House Price Movements

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Extremely Preliminary

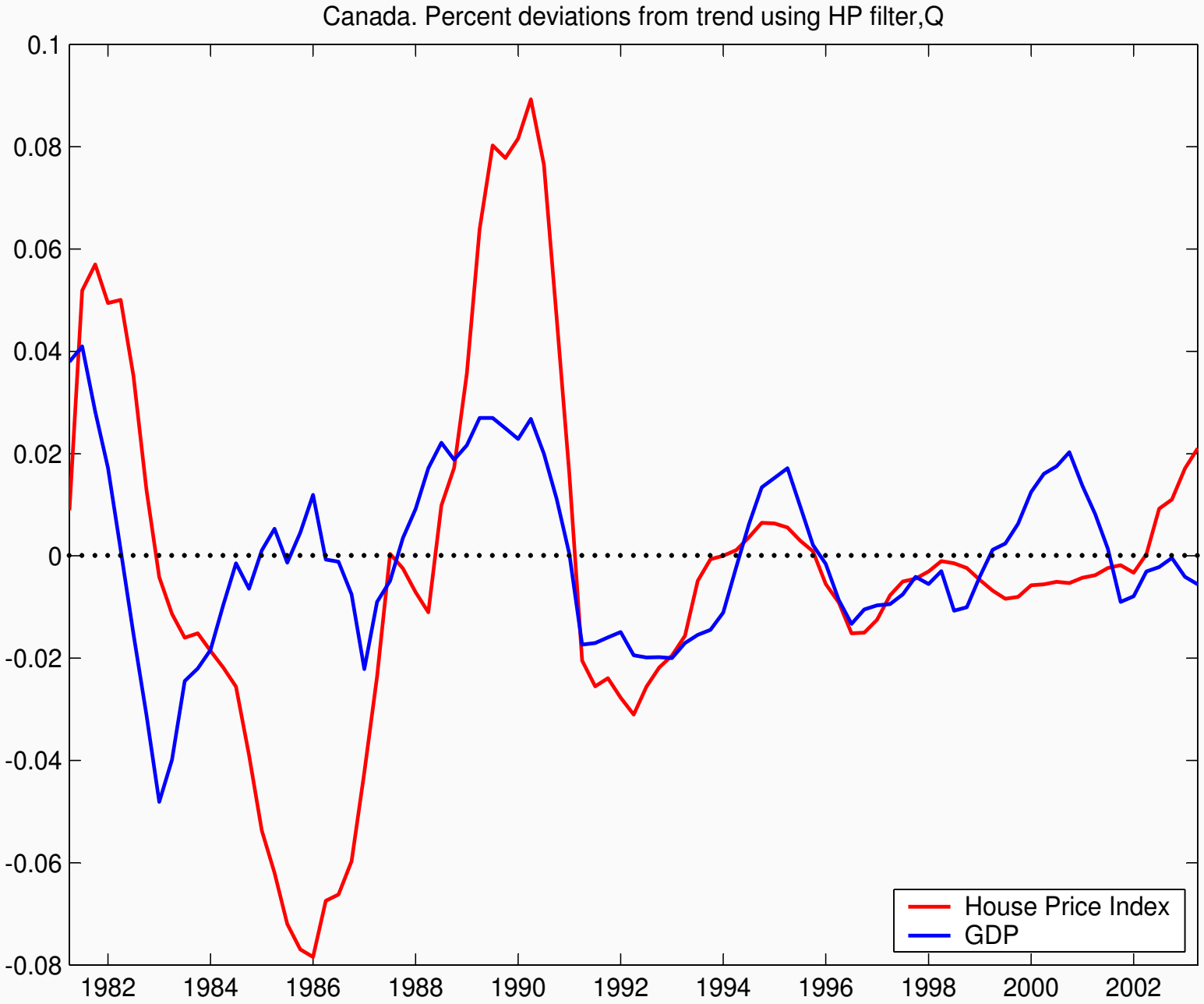
Harvard University
March 5, 2007

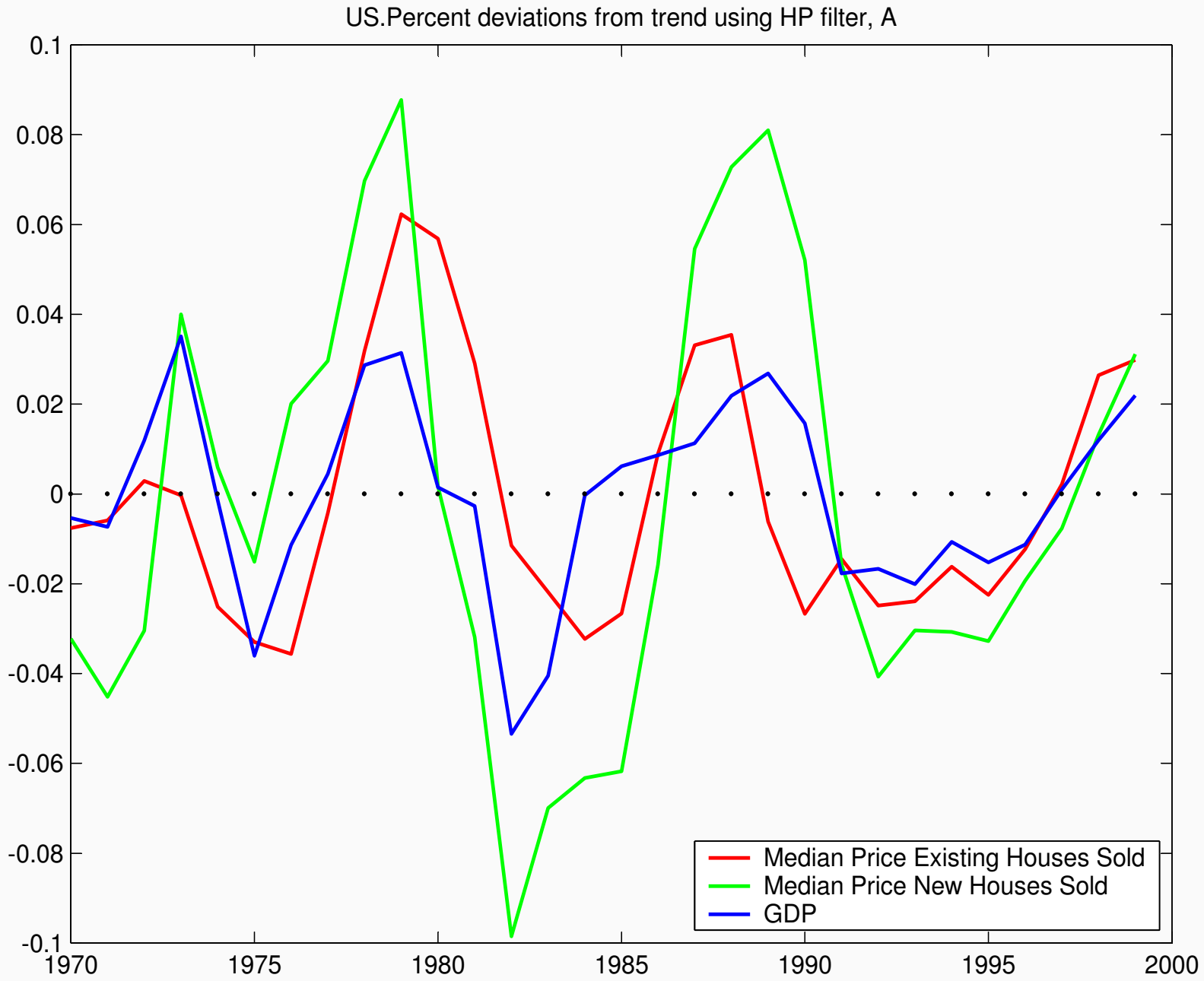
Housing Market

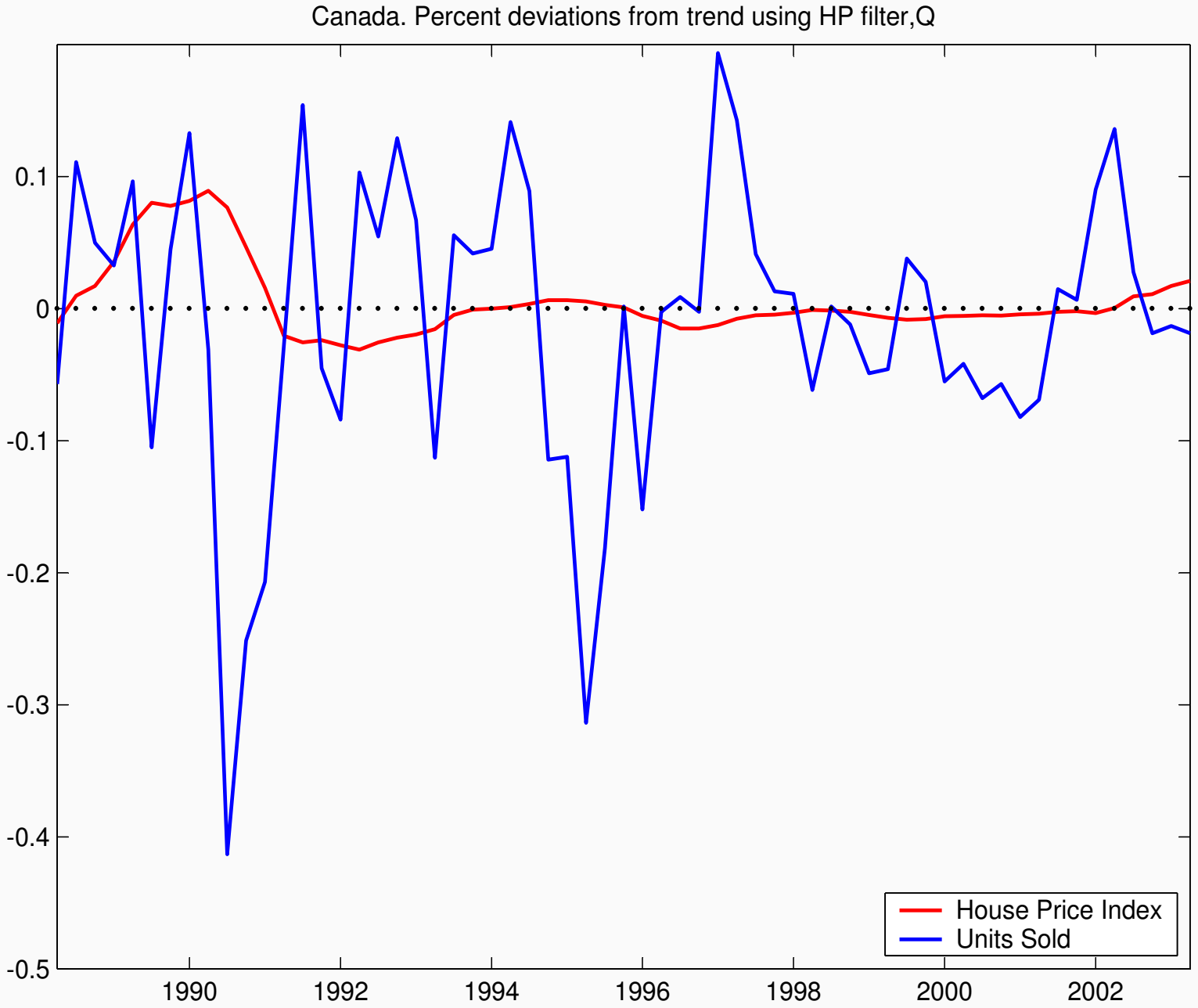
- Two properties of houses

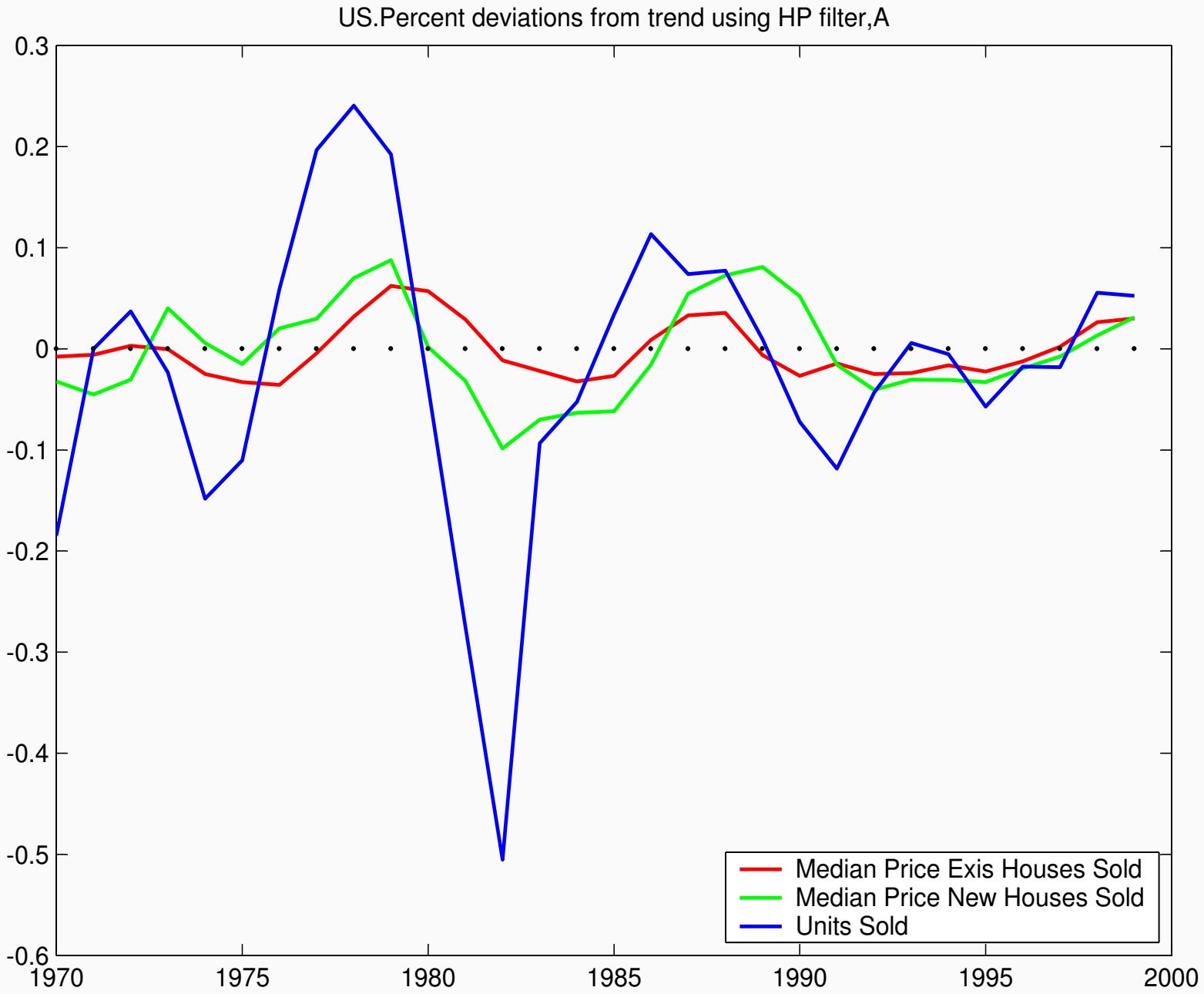
1. Houses prices are more volatile than GDP (Canada, U.S.). They are positively correlated (.56 for existing houses and .78 for new ones).

2. Units sold comove with house prices but with larger volatility (Canada, U.S.). The correlation is .78.


Canada. Percent deviations from trend using HP filter,Q
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
House Price Index
GDP


US.Percent deviations from trend using HP filter, A
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
1970
1975
1980
1985
1990
1995
2000
Median Price Existing Houses Sold
Median Price New Houses Sold
GDP


Canada. Percent deviations from trend using HP filter,Q
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
1990
1992
1994
1996
1998
2000
2002
House Price Index
Units Sold


US.Percent deviations from trend using HP filter,A
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
1970
1975
1980
1985
1990
1995
2000
Median Price Exis Houses Sold
Median Price New Houses Sold
Units Sold

Our Target

1. To have a model economy with suitable chosen frictions that resembles the data in certain dimensions: homeownership distribution, wealth distribution and some macroeconomic aggregates, including feautres of the mortgage issuing sector.

2. To ask whether the model delivers some of the features we observe in the housing market in relation to volatility of prices and sales.

Related Literature

Ortalo-Magne and Rady (2005) claim that capital gain associated to owning partial equity on the house and bearing all the price risk accounts for price volatility.

Diaz and Luengo (2005), Gruber and Martin (2003) investigate the effect of illiquid durables goods on precautionary savings and wealth distribution.

Nakajima (2004) asks whether the stock market and housing prices rise due to increase volatility in individual earnings.

Davis and Heathcote (2004) look at business cycle properties of housing construction. They care about quantities not prices.

Chambers, Garriga and Schlagenhauf (2005) relate the increase in homeownership to reduction in the down payment.

What are Houses?

Big items that people like.

- They are costly to buy and sell.
- There is more than one size (costly to change size).
- There is a large advantage to own the house you live in.
- Households can borrow some to buy the house.

Our model

Pose a model of the Bewley-Imrohoroglu-Huggett-Aiyagari variety with the above notion of houses and with aggregate fluctuations and study housing prices.

- Exponential population, so that there is a rationale for some buying and selling of houses.
- Uninsurable shocks to earnings.
- Borrowing constraints but houses serve as collateral, although borrowing commands a premium.
- Adjustments costs when buying or selling a house.
- Two types of property that we call dwellings : flats and houses.

Model economy 1: A stationary version

- Exponential population with turnover rate π.
- Shocks to earnings ϵ drawn from $F(\epsilon, e)$ with $e \sim \Gamma_{ee'}$.
- Assets: a tree and dwellings $d = \{0, f, h\}$. Own at most 1.

1. A Lucas tree in fixed supply of 1, with dividends r and price p_ℓ.
2. A flat, if held affects utility. $\exists \mu_f$ flats, with p_f.
3. A house. Like a flat but better $0 < \mu_f + \mu_h < 1$, with p_h.

- There are borrowing constrains and need of collateral (can borrow a fraction $1 - \alpha$ of dwellings value).
- Dwellings are traded with costs (on the buyer):

$$\phi(d, d') = p'_d(1 + \delta) \qquad \text{if } d = 0,$$

$$\phi(d, d') = p'_d(1 + \delta) - p_d \qquad \text{if } d \neq d'.$$

Maximization problem: $W_{e,d}(a) = \max_{d'} \left\{ W^{d'}_{e,d}(a) \right\}$

$$W^{d}_{e,d}(a) = \max_{y} \; u_d(c) + \pi\beta E \left\{ V_{e',d}(y) | e \right\} \qquad \text{if not trading dwelling}$$

$$c + p_\ell \, y = a, \qquad V_{e,d}(y) = \int_{\varepsilon} W_{e,d}(y + \varepsilon) \, F(d\varepsilon, e)$$

$$W^{d'}_{e,d}(a) = \max_{y} \; u_{d'}(c) + \pi\beta E \left\{ V_{e',d'}(y) | e \right\} \qquad \text{if trading dwelling}$$

$$c + p_\ell \, y - \phi(d, d') = a, \qquad V_{e,d}(y) = \int_{\varepsilon} W_{e,d}(y + \varepsilon) \, F(d\varepsilon, e)$$

- Note that while $W_{e,d}(a)$ is a non concave function of cash in hand, $V_{e,d}(y)$ may be a concave function of savings.

Steady State Equilibrium

It is a stationary distribution of agents x over dwellings, assets, and earnings shocks, and a set of prices $\{q, p\}$ such that agents maximize, markets clear,

$$\int_{e,d,y} y \; dx = 1 \qquad \int_{e,f,y} dx = \mu_f, \qquad \int_{e,h,y} dx = \mu_h.$$

and the distribution is stationary which is the typical condition that updating the distribution just repeats itself.

Mapping model to data: Stationary version: parameters

Some parameters can be set independently

Population turnover, 1.5%, (adult life expectancy of 67). Risk aversion set to 2.

Some features of the financial system: a 1.% mortgage premium, a 1.% minimum down payment and a 10.% cost of buying a dwelling.

Others have to be estimated

Preferences (3): $u_d(c) = \frac{c^{1-\sigma}}{1-\sigma}\,\gamma^d,$

Earnings Shocks (11): $F(\epsilon, e) = \left[\frac{\epsilon - \underline{\epsilon}}{\overline{\epsilon} - \underline{\epsilon}}\right]^{\chi}, \qquad \Gamma_{e,e'}, \quad e \in \{e^1, e^2, e^3\}.$

Asset parameters (3): Dividend d, number of dwellings μ^f, μ^h.

Mapping model to data: Stationary version: Targets

- Macroeconomic targets.
  1. Labor share out of income (not gdp) of 0.84.
  2. Risk free interest rate of 5%.
- Wealth and housing holdings
  3. Financial asset wealth relative to income: 2.18.
  4. Owner occupied housing wealth times relative to income: 2.61.
  5. Fraction of households that own a house: 0.35.
  6. Fraction of people with flat: 0.30
  7. House prices relative to flat prices $\frac{p_h}{p_f}$: 2.0.
- Financial targets associated to the purchases of houses.
  8. Down payment the first time a household buys a dwelling: 16.3%.
  9. Down payment of repeated buyers 26.5%.
  10. Ratio of mortgage debt to income of 34%.
  11. % of people with debt (those with negative financial assets) 44.4
  12. Average ratio of financial debt to housing value is 49.2%.

Mapping model to data: Stationary version: More Targets

- Cross sectional earnings and wealth distribution.

13. Average earnings of those aged 31-60 relative to those of the group aged 20-30: 1.4.
14. General Properties of the Lorenz Curve of earnings.
15. General Properties of the Lorenz Curve of assets.

Main Statistics in Model Economies and Data

	Economy	
	Model	Target
1. Labor Share	84%	84%
2. Interest Rate	7.3%	5%
3. Financial asset wealth relative to income	2.18	2.18
4. Owner occupied housing wealth relative to income	2.61	2.61
5. Households that own a house	35%	35%
6. Households what own a flat	30%	30%
7. House prices relative to flat prices $\frac{p_h}{p_f}$	2.0	2.0.
8. Downpayment first-time buyers	18.4%	16.3%
9. Downpayment repeat buyers	27.9%	26.5%
10. Ratio of mortgage debt to income	26.7%	34.0%
11. Fraction of People with Debt	44.6%	44.4%
12. Ratio Debt to Housing Value	67.9%	49.2%
13. Earnings of ages 31-60 relative to ages 20-30	1.8	1.4
Other Statistics		
Households that buy a flat each year	2.35%	
Households that buy a house	0.14%	
Households that buy a dwelling	2.49%	5.0%

Cross-Sectional Distributions

Wealth Distribution in Model and Data (1998 SCF)

		Quintiles					
		1st	**2nd**	**3rd**	**4th**	**5th**	**Gini**
Total	Model	0.24	1.30	2.27	9.92	86.27	0.819
Assets	U.S.	-0.29	1.35	5.14	12.38	81.42	0.796
Financial	Model	-22.34	-17.43	-1.39	2.33	138.83	1.568
Assets	U.S.	-7.27	-0.25	1.14	6.92	99.45	0.953
Housing	Model	0.00	5.69	20.92	31.56	41.84	0.457
Wealth	U.S.	0.00	1.40	12.31	22.08	64.21	0.656

Earnings Distribution in Model and Data (1998 SCF)

	Quintiles					
	1st	**2nd**	**3rd**	**4th**	**5th**	**Gini**
Model	3.5	5.0	7.8	11.1	72.7	0.654
U.S.	-.2	4.0	13.0	22.9	60.2	0.611

Model economy 2: Stochastic version

- Let the aggregate exogenous state of the economy be z with transition $\Gamma_{z,z'}$. We consider aggregate shocks to

1. Dividends, $d(z)$.
2. Earnings, $[\underline{\epsilon}^j(z), \overline{\epsilon}^j(z)]$.
3. Mortgage premium $m(z)$.
4. All of the above together.

- The problem is that now the state vector is $\{z, x\}$.
- We also have to calculate the pricing functions

$$\{p^\ell(x,z), p^f(x,z), p^h(x,z)\}.$$

- A daunting task, so we use a relative of Krusell and Smith (1997).

Solving the Stochastic version

- The key question is what moments of the distribution to use to both COMPUTE and FORECAST prices.

- The simplest is to use the asset price themselves.

- We need to pose a forecasting pricing function. Let $p' = \Psi_{z,z'}(p)$ be such a forecasting function. Moreover, let Ψ be an afine function. There are various possibilities depending on whether we index those parameters by z or by z and z'. We finally set on indexing the constant but not the slope by z and z'.

The Stochastic Problem

$$W_{z,e,d}(a,p) \quad = \quad \max_{d'} \quad \left\{ W^{d'}_{z,e,d}(a,p) \right\}$$

$$W^{d}_{z,e,d}(a,p) = \max_{y} \; u_d(a - p_\ell y) + \pi\beta E\left\{V_{z,e',d}(y,p)|e\right\} \qquad d = d'$$

$$V_{z,e,d}(y,p) = \sum_{z'} \Gamma_{z,z'} \int_{\varepsilon} W_{z,e,d}[(\Psi^{\ell}_{z,z'}(p) + d(z'))\, y + \varepsilon, \Psi_{z,z'}(p)]\; F(d\varepsilon, e)$$

$$W^{d'}_{z,e,d}(a,p) = \max_{y} \; u_{d'}[a - p_\ell y - \phi] + \pi\beta E\{V_{z,e',d'}(y,p)|e\} \quad d \neq d'$$

$$V_{z,e,d}(y,p) = \sum_{z'} \Gamma_{z,z'} \int_{\varepsilon} W_{z,e,d}[(\Psi^{\ell}_{z,z'}(p) + r')y + \varepsilon, \Psi_{z,z'}(p)]\; F(d\varepsilon, e)$$

Equilibrium with Limited Rationality

• A set of decision rules that depend on the aggregate exogenous state, on prices and on individual states. A true pricing function $p = \zeta(z, x)$, and a forecasting function Ψ such that

- Decision rules solve the hhold problem given forecasting function Ψ.
- Pricing function ζ clears the market.
- Forecasting function Ψ is a good one, i.e. is the best linear predictor of prices given the aggregate shock and current prices and, moreover, lagged prices and aggregate statistics of the distribution (correlation of financial and housing wealth for instance) do not really help to forecast prices.

• Note that function ζ does not really have to be computed. Along the simulations we solve each period for the market clearing prices.

Forecasting Function, We use

$$p^{j\prime} = \Psi_{z,z'}(p) = \alpha_0^j + \alpha_1^j 1_{\{z=1,z'=2\}} + \alpha_2^j 1_{\{z=1,z'=2\}} + \alpha_3^j 1_{\{z=1,z'=2\}} + \alpha_4^j p^j$$

OLS Estimates for Price Forecasting Functions

	α_0	α_1	α_2	α_3	α_4	R^2
Dependent variable						
p^ℓ	5.230	1.398	-0.439	0.955	0.312	**0.989**
p^h	9.447	4.067	-1.926	2.225	0.499	**0.989**
p^f	2.856	1.758	-1.097	0.639	0.688	**0.990**

R^2 with various sets of regressors

Regressors	p^ℓ	p^h	p^f
Forecast depends only on z and z'	0.987	0.987	0.976
What we use	0.989	0.989	0.990
What we use + All Lagged Prices	0.989	0.990	0.990

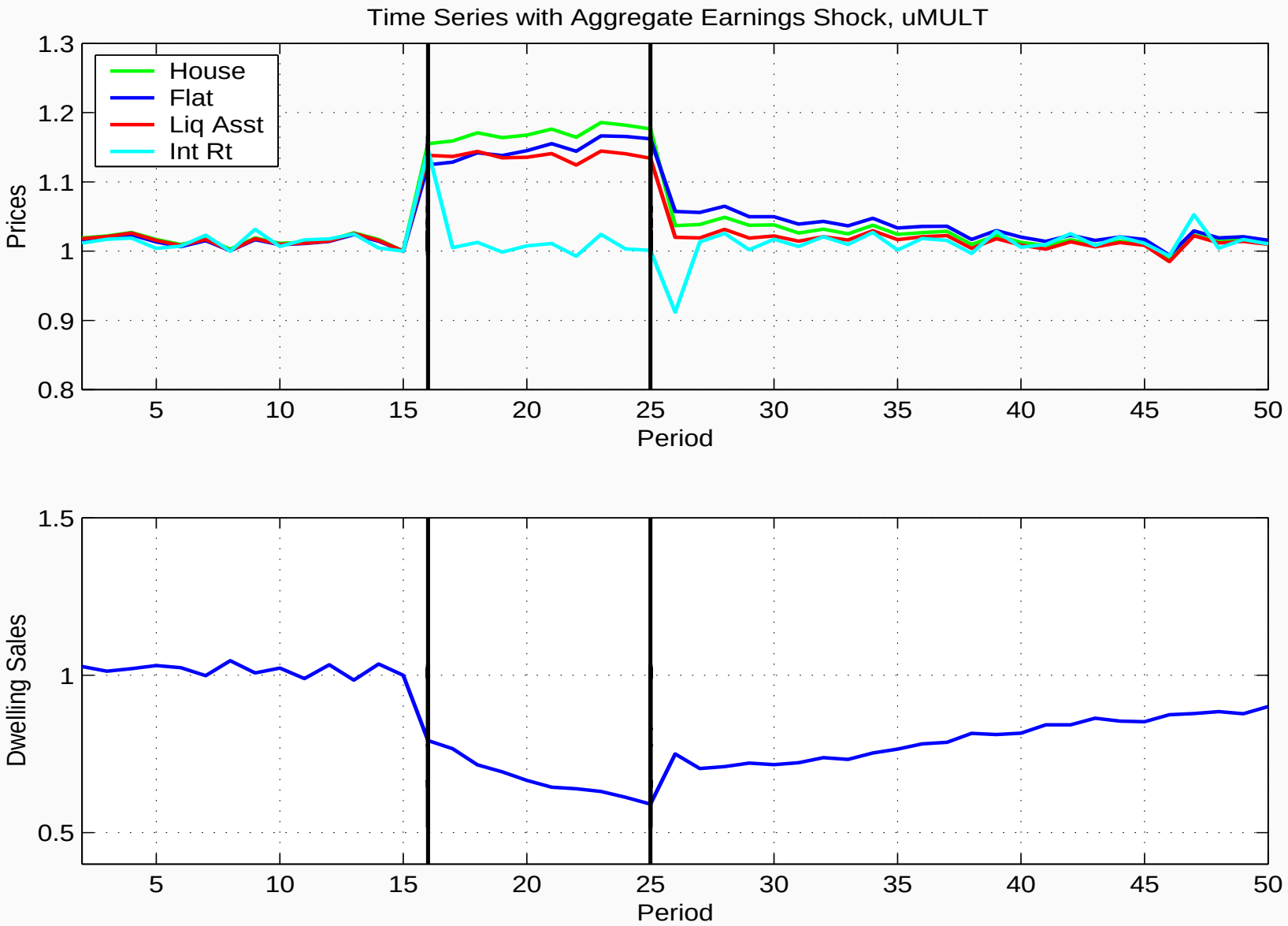
Experiments with Aggregate Shocks

- Experiments

  1. Shock to Labor earnings -5% to 5%.
  2. Shock to dividends -5% to 5%.
  3. Shocks to Mortage Premium 0% to 2%.
  4. All of the above perfectly correlated.

- We populate the economy with 250,000 households and let it run

  - 16 periods with the first state
  - 10 periods with the second state
  - 25 more periods in the first state



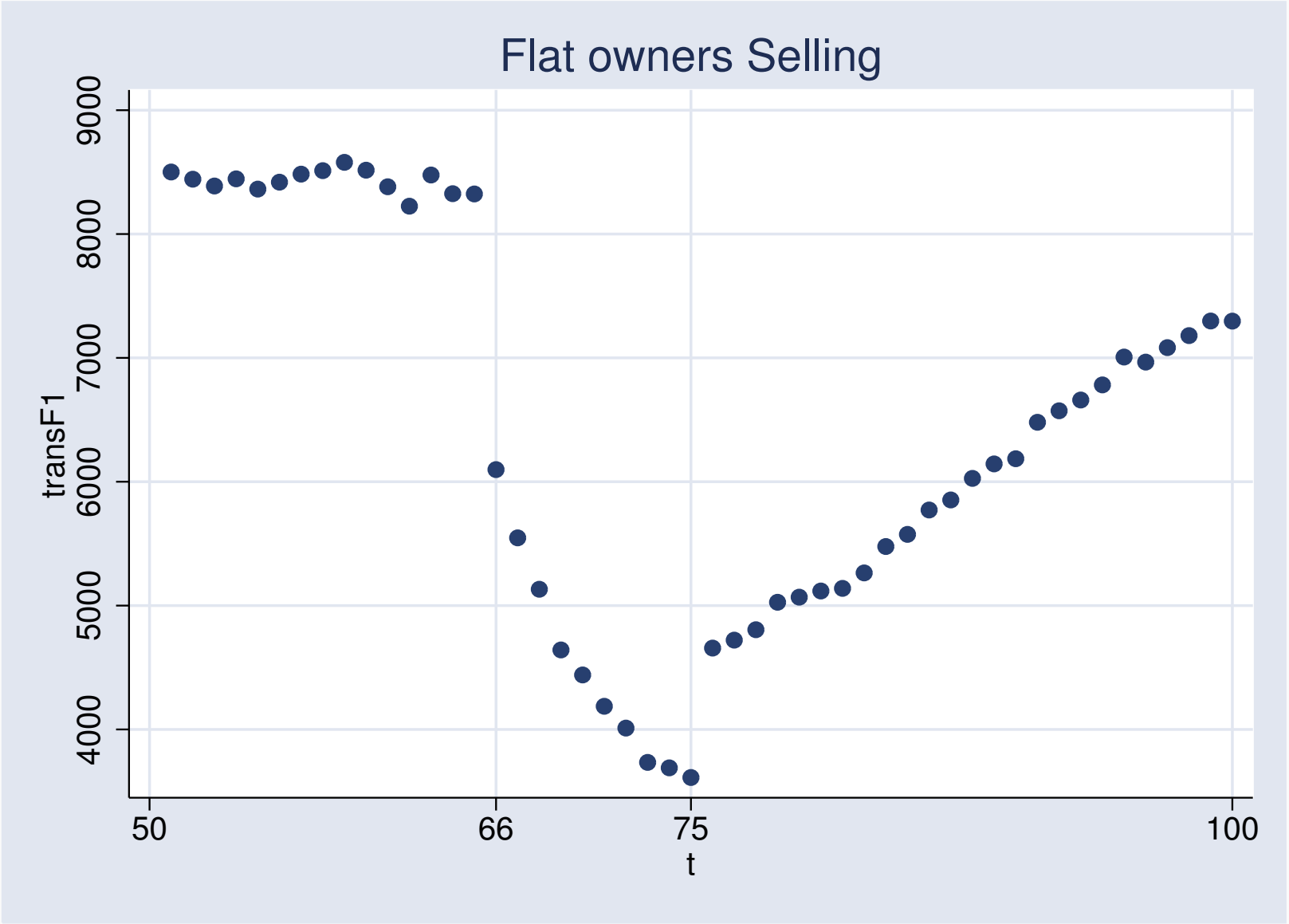
Labor Earnings -5% to 5%

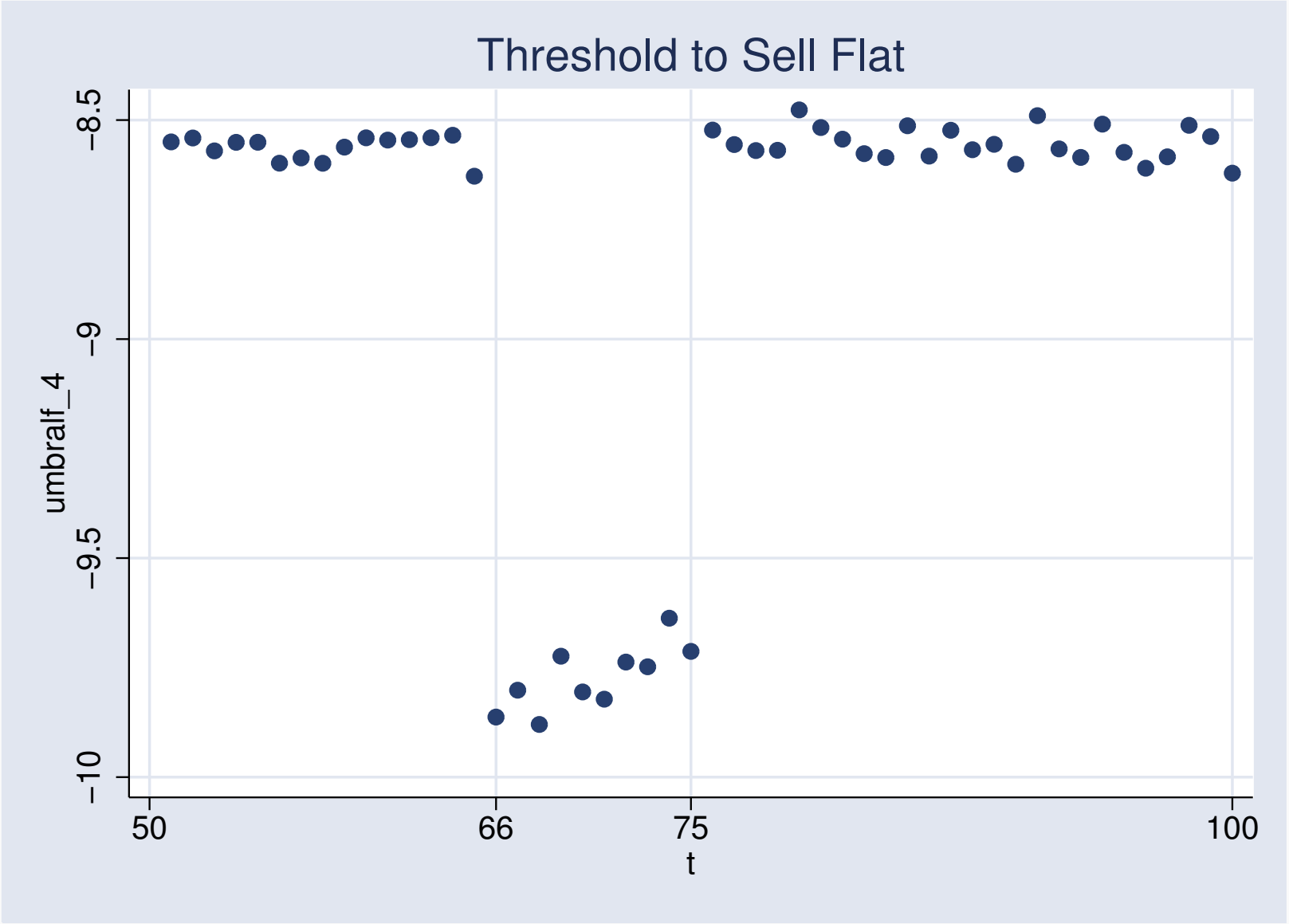
Properties of Earnings Shocks

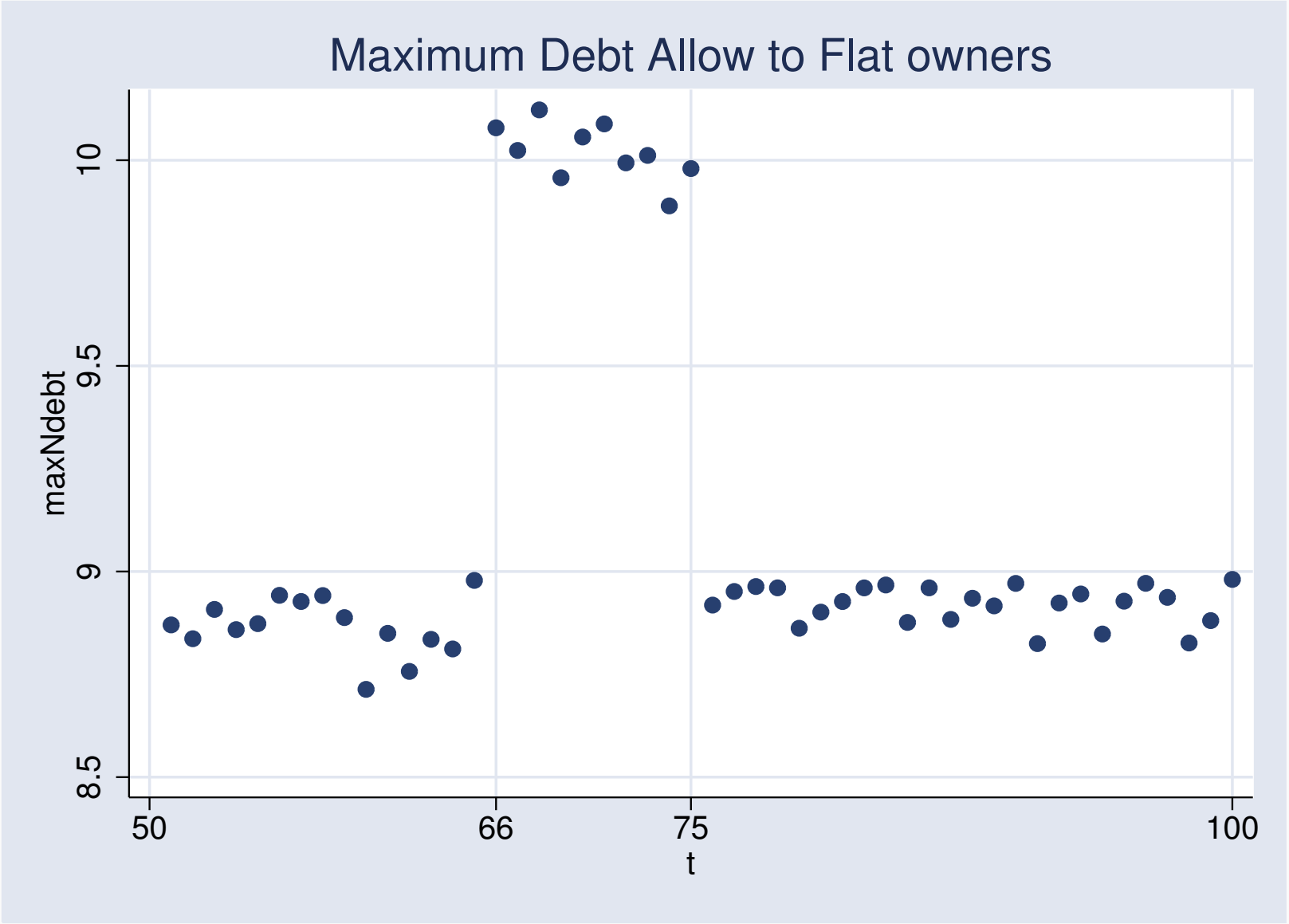
1. Upon the switch, the liquid asset jumps 12.13%, the flat 11.99% and the house 14.73%. A bit more than the increase in earnings.
2. While the rate of return seems unchanged, the expected rate of return goes down.
3. Subsequently, the price of the liquid asset remains stable while those of dwellings, especially those of the flat keep going up.
4. Sales drop dramatically and keep going down while the expansion keeps on going.
5. Recovery of sales is slow.
   LET'S SEE WHY

1 SHOCK A LOS EARNINGS

COMPRADORES




Threshold to Sell Flat
umbralf_4
−8.5
−9
−9.5
−10
50
66
75
100
t


Maximum Debt Allow to Flat owners
maxNdebt
8.5
9
9.5
10
50
66
75
100
t

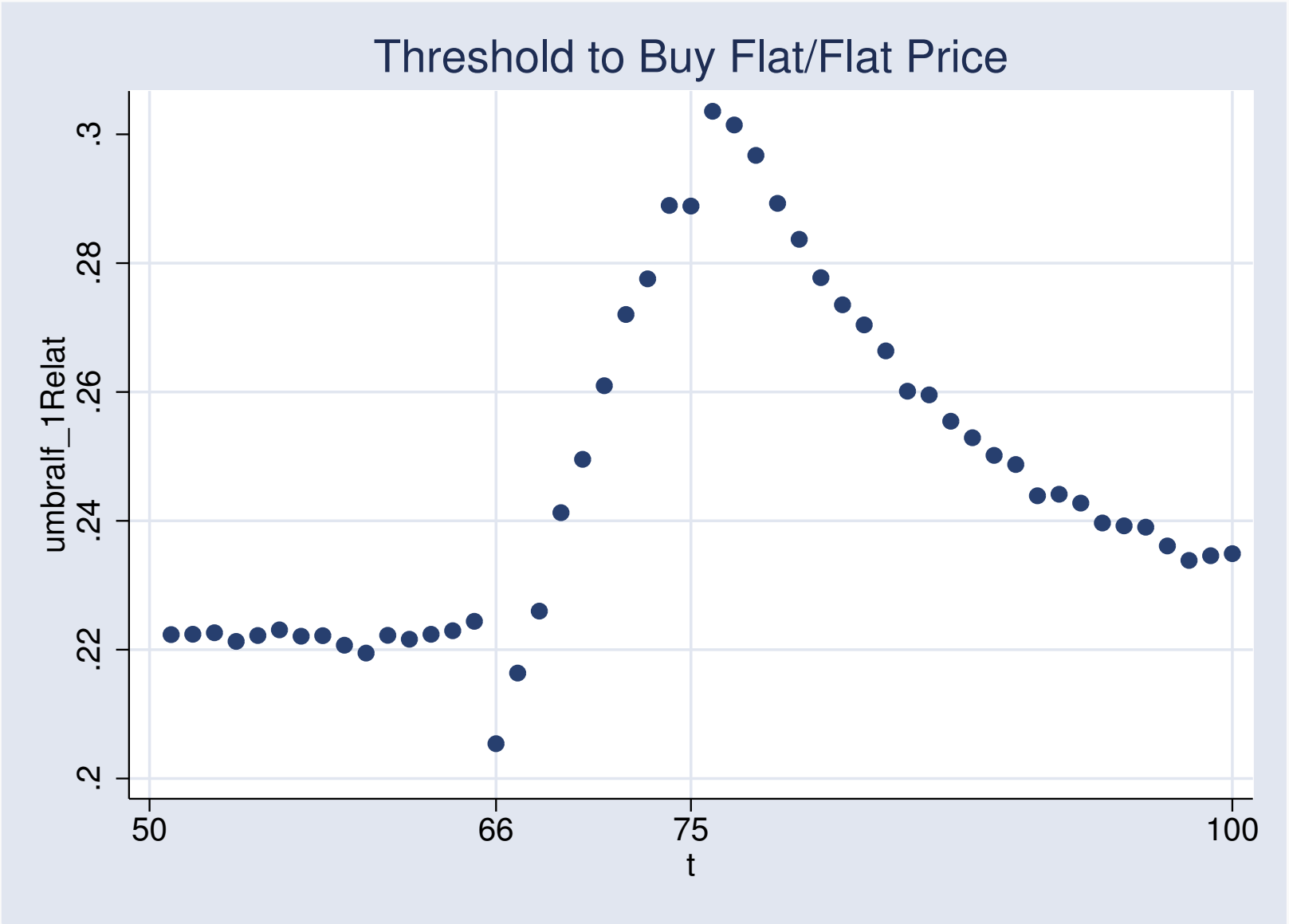
The sellers are less willing to sell upon impact

- The outlook is better, the interest rate is lower.

- But as time passes they are more willing to sell because the price is going up relative to the liquid asset.

- Yet what matters is how many of them are there.

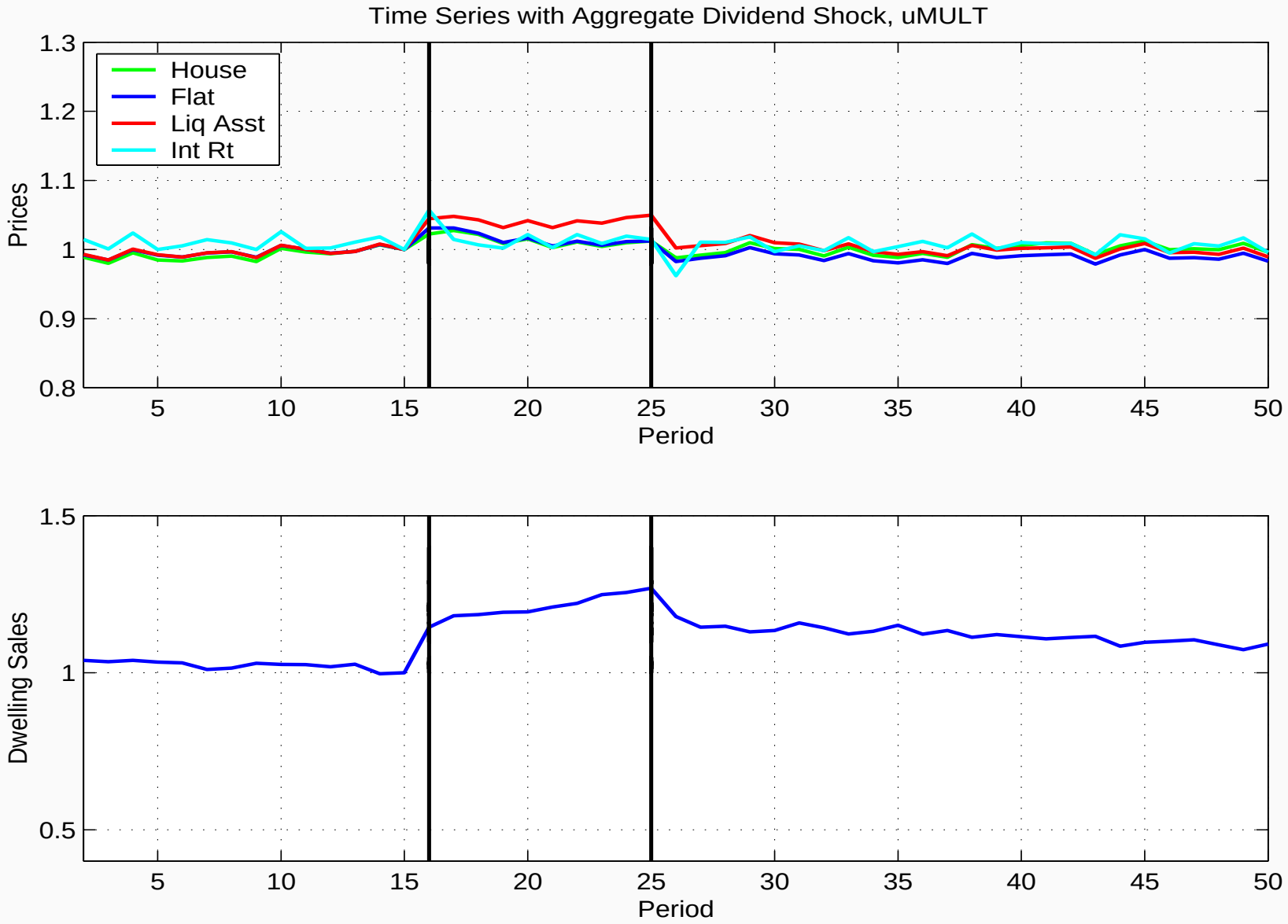

Threshold to Buy Flat
umbralf_1
2
2.5
3
50
66
75
100
t


Threshold to Buy Flat/Flat Price
umbralf_1Relat
.2
.22
.24
.26
.28
.3
50
66
75
100
t

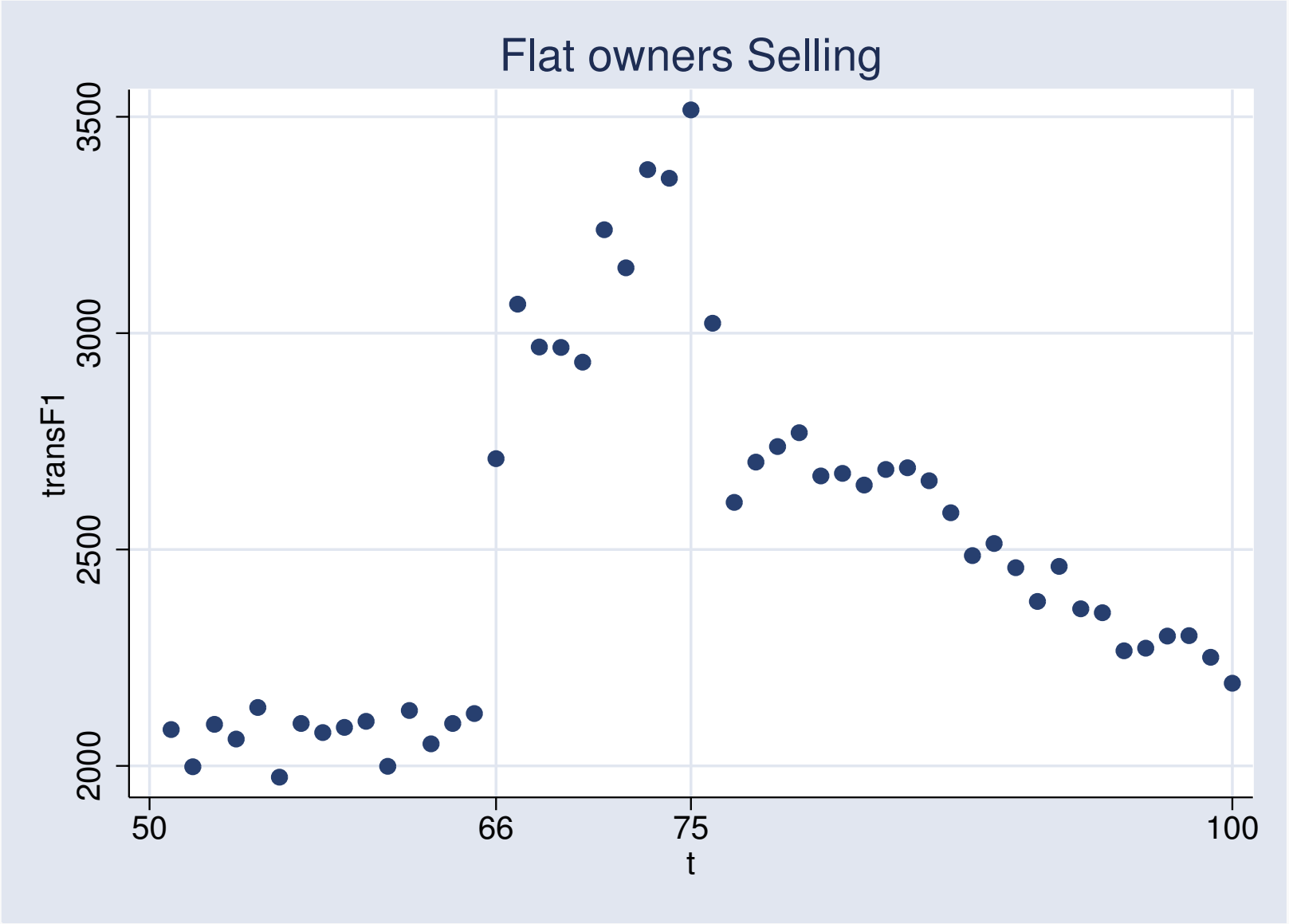
The buyers

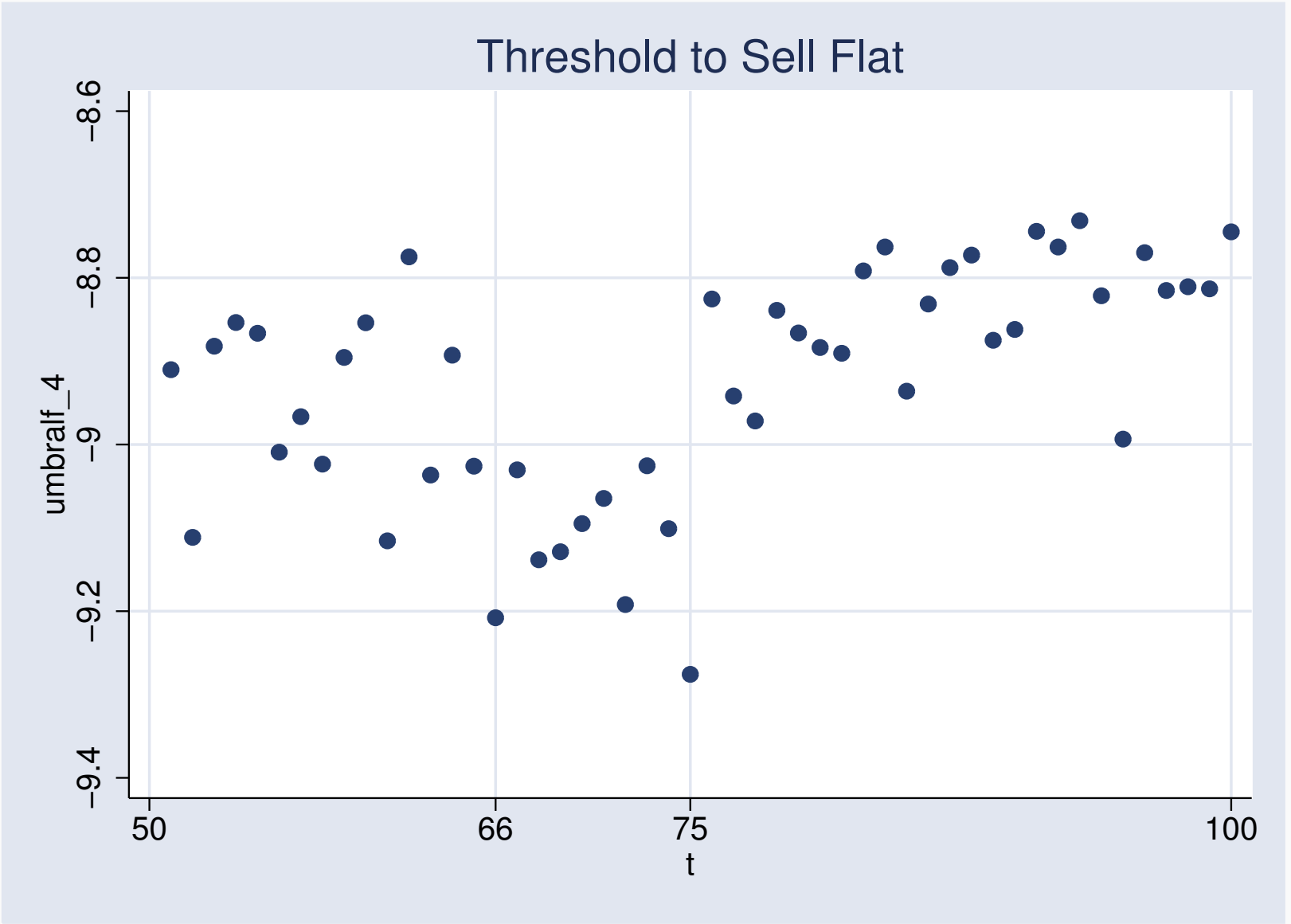
- At the beginning the same cash in hand is needed to buy even if they pay more.
- The outlook is better, the interest rate is lower.
- But as time passes the willingness to buy is reduced. Because the price is going up.

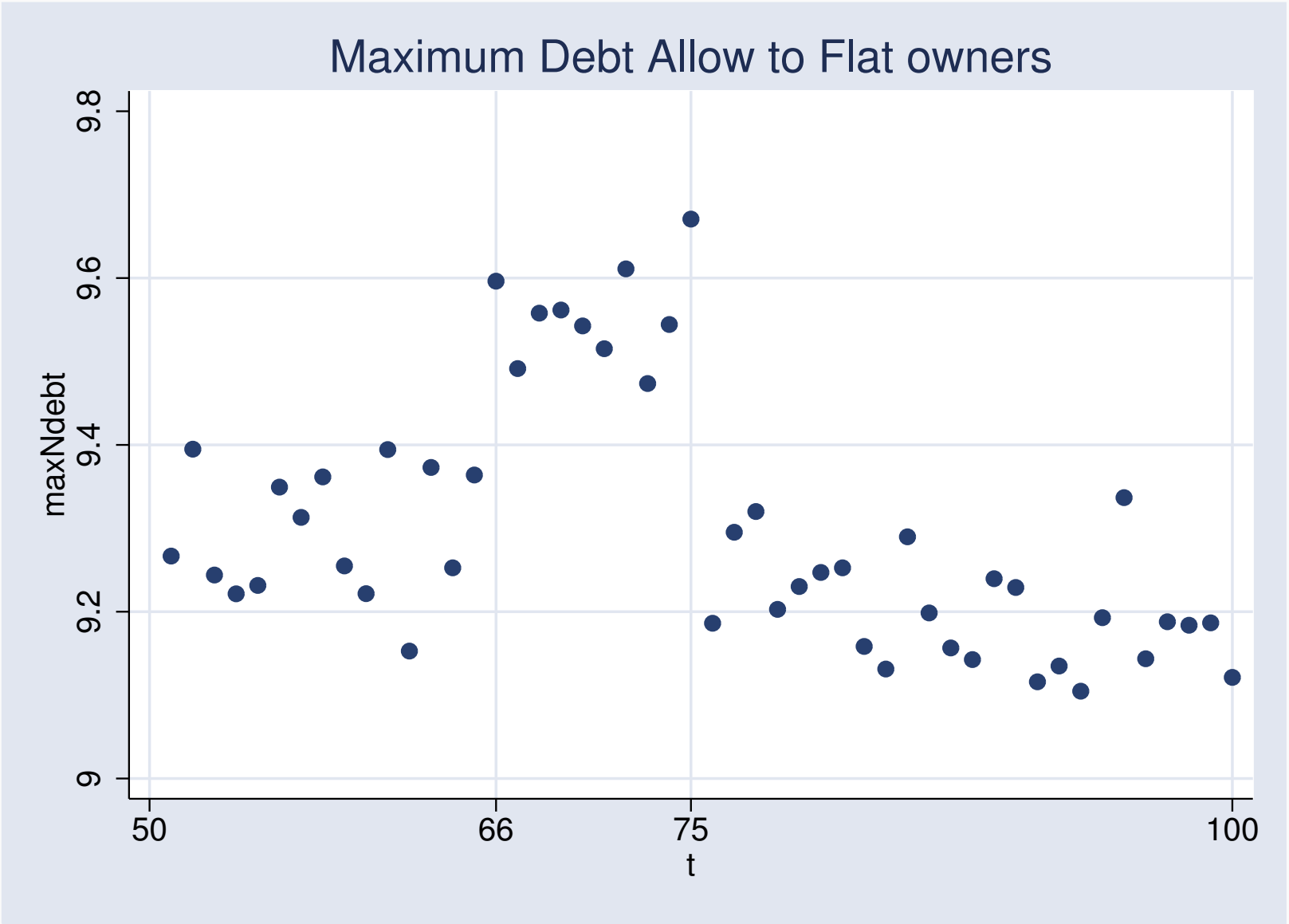
- The reason why the price is going has to be there are less and less willing sellers.

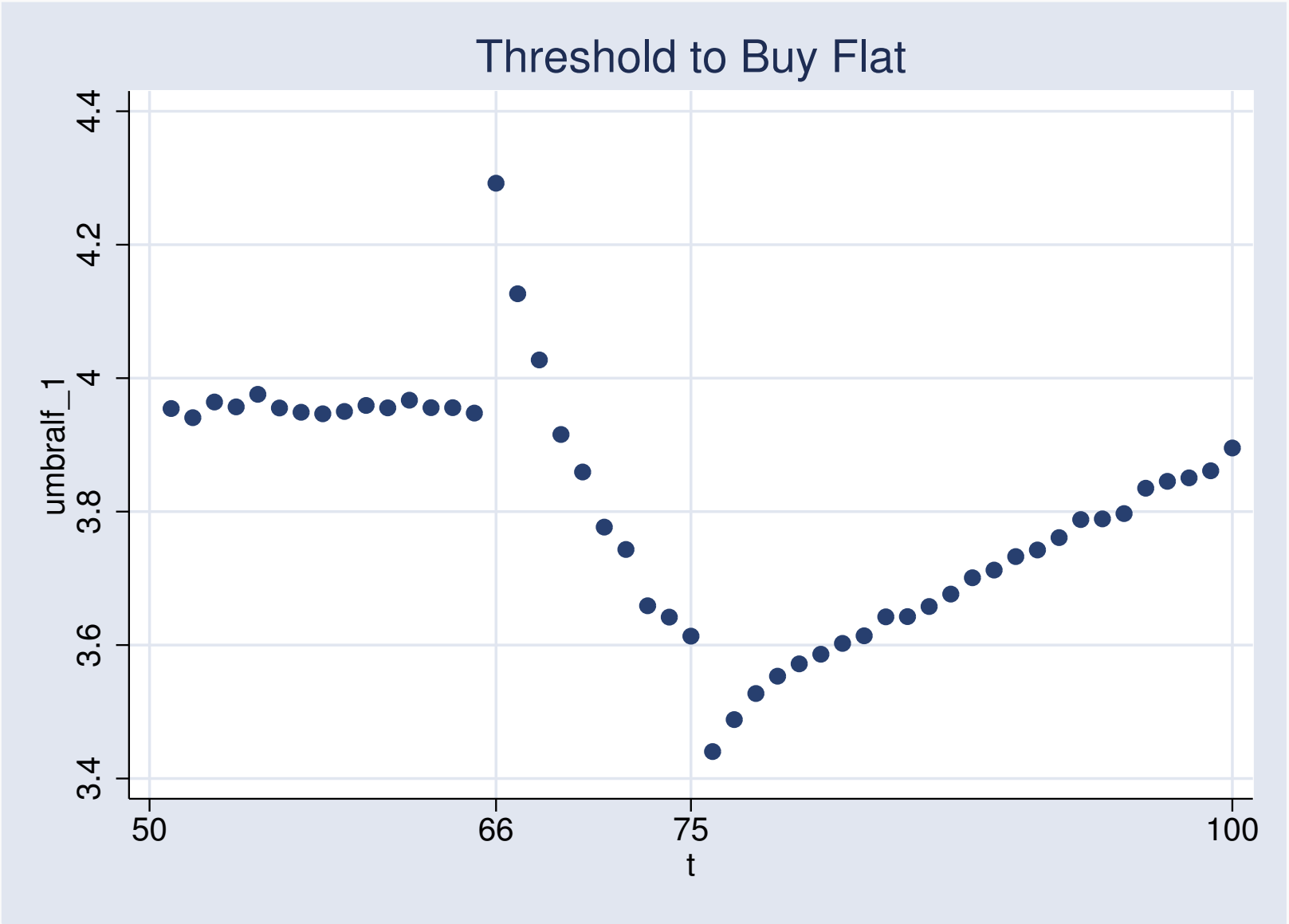


$+-$ 5% of Dividends, (increase in interest rate) 0.7% of GDP


Flat owners Selling
transF1
2000
2500
3000
3500
50
66
75
100
t


Threshold to Sell Flat
umbralf_4
−8.6
−8.8
−9
−9.2
−9.4
50
66
75
100
t

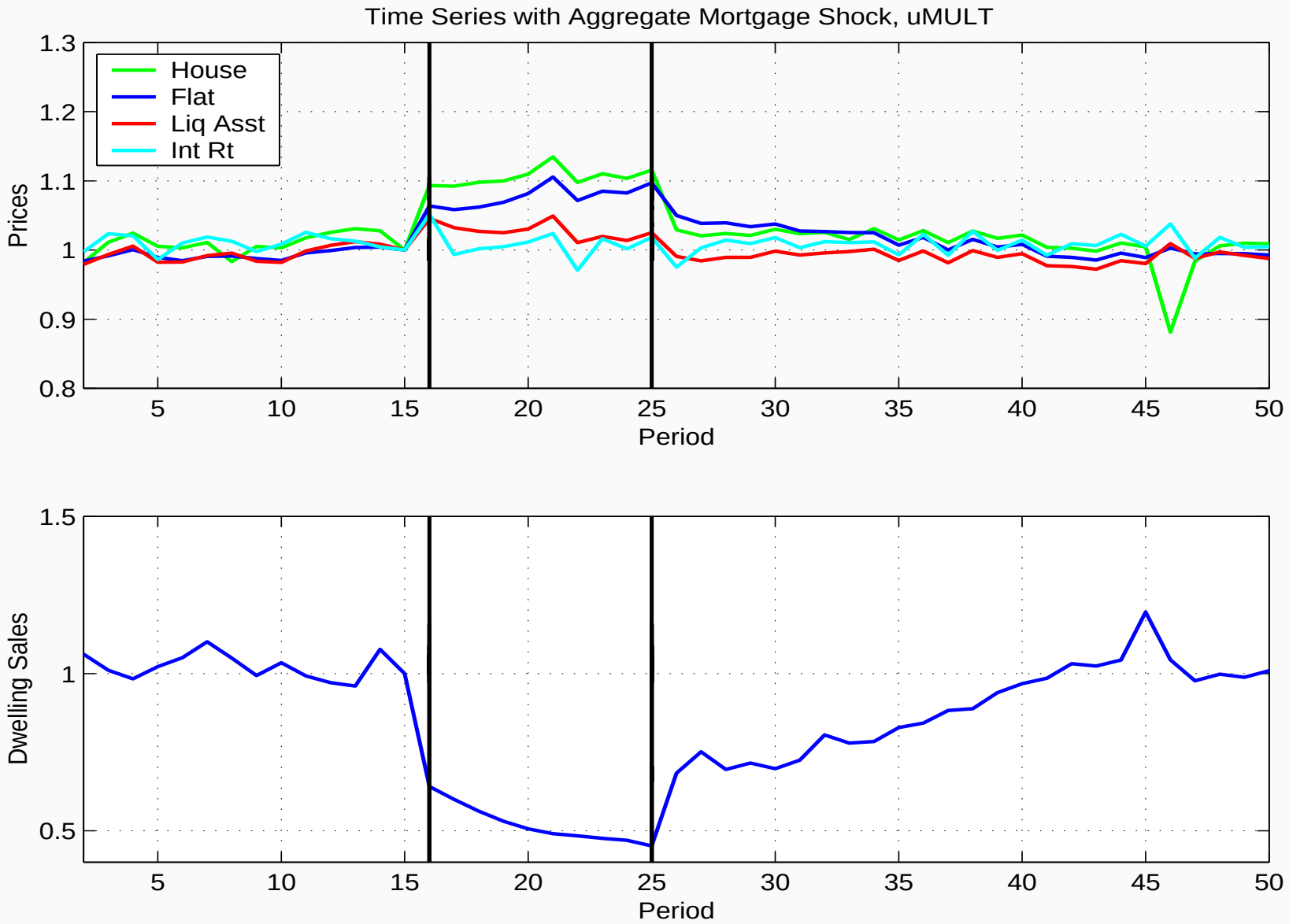

Maximum Debt Allow to Flat owners
maxNdebt
9
9.2
9.4
9.6
9.8
50
66
75
100
t


Threshold to Buy Flat
umbralf_1
4.4
4.2
4
3.8
3.6
3.4
50
66
75
100
t

Shocks to Dividends

- (Expected) Interest rates go down so there is some dissaving by homeowners which increases turnover.

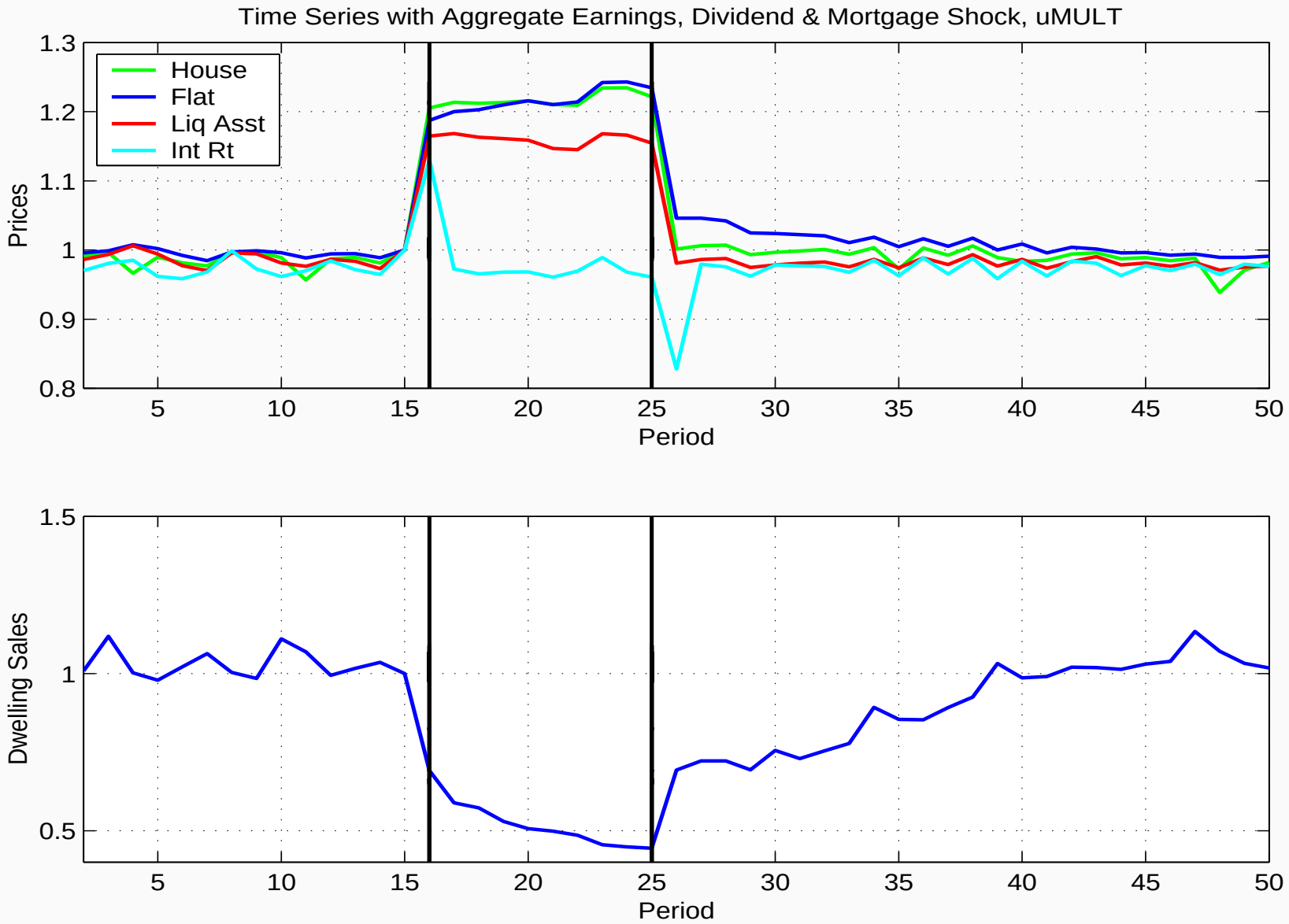
- Change in the relative price of housing services (they are more expensive).



Mortgage premium 0-2%

Shocks to Mortgage mark-up

- Reduction in the user cost of dwellings for poorer people. Prices go up.
- Again capital gain for homeowners and less turnover.



Earnings, Dividend and Mortgage Shock

Shocks to Everything

- Large reduction in interest rates and increases in housing prices beyond liquid assets.
- Again capital gain for homeowners and less turnover.

Conclusion (Tentative)

1. Shocks to fundamentals can move housing prices up to 2.5 times more than the fundamentals.
2. Initial jump in all asset prices and subsequent further increase only in housing prices.
3. But turnover is all counterfactual.
4. Lot's of open questions.