Assessing House Prices:
Simple Valuation and Prudential Measures

Michal Andrle
IMF Research Department

Miroslav Plašil
CNB Financial Stability Section

Czech National Bank Seminar,
July 10, 2018 Prague
The views expressed herein are those of the authors and should not be attributed to the International Monetary Fund, its Executive Board, or its management.

The views expressed here are those of the authors and do not necessarily reflect the position of the Czech National Bank.
Questions Asked:

- Are the Czech and Prague house prices overvalued?

- What are ‘fair values’ given by the fundamentals?
- How much housing can households safely borrow for?

- How do fundamental valuations compare to market prices?
House Prices

Questions Answered:

- Our indicators suggest that on average house prices are **overvalued** with respect to fundamentals.

- Our indicators suggest **house prices should be growing**, due to increase in disposable income and low interest rates...
How Do We Assess House Prices?

Houses are durable assets. And people borrow to buy it...

- **Intrinsic/Fair Value**
  - Expected present value of net rental income.
  - Should you rent or buy?

- **Borrowing Capacity**
  - How much can the household safely borrow?
  - How much housing can they afford?

borrowing capacity ≠ fair value
Value of Valuation

- Valuation provides a way to find an intrinsic value of an asset and compare it to the market price...

- Valuation is simple, we choose to make it complex
  A. Damodaran
Valuation is a Process

- We provide a flexible framework, not just numbers
- Thinking hard about parameters and assumptions entering valuation is crucial (and fun)
- So, YES, valuation is inherently subjective... ...but transparently so
- Valuation is simple but not easy... (Ch. Munger)
Approach Taken

- We use theory directly to obtain valuation measures, not to motivate regression equations...

- We take units of measurement seriously
  Working with prices, not just price indexes is essential

- We explain housing value and its dynamics
  It’s about levels, not just about house prices growth!!

- We do not use an ad-hoc regression model
  but create simple and flexible indicators and models
Approach **Not Taken**

1. **Most of the literature** uses estimated **time-series models** to explain house prices indices.

2. Also popular is to compare normalized price/rent or price/income **multiples** with history, etc.

3. Occasionally, a **static** versions of steady-state arbitrage formulas are used (a la Gordon model). E.g. $P_t = \frac{rent_t}{\text{"usercost"}}$

4. ...
ON HOUSE PRICES REGRESSIONS...  
And why we do not use them
House Prices Regressions: Typical Example

Most of the time, the models are either growth or level regressions:

**OLS:**

\[ \dot{p}_t = \alpha_0 + \alpha_1 \dot{w}_t + \alpha_2 \dot{i}_t + \alpha_3 \dot{crdt}_t + \alpha_n \dot{x}_t + \varepsilon_t \]

or

**ECMs: (Error-Correction Models)**

\[ \dot{p}_t = \alpha_0 + \alpha_1 \dot{w}_t + \alpha_2 \dot{i}_t + \alpha_3 \dot{crdt}_t + \alpha_n \dot{x}_t - \gamma EC_{t-1} + \varepsilon_t \]

\[ EC_t \equiv p_t - (\beta_0 + \beta_1 w_t + \beta_2 i_t + \beta_3 crdt_t + \beta_n x_t) \]
House Prices Regressions

- Vaguely motivated by economic theory, often without any theory restrictions, **backward-looking**...

- Econometric **models require a lot of data** for estimation, preferrably over multiple housing and/or business cycles

- The parameters are not structural and possibly unstable

- Often over-parameterized / over-fitted...

- Often, the co-integrating model fit is considered as ‘equilibrium’;

- Difficult to handle over-valuation-only data [zero-mean residuals]
House Prices Regressions: Toy Example
House Prices Regressions: Coefficients

Wages

Mgt Rates

Constant
House Prices Regressions: Sample Matters!

Regression House Price Gap (%)

-15
-10
-5
0
5
10
15
20
25
30


2008:1
2014:1
2018:1
Macro vs. Micro

- All indicators we compute are **applicable at individual household** and real-estate property level...

- Trivial to extend to countries, regions, and individual-level data

- We use macro data and rely on averages and/or medians
BORROWING CAPACITY
Borrowing Capacity (BC)

Borrowing Capacity:
House price implied by how much households can safely borrow given interest rates and their income. . .
Borrowing Capacity (BC)

Borrowing Capacity comes in flavors:

1. **Static Borrowing Capacity (SBC)**
   Considers current interest rate and income only.

2. **Dynamic, Look-Ahead BC**
   Based on current rates and income but considers growth of income and possible changes in rates...

3. **Dynamic, Look-Ahead BC with ‘Offset/Safety Deposit’**
   Augments the Dynamic BC by allowing household to set aside money to lower their debt service...
Given their income, $Y$, households can afford to pay mortgage annuity payment up to $\alpha$ percent of their income...

$$a_t = \alpha \times Y_t \quad (1)$$

Given mortgage rate, $i_t$, the mortgage annuity, $a_t$, uniquely determines the amount of the loan, $L_t$ for $N$ months:

$$L_t = \left[ \frac{z_t(1 - z_t^N)}{(1 - z_t)} \right] \times a_t \text{ with } z_t \equiv \frac{1}{1 + i_t^m}. \quad (2)$$

With a down-payment given by loan-to-value of $ltv$, the affordable house price, is then

$$P_t^{sbc} = \frac{1}{ltv} \times L_t \quad (3)$$
Static Borrowing Capacity (SBC) – Formula

Put together:

\[ P_{sbc}^t = \frac{1}{ltv_t} \times \left[ \frac{z_t(1 - z_t^N)}{(1 - z_t)} \right] \times \alpha Y_t. \]  (4)
Dynamic Borrowing Capacity (DBC)

Dynamic (Look-Ahead) Borrowing Capacity:

- Given expected changes in income and interest rates, find maximum sustainable loan such that the debt service burden always stays within limits $\alpha_{t+i|t} < \alpha_{MAX}$ (ex-ante)

- This is an **asymmetric** measure, $P_{t}^{dbc} \leq P_{t}^{sbc}$

- When rates are expected to decline, DBC still prevents households from borrowing in excess of maximum static borrowing limit...
Dynamic Borrowing Capacity (DBC)

Dynamic Borrowing Capacity with Offset Deposit:

- Every period, households deposit the difference between the constant annuity payment, $A$, and $\alpha \times Y_{t+i}|t$ in an interest-bearing, liquid, security deposit. . .

- Households are allowed to **lower their debt service** using their savings and interest proceeds if $\alpha_{t+i} > \alpha_{max}$

- Find maximum sustainable loan **now** such that the expected debt service burden stays in the limit, given the option to use the offset account
BC Measures – Real-Time Implementation

Assumptions:
- Household Income, $Y_t$: $1.65 \times$ Household Disposable Income per capita
- Debt-Service Share of Income: $\alpha_{max} = 0.35$
- Loan-to-Value Ratio: $ltv = 0.8$
- Mortgage Duration: 25 years, 5 years re-financing
- Forecast of Income: CNB forecast + growth convergence to 4% in LR
- Forecast of Mortgage Rates: 5Y fix long-run value 5%
- Interest Rate on the ‘Offset/Safety Deposit’: Mortgage Rate - 100bp.

House Prices Data:
Czech Stat Office, Deloitte/‘Cenova mapa’ in Mil. CZK for 68m² apt.
Results: Borrowing Capacity Measures

Apt Prices & Borrowing Capacity Measures (Mil. CZK)

- Market Price
- Static BC (SBC)
- Dynamic BC (DBC1)
- Dynamic BC with Deposit (DBC2)
Results: Borrowing Capacity Measures

Price-to-BC (%)

- Static BC (SBC)
- Dynamic BC (DBC1)
Results: Angel Chart for SBC

Borrowing Capacity Angel Chart (Prague, Mil. CZK)

- 1999:1
- 2001:1
- 2003:1
- 2005:1
- 2007:1
- 2009:1
- 2011:1
- 2013:1
- 2015:1
- 2017:1

- 1.5
- 3
- 4.5
- 6

- 30%
- 35%
- 40%
- 45%
Counterfactual Scenario:

Counterfactual: Constant Mortgage Rate since 2014:1

Price
SBC cfactual
SBC
Sensitivity to Interest Rates

Household Income: 45k/month, $\alpha = 0.35$
Flexible Toolbox

House Price Assessment

This application calculates three versions of the borrowing capacity:

a) Static BC
b) Simple Look-Ahead BC
c) Look-Ahead BC with offset deposit

Price implied by the static borrowing capacity of households: 4488600

Net income: 45000 CZK per month

Graph showing house prices implied by the borrowing capacity vs. interest rates.
INTRINSIC VALUE APPROACH
‘Fair Value’ – Investment Approach

House value is the net-present value of rental profits.

- **Forward-looking**, income and interest expectations are absolutely essential components
- Reflects mortgage structure and duration, tax structure, opportunity costs
- **We refine simplified models** from the literature and consider important real-life details, without adding complexity
Types of Investors

1. Owner-Occupiers and Retail Buy-to-Let Investors
   ▶ Mostly re-pay their mortgage in full...

2. Professional Investors
   ▶ No intentions to repay their mortgage, staying leveraged
   ▶ Better access to financing than owner-occupiers
   ▶ Different tax structure than retail
   ▶ With large volumes, lower importance of transaction costs
Motivation: Stylized Rent-or-Buy Decision

Rent:

1. Take savings (downpayment), $X_t$ and invest with return $i_t^e$
2. Pay the rent, $rent_t$

Buy:

1. Use downpayment, $X_t$ and borrow $L_t$ to buy a house at a price $P_t = X_t + L_t$, with LTV ratio $\phi \equiv L_t / P_t$
2. Face the mortgage rate $i_t^m$ and pay $i_t^m L_t$
3. Pay the maintenance cost and property tax, $(\delta + \tau_p) P_t$
4. Interest payments are tax deductible with the marginal tax rate $\tau$
5. Sell the house at a price $P_{t+1}$
Motivation: Stylized Rent-or-Buy Decision

Assuming no arbitrage between buy and rent decisions:

\[ P_t = rent_t + \frac{1}{1 + z_t} P_{t+1|t} \]  
\[ \text{(5)} \]

with

\[ (1 + z_t) \equiv (1 + [(1 - \phi)i_t^e + \phi \times (1 - \tau)i_t^m]) + \delta + \tau_p \]  
\[ \text{(6)} \]

Reasoning recursively for \( P_{t+1}, \ldots, P_{t+T} \) and \( T \to \infty \) we get an intuitive expression

\[ P_t = \sum_{i=0}^\infty \frac{rent_{t+i|t}}{\prod_{j=0}^i (1 + z_{t+j})} \quad \text{and} \quad P_{ss} = \frac{rent}{z - gn} \]  
\[ \text{(7)} \]
Simple Formula Problems...

‘Textbook formulas’ have a few important assumptions:

- Constant loan-to-value ratio, $\phi$, with households borrowing more to keep up with the price...
- Mortgage with infinite duration (interest-only mortgage)
- Identical value of mortgage rate and other financial returns
- ...
Realistic Retail Investor Problem

Three-step present value computation:
1. First $K$ years of current interest fixed, $i_0^m$
2. Remaining $N - K$ years of expected long-run interest, $i_K^m$
3. After $N$ periods no mortgage payments, steady-state growth of rents, $g_n$

Value of income flow to EQUITY holders:
- Rental cash flow adjusted for mortgage payments and tax deductions
- Income to equity discounted by cost of equity, $i_t^e$
Retail Investor Problem

\[
V_{t|t} = \sum_{i=0}^{K-1} \frac{(1 - \tau) rent_{t+i|t} - mpay_{t+i|t} + \tau \times intcost_{t+i|t}}{\prod_{j=0}^{i}(1 + i_{e,t+j|t})}
\]

\[
+ \sum_{i=K}^{N-1} \frac{(1 - \tau) rent_{t+i|t} - mpay_{t+i|t} + \tau \times intcost_{t+i|t}}{\prod_{j=0}^{i}(1 + i_{e,t+j|t})}
\]

\[
+ \frac{1}{\prod_{j=0}^{N}(1 + i_{e,t+j|t})} \frac{gn \times (1 - \tau) rent_{t+N|t}}{i_{e} - gn},
\]
Assumptions:

- Mortgage lasts for $N$ years and household fully repay the loan
- Mortgage payments follow the exact amortization schedule as in commercial banks, based on monthly compounding
- The initial mortgage rate is $i_0^m$ and will be fixed for $K$ years, until a new and final rate is assumed, $i_K^m$
- Households face a particular loan-to-value requirement
- Interest-rate component of the mortgage payment is tax deductible
- Rent is a given share of household disposable income, $rent = \alpha \times Y$
- In the long-run nominal income grows at a rate $gn$
- The opportunity cost of households is $i_e$
Parameterization:

- Mortgage lasts 25 years, re-financing in 5
- Mortgage rates for 3Y-5Y mortgages
- Household income is $1.65 \times$ the average local income
- Rent is 35% of income
- Opportunity cost of households is 6.5%
- Marginal tax rate 15%
- Long-run mortgage rates 5%
- Long-run nominal income growth is 4%
- Medium-term income growth forecast sourced from the CNB forecast archives starting from 2008Q3
Prague House Prices: Rent and Income Forecasts

The expected path of rents is a key component of the valuation.

Income growth beyond CNB forecast horizon extended by an AR(1) process:

**Case A:**
With **realistic** persistence \( \rho \) (realistic wage growth)

**Case B:**
With **very high** persistence \( \rho \) (optimistic wage growth)

**Case C:**
No CNB forecast are used, a realistic AR(1) process for income
Prague House Prices: Case A (CNB + low $\rho$)

Housing Valuation: Prague (Mil CZK)

- fair value
- price
Housing Valuation: Prague (Mil CZK)

- **Fair Value**
- **Price**

<table>
<thead>
<tr>
<th>Year</th>
<th>Fair Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999:1</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>2001:1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2003:1</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>2005:1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2007:1</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>2009:1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2011:1</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>2013:1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2015:1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017:1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Prague House Prices: Case A & SBC

Housing Valuation: Prague Price/Value (%)

- Price/fair-value
- Price/sbc
Re-Cap: Borrowing Capacity or Fair-Value?

Shared features:
- Neither is a forecast of house prices
- Both are frameworks for thinking about house prices
- Both reflect current income and interest rates...
- Both do not require past data
- House prices do not enter the valuation formulas

Differences:
- Borrowing Capacity less forward-looking and asymmetric
- Investor’s approach also reflects opportunity cost and tax code
... and Nothing Else Matters?

Sure it does!

Demographics, supply constraints, regulation, ...

- Most factors reflected in income, interest rates, ...
- Demographic changes are predictable and rarely abrupt
- Supply-side constraints are usually transitory
- Inter-city mobility must be profitable (expensive rents lower competitiveness)

It is important to avoid ‘analysis paralysis’
Recognizing Uncertainty...

- The framework itself invites to scenario analysis...

- Introducing scenarios and uncertainty about income and interest development is conceptually simple

- Things should be kept simple and explainable, avoiding pretense of knowledge...
Flexible Toolbox

- This is a toolbox and a calculator.
- No econometrics needed...
- No historical data for estimation needed, forecasts not tied to a particular model, links to anything
- Natural to create scenario analysis and counterfactuals, or sensitivity analysis
Flexible Toolbox

House Price Assessment

This application calculates three versions of the borrowing capacity:

a) Static BC
b) Simple Look-Ahead BC
b) Look-Ahead BC with offset deposit

Price implied by the static borrowing capacity of households: 4488600

Net income: 45000 CZK per month

[Diagram showing house prices implied by the borrowing capacity vs. interest rates]
Conclusions

Borrowing Capacity and Fair-Value indicators are:

- Simple to compute
- Intuitive and based on economic fundamentals
- Available in real time
- Not prone to revisions due to change in sample size
- Not based on ad-hoc least-squares regressions...
Thank you for your patience...