

PROPERTY PRICE DETERMINANTS IN THE CZECH REGIONS

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This article, based on an empirical analysis, discusses factors affecting property prices and tries to identify periods of property price overvaluation by time series analysis for the Czech Republic as a whole and by panel regression for the Czech regions. The time series analysis identifies overvalued property prices in 2002/2003 and 2007/2008. In 2007/2008, however, the rise in property prices was largely explainable by fundamentals, meaning that the price overvaluation in this period was considerably smaller than that in the first. From the regional perspective, there is a higher degree of overvaluation in regions with higher property prices. The exception is Prague, which seems to be a "specific" region – partly due to the properties of the estimation technique.

1. INTRODUCTION

Property prices surged in the Czech Republic in 2007. The rise continued in 2008 despite the fact that the global financial crisis had already led to major falls in property prices in countries where such prices had surged in the previous decade. A simple comparison of property prices in the Czech Republic and in other countries raises questions about whether the Czech Republic, too, faces such a property price bust and whether the recent growth is a sign of a "bubble" which, if it bursts, might have grave macroeconomic and social consequences.¹⁶ Historical experience shows that the effects when housing market bubbles suddenly burst are accompanied by larger output losses and last longer on average (4 years) than those when stock market bubbles burst (1.5 years). Housing market bubbles pose a greater threat to the financial stability of a country/region if mortgage loans account for a large proportion of total loans (see, for example, Helbing and Terrones, 2003, or Bordo and Jeanne, 2002).

The effect of asset price bubbles on the functioning of the economy can distort the economic and investment decisions of individual economic agents. Their impact can pass through to the housing market via: (i) household consumption through the wealth channel (growth in the prices of property and financial assets held by households is perceived as growth in wealth and consumption financing sources); (ii) the banking sector balance sheet (property prices often serve as collateral in lending operations).¹⁷ These effects differ in strength over time and across economies, but they affect the real economy all the same.¹⁸ What is more, the economic literature does not offer clear recommendations regarding the degree of activity and preventiveness of central bank action – see, for example, Roubini (2006) and Posen (2006) and, for an application to transition economies, Frait and Komárek (2007).

Whether it is possible to identify excessive growth in past and present property prices in the Czech Republic depends to a large extent on whether this growth can be explained using standard demand and supply mechanisms and macroeconomic and demographic indicators and/or various structural characteristics of the housing stock. In addition to the usual difficulties relating to the heterogeneity of property as an asset, such an assessment is complicated by the convergence nature of the Czech economy, where property prices were probably "undervalued" at the start of the period under review and so part of their growth can be classed as "catching-up" with the usual level in developed economies, a process also linked with the constantly expanding

¹⁶ We define an asset price bubble simply as an explosive and asymmetrical deviation of the market price of an asset from its fundamental value that has the potential to correct suddenly and sharply. Asset price bubbles are often caused by psychologically and behaviourally determined factors, self-fulfilling expectations and suchlike. This makes them difficult to identify from both the ex-ante and ex-post perspective.

¹⁷ If property prices rise, the probable loss from selling the collateral on a mortgage loan decreases, which, in turn, notionally increases the bank's capital and allows it to expand its investments and loans. However, a slump in property prices can lead to credit constraints, a credit crunch and a negative impact on economic activity.

¹⁸ According to many studies (e.g. Bordo and Jeanne, 2002, and Borio and Lowe, 2002), credit booms and asset price busts have had grave financial and economic consequences leading to financial crises in emerging markets.

mortgage market in the Czech Republic. Analysis of property prices for the Czech Republic as a developing economy is also complicated by the relatively low liquidity of its housing market, particularly at the start of the transformation process, by comparatively large changes in housing quality growth, which price indices are unable to identify, and by the distorting effects of the persisting regulation of rents.

In the article, we apply two alternative approaches to determining “equilibrium prices”. In the first, we try to explain by time series regression analysis the growth in property prices in the Czech Republic as a whole and in Prague as its capital city, which can be expected to show a different trend than the rest of the country and to display a “price leader” effect. For this analysis, we use quarterly property transfer price index data for the period 1998 Q1–2008 Q3. The figures for 2008 are estimated from supply prices. In the second approach, we apply panel regression analysis on annual data for 1998–2007, with dependent variable being property transfer prices in the individual Czech regions. Most of the explanatory variables in the panel regression were also obtained in a regional breakdown. Égert and Mihaljek (2008) performed a similar analysis across the countries of the Central European region.

2. FACTORS DETERMINING PROPERTY PRICES

The fundamental factors determining property prices in the Czech Republic on which the quantitative analysis below is performed can traditionally be divided into supply and demand factors (see, for example, HM Treasury, 2003, or Égert and Mihaljek, 2008).¹⁹ Their descriptive statistics for the average Czech region, based on annual data, are given in Table 1. The source of data on apartment prices was CZSO property transfer prices.²⁰ Except for the housing loan volume (CNB figures combined with MRD data) and the estimate of market rent (IRI), all the other data came from the CZSO as well. Among other things, Table 1 confirms the assumption that the variability of apartment prices and their individual determinants is in most cases higher – sometimes quite a lot higher – across regions than over time.

Supply factors

Supply on the housing market is generally driven primarily by the profitability of the construction business and is regarded as sticky in the short run (see, for example, Poterba, 1984). The housing market is often divided into two segments: the segment of existing housing with inelastic supply, where the price is already fixed, and the segment of new housing construction, where the price determines the amount of new construction. Supply in the existing housing market can be proxied using the saturation of housing needs (the number of apartments per 1,000 inhabitants) or the dynamics thereof (the number of newly completed apartments). Higher saturation of housing needs should lead, *ceteris paribus*, to lower upward pressure on apartment prices.

The supply factors also include the majority of cost factors, such as land prices, average apartment acquisition amounts and building construction costs (the construction work price index). All these cost factors can be proxied using “apartment construction prices”, which aggregate the total projected construction investment costs. Another possibility is to use the construction output price index. A rise in the costs of acquiring a new apartment should, at a given level of demand, lead to a rise in the value of existing apartments. Supply factors often pass through to property prices with a long lag, due to the long time it takes to prepare and actually implement a construction project.

¹⁹ Égert and Mihaljek (2008) explain real property prices using real variables. In their paper, real variables are calculated from nominal ones deflated by the national consumer price index. However, CPI data were not available for individual regions. Moreover, it is reasonable to assume that the price variability across regions and over time was low relative to the variability across transition countries. As a result, we opted for an analysis based on nominal variables. That said, we performed a calculation by deflating to real variables using the nationwide CPI, but the results turned out to be similar to those obtained using nominal variables.

²⁰ The CZSO computes property transfer prices from data taken from property transfer tax returns. In addition to a large data publication lag, this may imply some data distortion due, for instance, to tax optimisation. On the other hand, these data are more reliable than estate agencies' supply price figures.

Demand factors

Demand for property is determined primarily by households' disposable income, the main component of which is wages and salaries. They affect both the accumulation of savings and wealth by households and the availability and riskiness of housing loans. Other labour market factors that can influence property prices include the unemployment rate, the economic activity rate of the population and the number of vacancies. These factors mostly affect disposable incomes either directly (lower unemployment and a higher economic activity rate of the population mean higher disposable income of households at any given wage level) or indirectly via labour force mobility (migration in search of work). With the exception of unemployment, growth in labour market factors should lead to growth in apartment prices.

Apartment prices can also be affected by various demographic factors: linked with the aforementioned labour market factors is population growth due to migration; natural population growth should act in the same direction. Property price growth should also be fostered by a higher divorce rate, as most divorces turn one household into two, thus giving rise to a need for a new dwelling. The marriage rate can act in the same direction, as a wedding often establishes a completely new household. Demand for housing can also be affected by the age structure of the population, which, however, is reflected in the economic activity rate of the population.

The major factors of property price growth have recently also included the development of the financial market. This is being reflected primarily in growth in housing loans and is reducing the liquidity constraints on households when acquiring their own housing and should therefore be pushing property prices upwards. The mortgage interest rate (proxied by the one-year money market rate) is acting in the opposite direction, as its growth is making loan financing of property purchases less attractive and increasing households' repayments of existing loans. Demand from abroad can affect demand for housing quite strongly. As a proxy for this demand we used the ratio of foreign direct investment to GDP, which, however, like the interest rate, was available only for the Czech Republic as a whole.

Demand for property can also be affected by market rents, growth of which tends to lead to rising apartment prices. This factor reflects substitution between renting and home ownership, as rising rents motivate households to buy a flat of their own. The level of rents also affects investment in housing for speculative reasons, as growth in rents *ceteris paribus* increases the returns on such investment and leads to rising demand for apartments.²¹

Table 1 – Descriptive statistics (figures for average region; annual data for 1998–2007)

	Variable	Unit	Mean	Median	Variability over time (%)	Variability across regions (%)
Supply factors	Apartment prices	CZK/m ²	14,079	13,509	30.1	36.3
	Building plot prices	CZK/m ²	1,410	1,109	20.7	69.7
	Apartment construction prices	CZK/m ²	26,403	26,139	8.3	10.2
	Completed apartments	% of hous. stock	0.34	0.31	28.8	49.4
	No. of apartments per 1,000 inhabitants	number	378	376	2.1	5.0

²¹ The dependence between apartment prices and market rents can go in either direction, of course. The aforementioned substitution between rents and home ownership may therefore mean that, conversely, a rise in apartment prices will lead to a rise in market rents (home ownership will become less affordable, causing demand for rented accommodation to rise). Besides that, one needs to take into account the decisions of owners of rental properties as to whether to continue renting the property or whether to sell it (as happened in the past with many municipal flats with regulated rents). Given the limited length of the time series, however, we do not examine the direction of the causality between apartment prices and other variables in our analysis.

Table 1 – Descriptive statistics (figures for average region; annual data for 1998–2007) – continued

	Variable	Unit	Mean	Median	Variability over time (%)	Variability across regions (%)
Demand factors	Marriages	% of MYP	0.545	0.542	0.053	0.068
	Divorces	% of MYP	0.324	0.327	0.122	0.138
	Natural population growth	% of MYP	-8.9	-10.2	211.2	87.2
	Net migration	% of MYP	15.2	3.9	210.6	5,207.5
	Unemployment rate	%	7.4	6.7	16.4	38.5
	Economic activity rate of population	%	59.9	59.7	1.5	2.3
	Vacancies/labour force	%	0.98	0.86	42.8	30.4
	Average monthly wage	CZK	15,080	14,847	18.9	10.7
	Rent per month	CZK/m ²	84.8	83.1	17.9	27.2
	Loans	CZK millions	15,312	8,031	87.6	107.7

Source: CZSO, CNB, IRI

Notes: Variability computed as standard deviation in % of mean.
MYP denotes mid-year population.

For some of the aforementioned explanatory variables we can expect strong endogeneity within the model of apartment prices, which may be due to causality in the opposite direction. For example, the aforementioned substitution between rents and home ownership may run in either direction (i.e. a rise in apartment prices may lead to upward pressure on rents), higher prices may lead to greater housing construction, and so on. In addition, a common factor may be acting on some explanatory variables, one which is unobserved and which might be the cause of a bubble. For instance, irrational and self-fulfilling expectations regarding future price growth will very probably give rise to a bubble both on the housing market and on the land and rental markets. If we include these variables in the apartment price model, the estimated price bubble will be smaller than in reality. For this reason, we computed all the regressions in two variants – one in which all the variables are included (estimate A) and one in which we discarded the variables with the highest probability of endogeneity (estimate B).

3. RESULTS

The empirical analysis was conducted by means of (i) aggregate regression analysis of time series for the Czech Republic and Prague on quarterly data for the period January 1998–September 2008, and (ii) panel regression across the Czech regions (including and excluding Prague) on annual data for 1998–2007. The explained variable was apartment price growth (aggregate regression) or the apartment price level (panel regression), in nominal terms in both cases. The explanatory variables used are listed in Table 1. In both empirical calculations we work with unlagged exogenous variables (owing to the short length of the time series used). In both analyses we also conducted an estimate based on a narrower set of explanatory variables owing to the possible existence of interlinkages. By comparing them we will also get some idea of the stability and robustness of our results.

3.1 Time series analysis for the Czech Republic and Prague

The results of the regression analysis for Prague and the Czech Republic as a whole (see Table 2) show that the apartment price growth can be explained mainly by rising prices of land and rising rents. A weak effect is also observed for the ratio of foreign direct investment to GDP. The growth in apartment prices in Prague can also be explained by movements in unemployment. In the case of the Czech Republic, net migration was another significant factor, along with natural population growth and partly also the marriage rate in the case of the narrower estimate. The other variables used were not significant at the required level of significance. This can be interpreted as meaning that the evolution of apartment prices over time cannot be explained by the majority of demographic and other macroeconomic time series.²²

Table 2 – Results of regression for Prague and the Czech Republic

Variable	CZ – Estimate A		CZ – Estimate B		Prague – Estimate B	
	Coefficient	Std. dev. ^b	Coefficient	Std. dev. ^b	Coefficient	Std. dev. ^b
Apartment prices ^a						
Land prices ^a	0.665*	0.342	-	-	-	-
Construction output price index ^a	0.256	1.475	-1.127	1.102	1.155	2.286
Completed apartments ^{a,c}	0.026	0.028	0.091*	0.048	0.088**	0.041
No. of apartments per 1,000 inhabitants	0.000	0.001	0.001	0.002	0.000	0.001
Marriages ^c	0.483	0.487	0.830*	0.441	0.129	0.604
Divorces	-0.064	0.387	0.010	0.468	0.219	0.622
Natural population growth ^c	-0.408	0.529	-0.695*	0.381	-0.633**	0.296
Net migration	0.105**	0.055	-0.001	0.066	-0.025	0.024
Unemployment rate	-0.006	0.005	-0.007	0.006	-0.049***	0.017
Economic activity	-0.001	0.007	-0.007	0.015	-0.001	0.007
Vacancies/labour force	0.036	0.069	0.113	0.070	0.005	0.046
Average monthly wage ^{a,c}	0.370	0.268	0.441	0.268	0.197	0.273
Rent per month ^a	0.344*	0.203	-	-	-	-
Loans ^a	-0.037	0.066	-0.065	0.081	0.091	0.139
1Y PRIBOR	-0.002	0.002	-0.002	0.004	-0.006	0.004
Ratio of FDI to GDP	0.0034**	0.001	0.0034*	0.0018	0.0032*	0.0018
Adjusted R ²	0.48		0.20		0.15	
Durbin-Watson statistic	1.64		1.23		1.56	

Source: CZSO, CNB, IRI

Note significant at ***1%, **5% and *10% level of significance

^a differences, ^b Newey-West HAC standard deviations, ^c seasonally adjusted

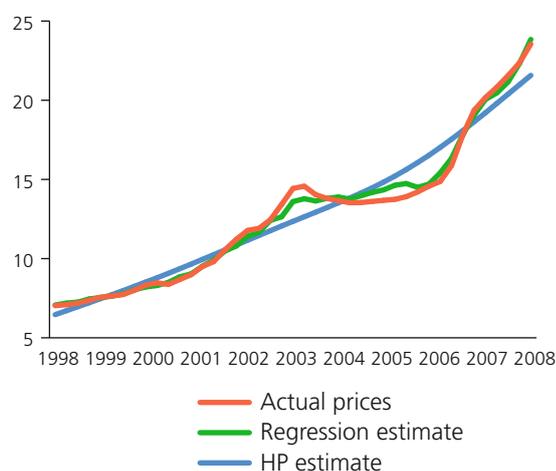
The above estimate A for the Czech Republic²³ can be used to broadly identify periods when property prices were overvalued and also to identify the magnitude of such overvaluation. The estimates of equilibrium property prices and the gaps between actual and equilibrium property prices are shown in Charts 1 and 2. These estimates were then compared with the “naive” equilibrium estimate obtained by applying the Hodrick-Prescott (HP) filter.

²² Tests of the residuals ruled out the occurrence of autocorrelation and non-normality at the usual level of significance. Moreover, tests of the stability of the coefficients by recursive estimation demonstrated relatively satisfactory stability.

²³ As our regression estimates the equilibrium quarter-on-quarter growth in property prices, the equilibrium absolute prices were computed from the estimated quarter-on-quarter increases.

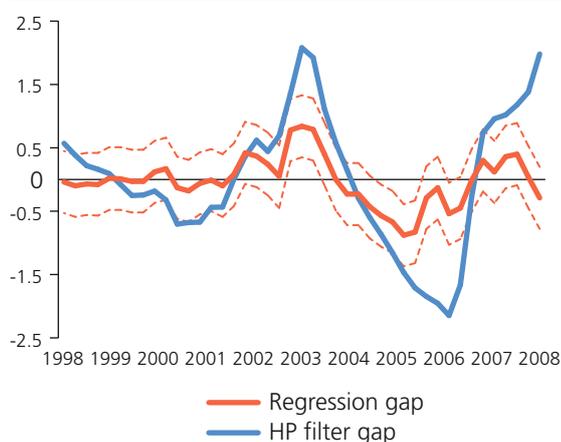
Like the HP filter, our regression identifies two possible periods of property price overvaluation (bubbles), namely the start of 2003 and late 2007/early 2008. The one-quarter to one-half level of overvaluation resulting from the model compared to the HP filter is not surprising.²⁴ One interesting conclusion, however, is that although it may seem from the simple view using the HP filter that the degree of absolute overvaluation of prices was roughly the same in these two periods, our estimated regression identifies roughly half the level of overvaluation for 2007–2008 compared to 2002, which is not all that significant from the statistical perspective.²⁵ This outcome reflects the fact that the growth in prices in 2002/2003 was driven mainly by speculation linked with the Czech Republic's accession to the EU, whereas the recent surge in 2007/2008 is due primarily to improved fundamentals (wage growth, higher population growth, lower unemployment, etc.).²⁶

CHART 1 – Apartment prices in the Czech Republic (CZK thousands per m²)



Source: CZSO, CNB calculation

CHART 2 – Gap in prices in the Czech Republic – deviation of actual prices from estimate in CZK thousands per m² (dashed lines indicate 10% confidence interval)



Source: CZSO, CNB calculation

Note: positive values overvaluation, negative values undervaluation; dashed lines indicate 10% confidence interval

3.2 The Czech Republic by regions

In order to capture analytically the aforementioned heterogeneity of houses as an asset at least partially, we estimated a panel regression for apartment prices covering the individual Czech regions.²⁷ The results are summarised in Tables 3 and 4.

²⁴ The fact that the regression-based estimate fits the actual data more closely than the HP filter is due to the additional effect of a relatively high number of explanatory variables. When the version of the model with endogenous variables excluded is used, the result lies somewhere between the HP filter and the model containing all the explanatory variables in Table 1.

²⁵ When the overvaluations are expressed in percentages of property prices, the regression identifies overvaluations of around 6.3% at the start of 2003 and around 2.4% at the start of 2008, whereas the HP filter identifies overvaluations of roughly 12% and 7% respectively for the same periods.

²⁶ This outcome is also linked with the nature of the data, i.e. with the different cyclical component in the individual variables in the regression, which to some extent prevents a bubble from manifesting itself.

²⁷ The statistical tests indicated that it was appropriate to use a panel regression with fixed effects. We tested the panel data for non-stationarity using the Hadri panel unit root test, which tests for stationarity in so-called heterogeneous panels.

To capture the differences in property prices between regions, we used absolute prices in CZK per m².²⁸ However, to eliminate non-stationarity of the residuals, we had to incorporate apartment prices lagged by one year into the regression. Not surprisingly, they turned out to be statistically significant, indicating some persistence in apartment prices.²⁹

The panel regression results also showed that cost effects are not a significant factor of apartment price growth. The effect of a rise in building land prices had the correct positive sign, but was insignificant. In the case of land prices, one can also, of course, discuss the direction of the implication between apartment prices and building land prices, or their substitutive relationship as assets to apartment prices. The regression implicitly considers this cost effect, as higher land prices lead to higher costs of new apartment construction and higher prices of new apartments. However, one can also consider the opposite effect where high apartment prices lead to more intensive apartment construction, reflected, in turn, in higher demand for building land, which, given its low price elasticity, leads to rising prices of land. The second component of apartment-building costs, "apartment construction prices"³⁰, which reflect the costs of building, also turned out to be insignificant and even had the opposite sign than expected. This is probably because this price shows little variability between regions or over time.

Of the other supply factors, the number of apartments per 1,000 inhabitants also proved significant, drowning out the number of newly completed apartments. The number of apartments had the opposite sign than expected (higher housing saturation should lead, *ceteris paribus*, to lower prices). The explanation here may again be the opposite implication, with higher apartment prices – given relatively stable construction costs across regions – leading to higher apartment construction and, in turn, to a higher number of apartments. However, when Prague is excluded from the dataset (see the Prague specifics described below) this variable turns out to be statistically insignificant.

Of the demographic factors, the divorce rate proved significant. The sign on it is consistent with intuition, as a higher divorce rate leads to a greater need for housing (a divorce usually gives rise to a new household). A similar effect can be expected for the marriage rate, although it turned out to be statistically insignificant. As for population growth, net migration was significant. Its higher statistical significance compared to natural population growth is quite logical. In the case of higher natural population growth, due to a higher birth rate, the "new inhabitants" mostly enter existing households, whereas migration more often gives rise to a new household and hence a new need for an apartment. The statistically insignificant effect of natural population growth was in fact opposite to what was expected, which may again be explained by the fact that higher availability of housing (i.e. lower apartment prices) may conversely motivate young couples to have larger families. The variables relating to the labour market (unemployment, economic activity, number of vacancies) also proved to be statistically insignificant. This may reflect the generally low labour mobility within the Czech Republic, as relatively few people move in search of work and labour market imbalances tend to be resolved by commuting or by the employment of foreign casual workers, whose demand for home ownership is low. The highest statistical significance (bordering on the 15% level), and also the logical sign, was recorded by the unemployment rate.

Of the other demand factors, growth in market rent proved significant, reflecting substitution between renting and home ownership. The significance of the coefficient meanwhile confirms the role of the price-to-rent ratio as an important indicator of the stability of apartment price growth. The significance of the price-to-wage ratio was also confirmed, as the coefficient on wage growth was significant at the 1% level with the expected sign. The expected role of housing loans as a major demand mechanism of property price growth was also confirmed.

²⁸ The use of absolute prices, however, precludes a simple comparison of the magnitudes of the resulting coefficients between Tables 2 and 3. In the first case the coefficients reflect the impact on price growth, whereas in the second they reflect the impacts on the price level. Moreover, the significance of the coefficients from the panel regression may differ from the results of the regression in section 3.1. Some of the variables may have insufficient variability over time (and so cannot explain the growth in prices) but sufficient variability across regions (which may lead to them being significant in the panel regression).

²⁹ The estimated coefficient here is less than one, so the estimated relation should converge.

³⁰ "Construction prices" mean the total projected construction investment costs (at least the amount stated the planning permission application documents, i.e. the tentative costs of the build, including equipment). The total acquisition amount does not include the cost of land. See CZSO (2008).

Of the variables that were used for all regions the same, only the interest rate turned out to be statistically significant, although unfortunately it had the opposite sign than expected. This deviation may have arisen because we used the interest rate on the interbank market, whereas interest rates on new housing loans would have been economically more meaningful (and the spread between these two rates can change quite significantly over time). Unfortunately, however, we did not have housing loan rates available for the whole time period (figures are only available from 2004 onwards).

Table 3 – Results of panel regression by Czech regions

Variable	CZ – Estimate A		CZ – Estimate B		CZ excl. Prague – Estimate B	
	Coefficient	Std. dev.	Coefficient	Std. dev.	Coefficient	Std. dev.
Apartment prices						
Apartment prices ^a	0.850***	0.207	0.570***	0.122	0.619***	0.144
Land prices ^b	0.437	0.726	-	-	-	-
Apartment construction prices ^b	-0.024	0.063	-0.031	0.084	-0.046	0.091
Completed apartments	-3,010	126,118	65,557	133,028	13,130	121,986
No. of apartments per 1,000 inhabitants	107.9*	66.0	100.7*	52.4	79.91	67.77
Marriages	-133.7	4,362	-1,748	5,503	-4,831	5,991
Divorces	5,795**	2,853	5,408	4,505	3,868	4,475
Natural population growth	-1,160	2,659	-4,201	2,787	-4,843	2,951
Net migration	1,333***	478.5	1,729***	480.0	1,422***	486.3
Unemployment rate	-200.8	142.7	-349.6**	147.6	-216.2	159.9
Economic activity rate of population	28.54	223.5	73.6	275.4	30.79	294.2
Vacancies/labour force	-3.85	6.37	7.03	5.83	3.61	6.24
Average monthly wage ^b	2.749***	0.958	3.402***	1.001	3.251**	1.139
Rent per month ^b	109.9***	26.9	-	-	-	-
Loans ^b	0.0778*	0.050	0.093**	0.046	0.365***	0.121
1Y PRIBOR	439**	204.8	27.64	232.69	210.9	241.0
Ratio of FDI to GDP	-6,100	4,569	-6,121	5,636	-4,146	5,993
Durbin-Watson statistics	1.64		1.23		1.56	

Source: CZSO, CNB, IRI

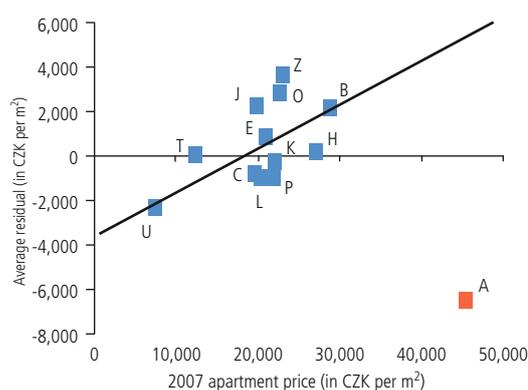
Note: significant at ***1%, **5% and *10% level of significance

^a variable lagged by 1Q, ^b differences

The overall statistical properties of the panel regression seem fairly good (see Table 4). We succeeded in explaining the variability of prices across regions better than their variability over time, but the difference was not large. The statistics confirm the appropriateness of using the fixed effects model. The F-test of equality of the constants for fixed effects rejects the hypothesis of equality at the 7% level of significance, which at least partly confirms the hypothesis that some regions are specific in nature. For example, one can assume that apartment prices in Prague are, *ceteris paribus*, higher than in other regions, because Prague is the capital city. The specific nature of property prices in Prague is confirmed by Chart 3, which compares the residuals of the panel regression by regions with prices in those regions. This chart shows that it generally holds that apartment prices in regions with lower prices are undervalued (negative residuals), whereas those in regions with higher prices are somewhat overvalued (positive residuals). But in Prague (labelled A in the chart), apartment prices diverge from this positive relationship between the price and the degree of overvaluation, recording an absolute undervaluation despite

being the highest of all.³¹ This undervaluation, however, may be partly due to the properties of the estimation technique. If prices in Prague were systematically higher than in the rest of the Czech Republic in the past (as the data show), the panel regression will assign them the highest fixed effect in absolute terms compared to the other regions. This may mean that the conclusion that apartment prices in Prague are undervalued is based on explanatory variables which are not necessary equilibrium variables themselves. For illustration, there are roughly 14% more houses per 1,000 inhabitants in Prague compared to the average region, while wages are 38% higher, unemployment is around 50% lower, net migration is 4.5 times higher and lending for housing purposes per person is roughly 2.5 times higher. Given the still relatively short length of the available time series, there is thus a question as to whether the resulting “undervaluation” is in fact real. The conclusion that apartment prices in Prague are undervalued compared to the other Czech regions is also inconsistent with the comparison of the price-to-income and price-to-rent ratios between regions, which indicates that Prague is, on the contrary, the highest-risk region (see Box 6 Identifying property market bubbles in CNB, 2007).

CHART 3 – Apartment price overvaluation relative to apartment price (average residual for 1998–2007)



Source: CZSO, IRI, CNB, CNB calculation

Note: Region abbreviations given in abbreviations list

Table 4 – Results of panel regression by Czech regions – statistics

Statistic	Value	Statistic	Value
No. of observations	117	No. of groups (regions)	13
R ² – within (between regions)	0.947	R ² – between (over time)	0.893
R ² – overall	0.896	rho	0.842
F (17, 87)	167.82	Prob > F	0.000
F test of equality of constants for regions (FE)			
F (12, 87)	1.73	Prob > F	0.073

4. CONCLUSIONS

In this article we focused on analysing property price determinants using two simple econometric models. To the best of our knowledge, this is the first such application of econometric techniques to property prices in the Czech Republic. For this reason, and also because of difficulties associated with the properties of the analytical methods applied and with the relatively short time series used, the results of the analysis should be interpreted with caution. That said, a number of conclusions can be drawn. Of the demographic factors, both regressions confirmed a positive effect of net migration on property prices. The divorce rate also seems to be important. The effects of cost factors were mixed: the time series analysis results showed land prices to be significant, while in the panel regression cost factors tended to be insignificant or even contrary to economic intuition (the number of apartments per 1,000 inhabitants). The unemployment rate and wage growth turned out to be significant among the labour market-related demand factors, as did credit growth among the other factors.

One interesting result is the identification of periods when property prices were overvalued. As expected, the model identified property price bubbles in 2002/2003 and 2007/2008. Rather surprisingly, however, the level of overvaluation in 2007/2008 was significantly lower than in the first period, even though the increases

³¹ In relative terms the price undervaluation in Prague (A) is second highest behind Ústí nad Labem (U).

in prices in the two periods were similar. Much of the recent rise in prices can be explained by fundamentals and the bubble is not as large as it might appear at first glance. Given the impacts of the financial crisis on the Czech economy, however, renewed inflation of the bubble “from below” via worsening fundamentals cannot be ruled out entirely unless property prices fall in absolute terms.

Looking at the individual regions, one quite surprising result is that the level of overvaluation of apartment prices in individual regions is positively related to the apartment price level (in regions where apartment prices are higher, they are also more likely to be overvalued). Apartment prices in Prague are the exception to this rule, recording the greatest absolute undervaluation. This undervaluation is probably due partly to the properties of the estimation technique, as the conclusion that apartment prices in Prague are undervalued may be based on explanatory variables which are not necessarily equilibrium variables themselves. This outcome is therefore not wholly consistent with earlier simple analyses. It may be due to the properties of the estimation technique and may thus not be entirely robust. However, it confirms that the property market in Prague is specific in nature compared to the other Czech regions. This type of analysis will be further systematically refined, as it forms an integral part of central banks’ financial stability map.

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