}) = Max($$

$$\max_s \left\{ \begin{array}{c} u^T(s,x) + \beta[(\omega - \delta^l)V^l(\epsilon^l w' + d's, \overline{A}') + \\ \delta^l V^m(\epsilon^m w^m + d's, \overline{A}') + (1-\omega)V^r(b' + d's, \overline{A}') \end{array} \right\},$$

$$\max_s \left\{ \begin{array}{c} u^C(s,x) + \beta[(\omega - \delta^l)V^l(\epsilon^l w' + d's, \overline{A}') + \\ \delta^l V^m(\epsilon^m w^m + d's, \overline{A}') + (1-\omega)V^r(b' + d's, \overline{A}') \end{array} \right\},$$
$$s$$

$$\max_s \left\{ \begin{array}{c} u^U(s,x) + \beta[(\omega - \delta^l)V^l(\epsilon^l w' + d's, \overline{A}') + \\ \delta^l V^m(\epsilon^m w^m + d's, \overline{A}') + (1-\omega)V^r(b' + d's, \overline{A}') \end{array} \right\})$$

Value functions for medium productivity worker and high productivity worker are similarly defined

Steady state growth with productivity growth $\frac{A_{t+1}}{A_t} = G_A > 1/G_N$

Growth rate of aggregate output

$$\frac{Y_{t+1}}{Y_t} = \frac{C_{t+1}}{C_t} = \frac{I_{t+1}}{I_t} = \frac{K_{t+1}}{K_t} = G_Y$$

Growth rate of aggregate structures

$$\frac{Z_{t+1}}{Z_t} = \frac{Z_{Yt+1}}{Z_{Yt}} = G_Z$$

$\rightarrow$

$$\begin{aligned} G_Y &= (G_A G_N)^{(1-\eta)/(1-\gamma\eta)} < G_A G_N \text{ if } G_A G_N > 1 \\ G_Z &= G_Y^{\gamma} < G_Y \\ G_r &= \frac{r_{t+1}}{r_t} = \frac{q_{t+1}}{q_t} = G_Y^{1-\gamma} > 1 \end{aligned}$$

Table 1: Long run aggregate features of the U.S. economy				
	1900	1939	1958	Average
Reproducible tangible assets/GDP	3.07	3.34	2.92	3.3
Land/GDP	1.61	0.96	0.66	-
Net foreign assets/GDP	-0.12	0.02	0.05	-
Fraction of productive structures	0.47	0.43	0.42	0.53

Table 2: Home ownership rates in %	1970	1980	1990	2003
United States	64.2	65.6	64.0	68.3
Germany	-	41.0	39.0	43.6
Italy	-	59.0	68.0	80.0
United Kingdom	50.0	55.0	66.0	70.0
Japan	-	60.0	61.0	62.0

Table 3: U.S. Home-Ownership Rates (in %)						
	1900	1920	1940	1960	1980	1990
whites	48.5	47.1	42.1	64.0	68.6	66.5
blacks	24.1	24.6	20.5	35.8	43.8	40.9

Baseline parameter values

$\eta = 0.26$: share of productive structures in output, $\gamma = 0.9$: share of capital in structures

$\alpha = 0.75$: share of consumption of goods, $\psi = 0.09$: fraction of utility loss from renting a house, $\theta = 0.3$: fraction of house that needs downpayment, $\xi = 20$: sensitivity of foreign share demand

$\varepsilon^l = 0.33$, $\varepsilon^m = 0.663$, $\varepsilon^h = 2.65$: labor productivity, $\delta^l = 0.08$, $\delta^m = 0.014$: probability of switching productivity, $\omega = 0.978$: probability of continuing working, $\sigma = 0.945$: probability of surviving, $b/w = 0.2$: ratio of retirement benefit to pretax average wage

$G_A = 1.02$: labor productivity growth, $G_N = 1.01$: population growth rate

FIGURE 1A: Policy functions for a low productivity worker

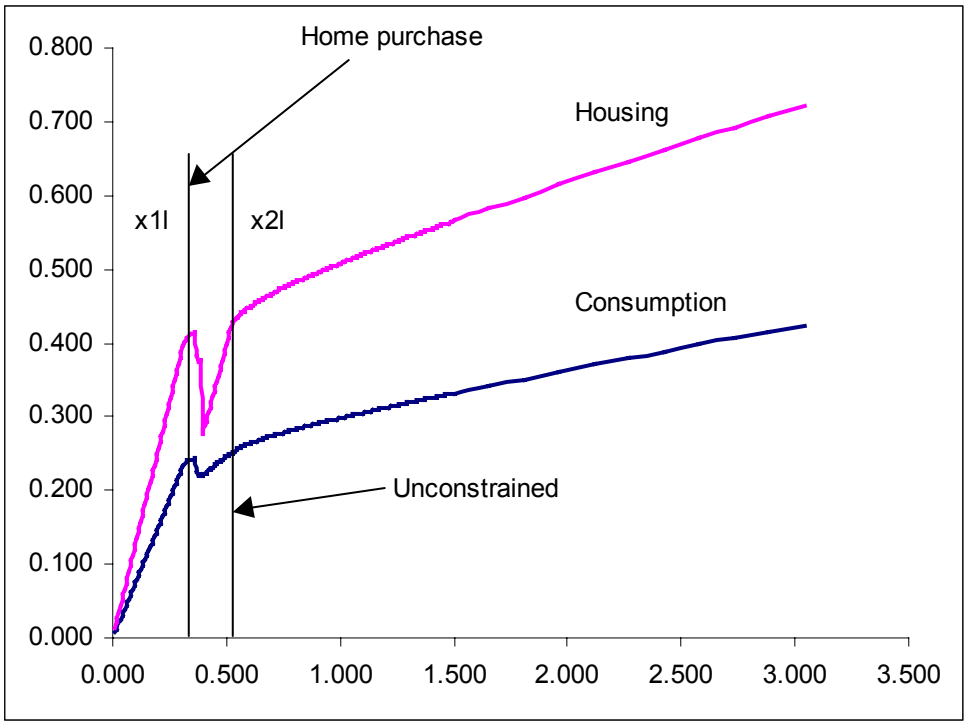


FIGURE 1B: Evolution of savings for a low productivity household

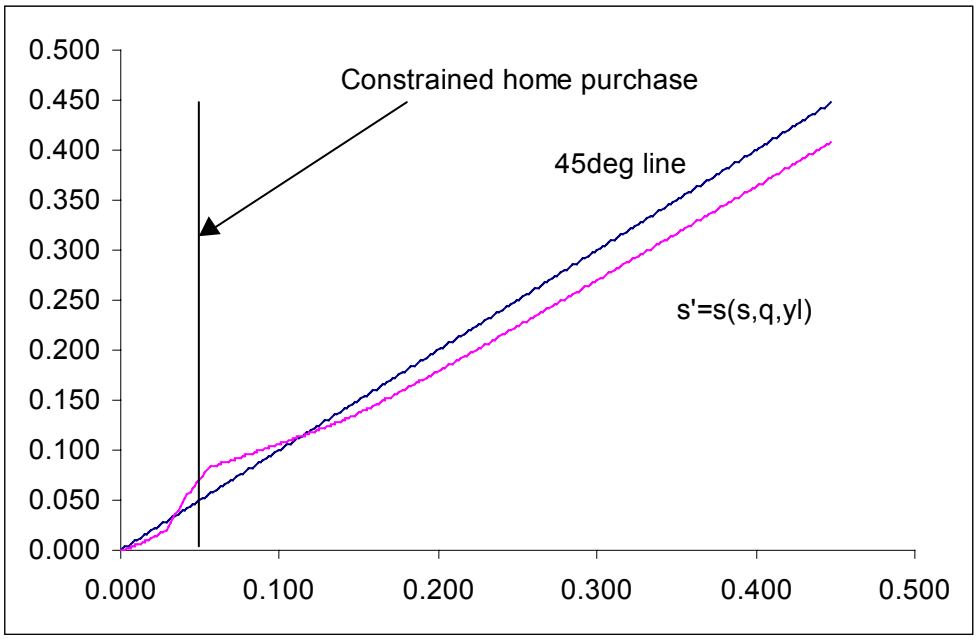


FIGURE 2A: Policy functions for a high productivity worker

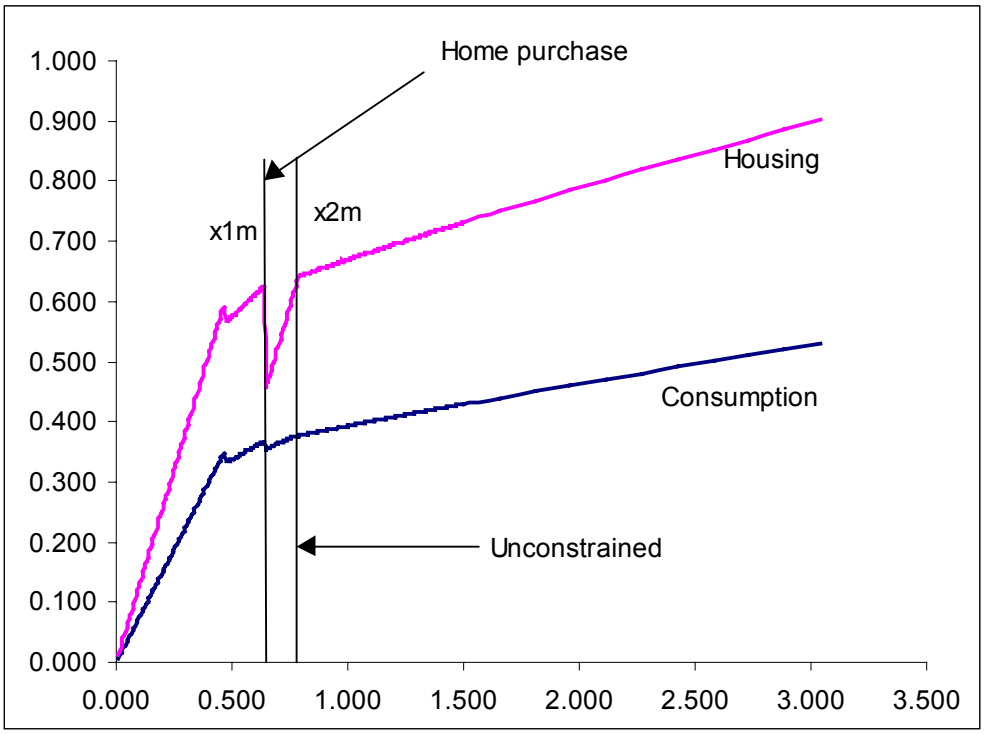


FIGURE 2B: Evolution of savings for a high productivity household

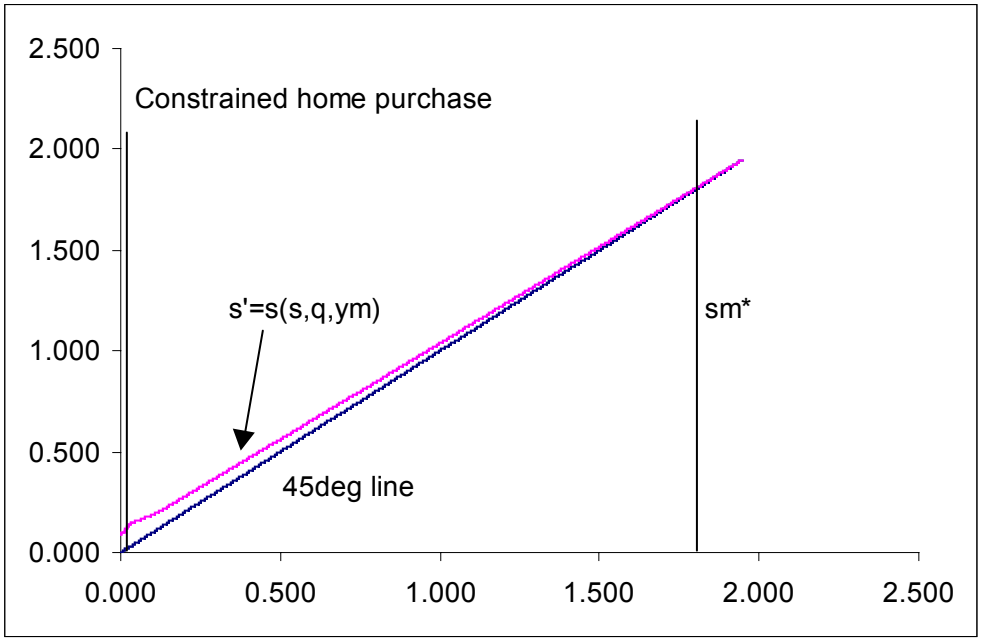


FIGURE 3A: Policy functions for the Retiree

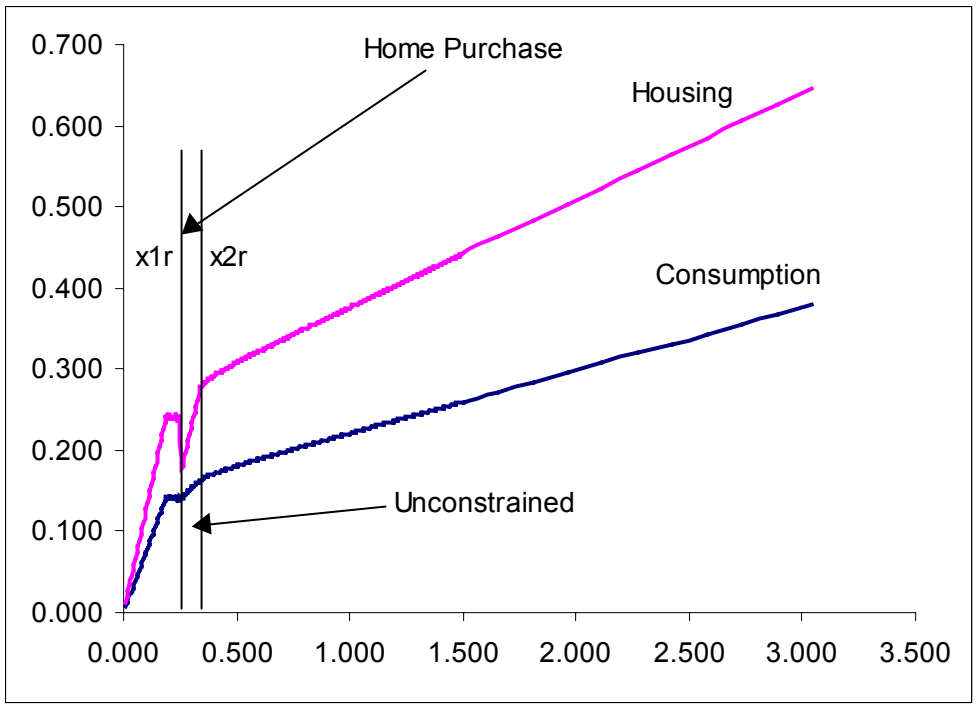


FIGURE 3B: Evolution of savings for the retiree

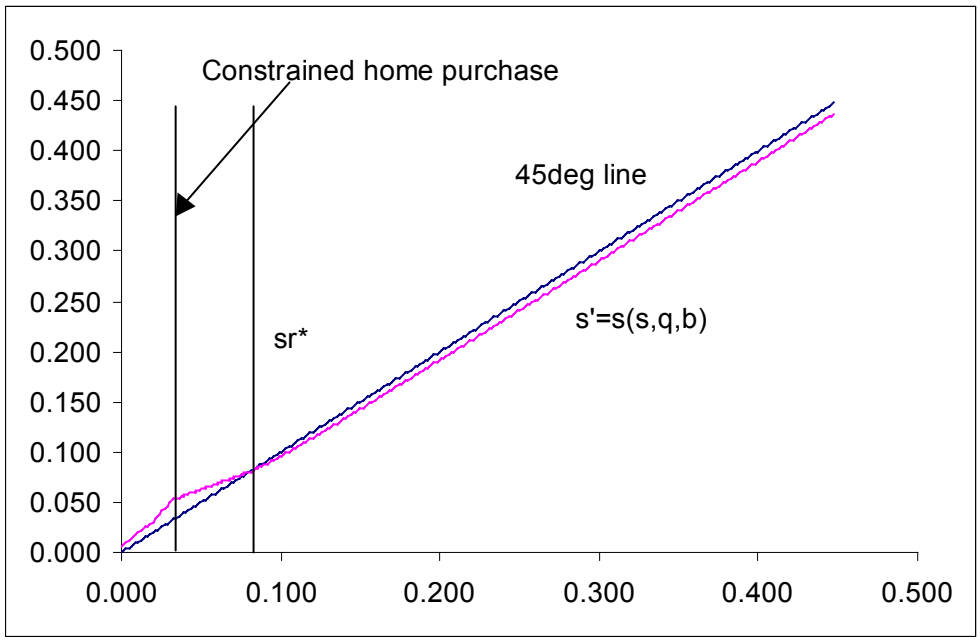
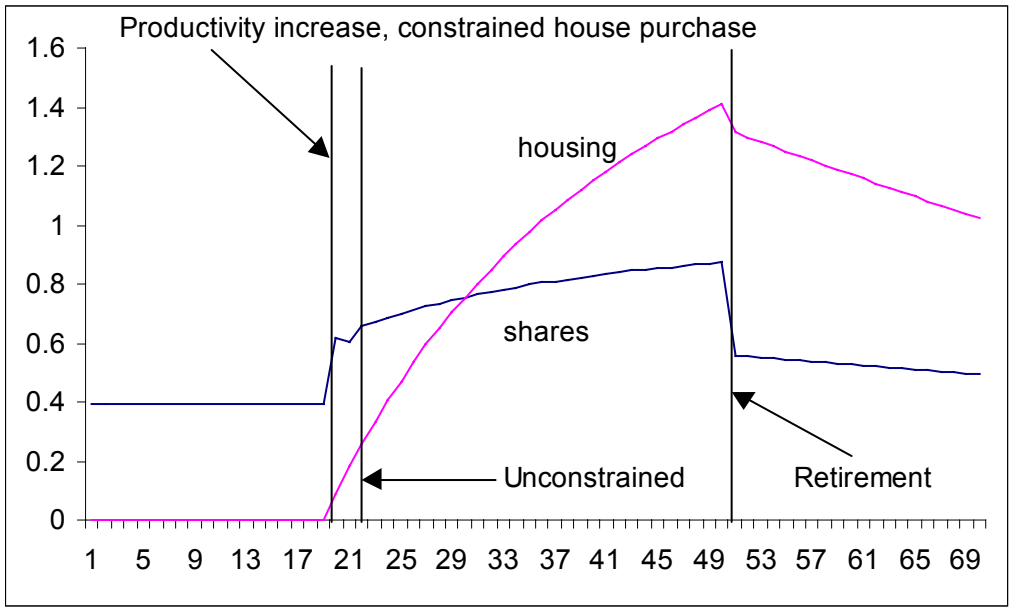


FIGURE 4: An example life time



Features of the steady state of baseline economy (detailed results in table 5)

$\longrightarrow$Tenants - 25% of population

Constrained - 8.3% of population

$\longrightarrow$ Average house size relative to unconstrained

Tenants - 34%

Constrained - 22%

$\longrightarrow$Average shareholding relative to unconstrained

Tenants - 0.08%

Constrained - 0.33%

$\longrightarrow$ Price-rental ratio of housing - 8.65 years

$\longrightarrow$ Real rate of returns on share in terms of output - 6.62%

Table 5

	baseline	*θ=0.1*	*θ=1.0*	*gn=1.02*	*ga=1.03*	*b=0.1*	*S*=0*	*γ=0.5*	*γ=0.5*
Column	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
% of tenants	24.76	2.59	37.32	42.35	38.77	21.10	36.85	25.34	12.84
% of constrained households	8.27	25.49	11.83	11.76	14.95	15.12	10.99	5.54	11.09
% of unconstrained homeowners	66.97	71.92	50.85	45.88	46.28	63.78	52.17	69.12	76.06
% of shares owned by tenants	0.08	0.02	0.80	0.93	1.06	1.07	0.87	0.07	0.16
% of shares owned by constrained	0.33	0.36	3.15	3.73	4.10	2.70	2.93	0.28	0.47
% of housing used by tenants	8.61	0.76	13.87	17.26	15.44	6.74	13.53	7.87	3.47
% of housing used by constrained	2.42	8.05	6.99	8.30	9.12	5.98	6.40	1.90	3.09
Current account as % of GDP	0.90	0.89	0.86	1.93	2.17	0.14	0.00	8.12	0.93
Net foreign Assets as % of GDP	-19.49	-19.32	-18.77	-34.76	-42.69	-3.17	0.00	-137.70	-13.26
Value of total structures to GDP	2.98	2.98	2.99	3.00	2.83	3.33	2.90	5.18	4.49
Housing structures to total structures	0.45	0.45	0.45	0.45	0.45	0.45	0.46	0.48	0.51
Value of housing to wages	2.50	2.50	2.50	2.48	2.35	2.74	2.46	4.49	4.22
Housing price to rental rate	8.65	8.66	8.69	8.77	8.31	9.61	8.43	13.89	11.86
Real return	6.62	6.61	6.58	7.27	7.69	5.86	6.84	7.54	8.64
House price (N=An=1)	1.66	1.66	1.66	1.71	1.67	1.78	1.63	4.95	4.40
Output (N=An=1)	1.11	1.11	1.11	1.10	1.09	1.12	1.10	0.89	0.88

Comparative steady state of large open economy

Lower collateral requirement: $\theta = 0.1$

$\longrightarrow$ Home-ownership rate is higher, fraction of constrained home-owners is higher

negligible difference in housing price and aggregate quantities

Higher population growth rate: $G_N = 1.02$

$\longrightarrow$ lower home-ownership rate, higher interest rate

Higher productivity growth rate: $G_A = 1.03$

$\longrightarrow$ higher interest rate, lower price-rental ratio, lower home-ownership rate

Lower retirement benefit: $b = 0.1$

$\longrightarrow$ higher home-ownership rate, higher price-rental ratio

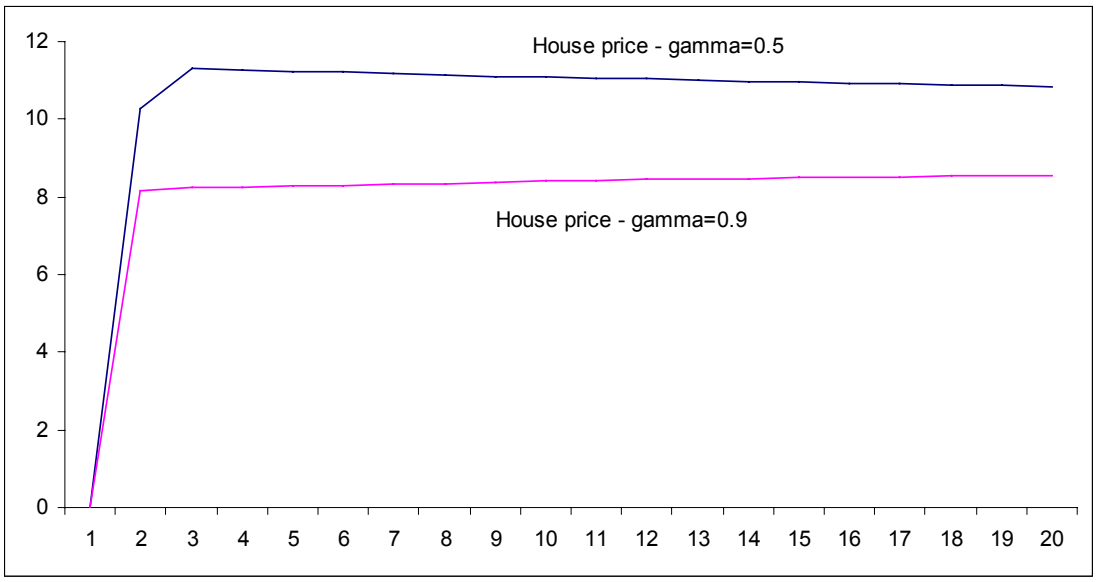
Transitions of small open economy: $\gamma = 0.9$, land unimportant vs $\gamma = 0.5$, land important

To a lower interest rate: $R^{*\prime} = R^* - 1\%$

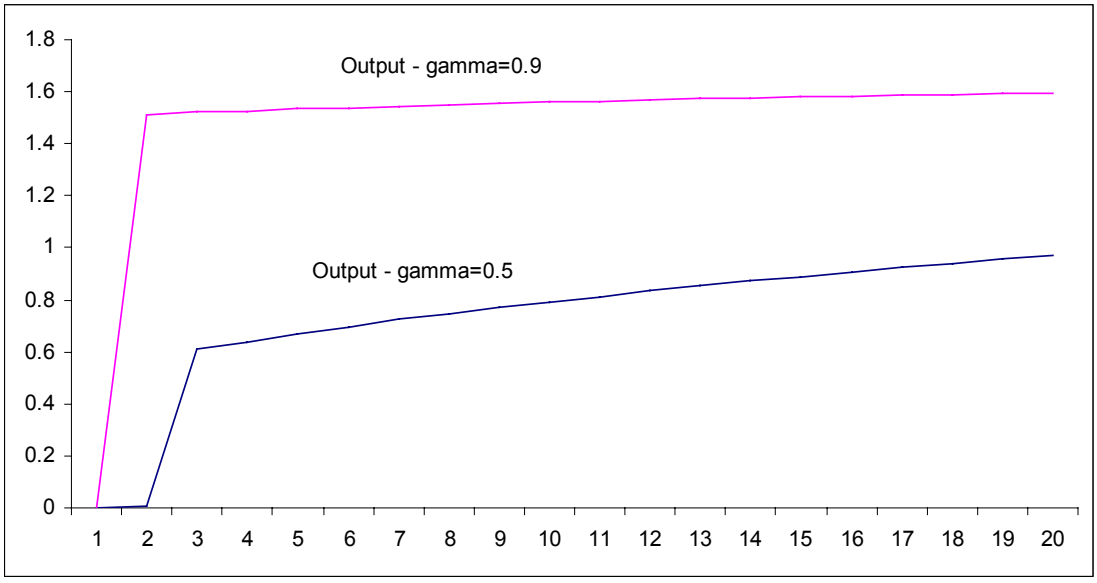
$\longrightarrow$ significant rise in the level of housing price, capital stock, and output

Figure 5: The world real interest rate declines by 1pp

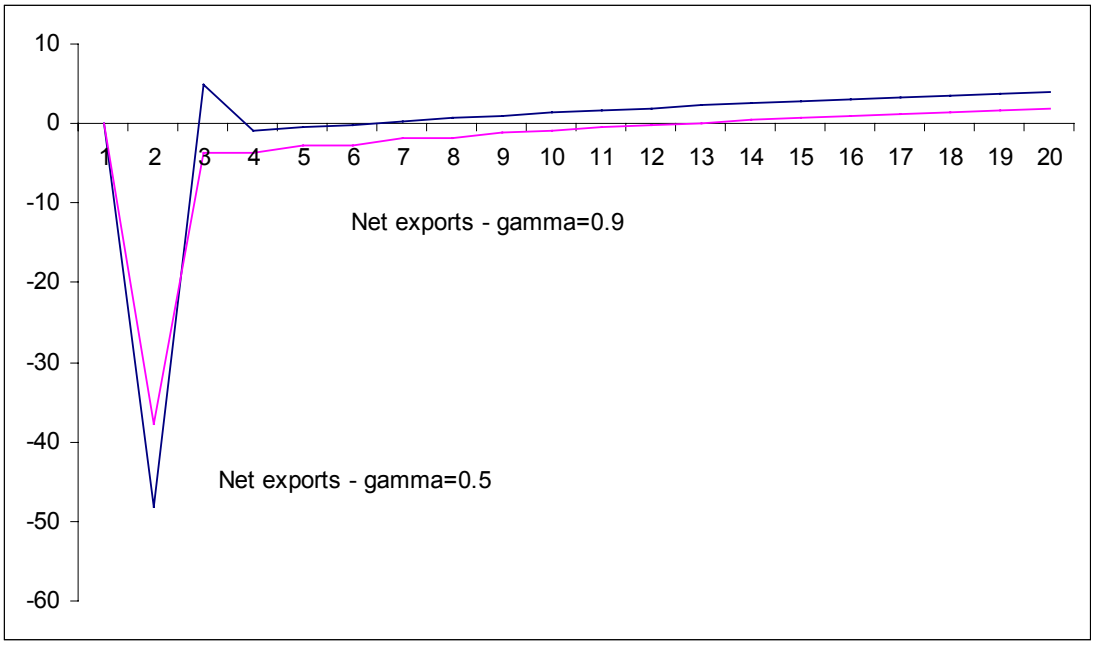
5A: Housing price (percent difference from baseline steady state)



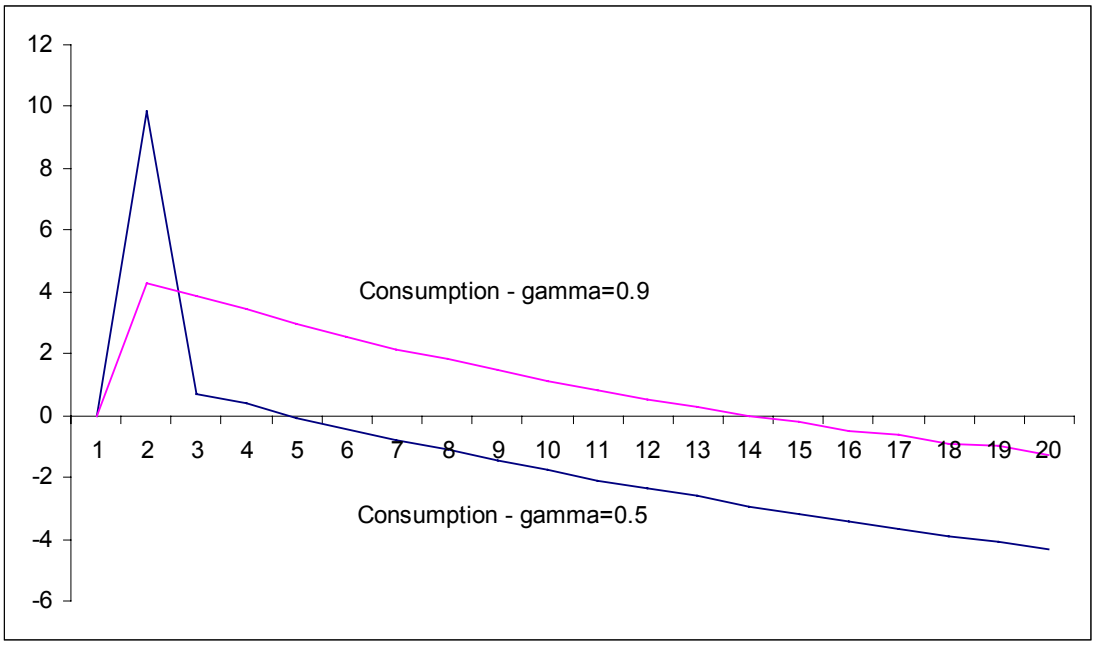
5B: Output (per cent difference from baseline steady state)



5C: Net exports as a percentage of GDP



5D: Consumption (per cent difference from baseline steady state)

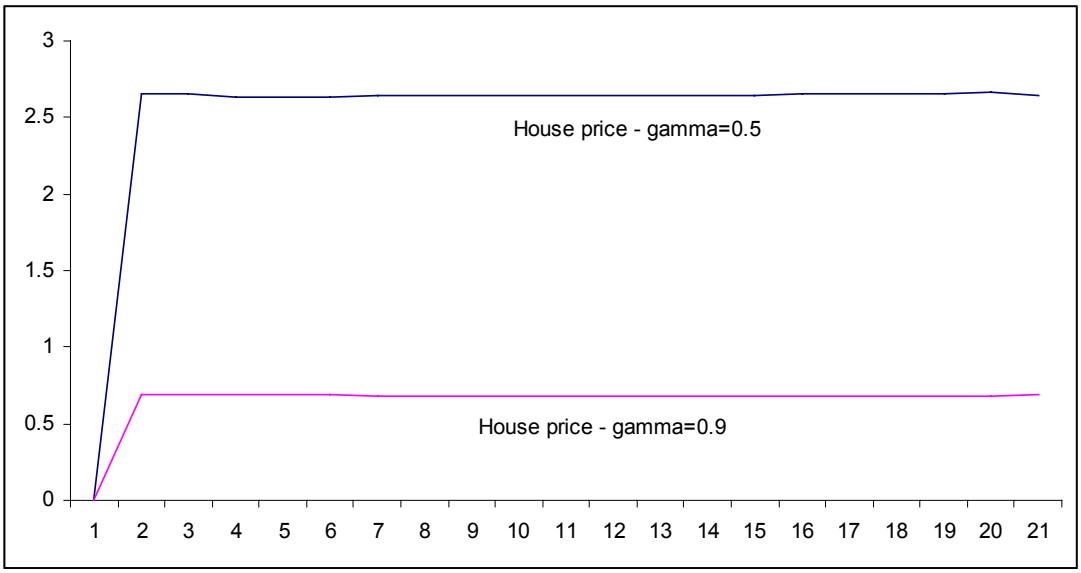


To a higher level of labor productivity: $A'_t = 1.05 A_t$

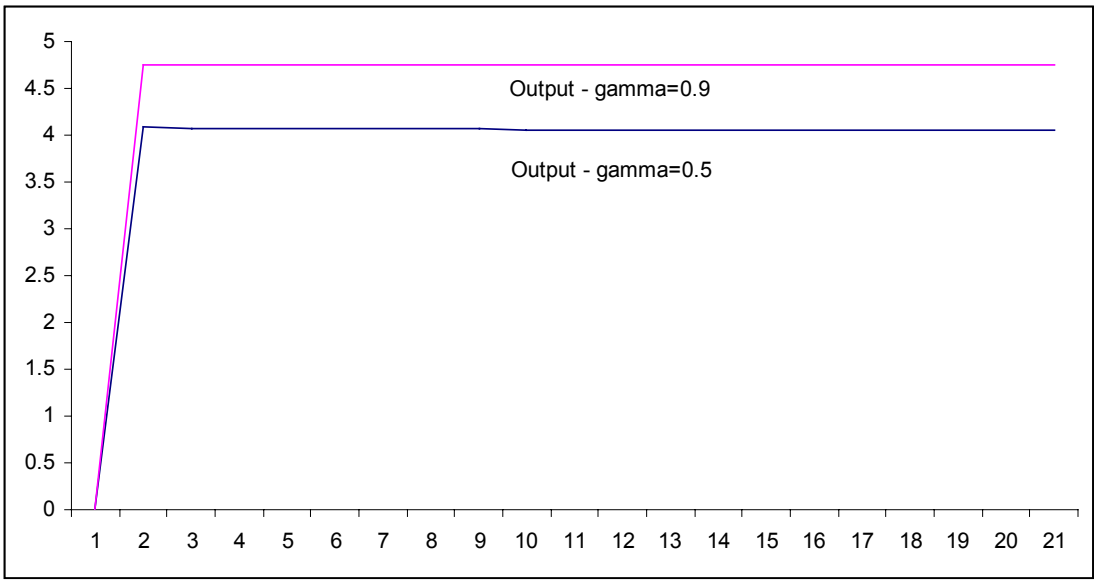
$\longrightarrow$ significant rise in the level of housing price and aggregate quantities

Figure 6: The level of labour productivity increases by 5%

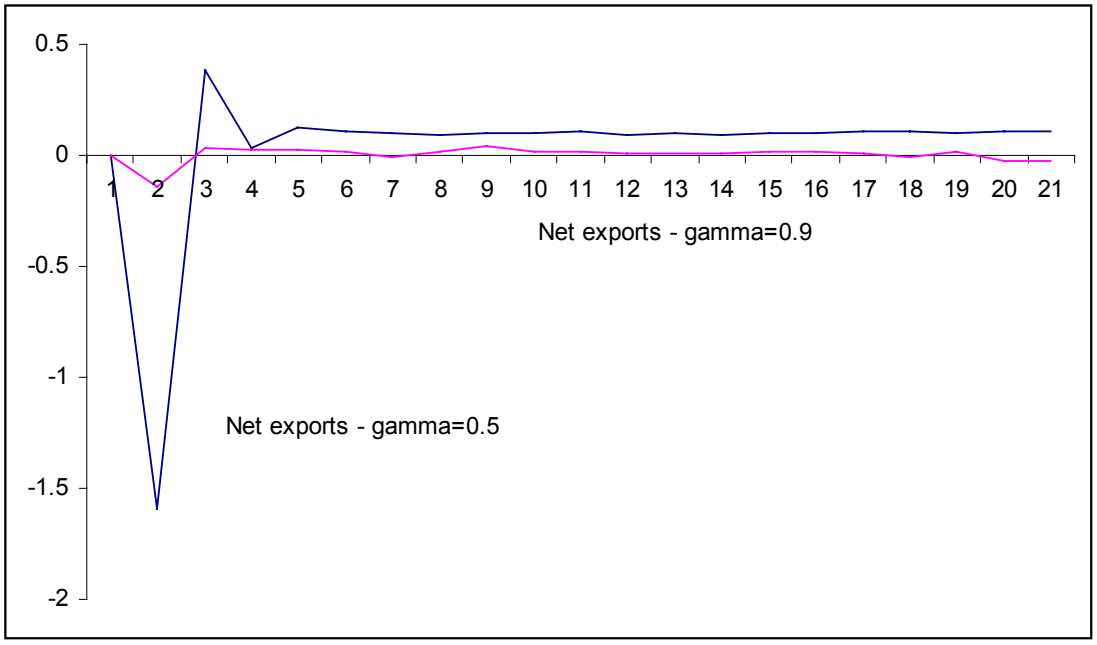
6A: Housing price (percent difference from baseline steady state)



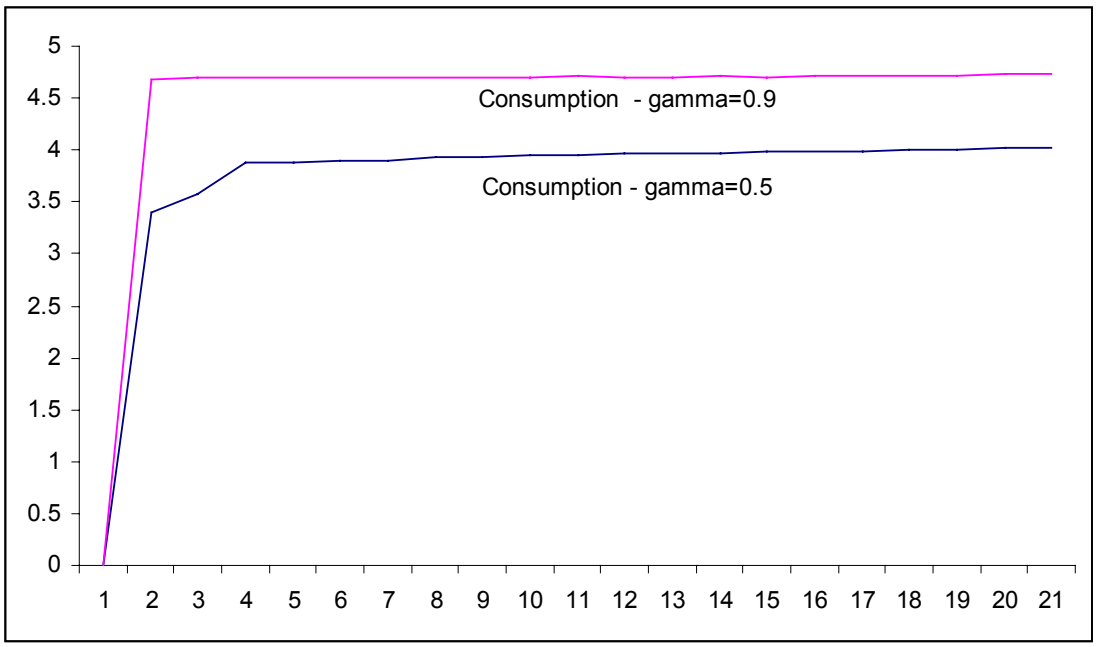
6B: Output (per cent difference from baseline steady state)



6C: Net exports as a percentage of GDP



6D: Consumption (per cent difference from baseline steady state)

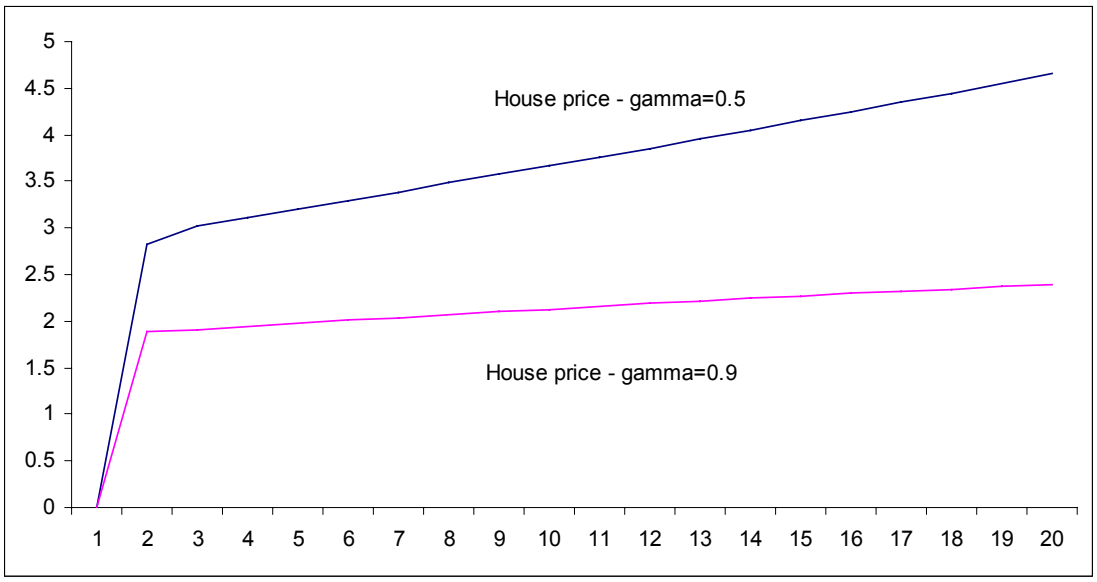


To a higher growth rate of labor productivity: $G'_A = 1.0225$

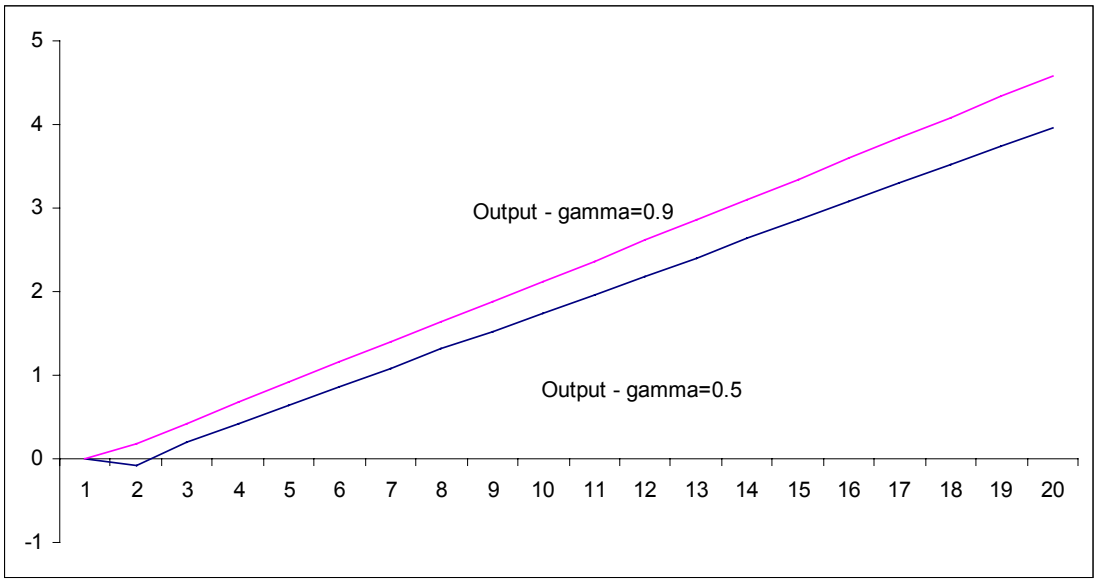
$\longrightarrow$ significant rise in growth rate and level of housing price and aggregate quantities

Figure 7: The growth rate of labour productivity increases by 0.25pp

7A: Housing price (percent difference from baseline steady state)



7B: Output (per cent difference from baseline steady state)



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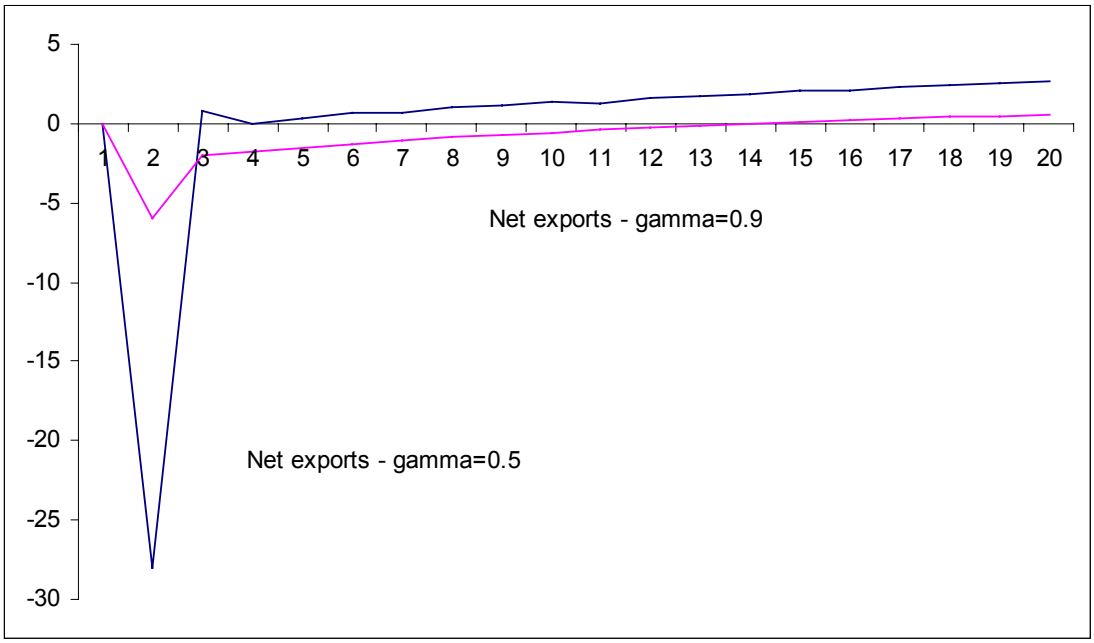


7D: Consumption (per cent difference from baseline steady state)

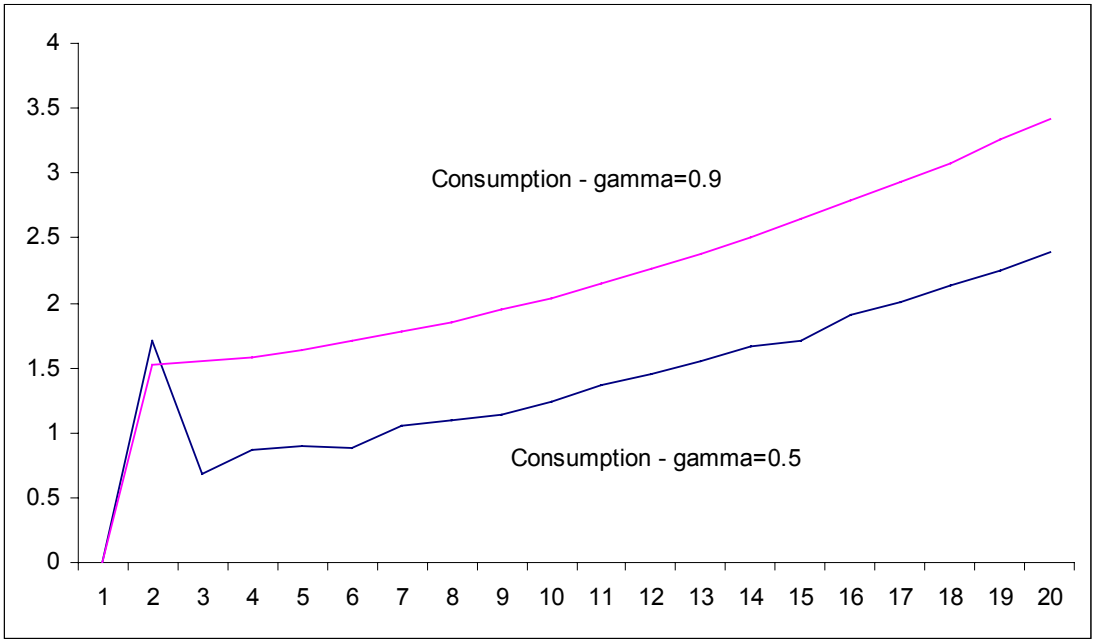
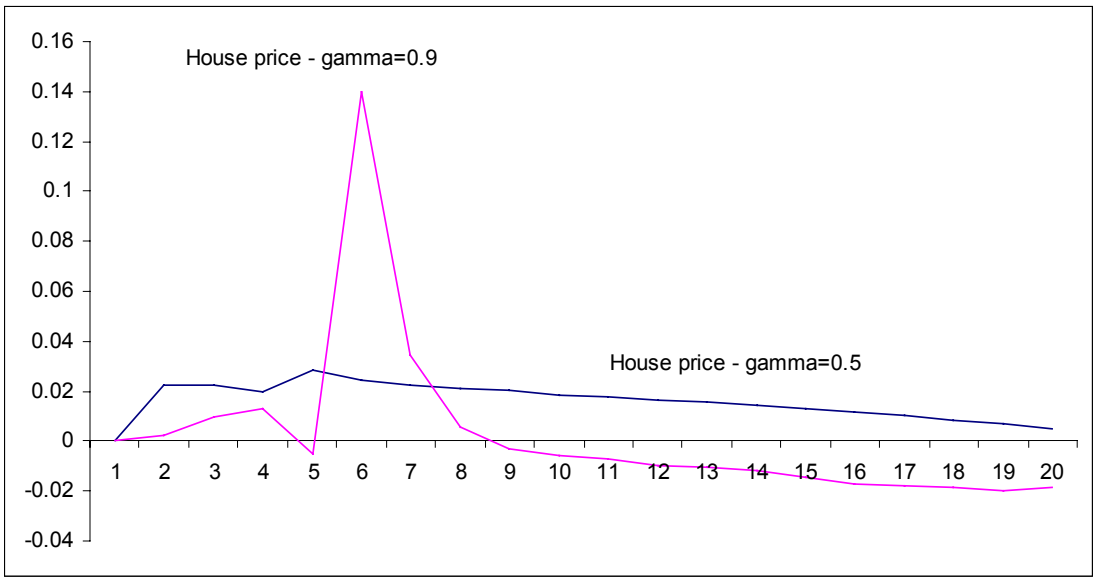
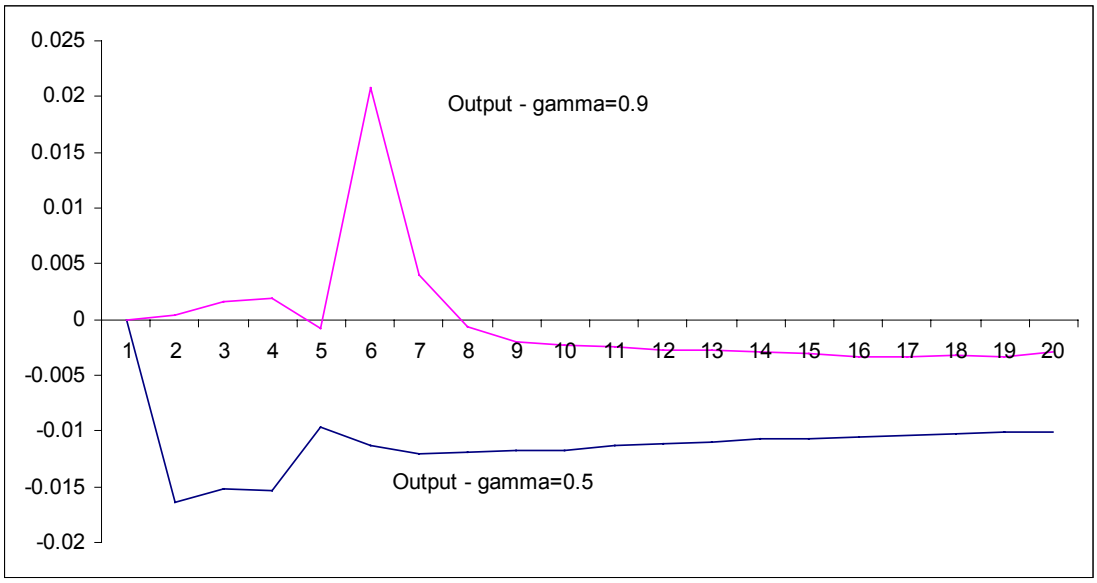


Figure 8: The down-payment requirement falls from 0.3 to 0.2

8A: Housing price (percent difference from baseline steady state)



8B: Output (per cent difference from baseline steady state)



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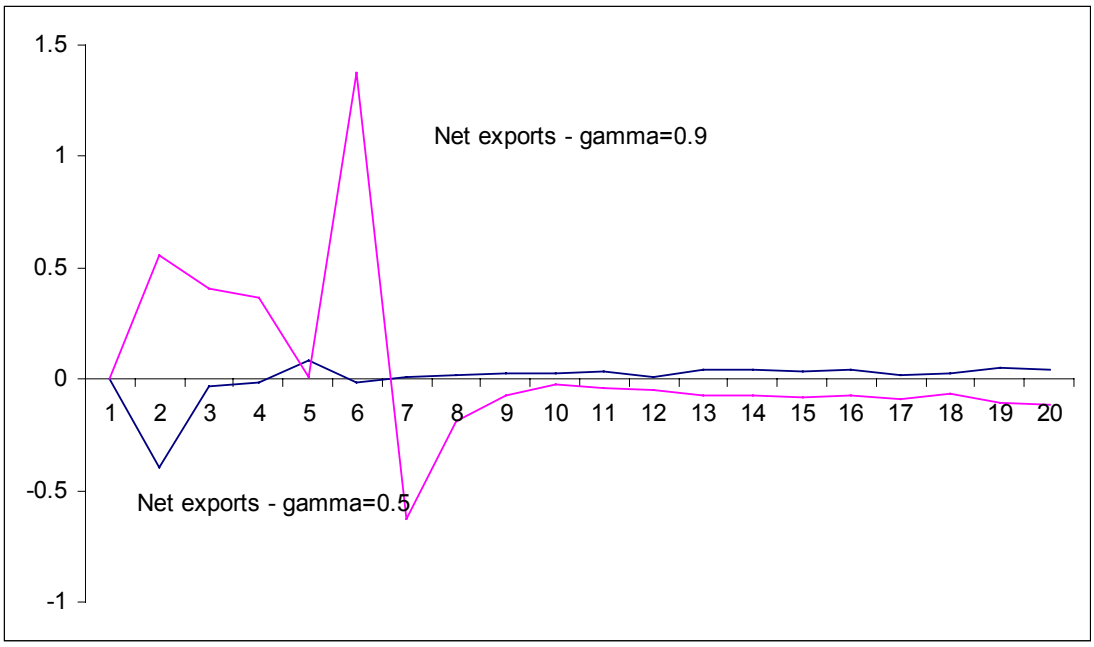

8D: Consumption (per cent difference from baseline steady state)