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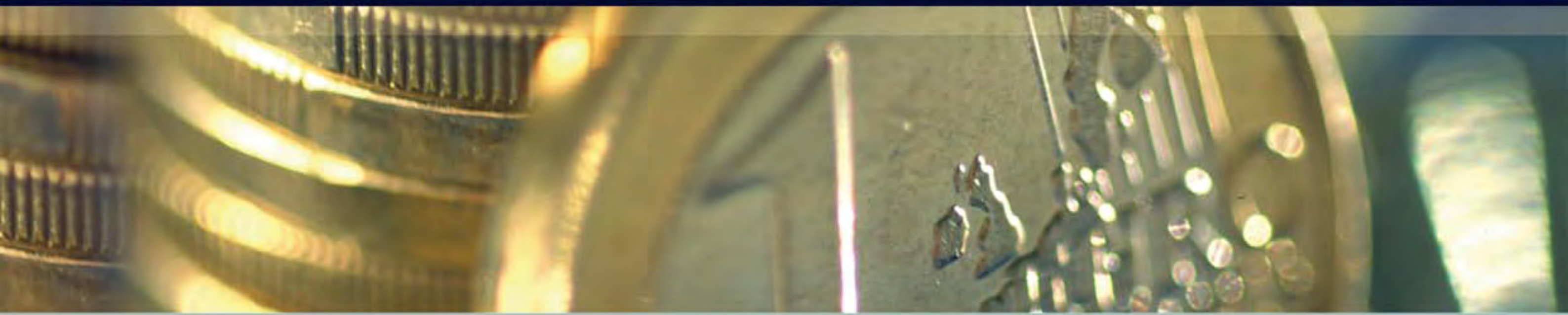

Household savings and mortgage decisions: the role of the "down-payment channel" in the euro area

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Household savings and mortgage decisions: the role of the "down-payment channel" in the euro area

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Abstract

This paper analyses the interactions between household wealth, mortgage decisions and savings in a single empirical framework and identifies an important role for a *"down-payment channel"* in the euro area. Contrary to the traditional housing wealth channel, the *"down-payment channel"* posits a positive relation between household savings and house prices: a rise in house prices forces credit-constrained households who wish to acquire a house to accumulate more savings in order to cover a higher down-payment (i.e. the share of the housing acquisition value that is not covered by a mortgage). The overall effect of a rise in house prices on private consumption can be seen as the result of two offsetting forces: a rise in house prices tends to push up consumption via the traditional housing wealth channel but it also tends to depress the consumption of credit-constrained households who wish to acquire a house via the down-payment channel. Estimates based on a structural VEC model for the euro area suggest that the down-payment effect tends to dominate in the medium term, translating into an overall negative impact of higher house prices on consumption in the euro area.

Keywords: consumption, savings, housing wealth, financial wealth, mortgage debt, euro area. **JEL Codes**: E21, E44, D12

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1. Introduction

In this paper we analyse the link between savings and mortgage decisions in the euro area and identify empirically an important *"down-payment channel"*. The channel captures the fact that, when house prices increase, credit-constrained households who wish to buy a property need to accumulate more savings because the down payment required by banks (i.e. the share of the acquisition price that is not covered by a mortgage) also increases. This down-payment requirement may affect both first time buyers and existing owners who wish to move up into a more expensive property. Several authors have recently pointed at the potential importance of down-payment requirements for housing wealth effects and housing market dynamics[2] but, to the best of our knowledge, there is so far little information on the empirical relevance of this channel. The main contribution of the present paper is to offer an estimate of the magnitude of the down-payment channel in the euro area.

We model jointly savings and mortgage decisions, taking into account, alongside traditional variables such as disposable income and financial and housing wealth, the link between borrowing and savings decisions. In particular, we estimate jointly two cointegrating vectors (i.e. a savings and a mortgage equation) in a Vector Error Correction Model (VECM). The estimated model allows identifying empirically the *"down-payment channel"* through the interaction of housing wealth and mortgage indebtedness. While financial wealth comes out as the main determinant of the savings ratio in the medium-term, the effect of housing wealth is the result of two offsetting channels: the traditional housing wealth effect (where an increase in housing wealth is associated with a reduction in the saving ratio) and the down-payment channel (where an increase in housing wealth that is not accompanied by an equally important increase in mortgages is associated with an increase in the savings ratio). The down-payment channel appears to be quite sizeable in the euro area and, in the medium-term, dominates the traditional housing wealth effects channel, translating into a positive impact of a rise in house prices on savings. The existence of these two offsetting channels explains why housing wealth effects have been notoriously difficult to identify empirically in the euro area, with housing wealth variables generally coming out as statistically insignificant in consumption equations.[3]

Observed trends in savings in the euro area over the past three decades can largely be explained by a combination of financial wealth effects and the interaction between credit constraints and house prices. In contrast, traditional housing wealth effects have played only a limited role. The drop in the savings ratio in the late 1980s and the 1990s can be traced back to large gains in financial wealth and an easing of credit constraints (mostly in the latter decade). Its broad stabilisation since the turn of the century reflects a similar development in financial wealth and the fact that the further easing in banks' credit practices (e.g. in terms of loan-to-value ratios) has been largely offset by surging house prices, leading to only limited further gains in households' effective credit constraints.

Another contribution of the paper is to test how savings and mortgages react to departures from the equilibrium values given by the identified medium-term determinants. We find that when mortgages overshoot the level dictated by their fundamental determinants, correction takes place via an increase in savings. Moreover, this correction is found to be larger in periods of overshooting than in periods of undershooting.

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[2] See for instance Muellbauer (2007) and Ortolo Magne and Rady (2006).
[3] See Section 2 for a detailed review of the literature.

An interesting feature tested in the model is that, given the estimated cointegrating vectors, wealth variables and inflation appear to be weakly exogenous with respect to the long run. Therefore, the short-term dynamics can be determined in a partial system conditioned on the current changes in the weakly exogenous variables. This makes the model more parsimonious with respect to the number of parameters to be estimated. Moreover, impulse response functions for the shocks to housing and financial wealth can be estimated without imposing too many restrictions for the identification.

The model includes seven variables for the sample period (1980Q1 – 2008Q3) at quarterly frequency: household savings, financial wealth, housing wealth, outstanding mortgages, short-and long-term real interest rates and inflation. Household savings, wealth and mortgage variables are all expressed as ratios to gross disposable income.

The paper is structured as follows. Section 2 gives a review of some relevant empirical literature. Section 3 describes some key stylised facts regarding households' savings and mortgage behaviour in the euro area. Section 4 sets out the empirical framework, describing the data and the model for household savings and mortgage demand. Section 5 presents the main estimation results. Section 6 concludes.

2. Literature review

This paper draws on several strands of empirical research which focus, respectively, on the size of wealth effects in consumption equations, on household credit constraints, on the determinants of mortgage demand and on the financial accelerator.

Considerable efforts have been put into estimating the size of wealth effects on private consumption with early work on the issue going back as far as the 1960s and possible differences between financial and housing wealth effects emerging as a central issue. There are a number of reasons to expect housing and financial wealth to affect consumption differently, including differences in taxation, liquidity and use as collateral. Assessing the impact of housing wealth is complicated by the fact the changes in house prices affect both wealth and the cost of consumption. For house owners, an increase in house prices implies an increase in wealth for but also an increase in the cost of imputed housing services. Changes in house prices also have strong distributional effects between home owners and tenants.

Whereas the debate on the relative sizes of financial and housing wealth effects is still largely ongoing in the US, the evidence for the euro area and its Member States generally points to the existence of a significant financial wealth effect and, in most cases, a comparatively smaller or insignificant housing wealth effect. Catte et al. (2004), using co-integration analysis, report a statistically significant impact of financial wealth on consumption in the euro-area countries included in their sample. In contrast, their estimated housing wealth effects are either small or statistically insignificant. Sousa (2009) applies several econometric methods (co-integration analysis as well as a "sticky consumption growth" model[4]) on aggregate euro-area consumption data and reports estimates of marginal propensity to consume (MPC) out of financial wealth of about 1.5 cents per euro. In contrast, estimated MPCs out of housing wealth are very small or insignificant. Skudelny (2009) adopts a dual strategy and estimates wealth effects on both aggregate euro-area data and on a panel of euro-area Member States. On the basis of aggregate data, the author reports an MPC out of financial

[4] For further details on the "sticky growth model" and its estimation see for instance Caroll et al. (2006) and Sommer (2007).

wealth of 2.4-3.6 and a much lower propensity to consume out of housing wealth of 0.8. Panel estimations point to a lower effect of financial wealth – with an MPC in the range of 0.6-1.1 - and to similar MPCs for housing and financial wealth. The differences between the panel and aggregate approaches are however difficult to interpret as the estimated models are different.[5] Finally, Slacalek (2009) assesses wealth effects on the basis of a "sticky consumption growth" model in 16 advanced economies and finds large differences in MPCs across countries. The estimated effect is somewhat smaller for housing than for financial wealth in the euro area but not in the rest of the sample.

Consumption equations have also been used to assess the extent to which household are credit constrained or liquidity constrained. The importance of credit or liquidity constraints can be tested by incorporating measures of credit in a consumption equation. Classical references on the issue are for instance Bacchetta and Gerlach (1997) or Ludvigson (1999). A more recent reference is Iacovello (2004) who, using US data, finds strong evidence for the presence of collateral effects in a consumption Euler equation with the presence of a non-negligible share of constrained consumers. Muellbauer (2007) estimates a consumption function for the UK and reports a substantial impact of an easing of credit conditions on consumption via several channels including a higher housing collateral effect. Beaton (2009) estimates a consumption function on US data in which large changes in credit availability (as reported by banks in the Federal Reserve's Senior Loan Officer Survey) affect consumer spending. Country differences in the size of the housing wealth effect have also been used as indirect evidence of country differences in the development and deregulation of household credit markets. For instance, Catte et al. (2004) document a significant correlation between cross-country differences in the size of housing wealth effects and cross-country differences in the completeness of mortgage markets and/or scope for housing equity withdrawal.

Our work also relates to a vast literature which has investigated the causes and consequences of the surge in household debt observed in many advanced economies since the 1980s and which was brought to a brutal halt in the recent financial crisis. There seems to be a consensus that the surge can in large parts be explained by a combination of financial liberalisation, low interest rates and low inflation.[6] From the very rich literature on household credit we retain and discuss briefly three themes that are of particular interest in the context of the present paper: i) the interactions between credit and house prices, ii) the effect of institutional features of mortgage markets and iii) the notion of credit misalignment.

- A number of papers have highlighted the two-way relation between credit and house prices. Hofmann (2004) uses a co-integrating VAR approach to look into the determinants of credit in the non-bank private sector in 16 industrialised countries and reports strong evidence of a significant two-way relationship between credit and property prices with rises in property prices fuelling lending and vice versa. Tsatsaronis and Zhu (2004) also find evidence of such a two-way relationship by looking at the determinants of house prices in a VAR framework on a sample of 17 countries. Goodhart and Hofmann (2008) assess the link between money, credit and house prices in a panel VAR model estimated on a sample of 17 industrialised countries and find multidirectional links between money, credit, house prices and GDP.

- In what concerns the effect of institutional features of mortgage markets, Tsatsaronis and Zhu (2004) conclude that the two-way relation between house prices and credit is stronger in countries where variable mortgage rates are more prevalent and market-based property valuation practices for loan accounting are more widespread. Goodhart and Hofmann (2008) report evidence of an increase in

[5] The co-integration analysis is performed on the aggregate data while the panel estimates are based on a model in first differences due the short time span of the data set.

[6] See for instance Debelle, 2004.

the impact of house prices on the macroeconomy since the mid-1985, a finding which they relate to the liberalisation of financial systems. Almeida et al. (2006) estimate house price and mortgage demand equations in a panel of 26 countries and find that the sensitivity of both variables to income shocks is higher in countries where loan-to-value ratios are higher. Calza et al. (2009), who estimate VAR models for 19 advanced economies, conclude that more developed mortgage markets tend to magnify the impact of monetary policy shocks on house prices, residential investment and consumption. Finally and more directly related to our work, Ortalo-Magné et Rady (2006) build a life-cycle model of the housing market that includes down-payment requirements and show how this can help explain the "excess" volatility of housing prices and their tendency to display phases of overshooting.

- There is also a fledgling literature which aims at assessing misalignments in private sector credit. To the best of our knowledge, this work has so far mostly focused on transitions economies in Europe. Drawing inspiration from the literature on equilibrium exchange rates, it estimates equations of fundamental credit demand in panel regressions and assesses deviations of actual credit from the level dictated by fundamentals (see for instance Cotarelli et al. (2005) and Egert et al. (2006)). Although the equations estimated in this literature are essentially ad-hoc and largely determined by the data, the idea of the possible existence of periods of overshooting in debt levels appears quite appealing in the context of the current financial turmoil. Two points are worth making here. First, the strong simultaneity issues highlighted previously point to a risk of serious bias with standard panel analysis. This, together with the non-stationary nature of most of the time series considered, militates for assessing credit misalignments in a co-integrating framework. Second, to the best of our knowledge, the literature on credit misalignments remains silent regarding the channels through which credit misalignment is corrected. Is the re-balancing process involving only housing investment and financial assets or is private consumption affected as well? These are important empirical matters which deserve further research, and which we begin to tackle in this paper.

A final strand of work which is worth mentioning in the context of the present paper is the considerable literature on the financial accelerator. Since the seminal work by Bernanke and Gertler (1989, 1995) and by Bernanke, Gertler and Gilchrist (1996 and 1999), an extensive literature has developed the idea that frictions on credit markets can amplify and prolong the macroeconomic effects of monetary policy shocks or real economic shocks. The amplification mechanisms may arise from the counter-cyclicality of the external finance premium (as originally proposed by Bernanke et al.) or changes in access to credit due to the pro-cyclicality of the prices of assets used as collateral (see for instance Kiyotaki and Moore (1997)).[7] While much of the work on the so-called financial accelerator has focused on the corporate sector, a number of researchers have also highlighted the role of households and house prices in this framework (see for instance Iacoviello (2005), Almeida et al. (2006), Darracq Paris and Notarpietro (2008), Calza (2009)). Like its corporate counterpart, the household financial accelerator posits that households' borrowing capacity or costs depend on their net worth. Hence fluctuations in asset prices affect household spending via wealth effects but also via their impact on households' net worth and borrowing capacity. Because of the special role of housing as collateral, house prices tend to play a central role in the propagation of shocks. The role depends however on structural features of the mortgage market. For instance, Aoki at al. (2004) construct a general equilibrium model incorporating a housing-based financial accelerator and find that deregulation of mortgage markets increases the impact of monetary policy shocks on private consumption. Calza et al. (2009) obtain a similar result.

[7] This has also been labeled the credit channel when focusing on the impact of credit frictions on the transmission of monetary policy. The credit channel of monetary policy can be further broken down into a balance-sheet channel (essentially an application of the financial accelerator) and a bank lending channel.

From this rapid review we retain a number of key considerations for the modelling of private consumption in the euro area. First, it is important to make a distinction between financial and housing wealth. Second, there are strong multi-way interactions between household debt, private consumption and housing which need to be properly taken into account. Third, financial market liberalisation and deepening may affect strongly the nexus formed by debt, consumption and housing.

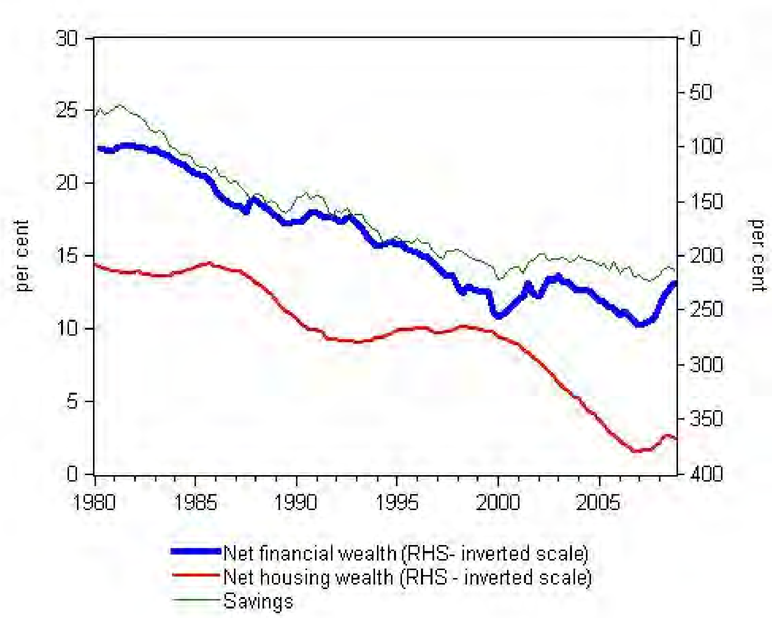
3. Household savings in the euro area: some stylised facts

This section reports a few key stylised facts that should be born in mind when trying to model the behaviour of household savings in the euro area.

As shown in Figure 1, the euro-area's savings ratio has experienced a steady decline from the early 1980s to the early 2000s and, since then, has fluctuated without showing any clear trend.[8] These developments are broadly matched by similar developments in household financial wealth. In contrast, the correlation between housing wealth and the saving ratio appears much weaker.[9] In particular, the rapid increase in house prices observed since the late 1990s does not seem to have affected consumption in the euro area in any notable way. Housing wealth has gained considerable importance in household balance sheets over the past two decades but its impact on consumer spending is difficult to detect.

Figure 1: Household savings and wealth, euro area

(in % of household disposable income)



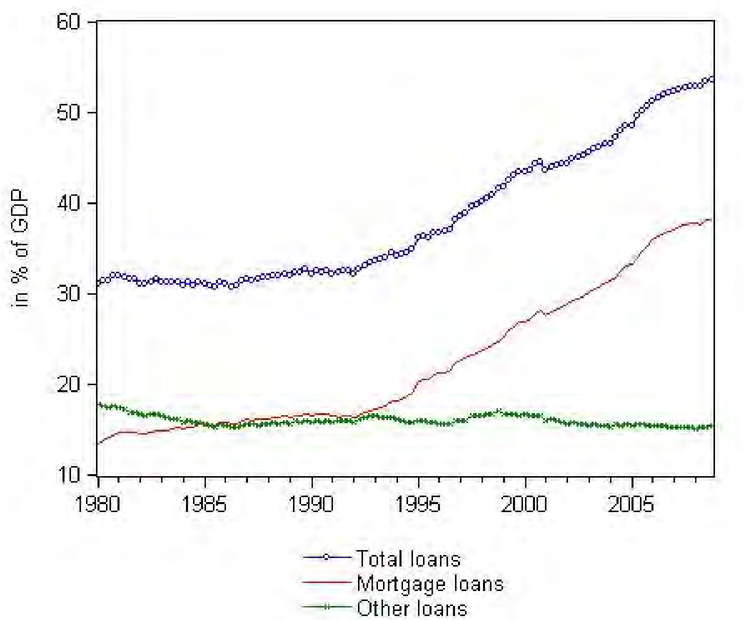
[8] The charts and econometric work presented in this paper are based on data covering the period 1980Q1 to 2008Q3.

[9] Net financial wealth is defined as financial assets minus non-mortgage related debt, while net housing wealth is defined as housing wealth minus outstanding mortgages.

There has been significant debt accumulation in the euro-area household sector since the late 1990s. The rise in indebtedness can be largely traced back to mortgage with consumer credit playing a comparatively modest role (see Figure 2). Debt accumulation has been very uneven across Member States: while Germany has registered a small decline in its debt to GDP ratio since the late 1990s, a number of Member States have experienced increases of 40-50 percentage points over the same period (Greece, Spain, Ireland, Portugal, Netherlands).

Figure 2: Household debt, euro area

(in % of GDP)

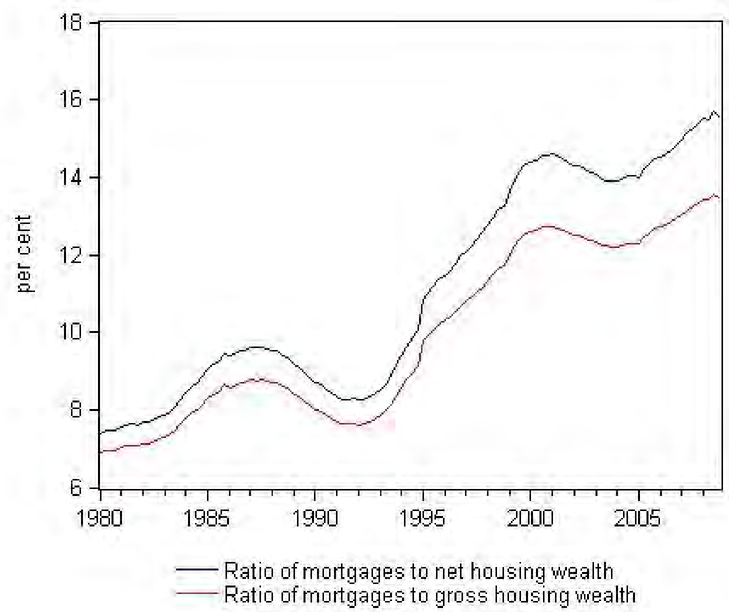


Another noteworthy feature of the euro-area economy is a relaxation of household credit constraints, at least on mortgage markets. Mortgage markets remain much less developed in most euro-area countries than in the US. For instance mortgage equity withdrawal which is current practice in anglo-saxon countries is still limited to a small number of euro-area Member States (mostly the Netherlands and Finland and, to a lesser degree, Ireland, and Spain[10]) but, as documented in ECB (2009), loan-to-value (LTV) ratios have increased, the typical duration of mortgages has been lengthened and more flexibility has been introduced in repayment schedules. At the macroeconomic level, these improvements to access to credit have contributed to a steady rise in the ratio of mortgages to housing wealth (see Figure 3). The increase was particularly rapid in the 1990s but has been much more moderate in the current decade.

[10] See for instance Calza et al. (2009).

Figure 3: Ratio of outstanding mortgages to housing wealth, euro area

(in %)



Given that credit constraints play an important role in our estimation work, we close this section with a discussion of its possible effects. Credit constraints may affect the link between consumption and housing via two distinct channels with opposite effects of changes in house prices on private consumption.[11]

- The first channel, which is also the one considered (or implicitly assumed) in most of the available empirical research, applies to existing homeowners via access to housing equity. A rise in house prices boosts debt and household spending of existing credit-constrained homeowners by raising the value of the collateral. The channel operates only to the extent that the mortgage market allows some form of mortgage equity withdrawal (MEW). Available evidence on the structure of mortgage markets in the euro area indicates however that MEW is not a common practice in most euro-area Member States, limiting substantially the possible scope for this channel.[12]

- The second channel, which we call hereafter the "down-payment channel" has received much less attention in the literature but is more likely to be at play in the euro area. When banks only accept to cover part of the full value of the housing investment, first time buyers or existing owners wishing to acquire a more expensive house have to save in order to accumulate the capital required to cover the down-payment. Data show that loan-to-value ratios (i.e. the share of the value of a housing property that is covered by the loan) practiced by banks are still significantly below 1 in most euro-area Member States.

[11] See Muellbauer (2007) for an extensive discussion.

[12] An additional factor limiting the importance of this channel in the euro area arises from the fact that, even in euro-area Member States where HEW is commonly practiced, most of the funds extracted from an increase in housing equity appears to be reinvested in housing, limiting the impact of house prices on private consumption. See, for instance, De Nederlandsche Bank (2003).

An interesting corollary of this distinction is that whereas financial liberalisation has similar positive effects on household spending in the two channels (i.e. liberalisation boosts consumption both via increased MEW and via reduced down-payments), the impacts of changes in house prices are radically different. A rise in house prices will boost consumption of existing home-owners via the MEW channel but will also reduce consumption of first-time buyers who face a higher down-payment.

4 The empirical framework

4.1 Data

In order to model jointly household savings and mortgage demand, the following macroeconomic variables for the household sector are considered: gross savings, outstanding mortgage loans, net financial wealth and net housing wealth (all expressed as ratios to household gross disposable income). These are complemented by short and long-term real interest rates and inflation. The data are at quarterly frequency and cover the period 1980Q1 to 2008Q3 for the euro area as a whole.

The euro-area series for household gross savings, gross disposable income, the short and long-term interest rates and the harmonised consumer price index (HCPI) are taken from Eurostat and extended backwards with the corresponding series from the ECB's Area Wide Model (AWM). The housing wealth and mortgage series come from the European Central Bank (ECB). We also use the national account concept of net financial wealth as provided by Eurostat and expanded backwards with data provided by the National Institute of Economic and Social Research (NIESR).

From these housing wealth, net financial wealth and mortgage debt series, we derive a measure of household net worth that is divided between financial assets and housing assets. In the estimations shown hereafter, the variable called ***"net financial worth"*** is calculated so as to capture only the net worth attributed to financial assets holdings. It is constructed from Eurostat data by adding mortgage loans (from the ECB) to Eurostat's national account concept of net financial wealth (which is net of all forms of debt, i.e. mortgage as well as other forms of credit). In other words, net financial worth is equal to the value of financial assets minus non-mortgage related debt. The counterpart to ***"net financial worth"*** is the variable ***"net housing worth"*** which captures the net worth attributed to housing assets and is calculated as housing wealth minus mortgage loans. We consider that net worth variables are more suitable than gross worth values for capturing wealth effects.

All variables used in the model presented below are seasonally adjusted and, with the exception of the interest rates and inflation, are expressed in logarithmic form. Their levels, growth rates and first differences are shown in Figure 4 and 5.

In the estimated model presented hereafter, the ratio of mortgages to net housing worth plays an important role as it captures the credit constraint effect due to the *"down-payment channel"*. As shown in Figure 3, the ratio displays the same dynamics as the ratio of mortgages to gross housing wealth. It can hence be considered

Figure 4: Savings ratio, mortgage ratio, net financial worth and net housing worth, euro area

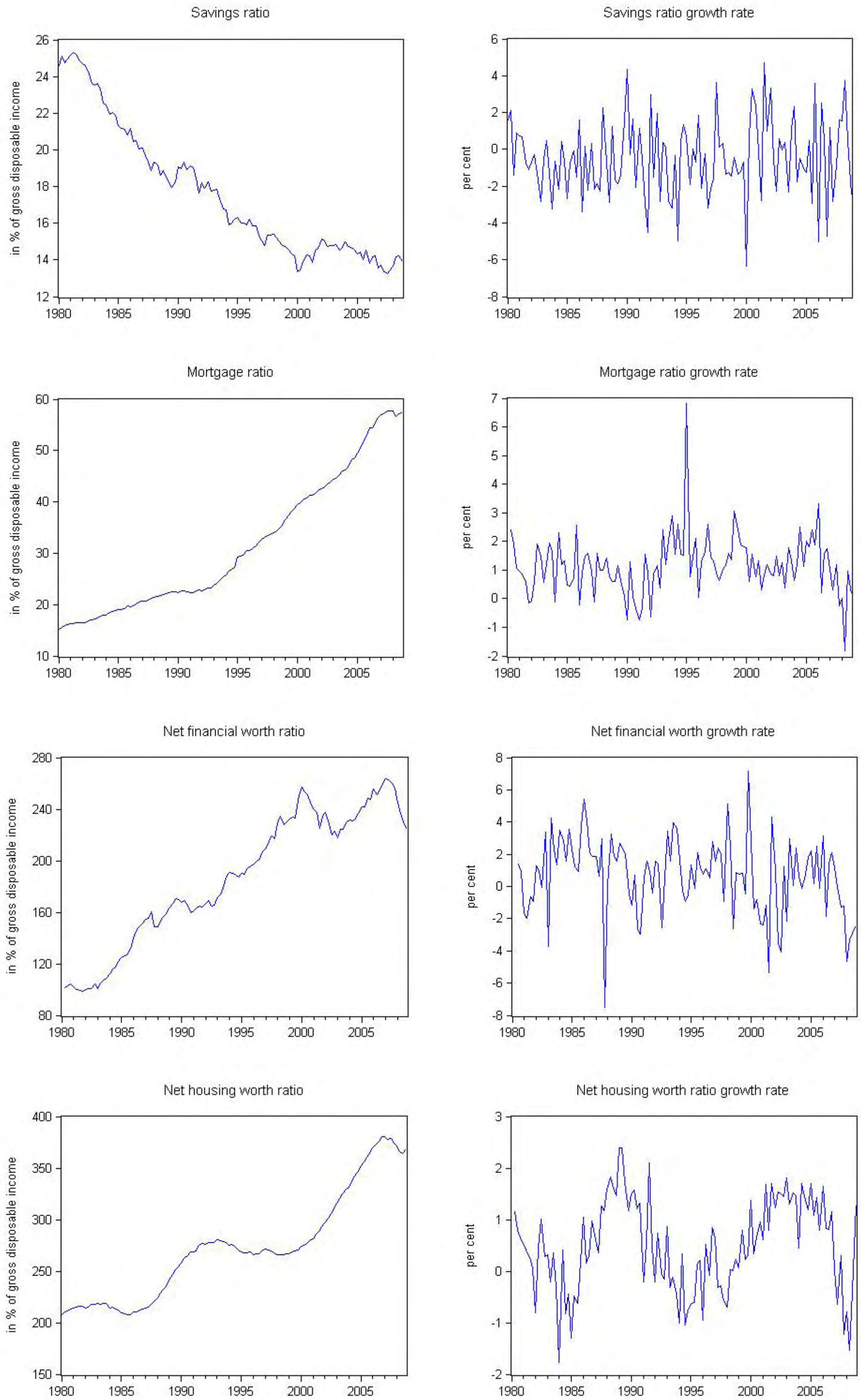
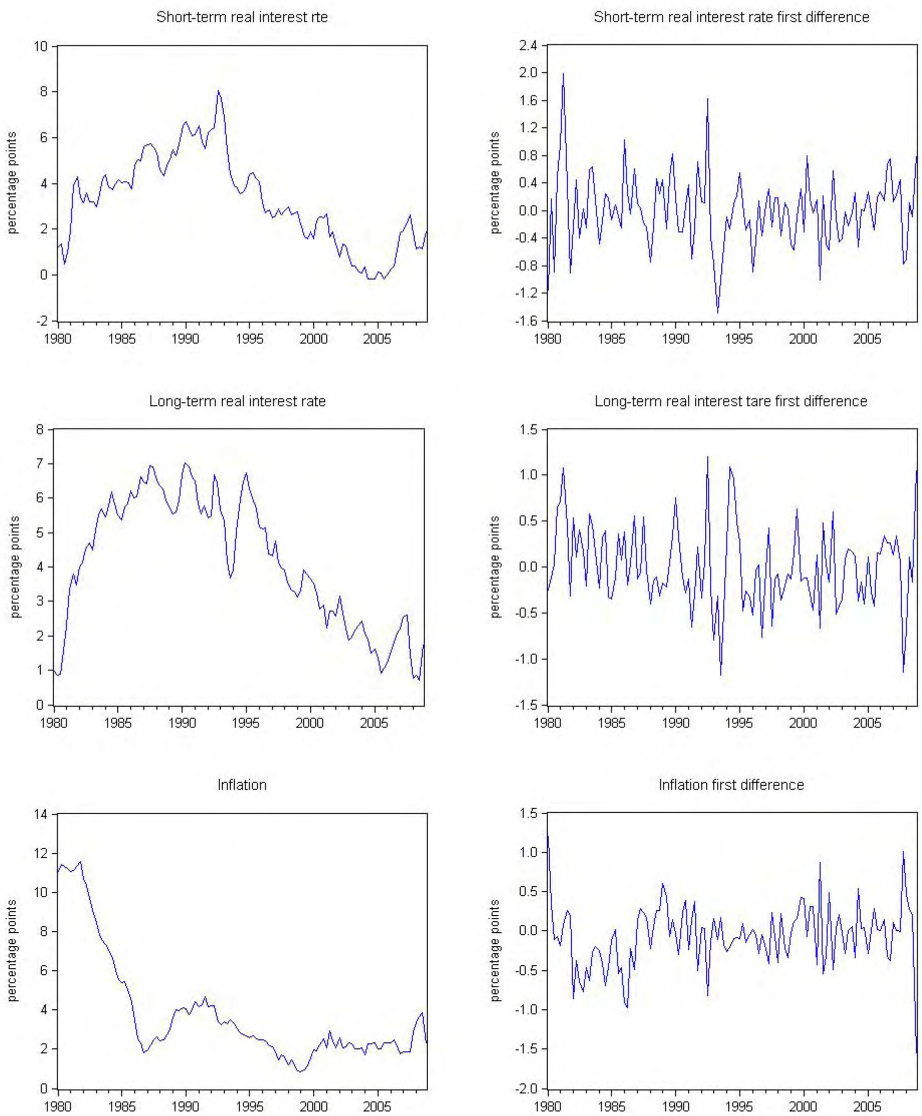


Figure 5: Short-term and long-term interest rates and inflation, euro area



as closely correlated with past average loan-to-value ratios, and therefore, as a proxy measure of the extent to which credit-constrained households need to save in order to pay for the share of the acquired property value not covered by the mortgage. In addition to loan-to-value ratios practiced by banks, the ratio is determined by a broad range of structural factors that influence the accessibility of households to credit such as taxation and mortgage market features. Therefore, it can be seen as the *effective loan-to-value ratio*.

All the variables in the model are found to be integrated I(1). Two different unit root tests are used: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests (see Table 1 in the appendix). In the ADF test the lag length is selected such that the residuals of the ADF regression do not show a significant autocorrelation.

4.2 The model for household savings and mortgage demand

The empirical analysis starts with a 7-variables VAR system in which all variables are, in a first step, treated as endogenous. The initial VAR model is given by the following multivariate equation:

$$Y_t = \mu + \sum_{k=1}^{p} A_k Y_{t-k} + \Phi D_t + \varepsilon_t \qquad (1)$$

where $Y_t = [s_t; m_t; f_t; h_t; sr_t; lr_t; \pi_t]'$ is a n-dimensional vector (n = 7) of I(1) variables and μ is a vector of constants. The variables household gross savings (s_t), mortgages (m_t), net financial worth (f_t) and net housing worth (h_t) are expressed as ratios to gross disposable income (yd_t). The variables (sr_t) and (lr_t) are, respectively, the short- and long-term real interest rates, while (π_t) is the CPI based inflation. D_t is a vector of dummy variables and ε_t is a n-dimensional random vector of normal serially uncorrelated errors with variance covariance matrix Σ. The dummy variables are needed in order to account for significant interventions and reforms that frequently show up as large (non-normal) shocks in the VAR analysis, thus violating the normality assumption on the residuals.[13]

The lag length of the VAR model in (1) is determined to be equal to two (p=2). The Autocorrelation LM test indicates that the residuals are serially uncorrelated (see Table 2 in the appendix), while normality is reached only with the inclusion of dummy variables.

The number of co-integrated relationships (r) is determined by Johansen's maximum likelihood-based method. Given the determined r co-integrating relationships, the VAR model in (1) can alternatively be written as a Vector Error Correction Model (VECM):

$$\Delta Y_t = \mu + \sum_{k=1}^{p-1} \Gamma_k \Delta Y_{t-k} + \Pi Y_{t-1} + \Psi D_t + \varepsilon_t \qquad (2)$$

where $\Pi = \alpha\beta'$ and $\varepsilon_t \sim N_n(0, \Sigma)$. The Δ operator is the first-difference operator, Γ_k are the short-run dynamic matrices and α and β are (n x r) and (n x r) (full rank) matrices of short-run adjustment coefficients and long-run coefficients, respectively, with r being the co-integration rank. The vector of constants is left unrestricted to allow for deterministic time trends in the levels of the data.

According to Johansen's trace test, the rank of the matrix Π is equal to two, indicating two co-integrated relationships (r = 2). The asymptotic critical values for the Johansen's trace test are obtained according to Johansen and Nielsen (1993) due to the presence of dummy variables (see Table 3 in the appendix).

Identification of the co-integrated relationships

Once the number of co-integrating relationships is determined, identification restrictions (m) are needed on all co-integrating relations in order to ensure the uniqueness of vectors α and β.

[13] Dummies were included to account for the mean-shift in the mortgage series in 1995Q1 and in the inflation series in 1986Q1. Transitory blip dummies were included to account for the large transitory shocks in interest rate series in 1992. (See also Figure 4 and 5, the variables in first differences and growth rates).

We start by imposing only just-identifying restrictions ($m = r^2$). The advantage of proceeding that way is that standard errors on the long-run coefficients can be calculated, and thus, a first idea of how to simplify the relations further is obtained.[14] The just-identifying restrictions are derived from economic theory. Additional restrictions on the structure change the value of the likelihood function and, thus are statistically testable using a Likelihood Ratio (LR) test statistic that is chi-squared distributed.

The two co-integrating vectors are defined as follows:

$$\begin{aligned} s_t &= \beta_{10} + \beta_{11} m_t + \beta_{12} f_t + \beta_{13} h_t + \beta_{15} lr_t + \beta_{16} \pi_t + \upsilon_{1t} \\ m_t &= \beta_{20} + \beta_{23} h_t + \beta_{24} sr_t + \beta_{25} lr_t + \beta_{26} \pi_t + \upsilon_{2t} \end{aligned} \tag{3}$$

We impose two normalization restrictions for the savings ratio and the mortgage ratio and zero coefficients for the real short-term interest rate ($\beta_{14} = 0$) in the savings equation and for net financial worth in the mortgage equation ($\beta_{22} = 0$). An additional over-identifying restriction is imposed by setting a zero restriction on the savings ratio in the mortgage equation ($\beta_{21} = 0$) as it was not found to be statistically significant. The LR test statistic did not reject the null hypothesis that the additional restriction is valid (see Table 4 in the appendix).

In the savings equation, the zero restriction on the real short-term interest rate is based on the assumption that the long-term real interest rate is more important for the savings decisions than the real short-term interest rate, the effect of the latter on savings being captured only indirectly through its impact on the mortgage ratio. In the mortgage equation, as the net financial worth ratio is generally not an important source of collateral for mortgage loans, a zero restriction on the net financial wealth ratio appears justified.

Weak exogeneity of the variables net financial worth, net housing worth and inflation

The dimension of the system can be reduced as tests indicate that the variables net financial worth, net housing worth and inflation proved are weakly exogenous. The null hypothesis of zero short-run adjustment coefficients for the changes in the net financial worth, net housing worth and inflation cannot be rejected (see Table 5 in the appendix). This means that net financial worth, net housing worth and inflation are influencing the long run stochastic path of the other variables of the system in levels, while at the same time they are not influenced by them (in levels and in the long run). This is called "no levels feedback" or long-run weak exogeneity.

In this case, the vector Y_t can be partitioned into g endogenous variables Z_t and $n - g$ conditioning variables X_t: $Y_t = (Z_t, X_t)$. The model in (2) is equivalent to a conditional model for Z_t, called the partial model,(4), and a marginal model for X_t, (5).

The partial model:

[14] See Juselius (2007) for a detailed analysis on identification issues for the co-integrated VAR model.

$$\Delta Z_t = \mu_1 + B\Delta X_t + \sum_{k=1}^{p-1} \Gamma_k^* \Delta Y_{t-k} + \Pi^* Y_{t-1} + \Psi D_t + \varepsilon_{1t} \qquad (4)$$

where $\Pi^* = \alpha^* \beta'$, $\varepsilon_{1t} \sim N_g(0, \Sigma^*)$, . $\Sigma^* = \Sigma_{11} - \Sigma_{12} (\Sigma_{22})^{-1} \Sigma_{21}$. The short-run dynamic matrices and the adjustment coefficients in the partial system are given by $\Gamma_k^* = \Gamma_{k1} - \Sigma_{12} (\Sigma_{22})^{-1} \Gamma_{k2}$ and $\alpha^* = \alpha_1 - \Sigma_{12} (\Sigma_{22})^{-1} \alpha_2$, respectively, where α_2 are not statistically different from zero.

The marginal model:

$$\Delta X_t = \mu_2 + \sum_{k=1}^{p-1} \Gamma_{k2} \Delta Y_{t-k} + \varepsilon_{2t} \qquad (5)$$

where $\varepsilon_{2t} \sim N_{n-g}(0, \Sigma_{22})$.

The partial model is estimated including the long-run relationships as identities. First differences of the endogenous variables g are regressed on the first differences of the exogenous variables, n-g, lags of the first differences of all the variables in the system and the two co-integrating relationships.

5. Results

Table 1 gives the estimated long-run coefficients β of the two co-integrating vectors.

Table 1: The estimated co-integrated vectors

	s_t	m_t	f_t	h_t	sr_t	lr_t	π_t	μ
β_1'	1.00	0.43 0.07 [6.3880]	0.56 0.08 [7.0114]	-0.19 0.08 [-2.3818]	0.00	5.66 0.71 [7.9456]	3.34 0.65 [5.1460]	-6.51
β_2'	0.00	1.00	0.00	-0.71 0.13 [-5.3980]	3.46 1.36 [2.5488]	8.89 1.88 [4.7322]	6.86 0.69 [9.8695]	-0.12

The savings equation

Financial wealth effects are present in the euro area, a 10 per cent increase in ***the ratio of*** financial worth ***to disposable income*** reducing ***the*** **savings** ***ratio*** by about 6 per cent. The estimated elasticity of financial wealth is in the range of the estimates generally reported for the euro area in the available empirical literature. It corresponds to a marginal propensity to consume of about 3 cents to the euro (i.e. an increase in financial worth of one euro is associated with an increase in consumption of 3 cents). This remains on the low side compared with similar estimates reported for the US. Rising financial wealth has nevertheless played an important role in the fall of the savings ratio in the euro area since the late 1980s as evidenced by the close historical correlation between the two variables.

The long-term interest rate and the inflation rate seem to co-move negatively with the saving ratio: an increase in real interest rates and inflation is associated with a decrease in savings. The positive correlation between consumption and long-term interest rates seems to go against the priors of economic theory which points to a negative effect of interest rates on the consumption of durable goods. Moreover, the ratio of housing worth to disposable income is significant but comes in with a "wrong" sign: an increase in net housing wealth is associated with an increase in savings in the medium-term. However, this apparently paradoxical result can be explained by the modelling approach used here (with joint determination of savings and mortgages) as discussed in the next few paragraphs.

Identifying the down-payment channel

Based on the estimated model, the medium-term interactions between housing wealth, mortgage and savings appear more complex than what is generally reported in the empirical literature on the euro area. Indeed, one can reformulate the estimated co-integrating saving equation so as to identify a small but significant housing wealth effect combined with a down-payment effect captured by the ratio of mortgage to net housing worth. The estimated co-integrated vector for the savings equation can be reformulated as follows:

$$s_t = \beta_{10} + \beta_{11}(m_t - h_t) + \beta_{12} f_t + (\beta_{11} + \beta_{13})h_t + \beta_{15} lr_t + \beta_{16}\pi_t + \upsilon_{1t} \qquad (5)$$

where $(m_t - h_t)$ represents the logarithmic form of the ratio of mortgages to net housing worth.

According to this re-interpretation, the savings ratio is determined in the medium term by the five following variables (see Table 2): the ratio of mortgage to net housing worth (instead of the ratio of mortgage to disposable income as in the original saving equation), net financial worth, net housing worth, the long-term real interest rate and inflation. An interesting and novel result of this re-interpreted model is that it shows that house prices affect savings via two offsetting channels: a rise in house prices tends to push up consumption up via the traditional housing wealth effect but it also tends to depress consumption via a credit constraint channel. The second effect translates the fact that, when house prices increase, credit-constrained households need to save more to pay for the share of their acquisition that is not covered by the mortgage. In the regression, this is captured by a negative relation between the savings ratio and the ratio of mortgages to net housing worth. We call this latter relation the *"down-payment channel"*.

Table 2: The estimated "down-payment channel" in the savings equation

	s_t	m_t - h_t	f_t	h_t	lr_t	π_t
β_1'	1.00	0.43	0.56	0.24	5.66	3.34

The identified credit constraint channel appears to be quite sizeable in the euro area. As evidenced by a large increase in the mortgage to net housing worth ratio, credit constraints have probably eased significantly over the past two decades (see Figure 3). Given the large size of the estimated elasticity of savings with respect to the mortgage to housing worth ratio, the easing of credit constraints has contributed as much as the increase in financial wealth to the fall in the savings ratio in the euro area in the 1990s. While the estimated impact on savings appears high for the down-payment channel, it is much lower for the traditional housing wealth effect. The estimated coefficient of the latter corresponds to a marginal propensity to consume out of housing wealth of only 1 cent in the euro which is considerably lower than estimates usually reported for the US economy. As a result of the small size of the housing wealth channel, the medium-term net effect of a rise in house prices on savings (resp. consumption) is positive (resp. negative). This stands in sharp contrast with data for the US where most available studies show a strong negative correlation between house prices and the savings ratio.

The interaction between housing wealth and savings is also characterized by relatively complex short-term dynamics (see Table 6 in the appendix). In the short-term, an increase in housing wealth has a relatively strong positive contemporaneous effect on consumption, suggesting the existence of confidence effects the impact quarter. However, if the rise is sustained, the increases in consumption and housing wealth tip the medium-term savings equation out of balance and equilibrium is progressively restored by raising savings. This is due to the lagged effect on the down-payment channel captured by the change in the mortgages to net housing worth ratio - the sustained decrease in this ratio has a positive effect on savings. This latter effect dominates the confidence effect in the euro area in the medium term.

The mortgage equation

In the medium term, mortgage demand in the euro area is determined by the level of interest rates (short and long), inflation and housing wealth. Long rates play a somewhat bigger role than short rates, a finding which is in line with the structure of most Member States' mortgage markets where fixed-interest-rate contracts tend to dominate. Higher inflation comes with lower mortgage demand, indicating the existence of some front-loading effect.[15] Higher net housing worth (i.e. housing minus mortgage) is associated with higher mortgage, which is in line with possible collateral effects and, more generally, with to the two-way relationship between credit and house prices generally reported in the literature.

An interesting feature of the model is that it points to strong short-term interactions between mortgage and savings decisions. When mortgage demand overshoots the level dictated by its four fundamental determinants, correction takes place via an increase in savings. The result is fairly intuitive: if the mortgage level turns out to be too high relative to fundamentals (for instance because households have embarked on an episode of irrational exuberance regarding their future income prospects), the cash needed to scale back debt is obtained by raising savings. Interestingly, tests show that the correction is asymmetric: an overshooting of mortgage compared to its fundamentals requires a relatively large reduction in consumption whereas an undershooting triggers a relatively smaller increase in consumption. Again the result is fairly intuitive: mortgage can be adjusted upwards by going to a bank and asking for an additional loan but can only be adjusted downwards by increasing savings.

The estimated mortgage debt overhang

The results suggest that the mortgage ratio to gross disposable income somewhat overshot its fundamental from 2006Q4 onwards, with an overhang peaking at about 15 per cent in 2007Q4. Over the period 2006Q4-2008Q3, the correction in the debt overhang has caused an average decrease of about 0.4 pp in the annual growth of consumption. An increase in the mortgage ratio feeds also into the savings equation. Thus, debt overshooting due to an increase in mortgages also reduces the equilibrium level of savings as dictated by fundamentals, pulling the actual savings ratio down in the next quarter through the offsetting effect from the

[15] With fixed mortgage installments, inflation is associated with a progressive erosion of the real burden of debt over time. This partial transfer of the real burden of debt to the early stages of a mortgage's lifetime is higher when inflation is higher

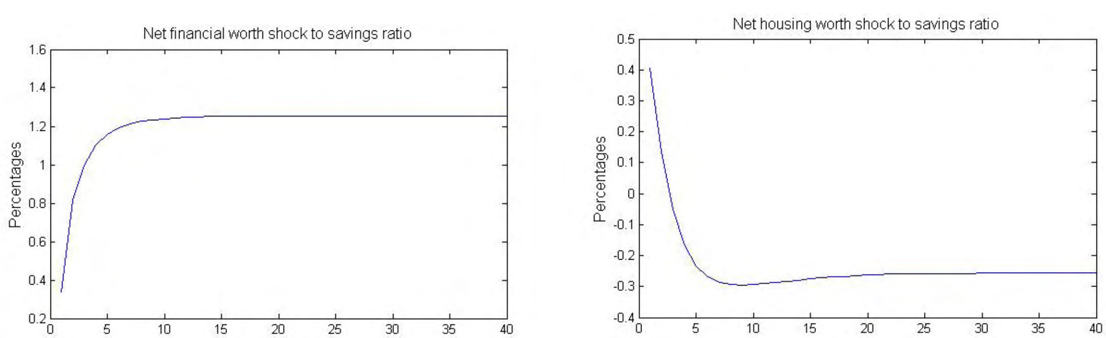
first error-correction term (i.e. 1 per cent increase in the deviation of the savings ratio from its medium-term value decreases the savings ratio growth by 0.28 per cent). However, this latter effect is smaller than the debt overshooting effect.

Impulse response functions

In order to illustrate the short-term and the medium-term dynamics captured in the estimated model, Figure 6 shows the impulse response functions of savings for shocks to housing and financial worth. In the euro area, a fall in the growth of the ratio of net housing worth to disposable income has a short-run positive impact on the savings ratio (negative impact on consumption) that turns into a negative effect (positive effect on consumption) after 4 quarters, while a fall in the growth of the net financial worth ratio has a short-run positive impact on the savings ratio (negative impact on consumption) that is reinforced over the following 10 quarters, the savings ratio converging towards a higher level in the medium-term (negative impact on consumption). As discussed before, the surprising dynamics of the housing wealth shock can be explained by the fact that households become less credit-constrained in the euro area when house prices are permanently lower.

The net effect is a rise in the savings rate in the medium-term when the shock to financial wealth growth is permanent. Overall, the dynamic effects of these asset price shocks is relatively short lived. The assumption of a lasting drop in financial wealth may appear as overly pessimistic as equity prices have historically shown a tendency to bounce back quickly after having reached their trough.

Figure 6: Impulse response functions for shocks to net financial and net housing worth



Note: The shocks are represented by one standard deviation of the estimated residuals in the marginal model. Identification by Choleski decomposition (Δf, Δh, $\Delta \pi$)

6. Conclusions

In this paper we have shown that the interaction between savings, net worth and indebtedness plays an important role in the euro area. While net financial worth comes out as a key determinant of the savings ratio in the medium term, the relationship between housing wealth and savings is complex. A rise in house prices tends to push consumption up via the traditional housing wealth effect, but it also tends to depress consumption because of the existence of credit constraints. The second effect reflects the fact that, when house prices increase, credit-constrained households need to save more to pay for the share of their acquisition that is not covered by the mortgage. We call this effect the "*down-payment channel*" and we show that it plays an important role for household savings decisions in the medium term.

The identified *"down-payment channel"* sheds some light on the root causes of the sluggish developments of consumption in the euro area in the present decade. The significant increase in net housing wealth in the period 2000-2007 did not fuel a consumption boom. This can be explained by the small size of housing wealth effects in the euro area but also by the interaction between credit constraints and house prices. Over 2000-2007 the ratio of mortgages to net housing wealth did not increase significantly as the relaxation of loan-to-value constraints by banks was largely offset by the rapid rise in house prices leading to higher down-payment requirements.

7 References

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8 Appendix

Table 1. Unit root tests

	Null Hypothesis	Alternative Hypothesis	Test statistics (McKinnon (1996) one-sided p-values)			
			ADF	**lags**	**PP**	**bandwidth**
s	I(1)	I(0)	0.5597	0	0.3988	7
	I(2)	I(1)	0.0000	0	0.0000	5
m	I(1)	I(0)	0.3780	3	0.7239	7
	I(2)	I(1)	0.0383	2	0.0000	6
f	I(1)	I(0)	0.1989	0	0.3125	5
	I(2)	I(1)	0.0000	0	0.0000	5
h	I(1)	I(0)	0.1909	2	0.6288	8
	I(2)	I(1)	0.0227	1	0.0000	6
sr	I(1)	I(0)	0.4079	1	0.4663	4
	I(2)	I(1)	0.0000	0	0.0000	13
lr	I(1)	I(0)	0.4226	1	0.5781	6
	I(2)	I(1)	0.0000	3	0.0000	11
π	I(1)	I(0)	0.1401	8	0.2608	3
	I(2)	I(1)	0.0048	7	0.0000	4

ADF is the Augmented Dickey Fuller (1991) test. The number of lags used in the model for each series is chosen by comparing three different information criteria (Schwarz, Hannan-Quinn and Akaike). Constant included in all auxiliary regressions, deterministic trend only if statistically significant at 5 per cent level. PP is the Phillips Peron (1988) test. The number of truncation lags is suggested by the Newey West criterion. Constant included in all auxiliary regressions, deterministic trend only if statistically significant at 5 per cent level.

Table 2. VAR Lag order Selection Criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	5.38E-22	-29.109	-28.9332	-29.0378
1	2006.789	1.74E-30	-48.6620	-47.2549*	-48.0917
2	150.261	8.50e-31*	-49.3887*	-46.7503	-48.3193*
3	69.334	9.66E-31	-49.2895	-45.4200	-47.7212
4	68.349*	1.06E-30	-49.2527	-44.1519	-47.1853
5	50.304	1.44E-30	-49.0468	-42.7148	-46.4804
6	57.368	1.69E-30	-49.0329	-41.4697	-45.9675
7	50.176	2.17E-30	-49.0043	-40.21	-45.4399
8	36.973	3.54E-30	-48.8344	-38.8088	-44.7709

*****indicates lag order selected by the criterion (each test at 5 per cent);
LR: sequential modified LR test statistic; FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

Table 3: Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value**
None *	0.393	150.433	122.924
At most 1 *	0.248	94.548	93.357
At most 2	0.202	62.558	68.569
At most 3	0.147	37.217	46.975
At most 4	0.121	19.467	29.142
At most 5	0.043	4.964	15.261
At most 6	0.001	0.058	3.858

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
** Johansen-Nielsen (1993) asymptotic critical values in the presence of dummies

Table 4: LR test on over-identifying restrictions
(Over-identifying restriction on the savings ratio coefficient in the mortgage equation)

Chi-sq	D.F.	P-value
5.50	1	0.48

Stability of the system is not rejected when the p-value is larger than 5 per cent

Table 5: LR test: weak exogeneity

H0: weak exogeneity	Chi-sq.	D.F.	P-value
s_t	16.31	3	0.06
m_t	12.68	3	0.005
f_t	1.73	3	0.63
h_t	1.25	3	0.74
sr_t	15.82	3	0.07
lr_t	11.56	3	0.009
π_t	1.02	3	0.79
f_t, h_t	2.96	5	0.70
f_t, π_t	2.27	5	0.81
h_t, π_t	4.37	5	0.49
f_t, h_t, π_t	5.42	7	0.60

Stability of the system is not rejected when the p-value is larger than 5 per cent

Table 6: Estimated coefficients of the partial model given β (f_t, h_t and π_t exogenous)

	Δs_t		Δm_t		Δsr_t		Δlr_t	
	Coeff.	s.d.	Coeff.	s.d.	Coeff.	s.d.	Coeff.	s.d.
α_1	**-0.28*** **	0.07	**-0.06** **	0.03	0.02	0.02	-0.01	0.01
α_2	**0.11*** **	0.04	0.00	0.01	**-0.02*** **	0.01	**-0.02*** **	0.01
Δs_{t-1}	-0.04	0.10	0.01	0.04	-0.01	0.02	-0.01	0.02
Δm_{t-1}	**-0.41*** **	0.20	**0.17** **	0.08	0.00	0.04	-0.03	0.03
Δsr_{t-1}	-0.23	0.45	-0.20	0.17	**0.36*** **	0.10	0.03	0.07
Δlr_{t-1}	0.40	0.60	0.33	0.23	0.18	0.13	**0.53*** **	0.10
Δf_t	**-0.18*** **	0.08	**0.06* **	0.03	-0.01	0.02	**-0.03*** **	0.01
Δf_{t-1}	-0.09	0.09	0.05	0.03	0.01	0.02	0.02	0.01
Δh_t	**-0.70*** **	0.30	**0.55*** **	0.11	-0.01	0.06	0.04	0.05
Δh_{t-1}	**0.89*** **	0.30	**-0.44*** **	0.11	0.04	0.07	-0.05	0.05
$\Delta \pi_t$	0.06	0.55	**-0.46** **	0.21	**-0.63*** **	0.12	**-0.71*** **	0.09
$\Delta \pi_{t-1}$	-0.39	0.68	0.15	0.26	**0.52*** **	0.15	**0.50*** **	0.11
Dummy0501	0.01	0.02	**0.06* **	0.01	0.01	0.00	0.00	0.00
Dummy9203	0.00	0.01	0.00	0.00	**0.01*** **	0.00	0.00	0.00

*/**/*** denotes significance at 0.10, 0.05 and, respectively, 0.01 level.