AN ANALYSIS OF PROGRESS WITH THE SALE OF RESIDENTIAL DEVELOPMENTS

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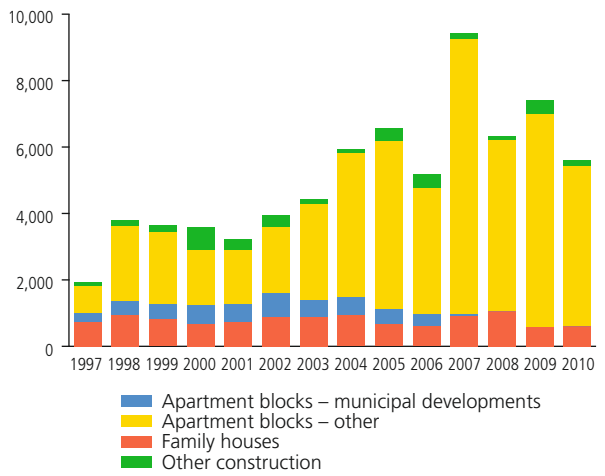
This article analyses residential developments using a database of individual projects for the years 2006–2010. Changes in the supply structure towards smaller apartments in recent years were identified in this unique database. These changes were probably a reaction to higher demand for smaller apartments, which also recorded the strongest fall in prices. The main part of the article contains estimates of so-called "sales progress S-curves". These estimates reveal quite a sharp deterioration in progress with the sale of apartments in 2009 and 2010. A model of the determinants of deviations of progress with the sale of individual projects from the estimated S-curve suggests the existence of unobserved factors that probably have an opposite relationship to apartment prices than expected. The other significant variables were apartment size, number of garage spaces per apartment and balcony area per apartment.

1. INTRODUCTION – MOTIVATION FOR THE RESEARCH

This article analyses residential developments in apartment blocks in Prague. The property development sector[1] has boomed in recent decades, driving forward apartment construction in the Czech Republic and especially in Prague (apartment construction has been more than twice as intensive in Prague and adjacent districts than in the rest of the Czech Republic owing to developers' ability to achieve higher selling prices for apartments in Prague). Back in 1997, commercial apartment construction in apartment blocks accounted for 43.3% of all apartment completions in Prague (the remainder consisting mainly of apartment construction in family houses and municipal apartment construction), whereas in 2007–2010 the figure was almost twice as high (85.8%). Apartment construction in family houses meanwhile remains stable, while municipal apartment construction has practically disappeared (see Chart 1). The recent surge in apartment construction (the average number of apartment completions in the Czech Republic was more than three times higher in 2007–2010 than in the mid-1990s) can therefore be attributed to commercial apartment block developments.

Chart 1

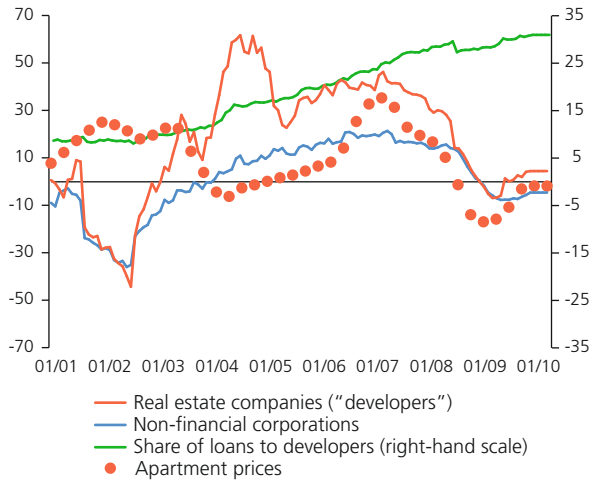
CONTRIBUTIONS OF COMMERCIAL DEVELOPMENTS TO NUMBER OF APARTMENT COMPLETIONS IN PRAGUE



Source: CZSO, Prague City Hall

Chart 2

CREDIT GROWTH: REAL ESTATE COMPANIES VERSUS NON-FINANCIAL CORPORATIONS
(y-o-y changes on left-hand scale, loan shares on right-hand scale)



Source: CNB, CZSO

1 For the purposes of this article, a developer is any business that invests in residential developments with the intention of selling them on or renting them out. Developers are often companies linked to financial institutions or property management companies. Building societies also often have a development aspect to their activities.

However, the expansion of the real estate sector entails numerous risks both for the financial sector and for the household sector. These risks are often associated with new channels of transmission of property prices to credit risk: a fall in property prices can now affect the banking system via developer default. Part of developers' credit risk is borne by households that have paid for apartments but do not yet own them.[2] Developers and other real estate companies have meanwhile become major clients of banks and can significantly affect the overall credit risk of the banking portfolio of non-financial corporations. The share of loans to real estate companies[3] in total loans to non-financial corporations has risen from around 9% at the end of 2002 to a current level of approximately 32% (see Chart 2). Recently, moreover, the link between growth in loans to developers and property price growth has been relatively strong. A similar link exists for the non-performing loan ratio. Real estate companies also have a higher proportion of foreign currency loans than other non-financial corporations (24.6% versus 18.4%), which may also indicate increased exchange rate and credit risk among such clients.[4] Banks have reacted to the potential deterioration in the financial condition of developers during the crisis by tightening their credit conditions. For example, minimum down payments have risen from around 10% in 2007 to a current level of 30–40% and projects are required to have high advance sales. The tighter lending conditions may exacerbate developers' situation.

One of the key factors of success of a development project is the rate at which individual apartments in the development are sold. If the sale of apartments falls significantly behind schedule, the developer receives its revenues later and the project financing costs go up. This, in turn, can increase the risk of the developer defaulting on loans to banks or being forced to postpone construction, which, however, will transfer part of the costs to clients who have already invested in the project.

To determine sales progress curves, the empirical part of this article uses a unique database[5] containing information on progress with the sale of residential developments in Prague. This database has been compiled over the last five years by co-authors from the Czech Technical University (CTU) in Prague. The article is structured as follows. Section 2 describes the database and the stylised facts that ensue from this description. Section 3 describes the method used to estimate the sales progress curves. Section 4 analyses the determinants of deviations of individual projects from the estimated sales progress curves. The final section concludes.

2. DESCRIPTION OF THE SOURCE DATABASE AND STYLISED FACTS ABOUT THE PROPERTY DEVELOPMENT MARKET

The analyses conducted in this article are based on a database of property development projects compiled by co-authors from CTU (see Čápová, 2005, or Prostějovská, 2010). The data in this database are sourced mainly from websites on which individual developers post information about their projects. The database covers residential projects in apartment blocks in Prague. It only contains projects with 10 or more apartments for which all the necessary data are available. It does not include family house developments and purely commercial (office, retail and industrial) developments. The database has been collected for several years now, always in the middle of the year, and covers the period 2006–2010. As Table 1 shows, the number of apartments in the database each year fluctuates between 3,500 and 9,000, accounting for 30–75% of all apartments under construction in apartment blocks in Prague. The database is therefore fairly representative. For the entire period, the database featured a total of 139 projects with 15,489 apartments (some projects appear in the database in more than one year[6]). The total value of all the apartments in the database

2 The property price channel through the property development sector can be illustrated by the slump that occurred in prices of developers' shares traded on the stock exchange in 2009 in response to falling apartment prices. Of course, developers' activities are not limited to residential projects. However, it is simpler to analyse residential projects, partly because the final product is more homogeneous and partly because the number of transactions is much higher than in the case of commercial projects.

3 However, developers are just one group within this CZ-NACE category. Others include estate agents, housing cooperatives and owners' associations. At the same time, not all loans to developers are earmarked for residential projects; a large proportion are used for commercial (office, industrial and retail) developments.

4 The higher proportion of foreign currency loans is probably linked mainly with developers' commercial projects, where transactions are mostly denominated in foreign currencies.

5 To the best of our knowledge, the only comparable database is that of property development company Ekospol (for a description, see Korec, 2010). However, the analyses published by Ekospol are only partially comparable with ours (for example, they cover projects with 50 or more apartments, whereas our database selects projects with 10 or more).

6 In all, 56 projects appeared in the database only once, 53 projects in two years, 20 projects in three years, 8 projects in four years, and 3 projects in all five years.

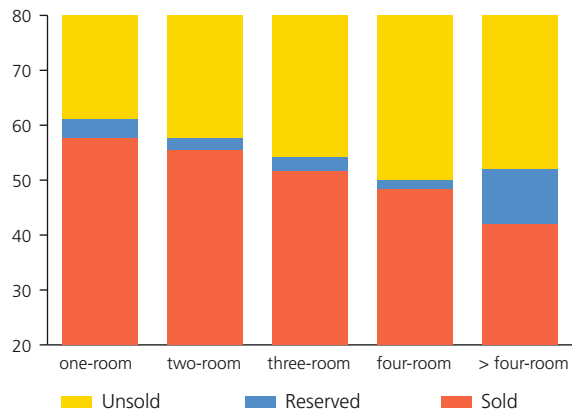
Table 1

BASIC DESCRIPTION OF DATABASE

		2006	2007	2008	2009	2010
No. of projects		72	55	32	56	47
No. of apartments		9,865	6,820	3,518	5,837	4,491
Apartments under construction (CZSO)		12,704	10,806	11,980	13,814	13,814
Representativeness of sample		77.7	63.1	29.4	42.3	41.8
Value of apartments (CZK bn)		33.0	24.0	16.5	24.8	16.9
Shares of apartment types in %	one-room	11.1	12.5	9.6	11.7	12.5
	two-room	33.9	30.5	28.9	30.9	32.3
	three-room	38.3	38.7	41.0	40.1	40.4
	four-room	13.2	15.9	18.6	15.5	14.4
	> four-room	3.4	2.4	1.9	1.8	0.5

Chart 3

SOLD, RESERVED AND UNSOLD APARTMENTS IN 2010 BY APARTMENT TYPE
(in %)



Note: The number of rooms given does not include kitchen, hallway, bathroom and toilet. The apartment type structure is calculated using the total floor area in square metres.

varied between CZK 16.5 billion and CZK 33 billion in individual years (and was CZK 54 billion for the period as a whole, again treating duplicate data).

The database contains basic project identification data, i.e. the project name, the address, the website from which the data were sourced, the name of the developer and the name of the financing bank. Other important pieces of information include the scheduled project completion date, the number of garage spaces and the proportion of commercial space. The project structure according to the number of rooms per apartment (not including kitchen, hallway, bathroom and toilet) is also given for each development. For each of these categories the following information is presented: the number of sold, reserved[7] and unsold apartments, the average apartment size in square metres, the supply (i.e. asking) prices of unsold apartments, balcony area, etc. As Table 1 shows, the shares of the individual apartment types in projects have changed relatively little. Between 2006 and 2008 the proportion of one-room and two-room apartments decreased and the proportion of larger apartments increased. In 2009 this trend reversed, and in 2010, for example, there were hardly any apartments with five rooms or more in the database. Chart 3 shows that in 2010 there was quite a strong negative correlation between the number of rooms per apartment and the percentage of apartments sold, so the decline in the share of large apartments may reflect some reaction of the apartment supply structure to changes in demand. It is clear from the chart that the apartment size structure of property development projects can be a significant factor of sales success.

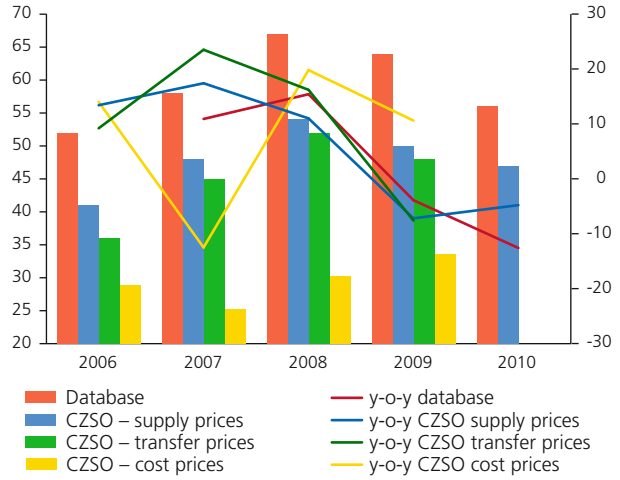
Another important characteristic of the projects in the database is their price. Generally, a higher price should *ceteris paribus* increase the developer's revenues and profit, but on the other hand it reduces demand for projects and therefore increases the time to sell. Chart 4 shows that the supply prices of new apartments in the database in individual years were 23.4% higher on average than the supply prices of older apartments, 33.8% higher than the actual transaction prices of older apartments and more than double the "cost" prices of apartments in apartment blocks (referred to by the Czech Statistical Office as the "acquisition value per dwelling").[8] The dynamics of apartment prices in the database are broadly in line

7 Developers often overstate the numbers of reserved apartments as a marketing trick, so in the end we did not use the data on the number of reserved apartments and instead treated them as unsold apartments.

8 However, the fact that the supply prices of property development projects were roughly twice as high as the cost ("acquisition") prices does not mean that developers had 50% profit margins. The "acquisition value per dwelling" comprises the investment costs of building a new apartment and de facto reflects purely construction costs only. It does not include the price of land or any other additional costs (design, administration, marketing). The profit margins achieved in reality are therefore lower. According to information from developers themselves (published at the start of 2011), margins were squeezed to a minimum. This information, however, is difficult to verify.

Chart 4

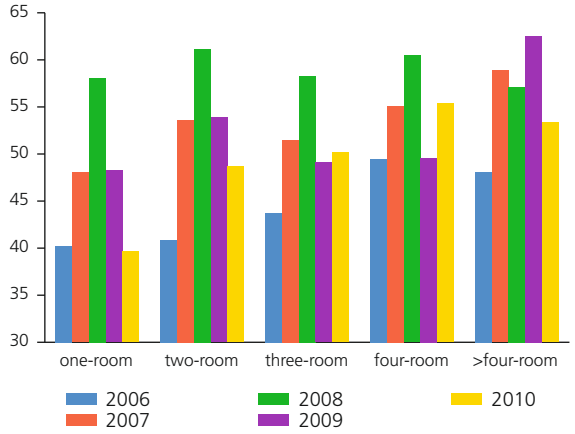
COMPARISON OF AVERAGE APARTMENT PRICE IN DATABASE WITH OTHER DATA SOURCES
(average price in CZK thous./m² on left-hand scale; year-on-year growth in average price in % on right-hand scale)



Source: CZSO, CTU

Chart 5

AVERAGE APARTMENT PRICE IN DATABASE IN CZK THOUSANDS PER SQUARE METRE BY APARTMENT SIZE



Source: CTU

with those of market prices of older apartments. Prices of used apartments fell faster in 2009 (i.e. developers were unwilling to respond to the reduced demand by cutting their prices), whereas prices of new apartments fell faster in 2010. In our analysis, we compared the prices of individual projects with supply prices of older apartments[9] in the same locality and used this "relative" price as an explanatory variable. This should filter out the heterogeneity of prices across different administrative districts in Prague. The fact that growth in cost prices was higher than growth in supply prices of new apartments in 2009 also suggests cost pressure on developers' profits.

Chart 5 shows the link between the aforementioned apartment size structure and apartment prices. For most of the period smaller apartments were cheaper than larger ones (although this did not apply in 2008–2009, when prices per square metre were similar across all types of apartments). The hypothesis that there is a U-shaped relationship between the price per square metre and apartment size is not really confirmed here. According to this hypothesis, the unit price of a small apartment should more strongly reflect the fixed costs (main entrance, bathroom, kitchen, etc.), which are similar for all apartments regardless of their size, while very large apartments are more luxurious and more expensive. The chart also shows that prices of small apartments reacted far more strongly than those of larger apartments during the 2009–2010 financial crisis (one-room apartments fell in price by more than 30%, four-room apartments by 9.5% and five-room apartments by 6.6%). This indicates stronger price elasticity of demand in this segment of the market and also helps to explain the better sales rate recorded for small apartments (see Chart 3).

3. SALES PROGRESS S-CURVE ESTIMATES

To follow progress with sales we estimated so-called "sales progress S-curves". S-curves are used in a whole range of fields to track the evolution of various processes or projects over time. They have been applied, for example, in hydrology (Brutsaert, 2005). In economics they have been used in project management (Forster, 1986; Barraza et al., 2004) and in the study of innovation cycles and R&D (Brown, 1992; Mann, 1999). To the best of our knowledge, however, they have never before been used to analyse the property market.[10] The meaning of the S-curves is illustrated in Chart 6, which plots the developer's cash flow over time

9 These apartment supply prices in the individual districts of Prague were sourced from data published regularly by Václav Dolanský in the weekly Realit (see Dolanský, 2011). These data are also the primary source for the apartment supply prices published by the CZSO.

10 For the purposes of this article, the S-curves were estimated using the normal cumulative distribution curve; however, we obtained similar results for other curves of similar shape (for example the logistic distribution).

in relation to the shape of the aforementioned S-curves (excluding project financing costs). "*T*" in Chart 6 denotes the time of completion of apartments in the development. The costs/revenues per apartment, which, for the sake of simplicity, are normalised to the cost prices per apartment (the "apartment acquisition price"), are shown on the vertical axis. The developer's costs also take the form of an S-curve (plotted in blue in Chart 6), although this curve is to the left of the sales progress S-curve. This is because the bulk of the costs are associated with actual apartment construction and the developer's post-completion costs (consisting de facto solely of necessary maintenance and marketing costs) are marginal. Moreover, the developer incurs a large proportion of its costs before starting the construction and sale of the apartments (land purchase, project costs, administrative costs associated with obtaining building permits, etc.). At each moment in time, the project revenues (the red curve) are given by the product of the chosen value on the S-curve and the corresponding progress with sales (denoted in Chart 6 as $S(t;p)$; the value – ranging between 0 and 100% – corresponds to the ratio of the number of apartments sold to the total number of apartments in the development) and the normalised apartment price. For high t (t tending to infinity), the value of revenues is given by the price per apartment p. The developers' revenues must be higher than its costs (thanks to normalisation the latter are equal to 1 for high t), i.e. the normalised apartment price must be higher than 1; otherwise the project cannot be profitable and will never be implemented. As the revenue curve for low t lies below (or to the right of) the cost curve, the project generates negative cash flow in its initial phases, which needs to be financed (either from the developer's own funds or, for example, by a bank loan). The total financing need is given by the grey area in Chart 6. If the sales progress S-curve shifts to the right (the revenue curve for this case is plotted in green in Chart 6), the financing need increases. This, in turn, increases the costs of the development (either the direct financial costs in the case of bank loan financing or the opportunity costs in the case of financing from the developer's own funds).

The developer can react to the negative situation by cutting the cost to p_1. This would shift the sales progress S-curve to the left towards its original shape and would in all probability reduce the financing need. On the other hand, however, the revenue curve for high t would be shifted downwards (indicated in Chart 6 by the purple curve). This would reduce the developer's profit. If the project is at the early stages of construction, the developer can also try to react by postponing completion of the project, which could shift the cost S-curve to the right (not shown in Chart 6). This will reduce the financing need, but on the other hand it transfers the financial costs to the developer's clients who have already purchased apartments in the project. This, in turn, could reduce the developer's credibility and negatively affect progress with sales in the future.

Chart 6

APARTMENT SALE S-CURVES AND FINANCING NEED OF PROPERTY DEVELOPMENT PROJECTS

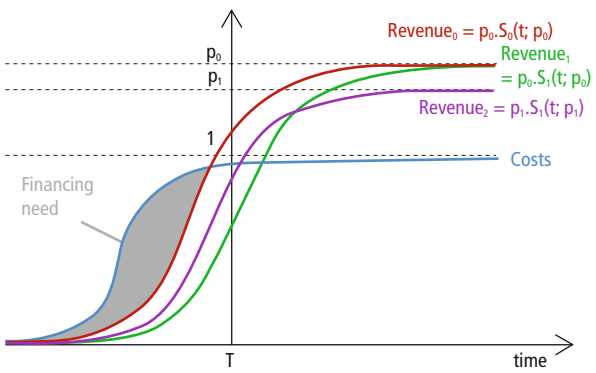
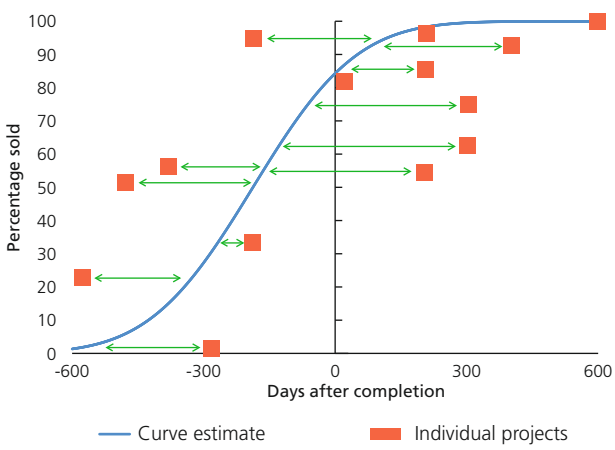


Chart 7

ILLUSTRATION OF S-CURVE ESTIMATION METHOD



The method used to estimate the sales progress S-curves is illustrated in Chart 7. For each project in each year, we first of all calculate the number of days after project completion as the difference between the current date and the scheduled project completion date.[11] Similarly, we compute the percentage of apartments sold in the given project in the given year, and the combination of the two values is then plotted on the chart for each project (the individual projects are represented in the chart by red points). The sales progress S-curve is then fitted to the resulting points in such a way as to minimise the sum of the squares of the horizontal distances of the individual points from the curve (the green arrows in Chart 7).[12] In the cumulative normal distribution case used, the optimisation parameters are the mean and the standard deviation. In this way it is possible to estimate the sales progress S-curves both for the entire period of 2006–2010 and for the individual years. Unfortunately, however, owing to the limited number of realisations for individual projects, it is impossible to meaningfully fit sales progress S-curves for individual projects (see footnote 3) – the estimates would make sense for only 11 out of the total of 139 projects.

The estimated S-curves for the individual years and for the entire period of 2006–2010 are presented together with their parameters in Chart 8 and in Table 2. These estimated curves allow us to quickly assess the residential development market situation in each year. The residential development market situation is better for S-curves that are further to the left, i.e. that have a lower estimated mean (this indicates when the most apartments in the project have been sold; for the projects in the database the estimated mean was negative, i.e. most of the development was sold before project completion). A similar indicator is the percentage of apartments sold before project completion (the intersection of the estimated S-curve with the y-axis). Developers prefer the sales progress S-curve with the highest such percentage. Consequently (given the negative mean), sales curves with a lower standard deviation are preferred – with a higher standard deviation the percentage of apartments sold well before project completion is higher, but fewer apartments have been sold as of the project completion date. The normalised deviation of the actual value from the estimated S-curve (the last row of Table 2) shows the average distance of the individual project points from the S-curve and therefore reflects the representativeness of the estimated S-curve in the given year.

Chart 8

ESTIMATED S-CURVES

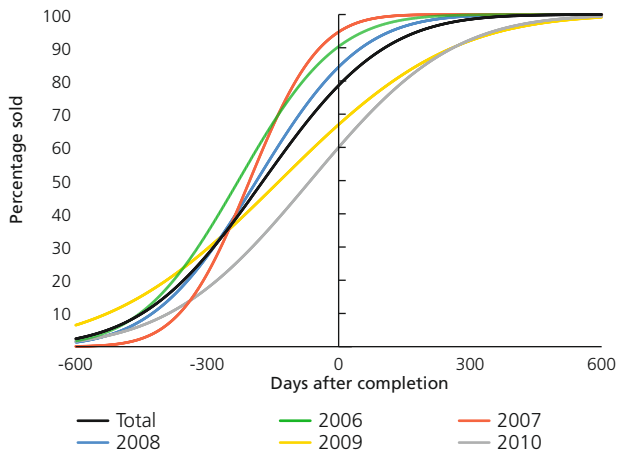


Table 2

PARAMETERS OF ESTIMATED S-CURVES

	2006	2007	2008	2009	2010	Whole period 2006–2010
Sold before completion (in %)	90.4	94.8	84.3	66.9	60.1	78.7
Mean of distribution (days)	-229	-203	-188	-134	-65	-172
Std. dev. of distribution (days)	176	125	186	307	253	216
No. of projects	59	49	29	45	40	222
Normalised deviation of actual situation from estimated curve (days)	29.4	33.6	72.9	44.5	64.4	21.7

11 In cases where the project completion date was shifted to a later date between two observations, we used the original scheduled project completion date.

12 We therefore minimise the sum of the squares of the difference between the monitored number of days until apartment completion and the "projected" number of days until project completion. The tracked sales percentage is inserted into the inverse function of the cumulative normal distribution (the value of the inverse function of the normal distribution here shows the phase the project would be in if it was going exactly according to the estimated curve). This calculation method, however, means that observations with zero or 100% sales, for which the inverse function is not defined, have to be excluded. The alternative would be to fit the S-curve by minimising the vertical distances from the S-curve (as was done, for example in CNB, 2010, p. 54), but this is more difficult to interpret economically.

The favourable property market situation in 2007 was reflected in a rise in the estimated percentage of apartments sold at project completion to almost 95%. However, in 2008, when supply prices of older apartments were still rising, most of the parameters of the estimated S-curve worsened. In 2009 and 2010, by which time the financial crisis was being reflected in falling prices of apartments, the S-curve parameters deteriorated further. In 2010, the majority of the S-curve parameters were at their worst levels since 2006 – the mean of the distribution, at -65 days, was less than one-third of the 2006 value in absolute terms, the standard deviation, at 253.4 days, was the second-highest after 2009, and the proportion of apartments sold before project completion was the lowest since 2006 (60% compared to a peak of 95%). The high deviation of projects actually implemented from the estimated curve indicates quite significant differentiation across projects, with the deterioration in the parameters of the estimated S-curve being driven by several projects that are not progressing as well as the rest.

4. DETERMINANTS OF PROGRESS WITH THE SALE OF APARTMENTS

Given that the deviations of individual projects from the sales progress S-curves are quite large (see Table 2), one can ask whether the relative success rates of individual products can be explained by their fundamentals. This section tries to identify such determinants using simple econometric methods.

As the dependent variable we consider the number of days a given project is "in front of" or "behind" the estimated S-curve. For points (projects) to the left of the estimated S-curve (see Chart 7), the dependent variable is therefore positive and corresponds to the horizontal distance from the S-curve, whereas for points to the right of this curve its value is negative. Hence, the higher the dependent variable, the more successful the project. As we are seeking the determinants of the "relative quality" of property development projects for the entire period of 2006–2010, the dependent variable is given by the horizontal distance of the point of a given project from the "Total" curve in Chart 8. Alternatively, we could construct the dependent variable on the basis of the deviation of the project from the S-curve estimated for each year and then estimate the five regression equations for each year separately and compare their estimated coefficients.

The explanatory variables considered for the individual projects (see Table 3) include the *relative price*, expressed as the ratio of the price asked per square metre in the project to the supply price of older apartments in the same locality (for a demand curve of the standard shape, a higher relative price should lead to slower progress with sales and its coefficient should be negative). The supply prices of older apartments should reflect the specific conditions in the locality ("more expensive city centre versus cheaper suburb"). By normalising the price of a given project to the price of older apartments, we should therefore at least partially adjust the price of the project for such effects. Given the result in Chart 3, we can expect a negative coefficient on *apartment size* in square metres of floor area, i.e. projects with a higher proportion of larger apartments should be harder to sell. Given the aforementioned U-shaped relationship between the price per square metre and the apartment size, the square of apartment size was also included in the regression analysis. The other explanatory variables include indicators of the development's amenities outside the apartments themselves, such as the number of *garage spaces per apartment*, the *average balcony area* and the *proportion of commercial space in the project*. A positive dependence is predicted for all these variables. Only for the proportion of commercial space was its square included (with the expected negative sign). Non-linear dependence of sales progress on the proportion of commercial space might be given by the fact that while a small proportion of commercial space can enhance residents' quality of living, an excessively large proportion can make it worse. The variables that are correlated with *apartment size* include the *shares of individual apartment types in the total floor area* of the development (one-room apartments, two-room apartments, three-room apartments and apartments with more than three rooms). The final set of variables consisted of *dummy variables for individual years*, which allow us, among other things, to observe the specific demand situation in individual years.[13]

13 Alternatively, we could have included macroeconomic and demographic variables that influence the demand for dwellings (see, for example, Hlaváček and Komárek, 2010, or Hlaváček and Komárek, 2011, who examine the determinants of prices of used apartments). However, the outcome of the analysis is no better than for the simple inclusion of dummy variables. The factors underlying the low dummy variables for 2009 and 2010 are linked with the financial crisis and are given primarily by lower wage growth, higher unemployment, fewer vacancies and lower population growth (both natural growth and growth due to migration).

Table 3

ANALYSIS OF DEVIATIONS OF INDIVIDUAL PROJECTS FROM ESTIMATED SALES PROGRESS S-CURVE

	Regression A		Regression B		Regression C		Stepwise regression	
	Coefficient	P-stat	Coefficient	P-stat	Coefficient	P-stat	Coefficient	P-stat
Relative price	1.404	0.04	1.150	0.10	1.284	0.05	1.344	0.01
Apartment size (m^2)	1.628	0.65	-	-	-0.582	0.80	-	-
Size squared	-0.0356	0.14	-	-	-0.0218	0.14	-0.02482	0.00
Garage spaces per apartment	89.9	0.08	46.0	0.30	83.2	0.06	89.2	0.04
Percentage commercial space	-0.913	0.52	-1.969	0.21	-0.955	0.53	-1.077	0.03
Commercial space squared	-0.00071	0.89	0.00301	0.63	-0.00083	0.89	-	-
Area of balcony	6.68	0.07	4.29	0.11	6.85	0.01	6.52	0.01
Share of one-room apartments	-0.996	0.58	1.779	0.22	-	-	-	-
Share of two-room apartments	-1.882	0.28	-0.07358	0.96	-	-	-1.232	0.27
Share of three-room apartments	-1.859	0.30	-2.125	0.22	-	-	-1.118	0.43
Dummy 2006	-3.61	0.98	-121.4	0.34	-53.70	0.65	-	-
Dummy 2007	40.9	0.72	-79.8	0.52	-4.6	0.97	38.7	0.46
Dummy 2008	5.69	0.96	-139.5	0.29	-44.68	0.71	-	-
Dummy 2009	-144.9	0.22	-265.9	0.04	-190.6	0.11	-144.5	0.01
Dummy 2010	-200.8	0.11	-302.1	0.02	-249.4	0.04	-200.0	0.00
R-squared	0.20		0.13		0.19		0.19	
Adjusted R^2	0.14		0.08		0.15		0.16	
S.E. of regression	300.0		310.9		298.9		296.8	
Durbin-Watson statistic	1.65		1.54		1.64		1.65	

Note: Variables significant at least at 15% level are highlighted in yellow.

Although the microeconomic nature of the underlying database might entice us to use panel regression methods, the nature of the underlying data (the low number of realisations for individual projects) unfortunately prevents us from using such methods. For our analysis, therefore, we used very simple OLS regression. Given the relatively strong correlation between apartment size and the shares of individual apartment types, the regression analysis was estimated in four variants. First, a wide spectrum of explanatory variables was included in the regression (Regression A in Table 3). Subsequently, variables related to apartment size (Regression B) and variables related to apartment type (Regression C) were excluded. The fourth variant was "Stepwise regression", where variables with low significance were automatically excluded from the list of variables.

The overall regression results are less than convincing ($R^2 < 0.2$; the lowest quality regression was Regression B, which excluded apartment size). The relative success of property development projects evidently depends on factors that do not figure among our chosen explanatory variables. These might include, for example, the layout of the development, the quality of the materials used, the effectiveness of marketing campaigns, the proportion of parkland in the locality, neighbouring properties and noise

levels. These factors may also explain why the sign on the relative price is opposite than expected and statistically significant.[14] The developer is probably aware of the worse measurable quality of its development and is reflecting this in the prices of apartments, hence the apartment price at least partially allows these unobserved factors to be captured.

Of the variables linked with apartment size (the apartment size itself, the square thereof, and the apartment type structure), the square of apartment size turned out to be statistically significant with the expected sign. However, the hypothesis of a U-shaped relationship was not confirmed. The shares of apartments broken down into various sizes were not significant. The number of garage spaces per apartment and the balcony area per apartment proved to be significant with the expected signs.

Of the dummy variables, those for 2009 and 2010 were significant and their signs confirmed the preliminary results of Chart 8 and Table 2 regarding a significant deterioration in progress with sales in these years. The question is whether this deterioration reflects a shift towards the internationally more common practice whereby apartments are not usually sold until after completion and whether, therefore, the situation in previous years was unusually favourable for developers. However, the authors are not aware of any comparable studies in other countries. In addition, it is important to take into account different institutional conditions. In Germany and Austria, for example, municipalities are much more active in housing development, whereas in the Czech Republic such development goes on almost exclusively on a purely commercial basis (see Prostějovská, 2010).

5. CONCLUSION

This article analysed progress with the sale of property developments in Prague. The property development sector has become significant in recent years thanks to its contribution to the renewal of apartment construction and to its increasing share in total bank loans. It has thus become another channel of transmission of property prices to credit risk.

The article uses a unique database of property development projects available for the years 2006–2010. Between 2006 and 2008, the proportion of one-room and two-room apartments in this database decreased, but since 2009 the share of small apartments has been rising. This is probably connected with the negative link between apartment size and saleability. The decline in the share of larger apartments may be a reaction by developers to changes in the structure of demand. It is also interesting to note that for most of the period smaller apartments were cheaper than larger ones and that during the 2009–2010 financial crisis prices of these apartments fell faster than those of larger apartments. This suggests stronger price elasticity of demand in this segment of the market.

Overall, the supply prices of new apartments in the database were 23.4% higher on average than the supply prices of older apartments, 33.8% higher than the actual transaction prices of older apartments and more than double the "cost" prices of apartments. The dynamics of apartment prices in the database are broadly in line with those of market prices of older apartments. By comparison with used apartments, the decline in prices of new apartments was smaller in 2009 and larger in 2010, suggesting some stickiness in the price reaction of developers.

A large part of the article was devoted to estimating sales progress S-curves using the cumulative normal distribution. The estimated curves indicate a relatively good situation in 2006 and 2007 (high percentages of apartments sold at project completion, and a low mean and standard deviation of the distribution). In 2008, however, most of the parameters of the estimated S-curves deteriorated sharply. In 2010, the majority of these parameters were at their worst levels since 2006 – the mean of the distribution, at -65 days, was less than one-third of the 2006 value in absolute terms, the standard deviation, at 253.4 days, was the second-highest after 2009, and the proportion of apartments sold before project completion was the lowest since 2006 (60% compared to a peak of 95%). The high deviation of the actual projects from the estimated curve indicates quite significant differentiation across projects.

14 As mentioned earlier, the relative price should be at least partially adjusted for the specifics of the locality, as it is calculated as the ratio of the project price to the supply price of existing apartments in the same locality. The supply prices of older apartments, however, are available broken down by main city districts or land registry districts only, and the quality of dwellings can differ considerably across such districts.

In the final section, we estimated an econometric model of the determinants of deviations of progress with the sale of individual projects from the estimated S-curve for the entire period of 2006–2010. The overall regression results are less than impressive, indicating that the relative success of property development projects evidently depends on factors that do not figure among our explanatory variables. The exclusion of these often difficult-to-measure variables probably explains why the relative price of the project was statistically significant with the opposite sign than expected. This may be due to the fact that the supply price at least partially reflects these hidden factors. This result may also explain the unwillingness of developers to react to reduced demand by cutting their prices. A price cut would do little to improve sales (at least according to the results of our model). What is more, for individual developers it might have a stigmatising effect and further worsen their situation.

Of the other project-related variables included, the apartment size, the number of garage spaces per apartment and the balcony area per apartment turned out to be statistically significant, in all cases with the expected signs. The coefficients on the dummy variables reflecting the specific situation in individual years confirms the results regarding a significant deterioration in progress with sales in 2009 and 2010.

Overall, our analysis revealed a sharp deterioration in the situation of developers in 2009–2010, due mainly to a sharp fall in demand. Developers' ability to respond in this situation was very limited and, in addition to the aforementioned relatively sharp cuts in prices of existing projects, included a significant reduction of new projects and a change in the supply structure in favour of smaller apartments. Sales of apartments in already completed developments will probably get a one-off boost over the next two years by a planned increase in VAT on new apartments[15] (households will try to speed up apartment purchases so that they pay the lower rate). However, sales will fall again once the higher VAT rate has been introduced. In the longer term, progress with sales will be determined by factors other than changes to VAT (the macroeconomic situation, demographic trends, etc.).

REFERENCES

BARRAZA, G. A., BACK, W. E., MATA, F. (2004): *Probabilistic Forecasting of Project Performance Using Stochastic S Curves*, Journal of Construction Engineering and Management 130(25), pp. 25–32.

BROWN, R. (1992): *Managing the "S" Curves of Innovation*, Journal of Business & Industrial Marketing 7(3), pp. 41–52.

BRUTSAERT, W. (2005): *Hydrology*, Cambridge University Press, New York.

ČÁPOVÁ, D. (2005): *Realitní bubliny v Praze (pohled z opačné strany)*, Stavebnictví a interiér 11/2005, pp. 10–11.

CNB (2010): *Financial Stability Report 2009/2010*, Czech National Bank.

DOLANSKÝ, V. (2011): *Indexy cen bytů v pražské aglomeraci*, Realit 18, 1–2/2011.

FORSTER, R. N. (1986): *Innovation: The Attacker's Advantage*, Summit Books, New York.

HLAVÁČEK, M., KOMÁREK, L. (2010): *Housing Price Bubbles and Their Determinants in the Czech Republic and its Regions*, CNB Working Paper 12/2009.

HLAVÁČEK, M., KOMÁREK, L. (2011): *Regional Analysis of Housing Price Bubbles and their Determinants in the Czech Republic*, Czech Journal of Economics and Finance 61, pp. 1–2.

KOREC, E. (2010): *Realitní statistiky: jediný objektivní nástroj mapování trhu*, presentation given at a meeting of the magazine Stavební fórum on 7 October 2010, http://www.stavebni-forum.cz/.

MANN, D. (1999): *Using S-curves and Trends of Evolution in R&D Strategy Planning*, TRIZ Journal, July 1999.

PROSTĚJOVSKÁ, Z. (2010): *Specifika trhu s novými byty v hl. m. Praze*, CTU Prague, Habilitační přednášky 22/2010.

15 The lower VAT rate is currently expected to go up gradually from the current 10% to 17.5%.