House Price Scenarios

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Outline

Motivation

- Are Dutch home prices too high in relation to fundamentals? (interest, inflation, income, construction costs, demographics, etc.)
- Can we expect price declines?
- Home price forecasts depend on
  - possible current overvaluation
  - forecast of fundamentals: different scenarios
- Uninterrupted price increase from 1985 to 2008
  - Yearly price change between 10 and 18% in 1996-2001
  - Peak in 2008
  - Price change 2008-2009: -3.3% ; 2009-2010: -2.0%

Setup

- Goal: produce house price scenarios
  - not only point estimates, but densities
  - correlations with other variables
- Setup:
  - estimate monthly house price index on 1973-5 – 2011-4
    1. Error-correction model: univariate:
       $y_t = f(y_{t-1}, \ldots y_{t-k}, \vec{x}_t, \ldots \vec{x}_{t-l})$
    2. Dynamic Scenario Model: multivariate ($>$ 300 series simultaneously)
       $$\begin{pmatrix} y_t \\ \vec{x}_t \end{pmatrix} = f(\begin{pmatrix} y_{t-1} \\ \vec{x}_{t-1} \end{pmatrix}, \ldots, \begin{pmatrix} y_{t-k} \\ \vec{x}_{t-k} \end{pmatrix})$$
  - forecast house prices from April 2011 to December 2020 (monthly): almost done
    - ECM: use forecasts of $\vec{x}$ from DSM
    - DSM: forecasts immediately follow from model
  - Compare results

Bubble

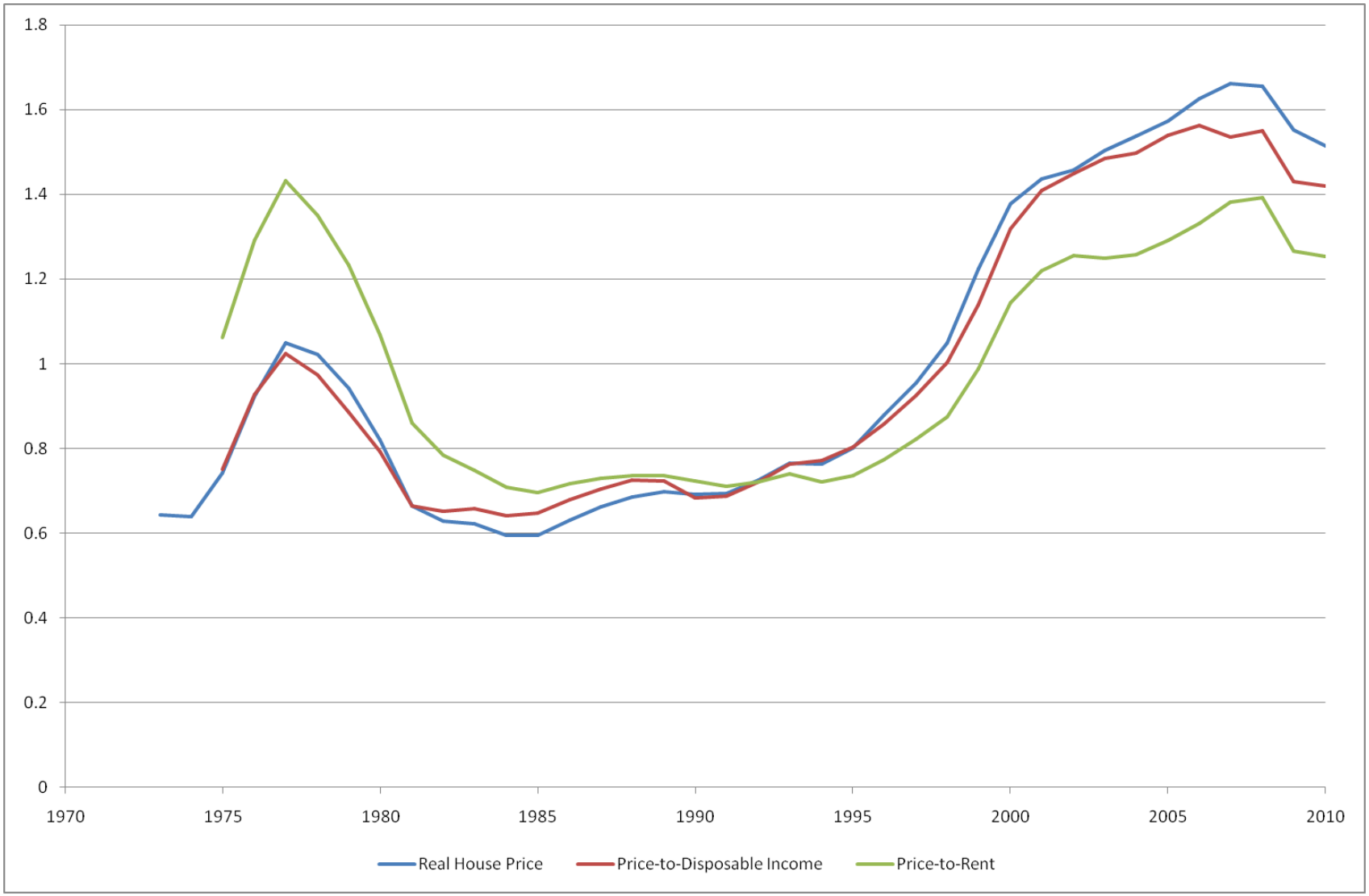
Stiglitz (1990)

"If the reason that the price is high today is only because investors believe that the selling price is high tomorrow - when 'fundamental' factors do not seem to justify such a price - then a bubble exists. At least in the short run, the high price of the asset is merited, because it yields a return (capital gain plus dividend) equal to that on alternative assets."

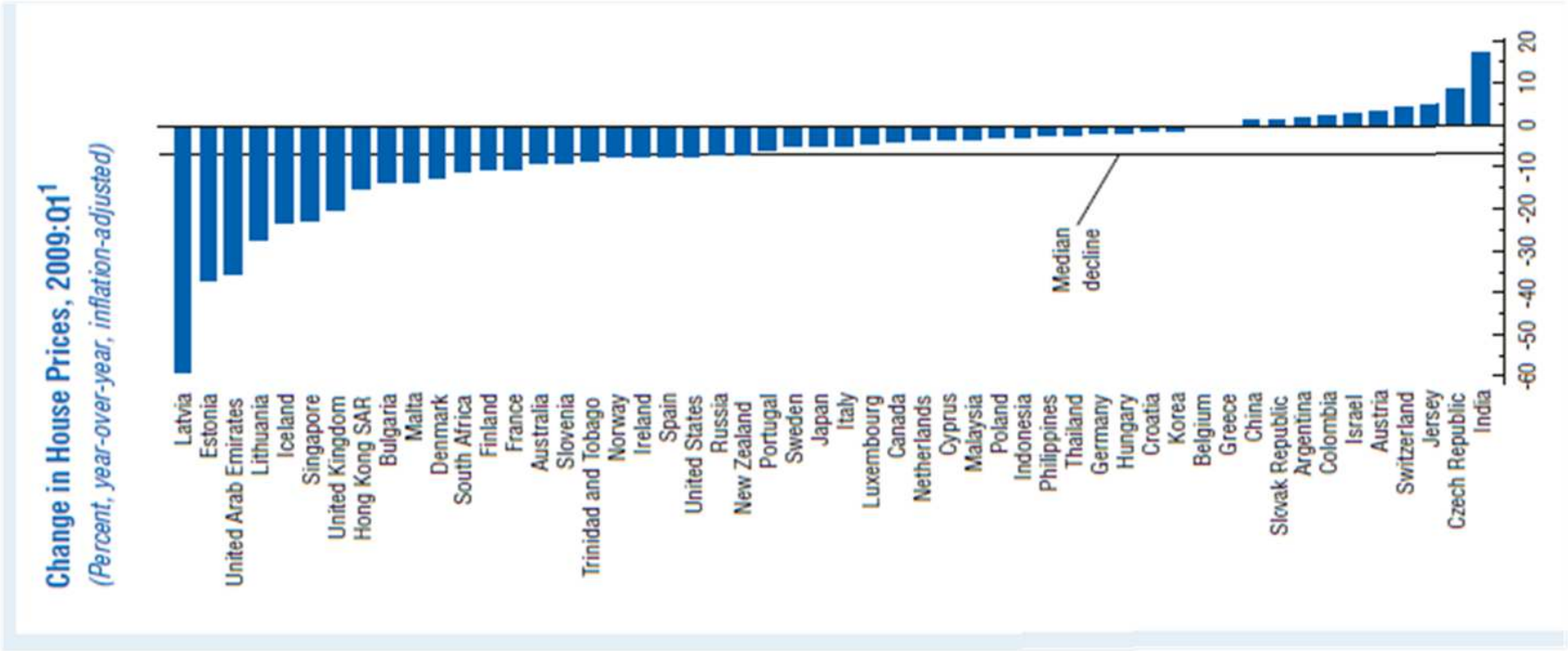
Several reports, with widely diverging conclusions:

- OECD (2005): overvaluation in 2004 of 20%
- IMF (2008): overvaluation in 2007 of 30%
- CPB (2008) in reaction on IMF: overvaluation 10% in 2003, 0% in 2007
- IMF (2009a): at the beginning of 2009 overvaluation 7%
- IMF (2009b): global housing prices are in agreement with fundamental economic factors
- De Vries (2009), research institute OTB. No overvaluation in 2009
- Underlying models: error correction models (different data and specifications)

House Price Index NL



Recent developments international



Source: IMF World Economic Outlook October 2009

Real house prices international

Table 1. Change in real house prices[1]

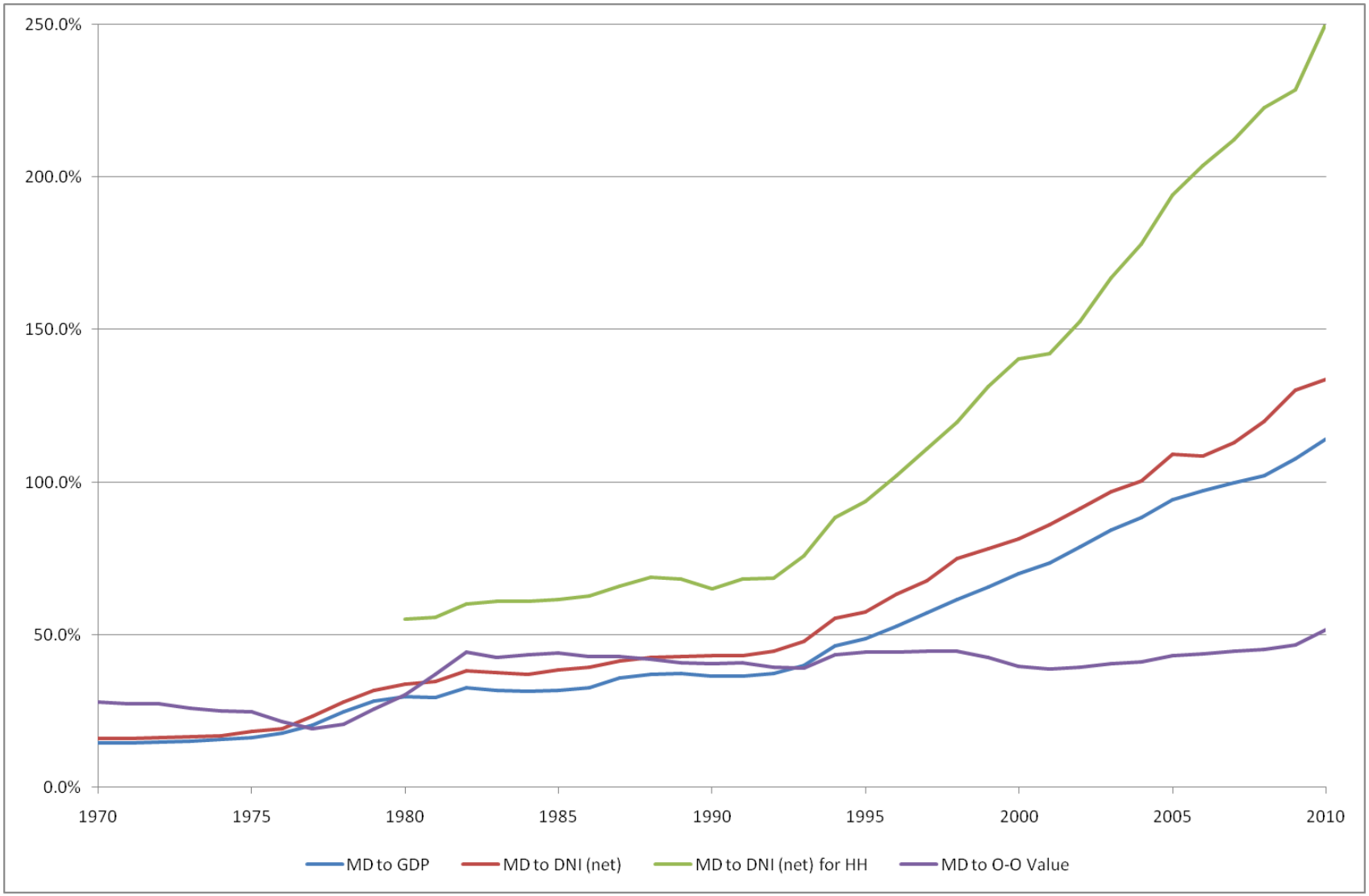
1980 (or earliest year available)-2008

Very large increases (90% or more)	Moderate to large increases (20% to 90%)	Stable or declining (less than 20% increase)
Australia	Austria	Chile
Belgium	Canada	Germany
Finland	Denmark	Hungary
Ireland	France	Israel
Netherlands	Greece	Japan
New Zealand	Italy	Korea
Norway	Slovenia	Portugal
Spain	Sweden	Switzerland
United Kingdom	United States	

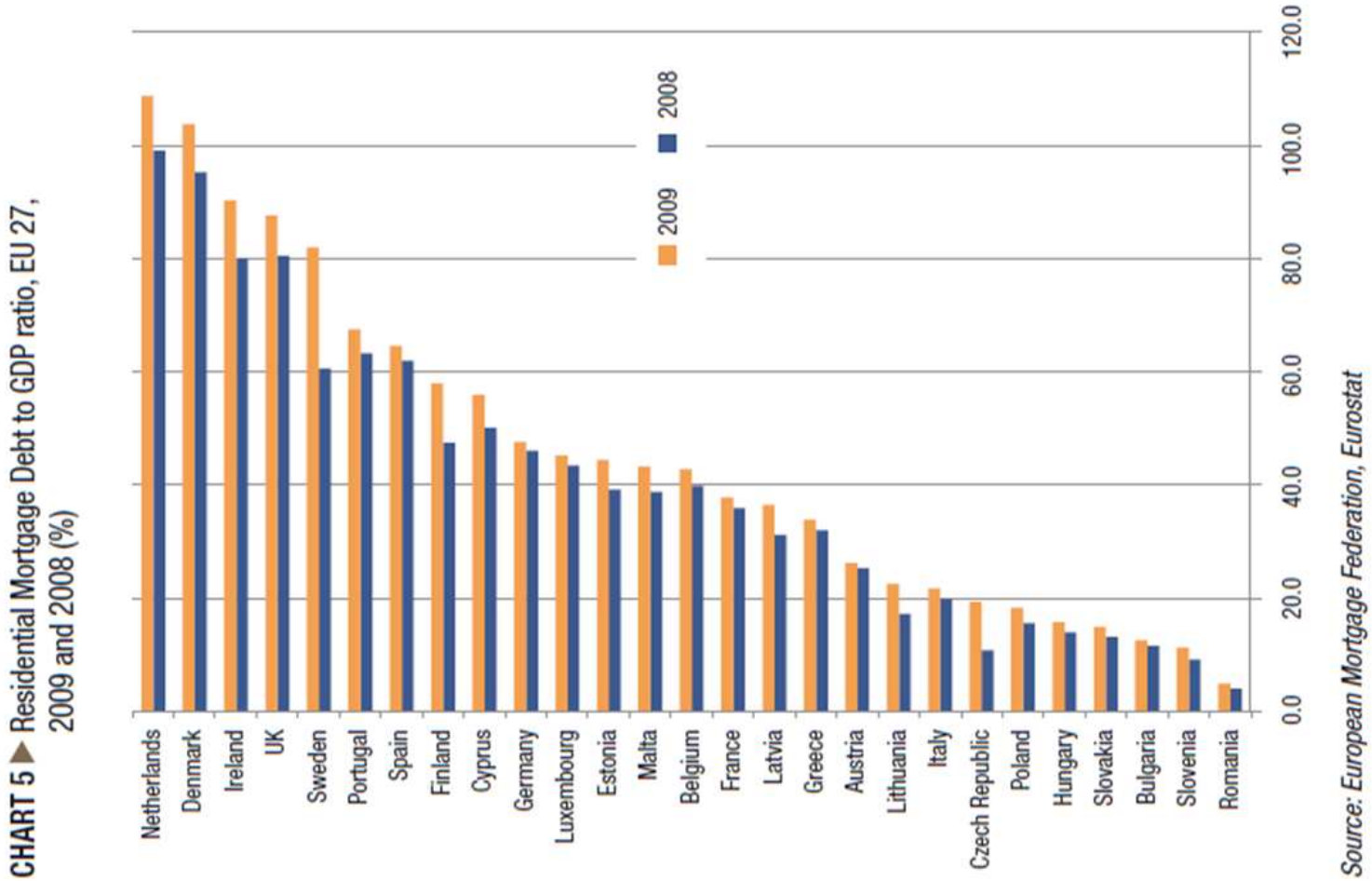
1. Nominal prices deflated by the consumer price index.

Source: National sources and OECD Economic Outlook No. 87.

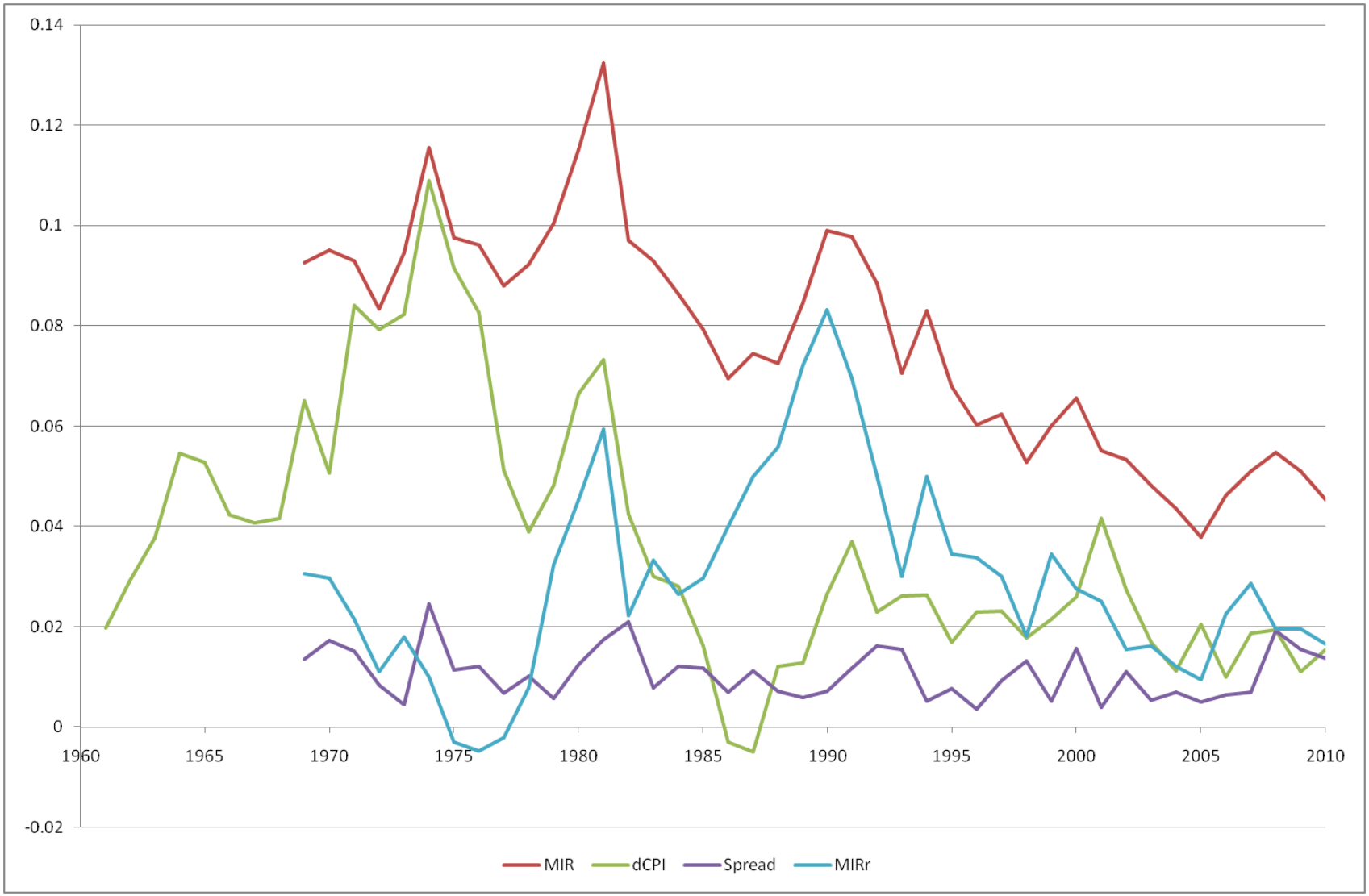
Mortgage debt to GDP NL



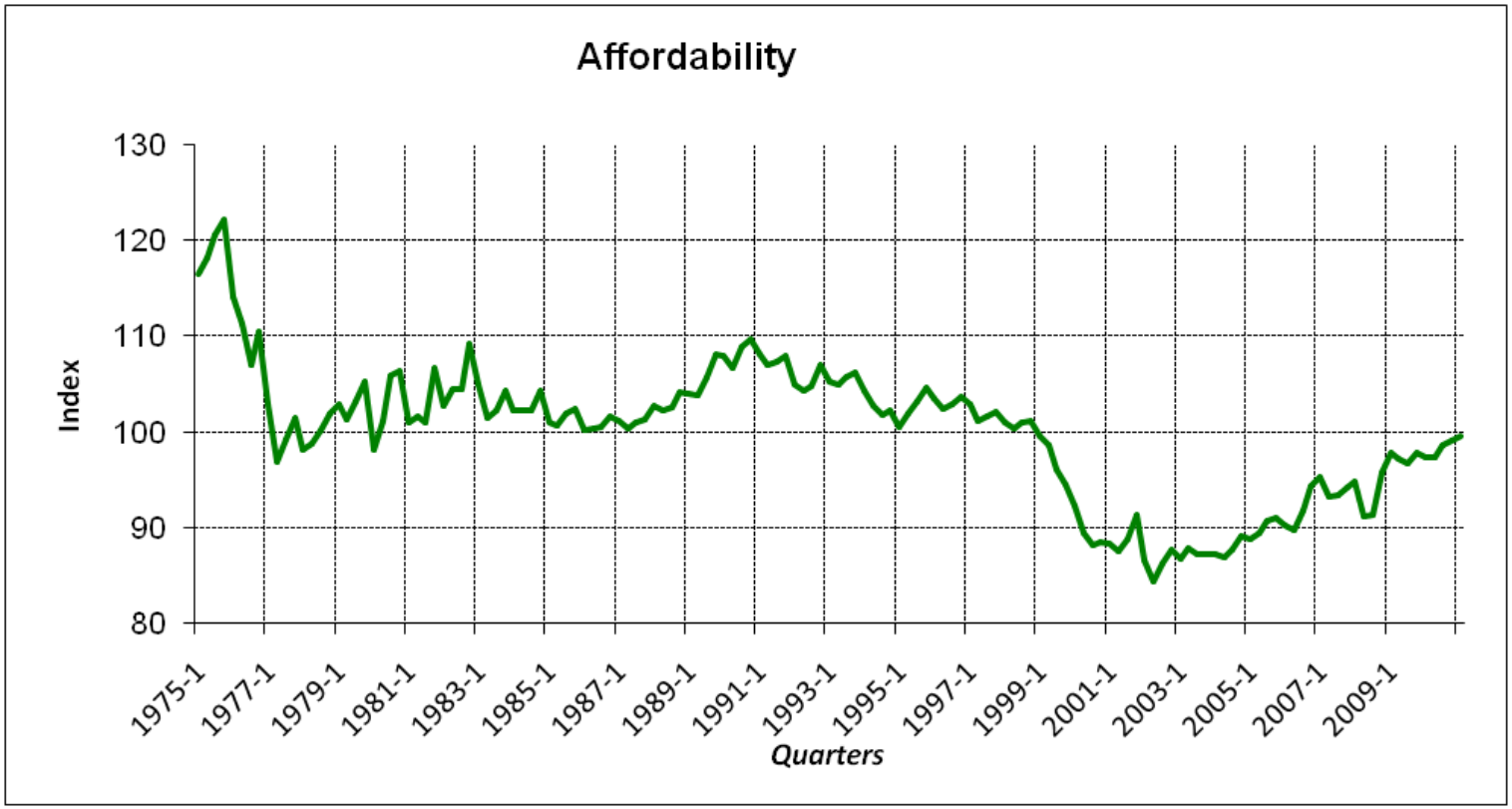
Mortgage debt to GDP international



Interest Rate and inflation NL



Affordability index NL

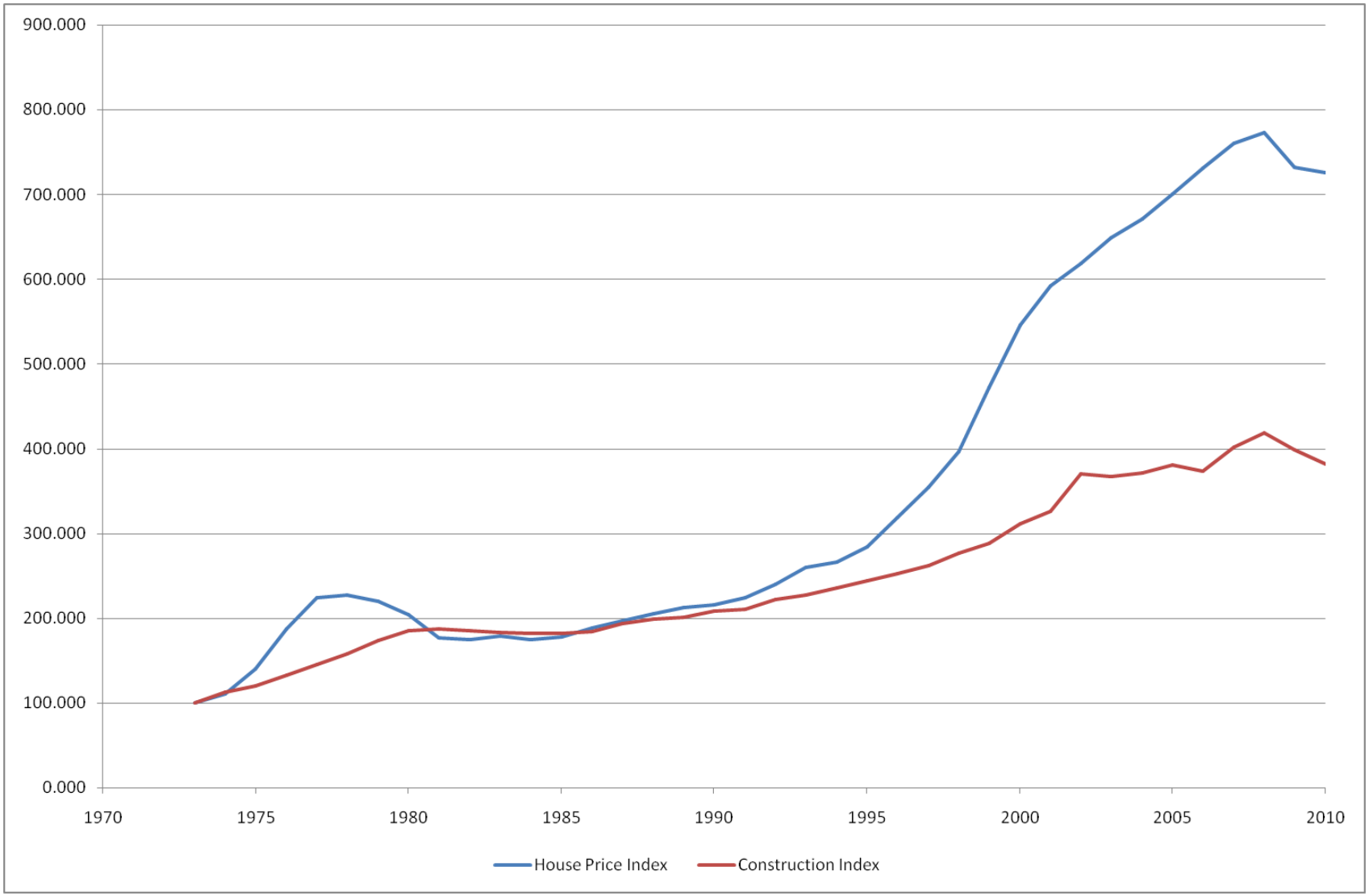


Residual income:
disposable household income minus net housing payment

Affordability index NHG NL

TABEL 3. NVM-Affordability Nibud 2011.Q1				
Mortgage NHG applicable if index > 100				
House type	Starter		Mover	
	112% financing		70% financing	
	One-income	Double-income	One-income	Double-income
Apartment	**91**	**180**	**145**	**288**
Row house	**74**	**148**	**119**	**236**
Corner house	**67**	**134**	**108**	**214**
Semi-detached	**55**	**109**	**88**	**174**
Detached	**39**	**78**	**63**	**125**
"average" home	*67*	*134*	*108*	*214*

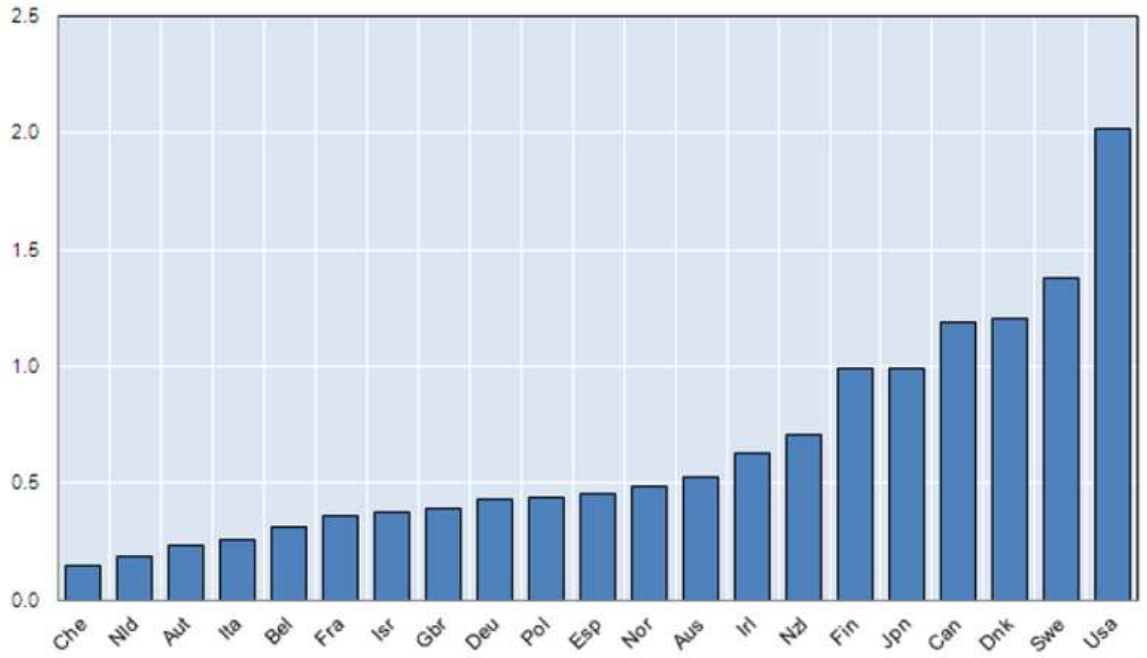
Construction costs NL



Price Elasticity Supply international

Figure 1. Price responsiveness of housing supply: selected countries

Estimates of the long-run price-elasticity of new housing supply[1]



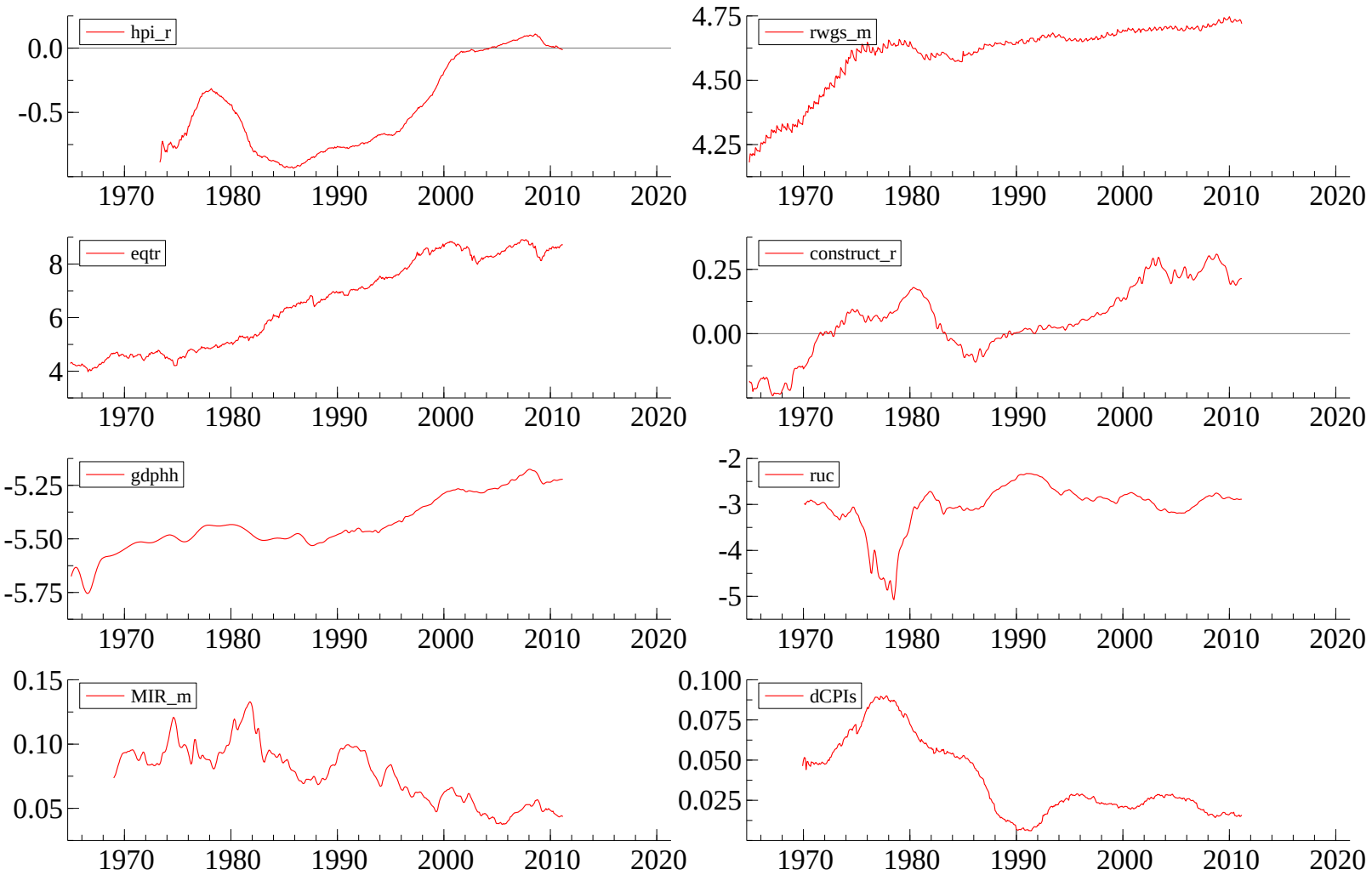
1. Estimates of the long-run price elasticity of new housing supply where new supply is measured by residential investments (i.e. the coefficient on lagged prices in the long-run investment equation as reported in Table 1, of Caldera Sanchez and Johansson 2010). Estimation is based on a system of two equations which model the demand and supply of housing in an error correction framework. All elasticities are significant at least at the 10% level. In the case of Spain, restricting the sample to the period 1995-2007, which would reflect recent developments in housing markets (such as the large stock of unsold houses resulting from the construction boom starting in 2000 and peaking in 2007-09), only slightly increases the estimate of the elasticity of housing supply from 0.45 to 0.58. Estimation period is early 1980s to early/mid-2000s. See Caldera Sanchez and Johansson (2010) for details.

Series

HPI_R	Real house price index
RWGS	Real wage price index
EQTR	Equity total return index
CONSTRUCT_R	Real construction costs index
GDPHH	GDP per household
RUC	Real usser costs

- Variables in natural logarithm
- Monthly/quarterly observation frequency
- House Price Index
  - RS: May 1973 - Dec 1995
  - SPAR: Jan 1995 - March 2011

Series


hpi_r
0.0
-0.5
rwgs_m
4.75
4.50
4.25
eqtr
8
6
4
construct_r
0.25
0.00
gdphh
-5.25
-5.50
-5.75
ruc
-2
-3
-4
-5
MIR_m
0.15
0.10
0.05
dCPIs
0.100
0.075
0.050
0.025
1970
1980
1990
2000
2010
2020

Basic form of error-correction model

- Long-run relation
  - price level depends on the levels of fundamentals (like interest rate, income, gdp, construction costs)
  - Long-run relation defines equilibrium prices h_t^*
  - If actual price h_t is above the equilibrium price h_t^*: overvaluation
- Short-run dynamics
  - Price changes are explained by
    - ★ previous price changes
    - ★ changes in fundamentals and
    - ★ the deviation between the actual and equilibrium price in the previous period

Basic specification of Error Correction Models

h_t: log real house price
Combining both levels and differences

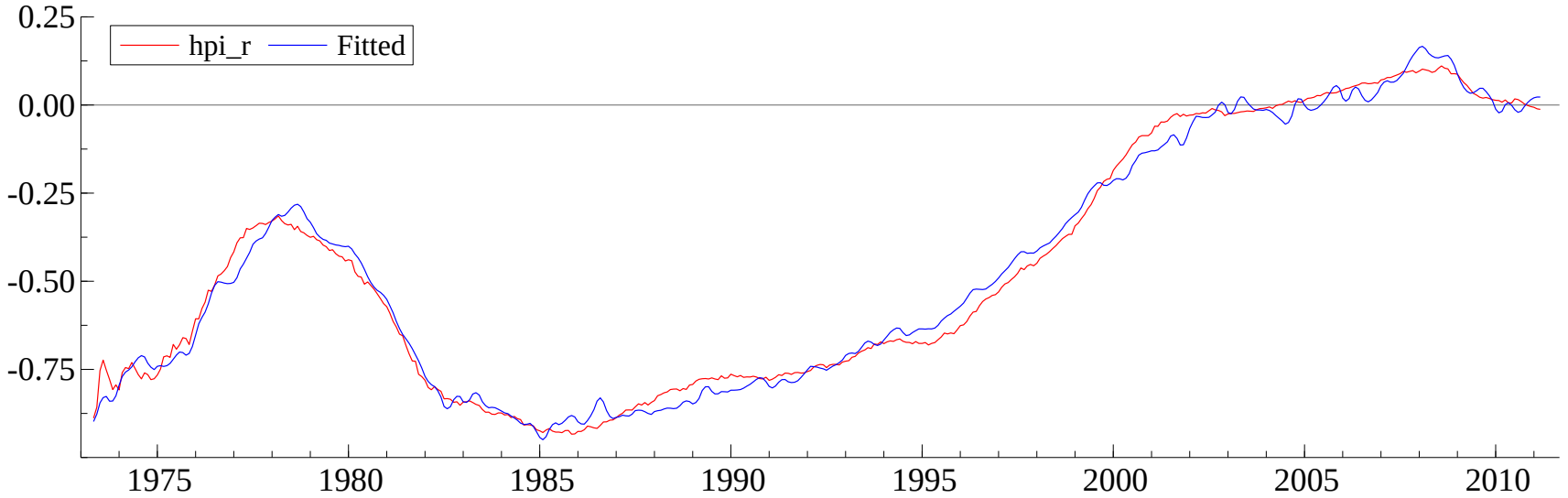
$$\begin{aligned} \text{Long-run:} \quad h_t^* &= \beta_1 x_{1t} + \cdots + \beta_k x_{kt}, \\ \text{Short-run:} \quad \Delta h_t &= \alpha \Delta h_{t-1} + \delta(h_{t-1} - h_{t-1}^*) + \gamma \Delta h_t^* + \varepsilon_t, \end{aligned}$$

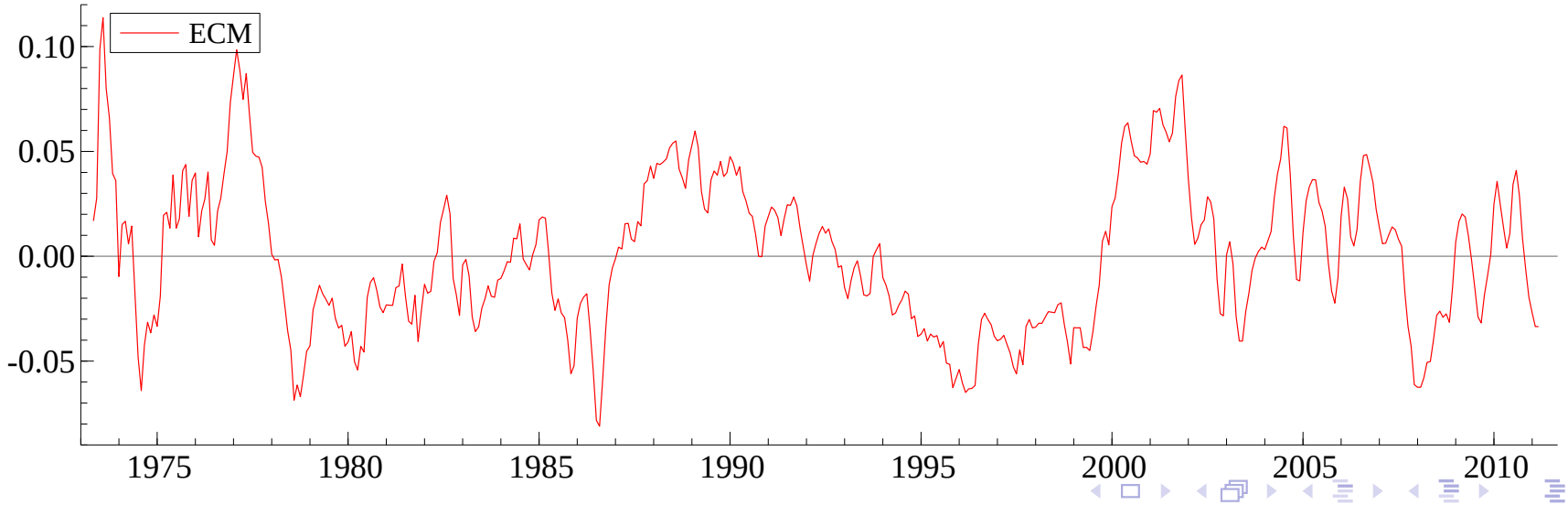
- Long-run (levels)
  - Exogenous variables x: income, interest, wealth, construction costs, housing stock, ...
- Short-run (differences)
  - Δh_{t-1}: bubble builder: the speculative influences on the market or the market's inefficiency, α: degree of serial correlation
  - $(h_t - h_t^*)$ bubble burster: error correction term, the deviation from the long term equilibrium, δ: degree of mean reversion
    - $(h_t - h_t^*) > 0$: overvaluation
    - $(h_t - h_t^*) < 0$: undervaluation
  - γ: contemporaneous adjustments of prices to current shocks

Long-run relation

```
EQ( 1) Modelling hpi_r by OLS
       The estimation sample is: 1973(5) - 2011(3)

                  Coefficient  Std.Error  t-value  t-prob Part.R^2
Constant            -0.585141     0.5422    -1.08  0.2811   0.0026
rwgs_ma               1.30401    0.08046     16.2  0.0000   0.3691
gdphh                 1.24611    0.07612     16.4  0.0000   0.3738
ruc_ma              -0.178566   0.005150    -34.7  0.0000   0.7281
construct_r           1.28825    0.04963     26.0  0.0000   0.6001
eqtr_ma             0.0383508   0.005465     7.02  0.0000   0.0988

sigma               0.0355926  RSS                 0.5688082
R^2                  0.989678  F(5,449) =     8610 [0.000]**
Adj.R^2              0.989563  log-likelihood        875.109
no. of observations       455  no. of parameters           6
mean(hpi_r)         -0.463775  se(hpi_r)            0.348388
When the log-likelihood constant is included:
AIC                  -3.82026  SC                  -3.76593
HQ                   -3.79885  FPE                0.0219222

Unit-root tests
The sample is: 1973(9) - 2011(3) (455 observations and 1 variables)

ECM: ADF tests (T=451, Constant; 5%=-2.87 1%=-3.45)
D-lag    t-adf      beta Y_1    sigma   t-DY_lag  t-prob       AIC  F-prob
  3     -4.529**     0.93288  0.01038     -2.265  0.0240    -9.125
  2     -5.141**     0.92540  0.01043    -0.4268  0.6697    -9.118  0.0240
  1     -5.407**     0.92391  0.01042      7.872  0.0000    -9.122  0.0712
  0     -4.077**     0.93945  0.01110                        -8.997  0.0000
Critical value: -4.744443729 (MacKinnon, 2010)
```

Long-run relation





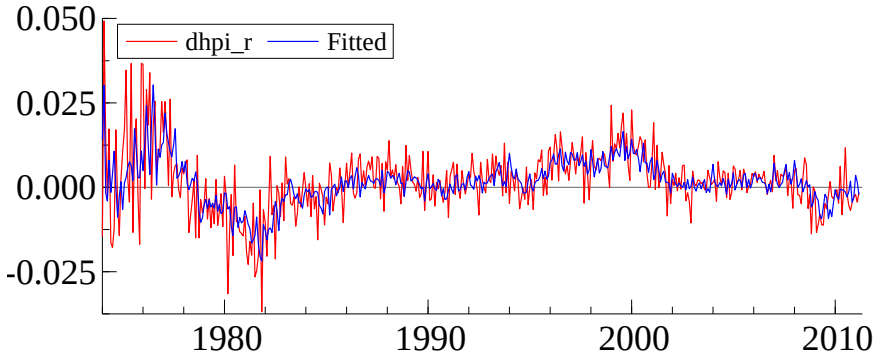
Short-run relation

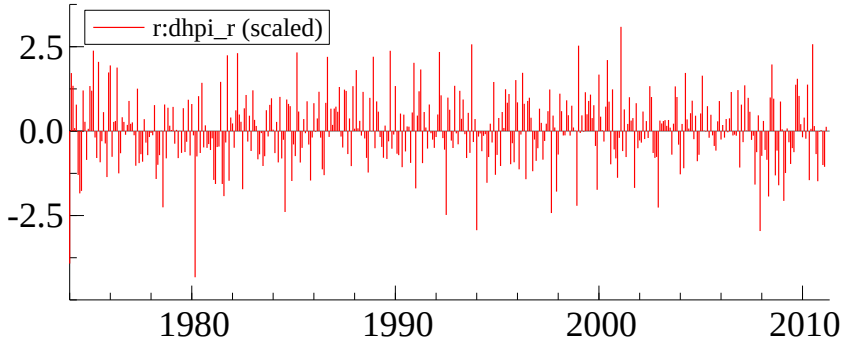
VOL(1) Modelling dhpi_r by restricted GARCH_t(1,1)
The estimation sample is: 1974(1) - 2011(3)

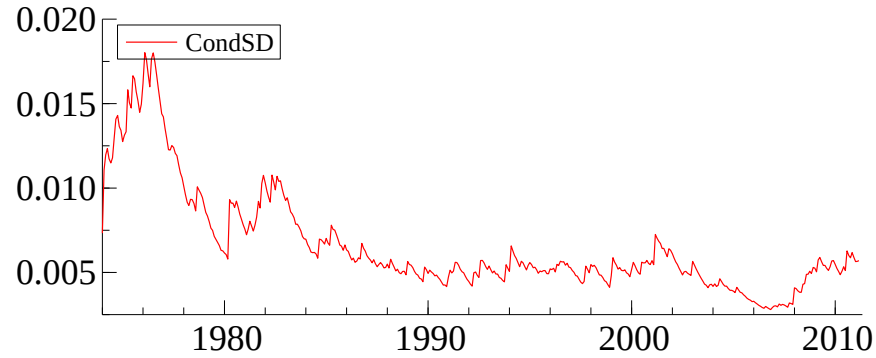
		Coefficient	Std.Error	robust-SE	t-value	t-prob
dhpi_r_2	Y	0.215931	0.04234	0.04960	4.35	0.000
dhpi_r_3	Y	0.226893	0.04183	0.05301	4.28	0.000
dhpi_r_6	Y	0.168959	0.04286	0.06613	2.55	0.011
dhpi_r_7	Y	0.163126	0.04039	0.04924	3.31	0.001
dgdphh	X	0.364142	0.1008	0.1128	3.23	0.001
druc_2	X	-0.0270639	0.009515	0.008949	-3.02	0.003
ECM_1	X	-0.0226563	0.007720	0.008865	-2.56	0.011
Seasonal	X	0.00282421	0.0008632	0.0008652	3.26	0.001
Seasonal_8	X	-0.00207935	0.0008623	0.0009099	-2.29	0.023
Seasonal_10	X	-0.00289343	0.0008524	0.0008673	-3.34	0.001
dconstruct_r	X	0.0632272	0.03476	0.03083	2.05	0.041
drwgs_m_1	X	0.163242	0.04418	0.05131	3.18	0.002
alpha_0	H	4.77464e-007	3.571e-007	3.948e-007	1.21	0.227
alpha_1	H	0.0890832	0.02743	0.02602	3.42	0.001
beta_1	H	0.900083	0.02536	0.02554	35.2	0.000
student-t df		8.84315	3.511	3.372	2.62	0.009

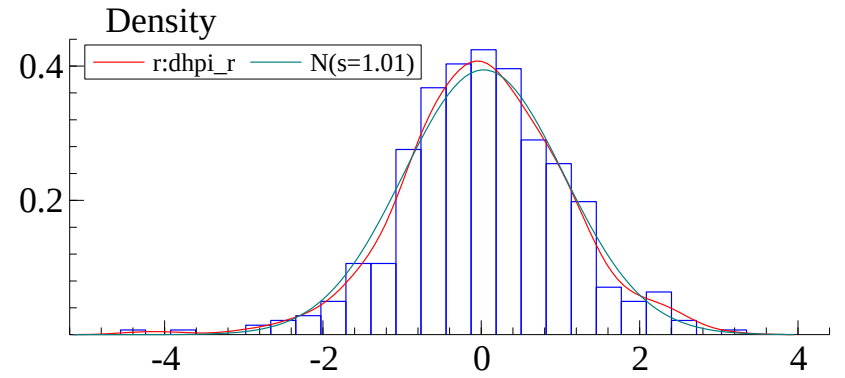
log-likelihood	1647.71209	HMSE	3.24002
mean(h_t)	5.33494e-005	var(h_t)	3.49772e-009
no. of observations	447	no. of parameters	16
AIC.T	-3263.42418	AIC	-7.30072524
mean(dhpi_r)	0.00174867	var(dhpi_r)	9.35696e-005
alpha(1)+beta(1)	0.989167	alpha_i+beta_i>=0, alpha(1)+beta(1)<1	

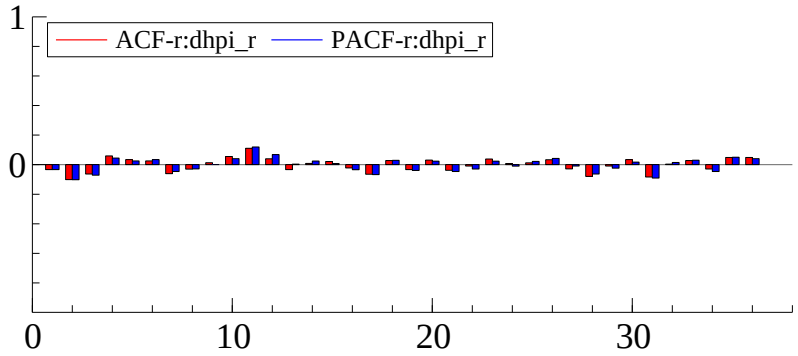
Short-run relation

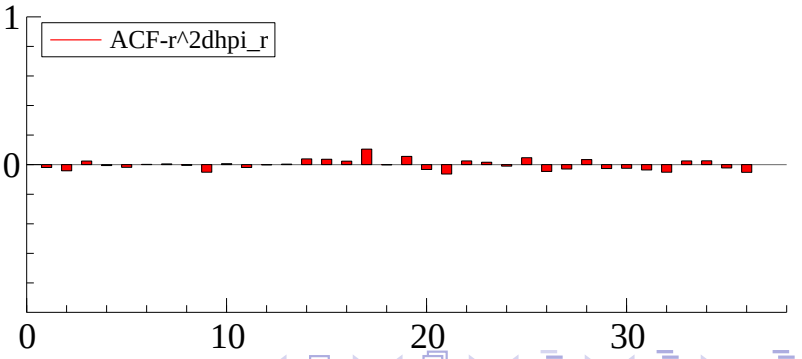








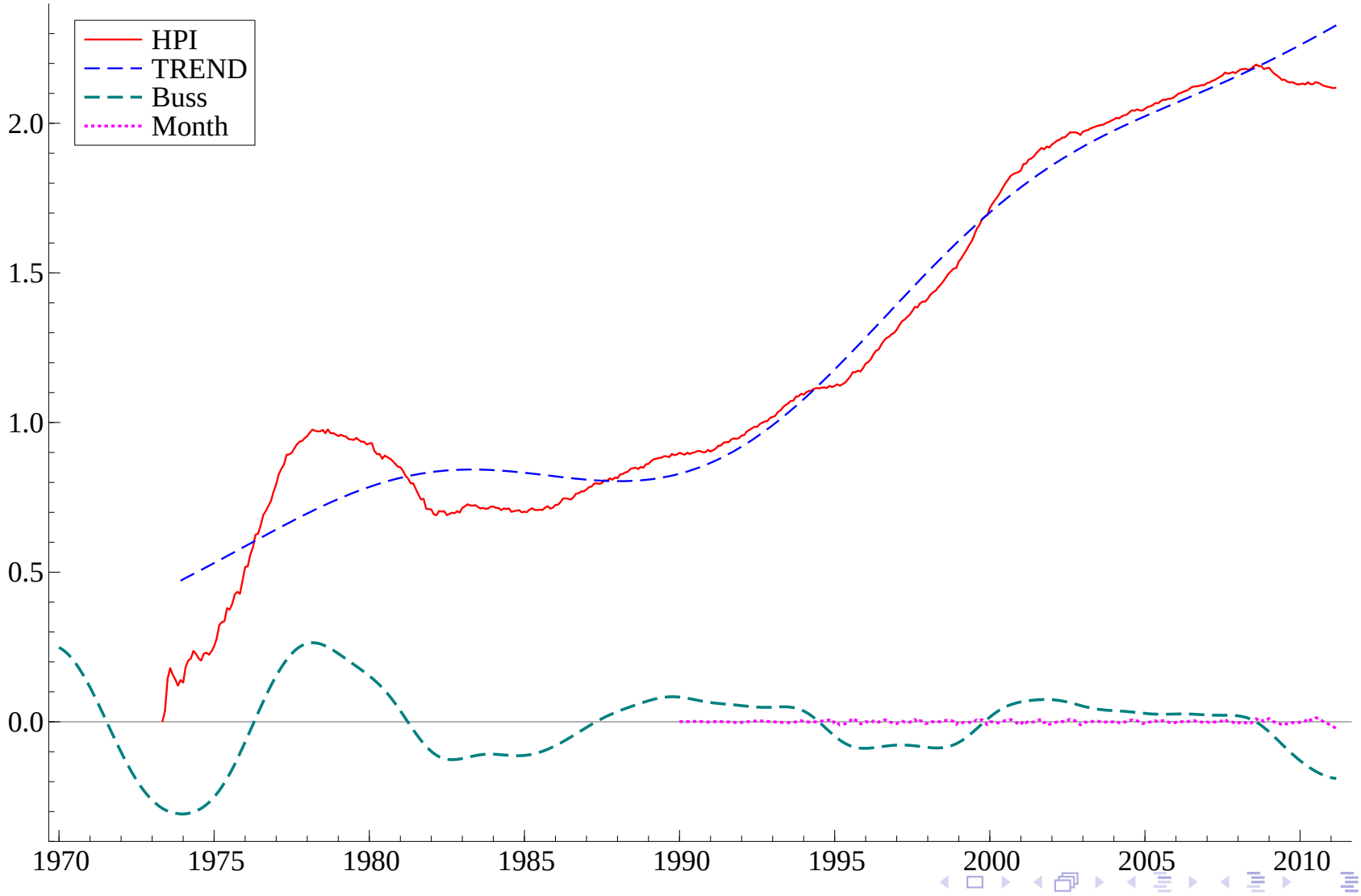




Dynamic Scenario Model

- Consistent scenarios
  - dealing with different horizons,
  - observation frequencies,
  - data granularity (years, months),
  - large model dimension
- Decompose (filtering) series in 3 components
  1. Trend
  2. Business Cycle
  3. Short-run
- Multivariate model for each component
  - Identify factors (reducing the number of series from +300 to 10–15
  - Estimate VAR models on factor returns (month, year, 8-years)
  - Regress filtered data on factors
  - Forecast factors with VAR model
  - Use regression results for forecasts of filtered series
- Forecast = sum of forecasts of filtered series

Filtered House Price Index



Business Cycle Model

- +300 variables reduced to 14 uncorrelated factors by principal components
- The most important loadings for house price index (in desc. order) 5 (51%) , 1 (19%) 2 (8%), 11 (8%)
  between brackets: percentage explained unconditional variance

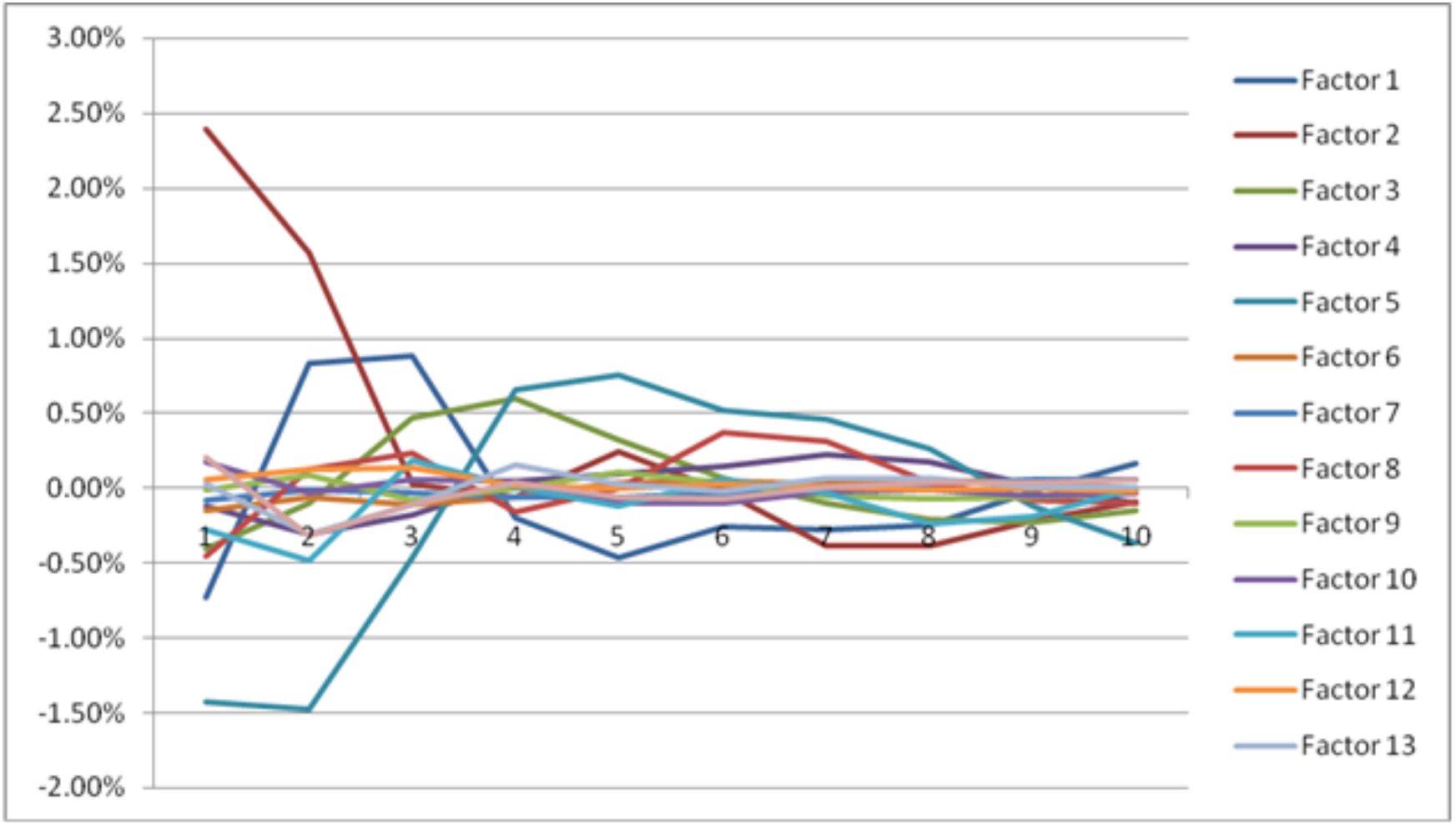
factor	loading	factor	loading
1	-1.90%	8	1.10%
2	-2.91%	9	-0.47%
3	1.14%	10	-0.58%
4	-0.99%	**11**	1.85%
5	-4.77%	12	-0.62%
6	0.43%	13	-1.05%
7	-0.25%	14	0.66%

Business Cycle Model

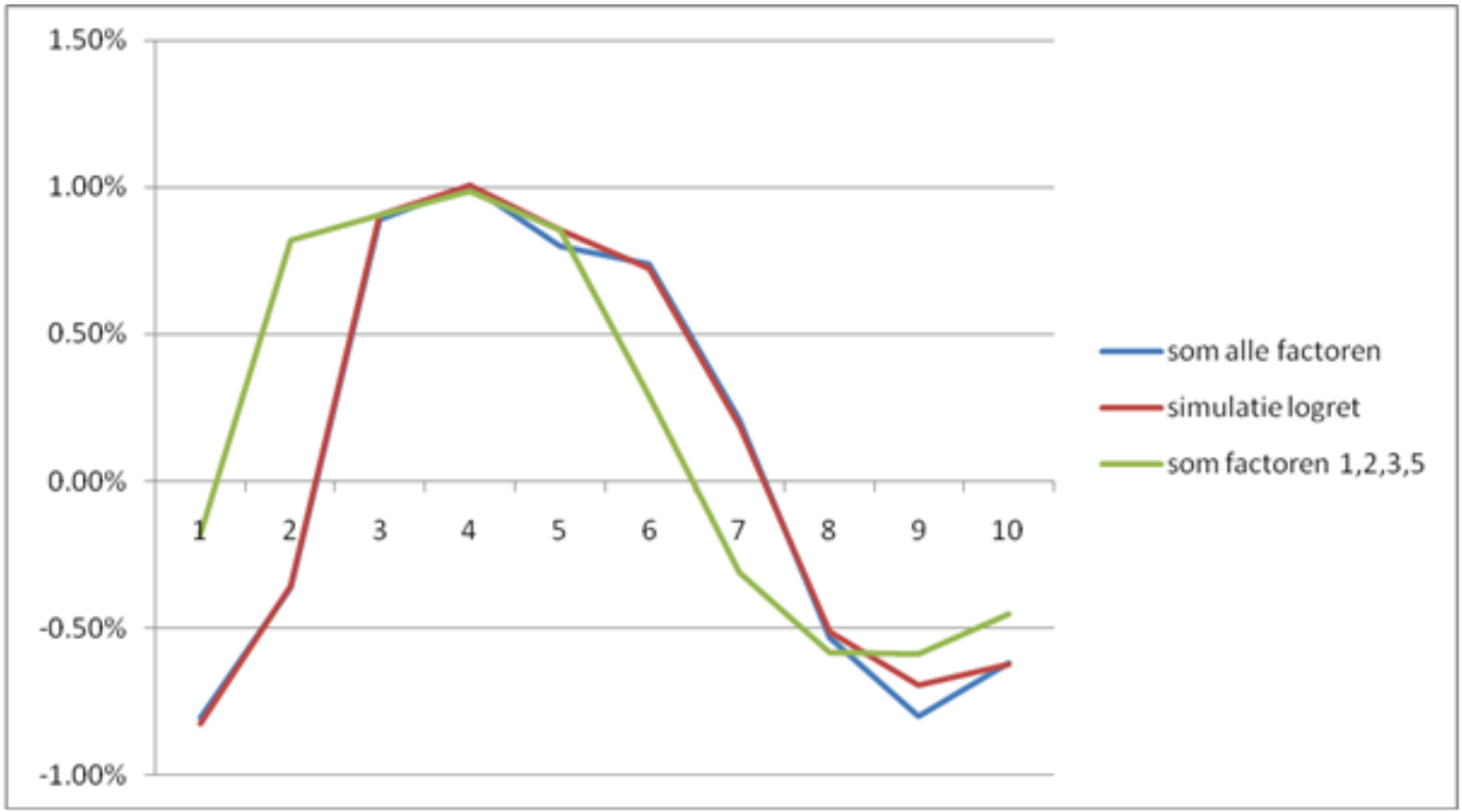
	Factor 1	Factor 2	Factor 5	Factor 11
CPI_NL	7.1%	5.6%	3.2%	7.0%
DIREH_NL	-3.6%	-6.9%	**-15.6%**	**8.9%**
EQCI_NL	**-10.2%**	6.0%	-3.7%	4.6%
EQDY_NL	**10.3%**	-0.3%	5.3%	-2.0%
EQPE_NL	0.7%	-2.8%	-5.7%	-2.7%
EQTR_NL	**-9.7%**	6.1%	-3.8%	4.9%
GDP_NL	-6.0%	4.9%	-1.4%	**11.5%**
NGLR_NL	8.7%	**11.6%**	0.7%	-1.5%
EQCI_NL	5.8%	-9.1%	-1.5%	2.7%
RWGS_NL	0.2%	-8.9%	-6.3%	-4.4%
TBSR_NL	6.5%	**10.4%**	3.6%	-1.1%
UNEM_NL	-2.4%	4.9%	-0.5%	0.6%

	Factor 1	Factor 2	Factor 5	Factor 11
Commod.	-3.0%	2.2%	**5.3%**	3.5%
CPI	4.7%	5.2%	**-4.1%**	1.6%
DIREH	-1.2%	-0.3%	-2.4%	**-5.0%**
EQCI	**-9.2%**	3.8%	-0.8%	0.1%
EQDY	**7.6%**	-0.2%	1.5%	-1.8%
EQPE	-0.1%	**-4.7%**	1.0%	-4.0%
EQTR	-9.0%	4.0%	-0.8%	0.0%
EXCH	-0.5%	5.1%	**4.3%**	-1.0%
GDP	-5.8%	2.8%	0.0%	**5.1%**
ILRE	**-7.1%**	0.6%	1.1%	-0.8%
NGLR	5.7%	**8.2%**	-2.3%	-0.5%
TBSR	4.4%	**7.3%**	-2.3%	3.4%
RWGS	-0.2%	-1.8%	-2.2%	**-4.1%**
UNEM	-1.8%	-1.0%	0.4%	-0.6%

Impact of different factors on HPI forecast (BUS)



Total HPI Forecast



Conclusions

- Relatively simple models explain house prices reasonably well
- According to the model there can be no talk of a correction of the home prices as a result of overvaluation
- Predictions of home prices therefore depend mainly on the predictions of the explanatory variables
  - Forecasts of fundamentals are based on a large model, including more than 300 series.
    - ★ Different models for different frequencies (frequency domain techniques): long-term/business cycle/month
    - ★ Dynamic factor model for each frequency domain