House prices in Portugal - what happened since the crisis?

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Abstract
House prices in Portugal have been increasing in the recent past, following a relatively inexpressive evolution during the 1990s and early 2000s. Prior to the crisis and despite the cyclical nature of residential real estate markets most models did not consider the need for breaks. This article analyses the factors driving house price movements in Portugal, with main emphasis on the crisis and post-crisis periods. First we analyze the relationship between a set of important fundamental variables and house price growth and second, we investigate if there have been any changes in the relevance of the fundamental variables. Finally, we determine whether house prices are likely to increase in the near future and we observe that the estimated probability is high. (JEL: C12, C22)

Introduction

Economic theory states that households' wealth is a key driver of aggregate consumption (Friedman (1957) and Modigliani and Brumberg (1954)). A house is the largest asset of most households and so changes in housing wealth may affect homeowners' consumption (Englund *et al.* (2002) and Case *et al.* (2005)). Moreover, changes in housing wealth are likely to impact more on the economy than changes in wealth caused by stock price movements. Helbling and Terrones (2003) analyze the real term effects of booms and busts on asset prices in industrialized countries and conclude that between 1960 and 2002 every 13 years stock indexes collapsed by 45% from peak to trough. The fall lasted for around 2.5 years and is associated to a contraction of 4% in GDP. In contrast, house price drops were smaller (around 30% and less frequent), but lasted longer, around 4 years, and had a greater negative impact on GDP (over 8%).

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In recent years, a vast number of studies analyzed the dynamics of real estate markets. Although some relevant fundamental factors driving house prices have been identified over the past decades, the recent worldwide financial crisis, triggered by the collapse of the US house price bubble in 2007, showed that understanding of price determination process in real estate markets still requires further research. The financial crisis also highlighted the importance of housing for macroprudential policy (see e.g. Hartman (2015)).

Long-term determinants of housing demand include growth in household disposable income, shifts in demographics (e.g. the relative size of older and younger generations), features of the tax system which may encourage home ownership, and the average level of interest rates. As to long-term determinants of housing supply the availability and cost of land, as well as the cost of construction and investments in the improvement of the quality of existing housing stock can be considered (Poterba (1991) and Tsatsaronis and Zhu (2004)). Higher GDP and disposable income, or less unemployment are expected to have a positive impact on the housing market. In contrast, higher interest rates are expected to drive borrowing costs up and demand down leading to a subsequent fall in house prices and make alternative applications of wealth more interesting.

The recent financial crisis has caused an unprecedented decline in house prices across the globe and it was particularly severe in countries with a real estate bubble before the crisis. Most economic fundamentals have been affected by credit shortage and failure of many mortgage holders to meet their payments. This study aims to examine the relationship between major economic fundamentals and house price changes in Portugal both during and after the financial crisis. We begin with an analysis of the complete sample considered (1996Q1 to 2017Q2) to test the relationship between a set of selected independent variables and real house price growth, enabling us to identify the directions and extent of the relationship. The results show that most indicators, including interest rates and GDP growth, behaved analogously during and after the financial crisis. However, since the significance and magnitude of parameter estimates may change when the market is in crisis, we also consider a regression framework which allows for breaks.

The sudden downturn in financial markets has attracted a lot of research which has focused on issues such as the causes of the crisis, the factors behind the spread of the crisis, and the impact of the crisis. Some studies investigated the impact of the financial crisis on the housing market (e.g. Dodd and Mills (2008); Qi and Yang (2008); Yener (2009); Bagliano and Morana (2010)). However, studies addressing the economic drivers of the housing market tend not to be looking at the behaviour of these drivers during economic prosperity and crisis periods. This article aims therefore to fill this gap by looking specifically at the determinants of house price growth in Portugal both during and after the financial crisis.

Although the real estate market is considered as one of the causes of the financial crisis, the transmission of financial shocks through banks and different markets does suggest that the real estate market is also a channel of shock transmission. Hence, the conjecture that this market is among the causes and channels of transmission of shocks raises the question of whether the relationship between the previously indicated aggregated variables and house prices is indeed stable.

Different approaches have been used to investigate the factors driving house price movements. For example, Himmelberg and Sinnai (2005) construct an index by comparing imputed rents with actual rents, which is then used to analyse if houses are highly priced. McCarthy and Peach (2004) apply an asset pricing model in order to capture the effect of interest rates on house price movements. Researchers have also used financial ratios, such as house price to annual income (Case and Shiller (2003)), rent to price (McCarthy and Peach (2004)) and rent to income ratios (Himmelberg and Sinnai (2005)) to measure the housing market activity. Each ratio is aimed at capturing the relationship between specific housing market drivers, however, these ratios fail to take into account continuous changes in some of the key variables affecting house prices.

In this paper we start by analyzing which factors drive house price movements in Portugal. As a first approach we consider a regression framework which enables us to evaluate the impact of each factor on house price growth over a period of time and to assess the direction of the relationship between the dependent and independent variables, which are considered in the model. The analysis is then complemented by the application of an approach which allows for parameter estimates to differ within different sub-periods of the sample.

The remainder of the article is organized as follows. Section 2 discusses the evolution of some important covariates following the financial crisis; Section 3 presents the empirical analysis of house price growth determinants; Section 4 analyses the probability of positive house price growth; and Section 5 concludes.

Analysis of house price drivers in Portugal since the beginning of the crisis

Before discussing the results of the empirical analysis of this article it is useful to describe briefly the evolution of some important covariates following the financial crisis, to better understand the dynamics of the real estate market.

House prices in Portugal declined 4% on average per year between 2007 and 2013 and have since been increasing by 4% on average per year. However, house prices are still below their long-term average. If we look at house prices measured in terms of bank appraisals rather than transactions, despite of banks' cautiousness following the crisis which probably moderated the upward price trend in recent years, the conclusions are similar (Figure 1) [1].

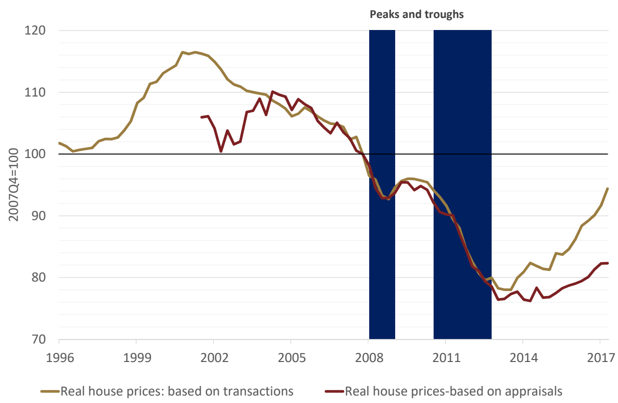

FIGURE 1: Real house prices and house price-appraisals

Sources: Banco de Portugal, INE, Confidencial Imobiliário and OECD.

In terms of residential investment (gross fixed capital formation - GFCF) we see that the downward evolution initiated in the late 1990s proceeded between 2007 and 2013. This class of investment contracted on average 12% per year compared to the 1% average per year fall in GDP. Since 2014 there has been an improvement in residential GFCF and in GDP, both increasing by 2% on average per year (Figure 2).

As to the conditions of the labour market, we observe that after the crisis the unemployment rate rose, reaching a peak in 2013, and that there was a significant decline in the labour force, as a consequence of increased emigration flows and aging of the population (Figure 3).

1. The peaks and troughs presented in Figures 1 - 6 are taken from the business cycle chronology of Rua (2017).

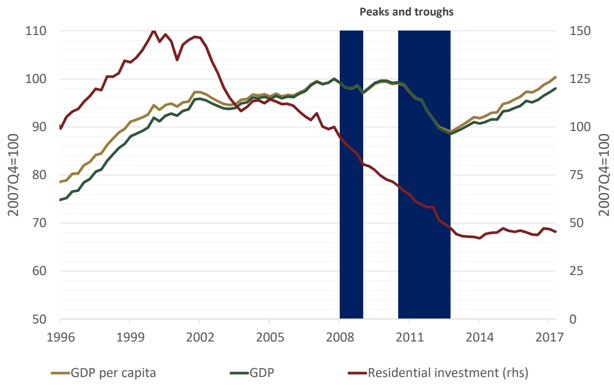

FIGURE 2: Residential GFCF and GDP

Sources: Banco de Portugal and OECD.

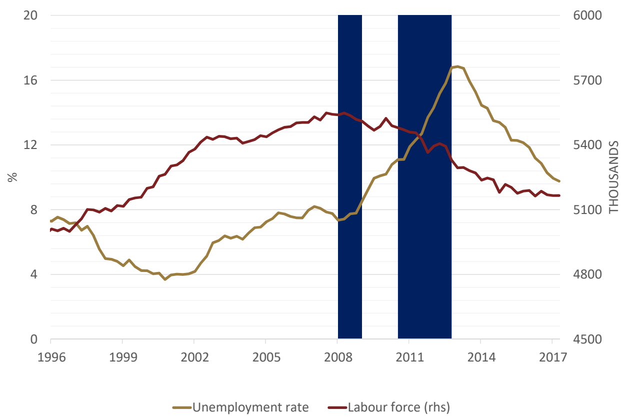

FIGURE 3: Labour market

Sources: Banco de Portugal and OECD.

Households' indebtedness, measured as housing loans in terms of disposable income, picked up from 25% in the mid 1990s to almost 90% by the end of 2007, in a context of rising disposable income and low interest rates (Figures 4 and 5). However, over this period house prices barely changed. Following the sub-prime crisis housing loans have been contracting since 2011 reflecting banks' deleveraging. Interest rates exhibited a lot of volatility in the first two years of the financial crisis (spiking in 2008 and bottoming in 2009 amidst highly expansionary monetary conditions) and again in 2011 reflecting the sovereign debt crisis. Finally, we may also look at what happened to foreign direct investment in housing to have an idea of the external conditions (Figure 6). Housing investment by non-residents has been increasing since the 1990s. Following the 2011 sovereign debt crisis it decelerated but since 2014 it began to accelerate again, growing 9% on average per year.

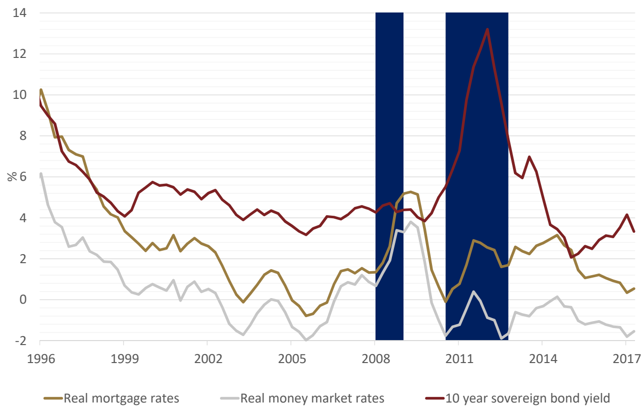

FIGURE 4: Interest rates

Sources: Banco de Portugal and ECB.

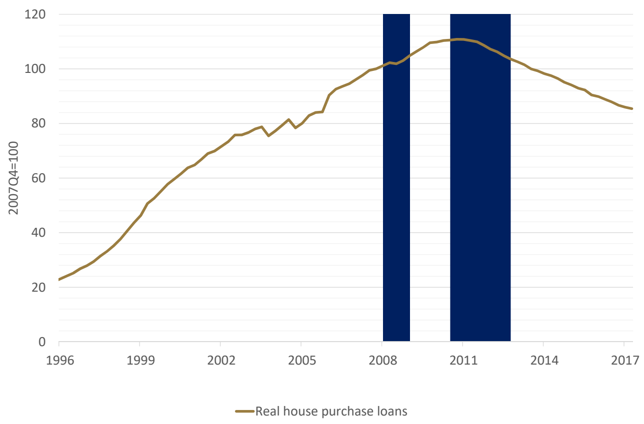

FIGURE 5: Housing loans

Sources: Banco de Portugal and ECB.

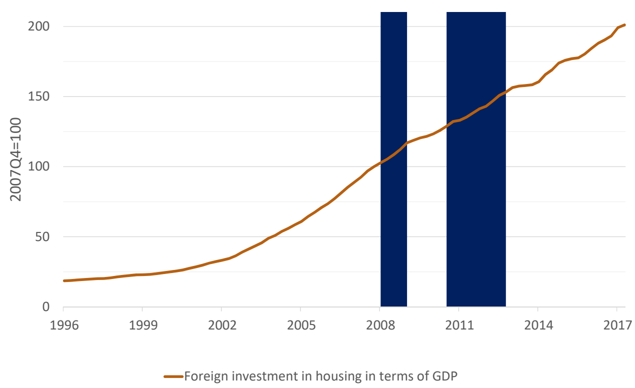

FIGURE 6: Foreign direct investment in housing

Source: Banco de Portugal.

Empirical analysis

Our data set comprises quarterly time series from 1996:Q1 to 2017:Q2 for Portugal. Data on real house prices, disposable income, GDP, private consumption deflator, population, real loan for house purchases, unemployment rate, real money market rate, real mortgage rate, real GFCF housing, foreign investment in housing, and interest rates were collected from the OECD, Banco de Portugal and the European Central Bank.

The house price series considered as from 2009 onwards is the one published by Statistics Portugal. The compilation of this transactions-based house price index is derived from the combination of two different fiscal administrative data sources. Before 2009 the house price index relied on data provided by a private producer using asking prices collected from a real estate portal. However, in both cases (before and after 2009), the calculation of the house price index is based on hedonic approaches to price measurement, characterized by valuing the houses in terms of their attributes (average square meter price, size of the dwellings involved in transactions and their location). All series are in real terms and are computed using the private consumption deflator.

The years of 2007 and 2008 signaled the start of a decrease in real estate prices (a general trend observed in the large majority of countries independently of whether they had gone up or down in previous decades). This reflects how the US sub-prime collapse in 2007 quickly spread worldwide and how housing market developments impact on the economy. However, judging by the recent evolution of house prices it appears that housing markets worldwide have been recovering.

Regression Results

As a first approach of our analysis we consider a standard multiple linear regression framework to examine the relationship between house price growth and a set of covariates. The period covered in this analysis is from 1996Q1 to 2017Q2, which enables us to evaluate the housing market determinants before, during and after the financial crisis.

The final specification of our fixed parameter regression model is,

$$\begin{aligned}\Delta rhp_t &= \alpha_0 + \alpha_1 \Delta GDPpc_{t-1} + \alpha_2 \Delta gfcf_{t-1} + \alpha_3 \Delta unemp_{t-1} \\ &\quad + \alpha_4 \Delta mtgr_{t-1} + \alpha_5 \Delta invest_{t-1} + e_t \qquad (1)\end{aligned}$$

where rhp_t corresponds to the natural logarithm of the real house price index, $GDPpc_t$ is the natural logarithm of real per capita GDP, $unemp_t$ the unemployment rate, $mtgr_t$ is a real mortgage rate, $invest_t$ is foreign direct investment in real estate and Δ is the usual first difference operator.

Table 1 reports the ordinary least squares (OLS) estimates of (1) and robust standard errors based on the approach proposed by Newey and West (1987), which provides consistent estimates of the covariance matrix in the presence of heteroscedasticity and autocorrelation in the residuals of the estimated model.

Var	Coeff	Std.Error	t-stat	Prob
const	-0.0007	0.0032	-0.2230	0.8241
$\Delta GDPpc_{t-1}$	5.1773	1.3625	3.7999	0.0003
$\Delta gfcf_{t-1}$	-0.0241	0.0413	-0.5827	0.5618
$\Delta unemp_{t-1}$	-0.0092	0.0035	-2.6093	0.0109
$\Delta mtgr_{t-1}$	-0.0016	0.0028	-0.5930	0.5549
$\Delta invest_{t-1}$	-0.0565	0.0704	-0.8026	0.4247
R-squared	0.2907		Mean dependent var	-0.0008
Adjusted R-squared	0.2453		S.D. dependent var	0.0141
S.E. of regression	0.0122		Akaike info criterion	-5.9039
Sum squared resid	0.0116		Schwarz criterion	-5.7303
Log likelihood	253.9647		Hannan-Quinn criter.	-5.8341
F-statistic	6.3943		Durbin-Watson stat	1.4022
Prob(F-statistic)	0.0001		Wald F-statistic	8.332
Prob(Wald F-statistic)	0			

TABLE 1. Regression output - determinants of real house price growth

Source: Authors' calculations.

From the estimation results for the whole period under analysis (Table 1) we observe that the main drivers of real house price growth are real per capita GDP and the unemployment rate. The signs are the expected ones, that is, an increase in real per capita GDP has a positive impact on real house prices, while an increase of the unemployment rate leads to a decrease of real house prices. Mortgage rates and residential investment are negatively correlated with house prices but are not statistically significant. The last explanatory variable is housing investment by non-residents. The negative sign of the parameter estimate of this variable is difficult to explain but it is not statistically significant.

Regression results allowing for breaks

To allow for the possibility of regression models with breaks we consider the approach of Bai and Perron (1998) and Bai and Perron (2003a). This approach is particularly suited to test the conjecture that the importance and impact of fundamentals on house price growth in Portugal may have changed over this period. The Bai and Perron tests are based upon an information criterion in the context of a sequential procedure, and allow one to find the number of breaks implied by the data, as well as the estimation of the timing and confidence intervals of the breaks, and the parameters of the models between breaks (see Appendix for details).

An interesting feature of the Bai and Perron procedure is that it allows testing for multiple breaks at unknown dates, so that each break point is successively estimated based on a specific-to-general strategy in order to determine consistently the number of breaks. An additional advantage of the approach is that it allows us to investigate whether some or all of the parameters of the estimated relationship have changed. Table 2 presents the estimation results using the Bai and Perron approach.

Var	Coeff	Std.Error	t-stat	Prob
2007Q2 - 2011Q3				
$const$	-0.0385	0.0045	-8.5673	0.0000
$\Delta GDPpc_{t-1}$	12.0742	3.3431	3.6117	0.0006
$\Delta gfcf_{t-1}$	-0.6032	0.1242	-4.8578	0.0000
$\Delta unemp_{t-1}$	0.0204	0.0046	4.4319	0.0000
$\Delta mtgr_{t-1}$	0.0012	0.0038	0.3196	0.7503
$\Delta invest_{t-1}$	0.3338	0.1247	2.6765	0.0094
2011Q4 - 2017Q2				
$const$	-0.0042	0.0039	-1.0904	0.2795
$\Delta GDPpc_{t-1}$	9.8791	3.0070	3.2853	0.0016
$\Delta gfcf_{t-1}$	-0.0457	0.0594	-0.7701	0.4440
$\Delta unemp_{t-1}$	-0.0065	0.0090	-0.7176	0.4755
$\Delta mtgr_{t-1}$	-0.0135	0.0070	-1.9303	0.0579
$\Delta invest_{t-1}$	0.2164	0.2998	0.7218	0.4729
R-squared	0.6178	Mean dependent var		-0.0008
Adjusted R-squared	0.5193	S.D. dependent var		0.0141
S.E. of regression	0.0097	Akaike info criterion		-6.2364
Sum squared resid	0.0063	Schwarz criterion		-5.7155
Log likelihood	279.9281	Hannan-Quinn criter.		-6.0270
F-statistic	6.2743	Durbin-Watson stat		1.6498
Prob(F-statistic)	0.0000			

TABLE 2. Bai and Perron's regression results

Source: Authors' calculations.

When allowing for breaks, three periods emerge (1996Q1-2007Q1, 2007Q2-2011Q3 and 2011Q4-2017Q2), but we will only focus on the crisis and post-crisis period, i.e., 2007Q2-2011Q3 and 2011Q4-2017Q2 (Table 2), since the period before the crisis has been widely analyzed in the literature (see e.g. Lourenço and Rodrigues (2014)). The results show that the fundamentals and their importance are not the same in the periods during and after the crisis. In the first period, all variables except mortgage rates play a role in explaining house price growth, while in the latter period only per capita GDP and mortgage rates are relevant.

From the beginning of the financial crisis until the end of 2011, house prices fell around 3% on average per year. The sign of per capita GDP is positive and significant as expected. The negative sign in residential GFCF suggests rising house prices as a consequence of a reduction in housing supply. However, it may also reflect that housing demand is lower and so given the existing housing supply, a lower demand would suggest that house prices would decrease. In this case to prevent prices from falling further an adjustment in supply may have occurred. Since house prices did not decline as much as they would if investment had not declined, this seems to be a plausible explanation. Moreover, if there was a housing overhang we would expect house prices to keep adjusting downwards along with declining residential investment. However, in Portugal it seems, that when the crisis began that there was no evidence of excess supply of new houses (see Lourenço and Rodrigues (2014)). The coefficient of housing investment by non-residents ($\Delta invest_{t-1}$) is large and affects positively and significantly house price growth, which is in line with the strong growth observed until 2011. In this case, the upward pressure on house prices given foreign investment may have contributed to contain the decline in house prices. Lastly, unemployment rate is significant but has not the expected sign.[2]

In the second period (2011Q4 - 2017Q2), per capita GDP was significant and positively correlated with house prices as expected. Interest rates were declining resulting in an upward pressure on house prices, possibly because low (or even negative) rates make housing more attractive than deposits as a saving strategy.

Probit Estimation

In this section we redefine the dependent variable as a binary variable, y_t, such that it takes the value of 1 if the quarterly house price growth rate is positive and zero otherwise, i.e., $y_t = 1$ if $\Delta rhp_t > 0$ and $y_t = 0$ otherwise. The latent variable representation for the purpose of Probit estimation is,

$$y_t^* = \gamma_0 + \gamma_1 \Delta GDPpc_{t-1} + \gamma_2 \Delta unemp_{t-2} + \gamma_3 \Delta mtgr_{t-1} + v_t. \qquad (2)$$

where the covariates considered are as defined in the previous section. The model is estimated by maximum likelihood. Hence, equation (2) relates the probability of a positive real house price growth to determinants previously considered, i.e., $P[y_t = 1] = F(y_t^*)$ where F is the normal cumulative distribution.

2. This is an issue that requires further analysis.

Figure 6 presents the evolution of the probability computed from (2) over the sample considered and Figure 7 presents the evolution of the probability computed from a dynamic version of (2), i.e.,

$$y_t^* = \theta_0 + \theta_1 \Delta GDPpc_{t-1} + \theta_2 \Delta unemp_{t-2} + \theta_3 \Delta mtgr_{t-1} + \theta_4 y_{t-1} + a_t. \quad (3)$$

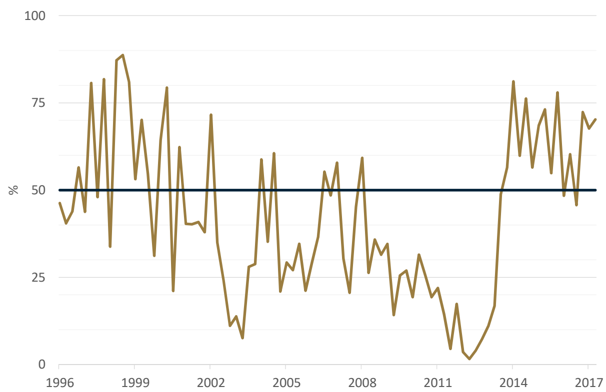

FIGURE 7: Probability of positive growth - Non-dynamic Probit

Source: Authors' calculations.

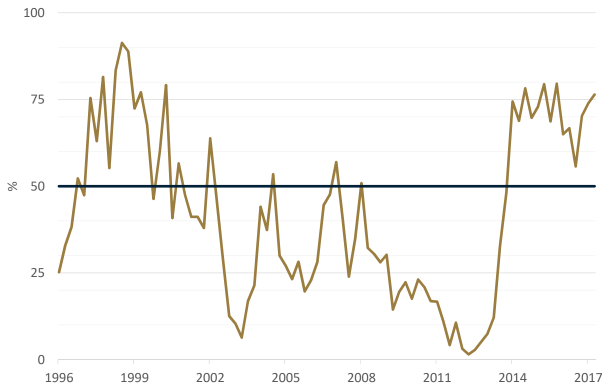

FIGURE 8: Probability of positive growth - Dynamic Probit
Source: Authors' calculations.

From the results of this analysis we observe that the probability of positive house price growth is quite high given the current projections of the Portuguese economy.

Conclusion

This paper presents a first analysis of the factors driving house price movements in Portugal, with main emphasis on the crisis and post-crisis periods. Multiple regression analysis was used to measure the relationship between house price growth and a set of independent variables, which were selected based on the existing housing market literature. The results reveal that interest rates and economic growth have the highest impact on house price growth.

House prices in Portugal have increased lately but are still below pre-crisis levels in real terms. Allowing for breaks (i.e. different regimes) makes it possible to have a fresher look at fundamentals. During the first period, 2007-2011, the fact that residential GFCF fell may have prevented house prices from declining even more during that period attenuating the contraction of housing demand. Also the growth in housing investment by foreigners may have prevented house prices from falling further. In the more recent period, 2011-2017, low (or even negative) interest rates may be affecting house prices through alternative saving options. Housing investment by non-residents decelerated following the years of the sovereign debt crisis. Finally, the Probit model results indicate that the probability of future positive house price growth is still high in Portugal.

Appendix: The Bai and Perron approach

To briefly illustrate the Bai and Perron approach (see Bai and Perron (1998) and Bai and Perron (2003a)) we consider a linear model with m multiple structural changes (i.e., $m+1$ regimes) as,

$$\begin{aligned} y_t &= x_t'\beta + z_t'\delta_1 + u_t, & t = 1,2,...,T_1 \\ y_t &= x_t'\beta + z_t'\delta_2 + u_t, & t = T_1+1,...,T_2 \\ &\vdots & \\ y_t &= x_t'\beta + z_t'\delta_{m+1} + u_t, & t = T_m+1,2,...,T \end{aligned}$$

where y_t is the observed dependent variable, $x_t \in \Re^p$ and $z_t \in \Re^q$ are vectors of regressors, β and δ_j $(1 \leq j \leq m+1)$ are the corresponding vectors of coefficients with $\delta_i \neq \delta_{i+1}$ $(1 \leq i \leq m)$, u_t is the error term and m is the number of structural breaks. The break dates $(T_1,...,T_m)$ are explicitly treated as unknown and $\lambda_i = T_i/T$, $i = 1,...,m$, with $0 < \lambda_1 < ... < \lambda_m < 1$. Hence, the objective is to estimate the unknown regression coefficients and the break dates $(\beta, \delta_1,...,\delta_{m+1}, T_1,...,T_m)$ when T observations are available.

The estimation method considered is based on least-squares; see Bai and Perron (1998). Consider that for each m-partition of $(T_1,...,T_m)$, denoted T_j, the associated least-squares estimates of β and δ_j are obtained by minimizing the sum of squared residuals

$$\sum_{i=1}^{m+1} \sum_{t=T_{i-1}+1}^{T_i} \left(y_t - x_t'\beta - z_t'\delta_i\right)^2$$

where $T_0 = 0$ and $T_{m+1} = T$, and let $\widehat{\beta}(T_j)$ and $\widehat{\delta}(T_j)$ denote the resulting least-squares estimates. Substituting the latter into the objective function and denoting the resulting sum of squared residuals as $S_T(T_1,...,T_m)$, the estimated break points $(\widehat{T}_1,...,\widehat{T}_m)$ are computed as,

$$(\widehat{T}_1,...,\widehat{T}_m) = \underset{(T_1,...,T_m)}{\arg\min}\, S_T(T_1,...,T_m),$$

where the minimization is taken over all partitions $(T_1,...,T_m)$ such that $T_i - T_{i-1} \geq h$. Note that h is the minimal number of observations in each segment ($h \geq q$, not depending on T). Thus, the break-point estimators are global minimizers of the objective function. Finally, the estimated regression parameters are the associated least-squares estimates at the estimated m-partition $\widehat{T}_j$, i.e. $\widehat{\beta} = \widehat{\beta}(\widehat{T}_j)$ and $\widehat{\delta} = \widehat{\delta}(\widehat{T}_j)$. For our empirical application, we use the efficient algorithm of Bai and Perron (2003a) based on the principle of dynamic programming which allows global minimizers to be obtained using a number of sums of squared residuals that is of order $O(T^2)$ for any $m \geq 2$.

Bai and Perron (1998) and Bai and Perron (2003a) propose three methods to determine the number of breaks: a sequential procedure (Bai and Perron (1998); the Schwarz modified criterion (Liu *et al.* (1997)) and the Bayesian information criterion (Yao (1988), and suggest several statistics to identify the break points:

- The $supF_T(k)$ test, i.e., a sup F-type test of the null hypothesis of no structural break (m=0) versus the alternative of a fixed (arbitrary) number of breaks (m= k).
- Two maximum tests of the null hypothesis of no structural break (m=0) versus the alternative of an unknown number of breaks given some upper bound M ($1 \leq m \leq M$), i.e., $UDmax$ test, an equal weighted version, and $WDmax$ test, with weights that depend on the number of regressors and the significance level of the test.
- The $supF_T(l+1|l)$ test, i.e., a sequential test of the null hypothesis of l breaks versus the alternative of l + 1 breaks.

The asymptotic distributions of all these tests are derived in Bai and Perron (1998) and the necessary asymptotic critical values are provided in Bai and Perron (1998) and Bai and Perron (2003).

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