Movements on the Price of Houses

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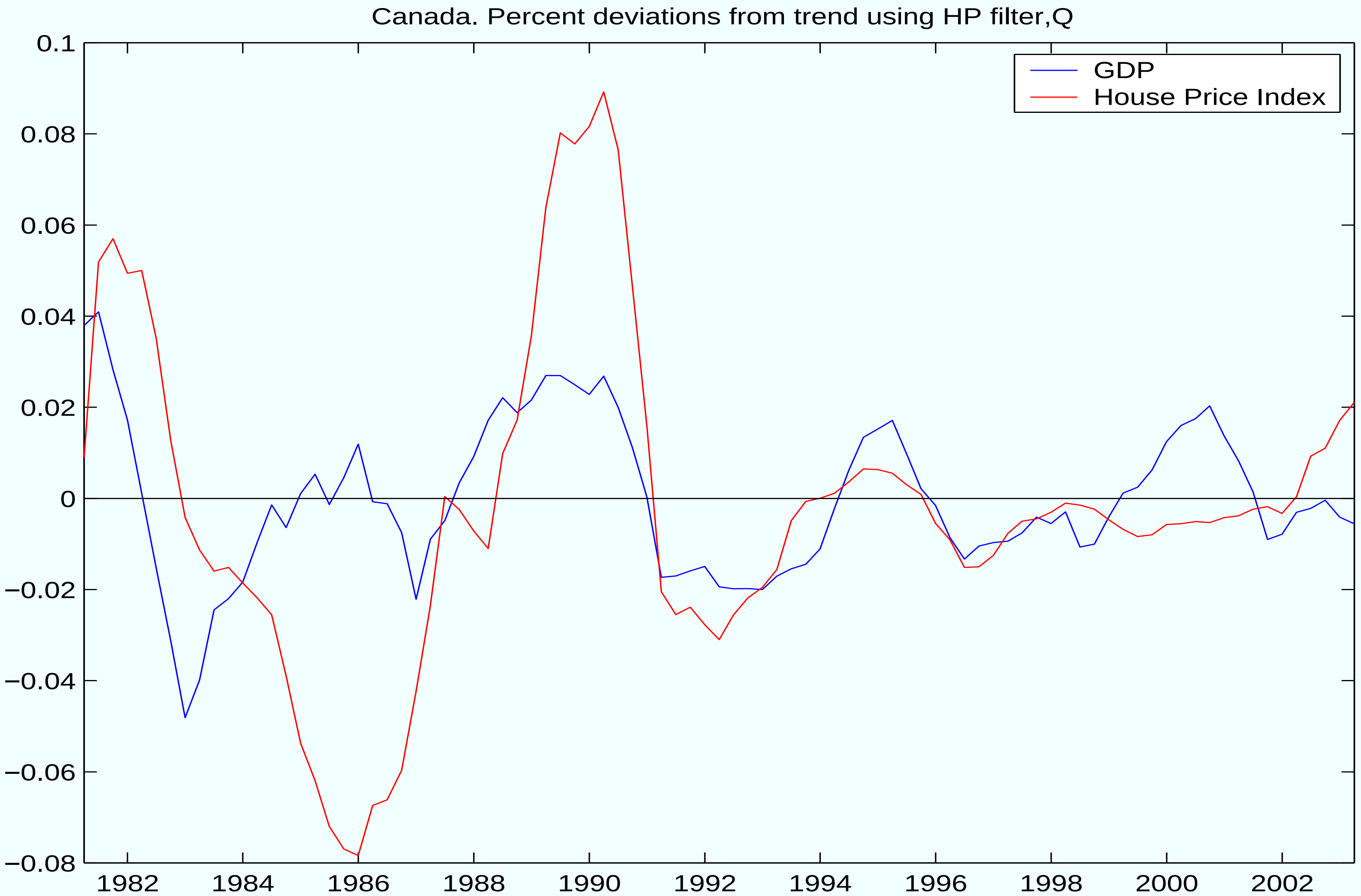
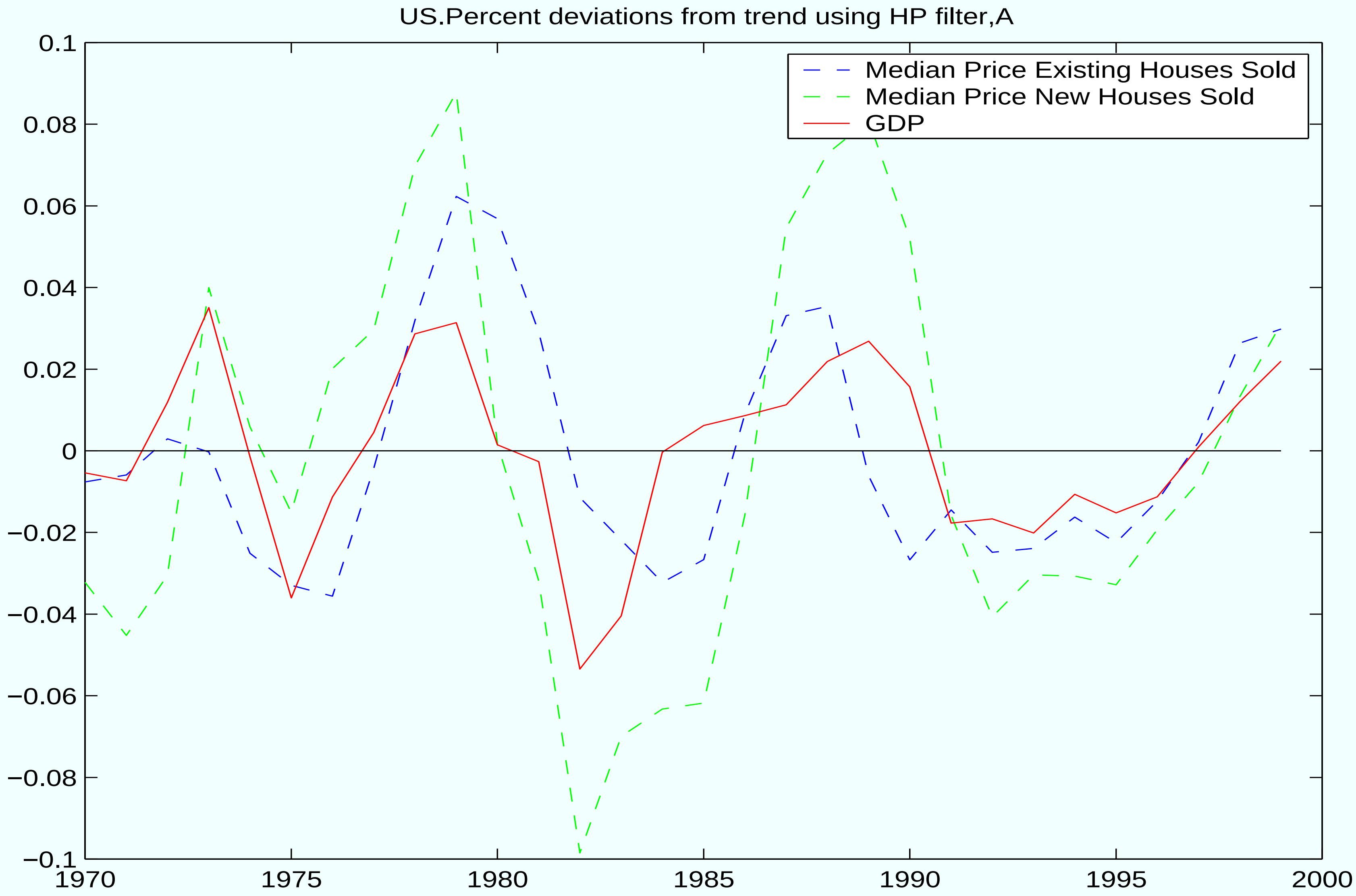
So Preliminary, There is Really Nothing

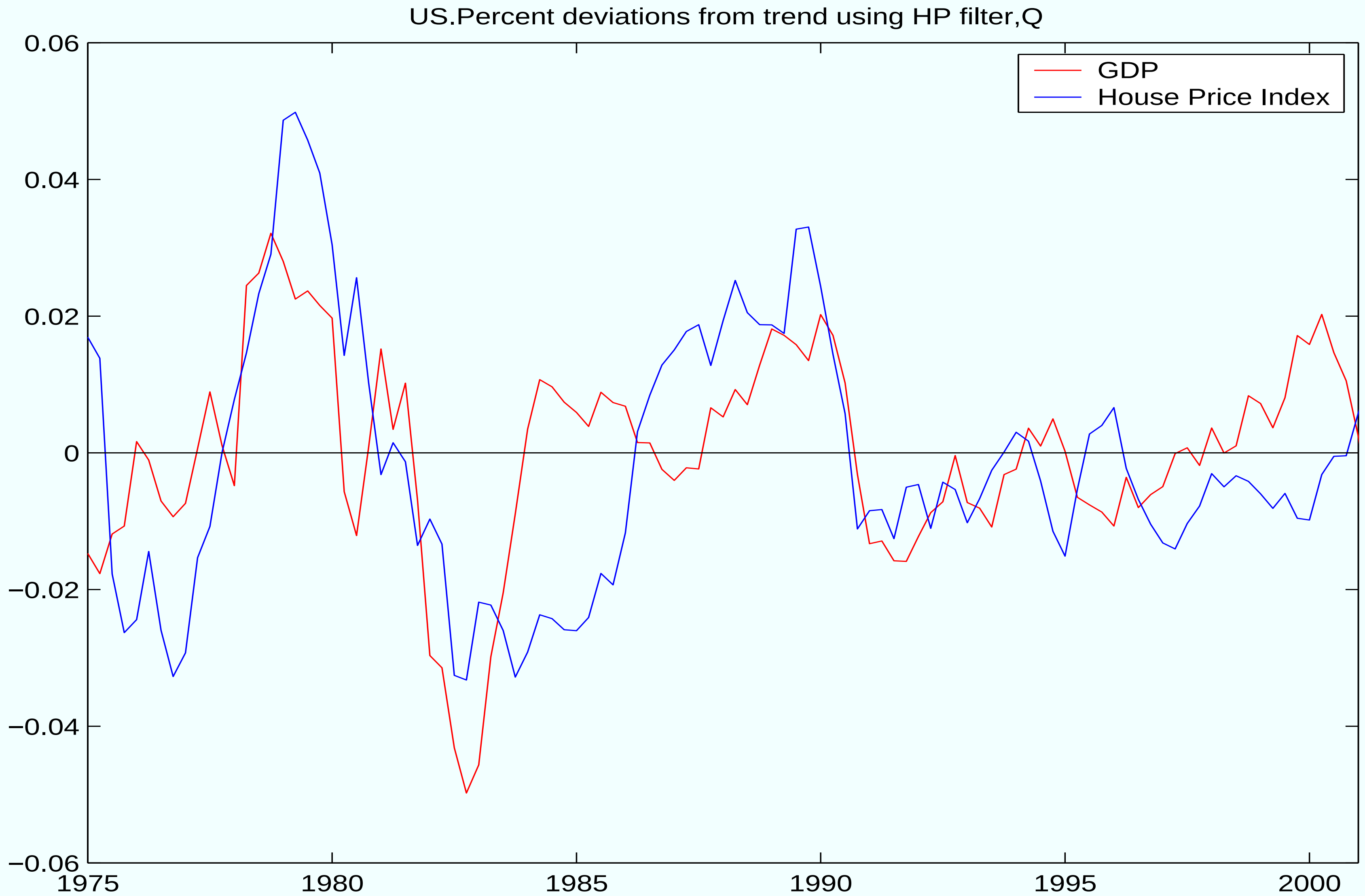
Introduction

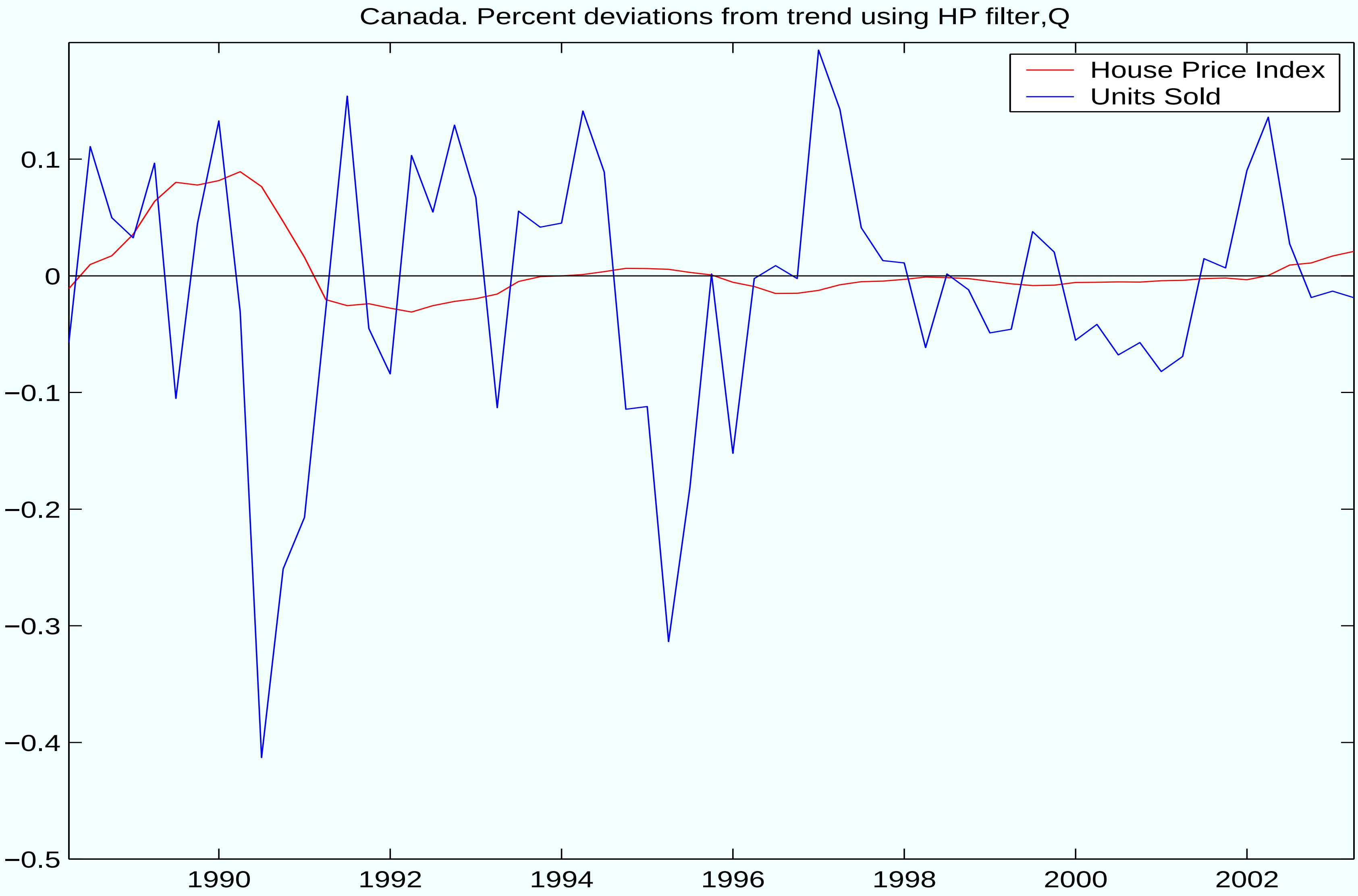
- **Two intriguing properties of houses.**

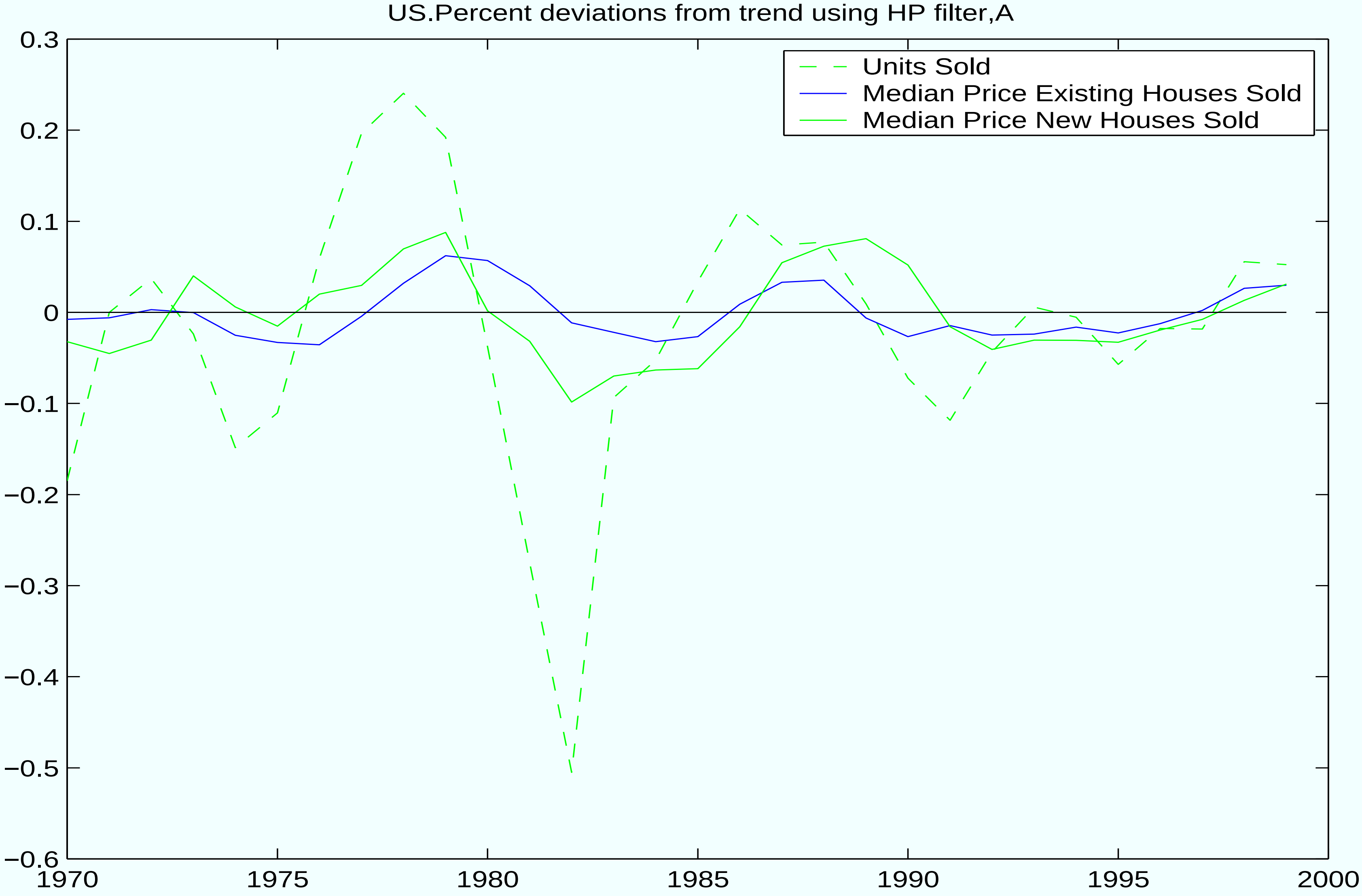
1. **Houses prices are much more volatile than GDP.**
2. **Fluctuations of units sold are huge compare with those of house prices.**


Canada. Percent deviations from trend using HP filter,Q
GDP
House Price Index
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


US.Percent deviations from trend using HP filter,A
Median Price Existing Houses Sold
Median Price New Houses Sold
GDP
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


US.Percent deviations from trend using HP filter,Q
GDP
House Price Index
0.06
0.04
0.02
0
−0.02
−0.04
−0.06
1975
1980
1985
1990
1995
2000


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


US.Percent deviations from trend using HP filter,A
Units Sold
Median Price Existing Houses Sold
Median Price New Houses Sold
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

Our Question

Can a model with suitable chosen frictions deliver some of these features?

What are Houses?

- **Houses are themselves the source of frictions:**

- 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 paper

Pose a model of the Bewley-Imrohoroglu-Huggett-Aiyagari variety with the above notion of houses and with 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.
- There is aggregate uncertainty: earnings, dividends and demographics together or alone.

Literature that is not here Today

Ortalo-Magne and Rady (2003). We basically ask whether their hunch (that it is the capital gain component associated to owning partial equity on the house and bearing all the price risk what accounts for price volatility) is quantitatively solid in a model designed to map a modern economy.

Nakajima (2004) Asks whether the stock market and, to a lesser extent, housing prices rise due to increase volatility in individual earnings. He finds that they do, although not dramatically (20%). This is a steady state comparison.

Diaz and Luengo-Prado (2004) are interested in the business cycle properties of housing construction. They worry about housing quantities not prices.

Diaz and Puch (1998) document how the properties of model economies relate to the down payment requirements.

Chambers, Garriga, and Schalagenhauf (2004) also connect the increase in housing ownership to reductions in the down payment.

Model economy 1: A stationary version

- Exponential population with turnover rate π.

- Agents subject to earnings shocks ϵ drawn from $F(\epsilon, e)$ with $e \sim \Gamma_{ee'}$.

- There are three assets: a tree and two types of dwellings. Agents can held at most one dwelling $d = \{0, f, h\}$.

  1. A Lucas tree in fixed supply of 1, perfectly divisible with w dividends z. Alternatively, there is a storage technology with return z. The latter does not have capital gains from dividend changes but it is harder to solve. If a tree, its price is p_ℓ, otherwise is 1.
  2. A flat, i.e. an object that if held affects utility and and that can be purchased with credit and down payments. There are μ_f flats.
  3. A house. Like a flat but yields more utility: $0 \le \mu_f + \mu_h \le 1$. We denote their prices by $\{p_f, p_h\}$, with $p = \{p_\ell, p_f, p_h\}$.

- There are borrowing constrains and dwellings can be used as collateral. Individuals can borrow a fraction $1 - \alpha$ of dwellings value. Dwellings are traded with costs that we pose on the buyer and that we write as $\phi(d, d') = p'_d(1 + \delta)$ if $d = 0$ and $\phi(d, d') = p'_d(1 + \delta) - p_d$ if $d \neq d'$.

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

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

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

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

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

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

Other details to take care of

- **People die with probability $1-\pi$. We build an annuity market so that no assets disappear. This means that in addition to the return z and to the utility from dwelling there is a bonus $\frac{1}{\pi}$ of the value of the assets. No big deal.**

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.

We calibrate this model meaning

– Target population turnover features, 2.5% per year, 40 years of adult life. We will add family size requirements as a characteristic.

- Choose the process for earnings so that the earnings and the financial assets joint distribution match the data. For now i.i.d. although it shouldn't be. We also target a Gini of .45. This does not generate a lot of wealth dispersion.

- Target value of financial versus housing wealth. Financial wealth is 2.8 times Disposable Income. Owner occupied housing wealth is 2.3 times Disposable Income.

– Target share of the population living in each of the type of dwelling. We target 2.5% in each type of dwelling and a price of houses that is twice that of flats.

- Cheap turnover of houses: 3%, borrowing interest rate premium: 3%, down payment of 20%, never binding, risk aversion of 2.

Model economy 2: Stochastic version

- We pose There is aggregate uncertainty on
  - [1.] Dividends, $z \sim \Gamma_{z,z'}$.
  - [2.] Earnings distribution, $e \sim \Gamma_{e'|e,z,z'}$.
  - [3.] Population size which changes by having random increases in the number of entrants. Say π is the survival probability but $\hat{\pi}$, the number of new entrants is random, $\hat{\pi} \sim \Gamma_{\hat{\pi}'|\hat{\pi}}$. The population size is Π.

Of course, the problem is that now the state variables now include $\{x, z, \hat{\pi}, \Pi\}$. In addition we have to calculate the pricing function $p(x, z, \hat{\pi}, \Pi)$. A daunting task. So we pull a relative of the bag of tricks 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 may be the price themselves so lets go for it.

- 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. Therefore it is characterized by 36 parameters $(3 \times 3 \times 4)$.

The Stochastic Problem without $\hat{\pi}$.

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

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

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

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

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

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 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 (log)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.

Absolutely Preliminary and Minuscule Findings: Rate of return

- We report the properties of a storage economy with stochastic rate of return between 4.5% and 5.5% with .7 of persistence.

- Notice that this is a pure interest rate shock. As a result houses become more undesirable when z is higher.

- Also housing prices are lower on average than the steady state.

- Unfortunately in this economy agents wait too long to buy a house and indebtedness is too small. We need more cross-sectional variation to match average mortgage issues.

- The price of flats oscillates between 2.33 and 2.32 while the price of houses between 4.64 and 4.65 (relative to National Income). This is nothing.

Absolutely Preliminary and Minuscule Findings: Earnings

- **Earnings move up and down 10%. A lot. Same persistence.**

- **Prices move between and 2.34 and 2.35 and 4.66 and 4.68. Again Nothing.**

Absolutely Preliminary and Minuscule Findings: Population Size

- **Population size shocks are more promising but we are having convergence problems.**

- **A new cohort is 5% larger 5 periods in a row. We are seeing so far no price change in flats but some price change in houses.**

- **But sales are procyclical and prices lag the shock. Both of which are promising.**

Conclusion

- We have to work a lot harder to generate any action. We plan to do so.
- We do not know exactly what may generate larger changes in prices.

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