The interaction between house prices and loans for house purchase. Revised evidence for the Spanish case.

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Abstract

This paper looks at recent developments in loans for house purchase and house prices in Spain and the linkages between them. It aims at identifying deviations of these variables from their long-term equilibrium levels and analyses the way in which they are corrected. For this purpose, a VECM model is estimated. Results show that the two variables are interdependent in the long run and also that house prices (credit for house purchase) adjust(s) when this credit aggregate (value of this asset) departs from its equilibrium level. The paper also offers some insight into how overvaluation in house prices (overindebtedness) can lead to a false sense of no overindebtedness (house price overvaluation).

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1 Introduction

The burst of the US subprime crisis and its vast consequences on the world economy have renewed and refocused attention on the existing feedback between the real economy and the financial sector, and, specifically, on the link between credit and house prices.

This analysis may merit special attention in the Spanish case, where a significant increase in household indebtendess and high concentration of resources in the housing sector took place during the long expansionary period witnessed between the mid-1990s and the mid-2000s. Since the scope of the correction will depend on the magnitude of the accumulated disequilibria, this raises the question as to what extent the large increase observed in housing prices and credit in Spain in recent years has led them to levels substantially above their fundamentals, as well as the existing links between them and the way in which disequilibria in these variables are corrected.

This paper analyses the linkages between loans for house purchase and house prices in Spain, placing special focus on the identification of potential deviations of these variables from their long-run (or equilibrium) levels, and the way in which these deviations are corrected. A vector error-correction model (VECM) is estimated in order to analyse to what extent house prices and loans for house purchase are in line with the value implied by their fundamentals. The model is also used to test wether levels of house purchase debt (house prices) above those implied by their long-run determinants imply adjustments in house prices (loans for house purchase).

The approach is in line with Hofmann (2004) and Gerlach and Peng (2005), who analyse the interaction between bank lending and property prices for a sample of 20 countries (including Spain) and for Hong Kong, respectively. Using a VECM, they estimate a long-run cointegrating relationship for bank lending (in real terms), as a function of real GDP and real property prices. Although the same econometric methodology is used here, there are some significant differences with respect to these two previous papers. First, the analysis focuses on a different

credit aggregate, namely loans for house purchase (instead of bank credit), which is expected to be more closely linked to house prices than total bank lending. Second, interest rates and the housing stock are included as major determinants of this credit aggregate in the long run. Nevertheless, the main difference is that also a cointegrating vector for house prices is estimated, which allows to test whether loans for house purchase adjust when disequilibria in house prices are recorded. While these papers do not allow an assessment of how disequilibria in house prices can result in a false sense of no overindebtedness, by modelling potential disequilibria in both markets at the same time it is possible to do it. Given the strong existing linkages between both variables, this is crucial.

This paper is an extension of the analysis presented in Gimeno and Martínez-Carrascal (2006), who also analyse the link between loans for house purchase and housing prices using a VECM approach. This paper differs from that one mainly in three respects. First, it presents a deeper analysis of the long-run interaction between the two variables and does not analyses short-run dynamics. Second, the data used covers the most recent period (from 2005), and hence the end of the credit and housing boom period and the first stage of the current crisis. Finally, the stock of housing is included in the analysis, which allows a better identification of long-run equilibrium levels of both variables.

The remainder of the paper is organized as follows. Section 2 describes the evolution of loans for house purchase and house prices in Spain in the last 25 years. In Section 3, a VECM model with two cointegrating relationships (one for house prices and another for loans for house purchase) is estimated, and this model is then used to analyse the recent developments in Spain in these variables. Section 4 summarizes the main results and concludes.

2 Loans for house purchase and house prices in Spain: some stylized facts

This section aims to describe the trends in house prices and loans for house purchase in Spain for the period covered in this analysis.

Figure 1 shows the annual growth rate of house prices and loans for house purchase. As can be seen, they tended to co-move during the sample period, although that for house prices shows a more cyclical pattern. For house prices, four different periods can be identified: a first expansionary period that took place during the second half of the 1990s and up to 1991, a period of stagnation (1992-1996), a new expansionary phase from 1997 up to mid-2005 and the most recent period (from mid-2005) in which the deceleration in house prices has led to negative annual growth rates in this variable by end-2008.

The increase in the value of house prices in real terms was somewhat less pronounced in the first expansionary phase than in the most recent boom, in which the revaluation was close to 150% between 1997 and mid-2007 (in the first boom period, it stood close to 115% between 1985 and end-1991) Also, the rise in house prices with respect to income has been larger in the latest expansionary period. This is probably partially linked to the significant decline observed in the last decade in interest rates, which has increased household borrowing capacity. Also, high construction volumes was recorded during the last housing boom, and, in line with this, the stock of housing has grown significantly in the last years.

It is also noteworthy that the correction that took place in house prices following the first of these boom periods took place mainly in real terms, while in nominal terms the correction was very limited. Indeed, house prices grew persistently below the inflation rate during a lenghty period (1992-1997), resulting in a reduction of around 20% in real terms. More recently, house price real growth rates stood at positive values up to 2008, when they started to decline.

As for loans for house acquisition, the highest growth rates recorded during the sample period where recorded between 1998 and 2005. As a result indebtedness increased significantly with respect to household income, raising concerns about the sustainability of household indebtedness levels. However, this increase is at least partially explained by structural supply and demand factors. Predominating in the pre-EMU period were supply side factors, such as the deregulation and liberalization of the banking system during the eighties. These resulted in better financing conditions for households and a change in the business strategy of commercial banks, which from the beginning of the eighties focused to a greater extent on the household sector. Later, EMU membership resulted in a reduction of financing costs, an improvement in income expectations and lower uncertainty, hence increasing the desired spending levels of households and, more specifically, housing investment. Additional developments favouring the increase in households' desired spending levels, and, hence, in household debt were labour market reforms and the aforementioned increase in house prices, which increased the available collateral. Supply factors also encouraged the expansion of household debt during these years of rapid indebtedness increase. Notable among them is the heightened credit market competition, which has resulted in significant downward pressure on bank margins and a lengthening of the repayment period. From mid-2006 until the end of the sample period, a rapid deceleration in this credit aggregate has been observed; the international financial crisis, the progressive deterioration in economic prospects and the high level reached by household indebtedness are factors behind the intense adjustment registered in loans for house purchase, which, in any case, and unlike house prices, was still showing positive growth rates at the end of the sample period.

3 The determinants of loans for house purchase and house prices

3.1 Model specification

In order to analyse the relationship between house prices and loans for house purchase, we estimate a three-order uVAR with the constant unrestricted:

$$\Delta X_t = \Pi X_{t-1} + \sum_{j=1}^{q-1} \Gamma_j \Delta X_{t-j} + \delta D_t + \varepsilon_t \qquad \varepsilon_t \sim N_p(0, \Lambda) \tag{1}$$

where X_t is a vector including loans for house purchase (lh), house prices (p), labour income (yh), nominal interest rates on loans for house purchase (i) and the stock of housing (sh). We express credit, income and the stock of housing in per-household terms, given that each household needs at least one house, owned or rented, for its own accommodation (and, hence, other things being equal, the higher the number of households the higher the demand for houses). All of these variables, except interest rates, are included in real terms using the private consumption deflator and expressed in log form[1]. In addition, a short run variable has

[1] See Data Appendix for details on the construction of the variables. The income and dwellings per household series have been adjusted for two additive outliers (1992 Q3 and 1994 Q1 in the case of the income series and 1987 Q2 and 1988 Q3 for the dwellings per household) using TSW (TRAMO-SEATS). Three dummies have also been added in the specification. One of them is included to capture the change in the user cost computation (explained below) and takes value of 1 from year 1992 onwards. The other dummies capture transitory changes in loans for house purchase (1991 Q2) and interest rates (1985 Q4). Their inclusion resolved the non-normality and autocorrelation in the residuals, ensuring the Gaussian properties in the residuals necessary to obtain valid cointegrating rank tests. Two additional dummies introduced to avoid non-normality and residual autocorrelation problems in the dwelling per household equation were removed from the specification when estimating the conditional model, in which this variable is considered to be weakly exogenous. According to unit root tests, the null of a unit root in the levels cannot be rejected for any of the series for conventional (95%)

been included to take into account the difference in the last year between the return on mutual funds and house price increases, in order to control for the fact that speculative reasons can also temporarily affect housing demand. This user cost proxy is computed as the mean difference (in four quarters) between lagged return on mutual funds and house price increases[2]. Data are quarterly and cover the period 1984 Q1 to 2008 Q4. Figure 1 shows the level and growth rate of these variables.

The above specification is similar to the ones proposed by Hofmann (2004) and Gerlach and Peng (2005) where they find a cointegrating relationship between bank lending, GDP and house prices. A key difference with respect to these papers is the inclusion of interest rates and the stock of housing as determinants for the credit aggregate in the long run, as will be shown later. As for house prices, the model here presented is in line with that in Martínez-Pagés and Maza (2003) and Gimeno and Martínez-Carrascal (2006)), who, using error correction models, link house prices to household income and nominal interest rates (loans for house purchase in Gimeno and Martínez-Carrascal (2006)), but they do not include the stock of housing.

As can be seen in Table 1, both the trace statistic and the maximum eigenvalue test indicate that when small sample correction is used, two cointegration relationships exist. Also, the critical values proposed by Pesaran et al. (2000), which take into account the presence of I(1) exogenous variables (the user cost, in our case) yield the same results. A conditional model in which labour income and dwellings per household are considered to be weakly exogenous, an assumption that will be tested later, also points to the existence of two cointegrating vectors (see

confidence levels. As for the first differences, the null is always rejected when the Phillips-Perron test is used. Only in the case of house purchase borrowing and house prices can a higher order of integration not be rejected when using the Augmented Dickey-Fuller test, but given the Philips-Perron test results and the low power of these unit root tests, we have treated these series also as I(1).

[2] We use mutual fund returns in order to build in a higher return than that of risk-free investments. This series is available from 1992; for previous years, risk-free interest rates have been used in this measure of the user cost, which seems reasonable given that household investment in shares was very limited at that time.

the lower panel of the table). Hence, we estimate a conditional model with two cointegrating relationships, which are identified as long-run equilibrium relationships for loans for house purchase and house prices, respectively.

In the first of the cointegrating vectors, loans for house purchase will be linked to labour income, interest rates, house prices and the stock of housing. The existence of financial frictions implies that loans for house purchase will be affected by house prices and the stock of housing not only due to wealth effects but also due to the existence of loan-to-value restrictions that banks apply when granting a loan. Likewise, the limit that banks apply on the intial debt burden (interest payment plus repayment of principal must be lower than a given percentage of current labour income) implies that this source of income, rather than wider income measures, as well as nominal interest rates, rather than real ones might be better determinants to model housing borrowing in the presence of this credit restriction. In this line, Ellis (2005) points out that this limit on the initial debt burden implies that the ratio of aggregate household debt to aggregate income converges on a long-run equilibrium level that depends, among other things, on the level of nominal interest rates. Likewise, Martínez-Carrascal and del Rio (2004) use labour income and nominal interest rates, as well as housing wealth, to jointly model household borrowing and consumption. This financial restriction may also help to explain why empirically the introduction of real interest rates in lending equations has sometimes posed problems[3]. Also, some other recent papers, such as those of Ellis (2005) and Iacoviello (2005), have identified both nominal interest rates and collateral constraints to be relevant for mortgage debt dynamics and for the economy as a whole. In the same line, Arce and López-Salido (2008) incorporate

[3] Gerlach and Peng (2005), who analyze the interaction between bank lending and property prices in Hong Kong, find real interest rates to be non-significant in a long-run relationship estimated for bank lending, in which they include, apart from bank lending, real GDP and real property prices. The same variables are considered by Hofmann (2004), who omits real interest rates in the estimation of a cointegrating vector for this credit aggregate on the basis of the unit root test results for this variable. Likewise, the estimated coefficient for real interest rates in Fitzpatrick and McQuinn (2004) has a wrong (positive) sign, although quantitatively it is very small.

endogenous collateral constraints that link the credit capacity of borrowers to the value of their real state holdings in a theoretical model aiming to explain the existence of housing bubbles.

The second cointegrating vector corresponds to house prices. In equilibrium, they depend positively on income and negatively on the user cost and the housing stock (see Poterba (1984) for greater details of the formula derivation). In addition, given the high cost of housing acquisition in relation to household income, mortgage financing will, in addition to household income, also affect housing demand, and, as a result, house prices. Therefore, changes in the restrictions on the supply of house financing can affect house price developments. The significant decline in nominal interest rates observed in Spain in recent years means that this effect is of special relevance to the Spanish case.

3.2 Estimation results

To identify the different cointegration relationships, it is necessary to impose two restrictions on the β coefficients of each equation. In the lh equation, we impose a normalization restriction on this variable and we restrict the coefficient of the stock of housing to be equal to that estimated for house prices (hence, borrowing elasticity with respect housing wealth is obtained). As for the house price equation, apart from the normalization restriction on this variable, a zero coefficient is imposed on interest rates. Hence, the credit aggregate is the variable that captures the impact of financing costs on house prices. This identification scheme allows mortgage market developments, which are not fully reflected in interest rate changes resulting from progressive liberalization and increased competition, to have an impact on long-run house price levels. Moreover, the lengthening of the repayment period has increased the borrowing capacity of individuals, another factor which is not captured by the inclusion of financing costs. In any case, the results presented here remain valid when the borrowing coefficient, rather than that associated with interest rates, is restricted to zero.

Table 2 shows the results. All the variables show the expected signs for both the house purchase borrowing and house price equations. As for the first one, this credit aggregate is found to depend positively on income and housing wealth. The existing link between borrowing and income and housing wealth is strong: as can be seen, the estimated borrowing elasticity with respect to both variables is close to one. This strong link is in line with the role that both variables have in determining households' indebtedness capacity (given the existence of collateral constraints and limits on the initial debt burden) and their impact on spending decisions (and hence also on their borrowing plans). Likewise, it is found to depend negatively on interest rates, as expected. The significant coefficient estimated for nominal interest rates in the credit equation contrasts with the results in Gerlach and Peng (2005) for real rates. This could be linked to the aforementioned relevance of nominal interest rates in the context of credit market imperfections. As for house prices, they are found to depend positively on income and credit (and, as a result, negatively on interest rates), and negatively on the stock of housing, as expected. All coefficients are significant at conventional significance levels.

As for the loading factors (α), the results suggest that feedback runs from the lending disequilibrium to housing prices, which could be the result of a decline in the desired residential investment level by households when they are over-indebted. This indicates that independent adjustment models in which the dynamics of each endogenous variable respond only to its own disequilibrium would be rejected. More specifically, these results indicate that when house purchase borrowing departs from the level implied by its determinants, the equilibrium is restored not only through reductions (increases) in this variable; rather, house prices also adjust downwards (upwards) when credit is above (below) its long-run level, the speed of adjustment derived from the two movements being 3% per quarter. Also, feedback from house price disequilibria to lending exists: when house prices are overvalued (undervalued), loans for house purchase decrease (increase).

As can be seen in the lower panel of Table 2, the weak exogeneity assumption made for labour income and dwelling stock is clearly accepted. Likewise, all the diagnostic tests for the residuals are passed at conventional significance levels[4].

3.3 Have recent developments in loans for house purchase and house prices in Spain been driven by their fundamentals?

This section uses the model presented in this paper to gain additional insight into recent developments in loans for house purchase and house prices in Spain. More specifically, by explicitly considering long-run relationships for these variables, this model allows to assess to what extent household credit and house prices are above their long-run equilibrium levels.

As has been mentioned in Section 3.1, the model has been estimated using data por the period 1984-2008. Since for most of the variables used in the analysis also data for 2009 Q1 are available, results presented in this section cover also this quarter (extrapolating the results of the model presented), in order to have more up-to-date measures of the potential divergence between loans for house purchase and house prices and their long-run levels[5].

Figure 2 shows the estimated long-run relationships and the error correction terms rescaled to average zero over the sample period. As for the error-correction term for borrowing for house purchase, it can be seen that, in spite of the high growth rates of house purchase credit from the early 2000s until recently, the lending error-correction term stands at negative levels between end-2001 and early 2006, due to the high levels reached by house prices in this period and the reduction of interest rates to historically low levels. Indeed, the significant increase observed in house prices between the late nineties and 2006 implies a 13% annual increase in the equilibrium level of loans for house purchase, and the reduction in interest rates registered in

[4] Results available upon request.

[5] Only for lavour income and the stock of housing data are not yet available for 2009 Q1; for these two variables in this quarter, I have used the available estimates.

these years would have implied a long-run level of indebtedness 17% higher than that observed at the end of the 1990s. Instead, from 2006 the error correction term stands at positive and (up to 2008 Q3) increasing values, in a context of rising financing costs and moderating house price growth rates. As a result, by end-2008 the error correction term for this loan aggregate reached the maximum levels observed in the sample period, somewhat above those observed in the early nineties.

As for the error correction term for house prices, the large increase in house prices in the last years has taken them above their long-run equilibrium level. According to the model, the increase in real house prices from the late nineties to mid-2002 implied a convergence towards their equilibrium level, while the increase recorded afterwards would have taken them above this long-run level. According to these results, the gap between house prices and their equilibrium level reached its maximum values between end-2004 and early 2006, and has diminished somewhat afterwards, amounting to around 15% in the first quarter of 2009. According to the results, the increase in loans for house purchase from the end of the 1990s would have induced on average a 5% per year increase in the house price equilibrium level (and almost 7% up to mid-2005). In contrast, the (moderate) reduction in the household income level from mid-2005 would have reduced the house price long-run equilibrium level and hence would have contributed to increase the gap between the price of this asset and its long-run level, as would also the increase in the number of dwellings per household. In this respect, when comparing the error correction terms derived from the model presented here and that obtained when the model presented in Gimeno and Martínez-Carrascal (2006), which differ only in the inclusion of the housing stock, is reestimated with data up to 2008, it can be seen that while the magnitude of the deviation of loans for house purchase with respect to their long-run level is very similar according to both models, for house prices the overvaluation obtained in the two cases differs for the periods in which the divergences of house prices with respect to their long-level are largest (mid-eighties, late-nineties and last years of the sample period. See lower panel of Figure 2 for

charts with this comparison). This seems to indicate that the inclusion of the stock of housing in the specification is particularly important for deriving a better measure of the deviation of house prices with respect to their long-run levels, and not so much for loans for house purchase. It can also be observed that the correction in house price overvaluation observed in the last few quarters has been larger according to the model presented in Gimeno and Martínez-Carrascal (2006) than according to the model presented here. This is linked to the increasing trend observed in the dwellings per household (as well as to the stronger link obtained in the model here presented between house prices and loans for house purchase).

The error correction terms capture the existing gap between the value of house prices and loans for house purchase and their long-run levels, according to the model, at a given point in time. We label these measures as *partial gaps* (that is, the deviation in these two variables from the long-run levels that, according to our model, they should have given the value of their determinants at a given point in time). However, these determinants are not necessarily at their long-run equilibrium level at any point in time. For example, excessive house prices (loans for house purchase) can wrongly lead to the conclusion that lending for house purchase (house prices) is not above its long-run level. Therefore, given that these deviations are expected to be corrected, the analysis of alternative measures of gaps, based on comparison of the observed values with the levels that would be observed when both variables are in equilibrium (which we label as *overall gaps*) is also relevant for a proper assessment of the existing deviation of both variables from their long-run levels.

Figure 3 compares the evolution over time of both deviation measures (partial and overall gap) for each of the two variables analyzed[6]. As can be seen, the two measures indicate that both

[6] More specifically, these overall disequilibrium measures are calculated as the difference between the observed value of loans for house purchase and house prices and the value when credit and house prices are in equilibrium (that is, replacing loans for house purchase (house prices) by their long-run level in the house prices (loans for house purchase) cointegrating vector). These measures assume that labour income, housing stock and interest

variables were above their long-run levels at the end of the sample period. For both variables, the disequilibrium are larger according to the overall gap measures than according to partial gaps in recent years, in line with the positive values of the partial gaps in this period. For house prices, the two measures stood at similar values by end-2005, but have diverged afterwards, in a context of increasing indebtedness over its long-run level; more specifically, while the partial gap showed a moderate reduction from end-2006, the overall measure increased up to the third quarter of 2008. These corrected measures show that in those periods in which higher gaps (error correction terms) were seen in housing prices and borrowing (early 1990s, late 1990s and 2008), the actual deviation from the long-run equilibrium in variables were in fact larger than reflected by these (partial) gaps. Overall measures reached their maximum levels in the third quarter of 2008, after a period of sharp increase, and, although they have diminished afterwards, they indicate that there is still a gap between the observed values of loans for house puchase and house prices and their long-run levels.

To sum up, according to the results of the model presented, the large increase observed in loans for house purchase and house prices in the last decade has taken both variables above their long-run levels, according to both partial and global disequilibrium measures presented. Since the results of the model indicate that when partial disequilibrium measures (error correction terms) of these variables stand at positive values both variables adjust downwards, reductions in real terms in both variables should be expected. In any case, the equilibrium might not be restored only through changes in these two variables; movements on any of their long-run fundamentals can also contribute to the reduction of the existing gap between loans for house purchase and house prices and their long-run levels.

rates are at their long-run levels.

4 Conclusions

This paper has analyzed the links between loans for house purchase and house prices in the Spanish economy. A VECM model has been estimated in order to derive long-run relationships for both variables and also as a tool to analyse the process of adjustment that exists when these variables depart from these long-run levels.

The analysis of long-run parameters indicates the existence of inter-dependence between the two variables. On the one hand, loans for house purchase depend positively on house prices in the long-run (first, borrowing capacity of households is positively related to house prices because these determine the collateral available and, second, since house prices determine housing wealth, changes in them can impact on spending and borrowing plans), and loans for house purchase are also found to be significant in the cointegrating equation estimated for house prices. On the other hand, the results show that when this credit aggregate departs from the level implied by its long-run determinants, the disequilibrium implies movements not only in this variable but also in house prices and, in this respect, there is also causality from loans for house purchase to house prices. More specifically, when credit for house purchase is above its long-run level, both variables decrease. In addition, the slow speed of correction of the lending disequilibrium implicit in the movements of these two variables (3% per quarter) implies that the contractionary impact of excessive indebtedness on house prices can be lengthy. Furthermore, given that house prices determine housing wealth (the main component of total wealth), the correction in house prices resulting from excessive borrowing for house purchase can additionally have a negative impact on consumption levels through negative wealth effects. Likewise, house price disequilibria imply changes in loans for house purchase (both variables decrease when house prices are overvalued and increase when housing is undervalued).

Regarding recent developments in the two variables in Spain, the evidence presented shows that the significant increase observed in house prices and loans for house purchase in past

years has raised them above their long-run levels. According to the model, overindebtedness and overvaluation in house prices reached, in the third quarter of 2008, the highest values observed in the sample period and have declined afterwards. The paper also offers some insight into how the failure to take overvaluation in house prices into account can lead to a more benign assessment of a potential overindebtedness situation. Similarly, it is important to take into account potential overindebtedness in order to properly quantify potential overvaluation in house prices.

Overall, these results illustrate the strong linkages between house prices and loans for house purchase in Spain. As pointed out, these linkages need to be taken into account in order to evaluate properly the potential disequilibria in these markets, posing challenges for policymakers both from a monetary policy perspective and from a financial stability point of view.

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Appendix. Description of the variables used

lh: *Loans for house purchase per household* measured in real terms (source: Banco de España)

p: *Real house prices.* The logarithm of the average price per square metre of new and second-hand houses (source: Ministerio de Fomento). This time series is available since 1987 Q1. Data prior to 1987 have been obtained using estimates of housing wealth.

i: *Nominal interest rate.* Interest rate on new loans for house purchase to households (source: Banco de España)

yh *Labour income per household,* defined as the logarithm of the real labour income divided by number of households (source: INE). It has been adjusted for two additive outliers (1992 Q3 and 1994 Q1) identified using TSW (TRAMO-SEATS)

sh *housing stock.* Dwelling stock per household (source: Banco de España).It has been adjusted for two additive outliers (1987 Q2 and 1988 Q3) identified using TSW.

uc: *User cost of housing*, defined as the lagged mean difference (using data for four quarters) between the return on mutual funds (source: Banco de España) and house price growth rate. The series for the return on mutual funds is available from 1992 Q1; for previous quarters, in which the share of household investment in shares was very limited, the user cost is proxied by the real risk-free interest rate.

Table 1. Johansen tests for cointegration

Unrestricted model

Ho: rank=r	λ-max test statistic	Small sample correction	95% critical values	95% Pesaran *et al* (2000) critical values	Trace test statistic	Small sample correction	95% critical values	95% Pesaran *et al* (2000) critical values
r = 0	92.22**	77.81**	33.5	36.8	168**	141.8**	68.5	81.45
r ≤ 1	56.44**	47.62**	27.1	30.7	75.82**	63.97**	47.2	58.6
r ≤ 2	**15.37**	**12.97**	21	24.6	**19.4**	**16.4**	29.7	38.9
r ≤ 3	3.522	2.972	14.1	18.06	4.0	3.4	15.4	23.3
r ≤ 4	0.4896	0.4131	3.8	11.47	0.5	0.4	3.8	11.5

Diagnostic tests

	LM test		Normality test		Arch Test		Heterocedasticity	
Single equation tests								
lh_t	2.042	[0.0847]	2.206	[0.3320]	1.626	[0.1795]	1.045	[0.4453]
p_t	1.674	[0.1539]	0.803	[0.6693]	0.936	[0.4491]	1.061	[0.4275]
i_t	0.525	[0.7564]	0.680	[0.7117]	1.125	[0.3532]	0.808	[0.7243]
yh_t	0.992	[0.1571]	1.272	[0.5295]	0.573	[0.6835]	0.774	[0.7628]
sh_t	2.093	[0.0779]	4.074	[0.1304]	0.681	[0.6075]	0.571	[0.9412]
System	1.383	[0.0210]	13.517	[0.1962]			0.633	[1.0000]

Number of lags used in the analysis: 3

Variables entered unrestricted:

uc_{t-1} uc_{t-2} uc_{t-3} uc_{t-4}

Constant CSeason_1 CSeason_2 CSeason

Restricted model

Variables entered restricted: labour income and dwellings per household

Ho: rank=r	λ-max test statistic	Small sample correction	95% critical values	95% Pesaran *et al* (2000) critical values	Trace test statistic	Small sample correction	95% critical values	95% Pesaran *et al* (2000) critical values
r = 0	81.34**	73.71**	21	30.74	135.1**	122.5**	29.7	53.41
r ≤ 1	50.76**	46**	14.1	24.22	53.8**	48.76**	15.4	33.35
r ≤ 2	**3.046**	**2.76**	3.8	16.9	**3.046**	**2.76**	3.8	16.9

Diagnostic tests

	LM test		Normality test		Arch Test		Heterocedasticity	
Single equation tests								
lh_t	1.978	[0.0941]	3.040	[0.2187]	0.366	[0.8317]	1.210	[0.2872]
p_t	2.032	[0.0862]	0.551	[0.7593]	1.610	[0.1836]	1.373	[0.1809]
i_t	0.374	[0.8646]	0.089	[0.9563]	0.177	[0.9493]	1.104	[0.3780]
System	1.0254	[0.4412]	3.6198	[0.7280]			0.760	[0.9596]

Number of lags used in the analysis: 3

Variables entered unrestricted:

uc_{t-1} uc_{t-2} uc_{t-3} uc_{t-4} Δyh_t Δyh_{t-1} Δyh_{t-2} Δsh_t Δsh_{t-1} Δsh_{t-2}

Constant CSeason_1 CSeason_2 CSeason

Variables entered restricted:

yh_t sh_t

Table 2. Conditional system. Cointegrating vectors

Long-run coefficient

	lh_t	p_t	i_t	yh_t	sh_t
β_1	**1.00**	**-0.98**	9.20	-0.96	-0.98
std errors		0.10	0.43	0.53	0.00
β_2	-0.54	**1.00**	**0.00**	-0.99	7.69
std errors	0.05		0.00	0.33	1.09

Loading factors

	Disequilibrium in			
	Vector 1 lh		**Vector 2 p**	
	α	std errors	α	std errors
Δlh_t	**-0.121**	0.020	-0.060	0.025
Δp_t	**-0.092**	0.018	-0.196	0.022
Δi_t	**-0.016**	0.004	-0.013	0.005

Weak exogeneity for long-run parameters

Variables in marginal model: yh_t,sh_t

Regressor	Distribution:
ECT_lh_{t-1}	F(2, 63) = 0.091553 [0.9126]
ECT_p_{t-1}	F(2, 63) = 0.25413 [0.7764]
ECT_$lh_{t-1,}$ ECM_p_{t-1}	F(4, 126) = 0.24863 [0.9100]
Ortogonality tests:	
ε_{yh}	F(3, 66) = 0.39352 [0.7581]
ε_{sh}	F(3, 66) = 1.1929 [0.3193]
ε_{yh} ε_{sh}	F(6, 132) = 0.90257 [0.4952]

Note: weak exogeneity tests are based on the null that the coefficients on the equilibrium correction terms (ECT) are equal to zero for the variables in the marginal model (yh, sh). A further tests, the ortogonality test, requires that the residuals (ε) from the marginal model are not significant in the conditional model (which includes lh, p, i). P-values associated to the null hipothesis are presented in brackets.

Figure 1. loans for house purchase, house prices and their determinants. Evolution over time

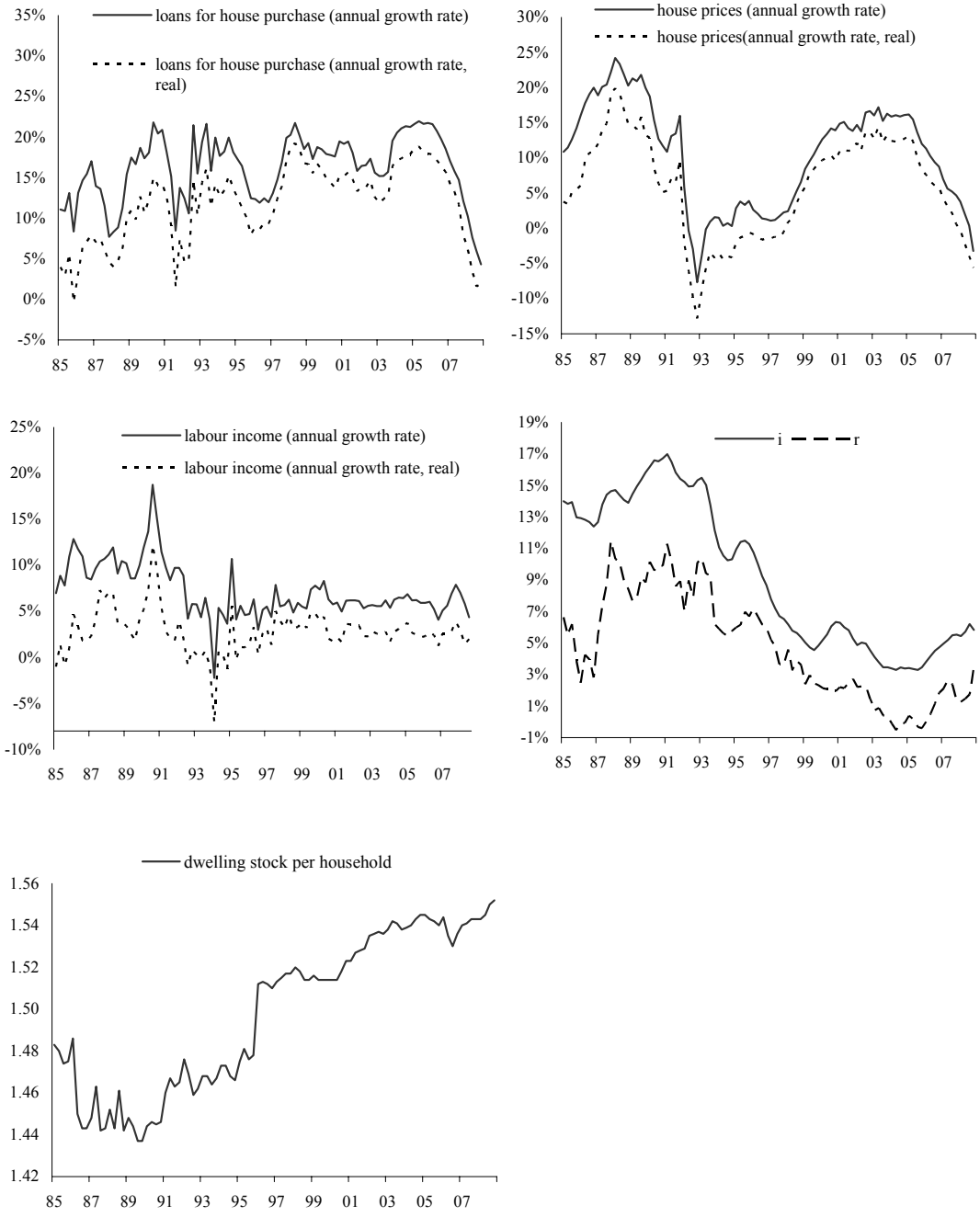
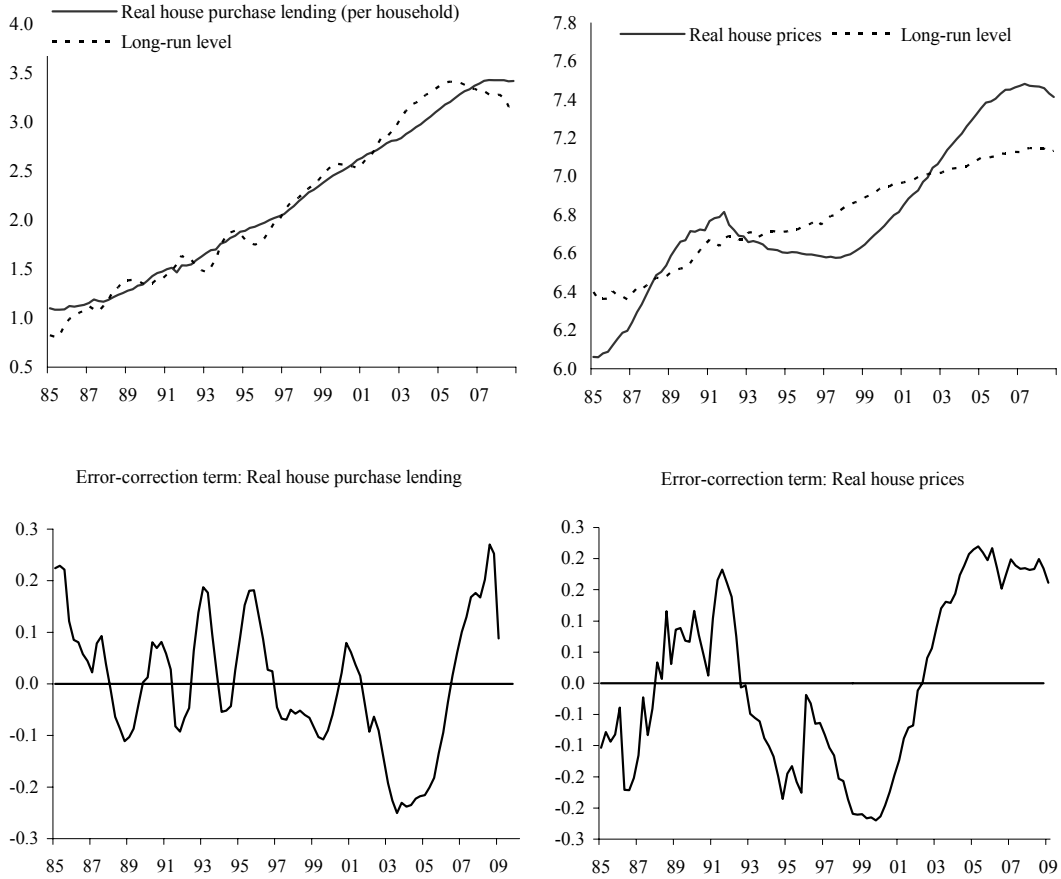


Figure 2. Estimated long-run relationships and error correction terms



Note: Re-scaled to average zero.

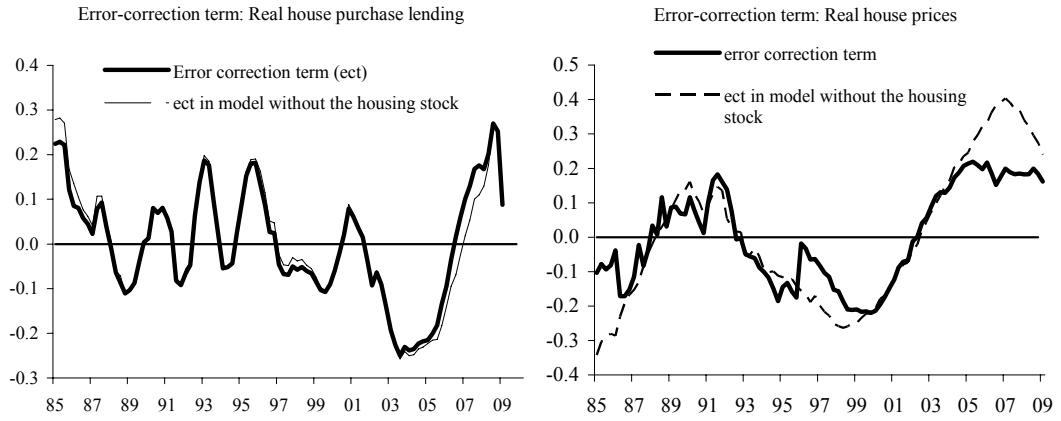
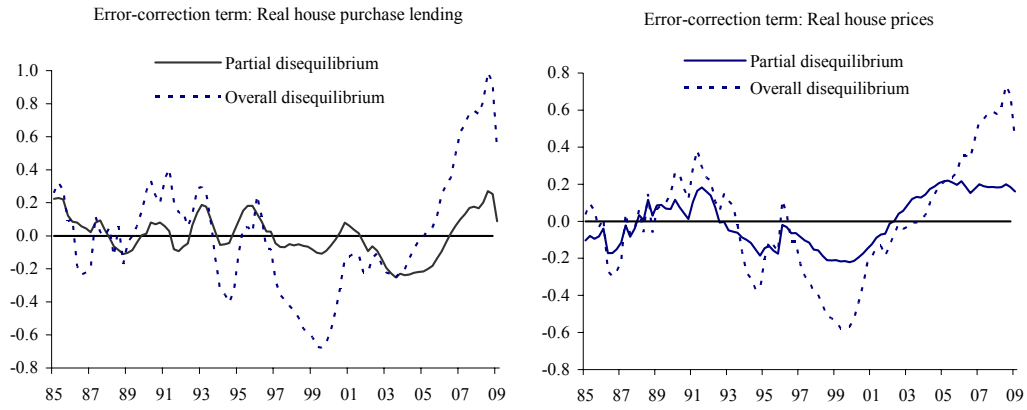


Figure 3: Loans for house purchase and housing prices disequilibria. Partial and global measures



Note: Re-scaled to average zero.