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Credit conditions in a boom and bust property market

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Abstract

The interrelationship between house prices and mortgage credit has been one of the more compelling issues to warrant attention after the recent financial crisis. Considerable financial innovation and liberalisation of wholesale international funding markets over the past 20 years greatly increased the ability of banking sectors to extend credit to the real economy. Almost inevitably many countries experienced significant house price booms over this period. The rate of house price appreciation in Ireland outstripped that of most in the OECD. Availing of two new related databases of Irish mortgaged households, this paper, firstly, quantifies the respective contribution to house price movements of changing credit conditions and, secondly, estimates an index of mortgage credit availability in the Irish property market, (MMCI), over the period 2000 - 2010.

JEL classification: E31, R32, R38.

Keywords: Credit, House Prices, Income, Interest Rates, Macro prudential.

Non-technical summary

In this paper we use two unique sources of data to examine the changing nature of credit conditions in the Irish mortgage market over the period 2000 to 2011. The first data source is the prudential loan level data collected as part of the ongoing stress-testing of Irish financial institutions. This is then complemented with the results of an income survey conducted on the mortgage books of the same institutions. Using these two databases we, firstly, quantify the respective contribution to house price movements of changing credit conditions and, secondly, estimate an index of mortgage credit availability, (MMCI), in the Irish property market. This indicator tracks the changing nature of credit conditions, while controlling for standard demand level factors such as income levels and interest rates as well as other household characteristics.

The Irish property market is particularly worthy of scrutiny for the period in question. Between 1995 and 2007 real Irish house prices grew by more than any other country within the OECD. The significant increases in house prices went hand in hand with a sizeable rate of activity in the Irish market. Between 2004 and 2006, for example, an annual average of 85,000 residential units were being built compared with just over 200,000 units in the United Kingdom. The buoyancy in the property market was determined by a number of factors.The emergence of the so-called Celtic Tiger in the mid-1990s saw the size of the economy double over the period 1995 to 2005 resulting in a marked increase in affordability levels amongst prospective Irish homeowners.

Simultaneously, however, the Irish credit market experienced a considerable degree of financial liberalisation. The ability of Irish credit institutions post-2000 to access international wholesale markets, increased significantly the supply of credit available to the domestic banking sector. The already thriving nature of the residential and commercial property markets provided considerable demand for this increased source of funding.

Our results suggest that when Irish financial institutions were keen to increase the level of credit to the residential property market, they particularly availed of what we label the "income fraction" channel. Thus, for a given income level and mortgage interest rate, credit institutions were able to significantly increase the level of loans available by varying the income fraction. The MMCI estimated suggests that significant movements occurred in the mortgage credit supply function during both the boom and subsequent downturn in the Irish market.

1 Introduction

The recent house price boom experienced across many OECD countries is noticeable for two characteristics (i) the prolonged manner of its duration and (ii) the systematic pattern of its occurrence across countries. Analysis of international house price data from the early 1970s onwards reveals that while periods of sustained increases in house prices were common, up to the early 1990s these tended to be somewhat sporadic and country-specific in nature. However, from the mid-1990s, house price booms appear to have been increasingly correlated across countries.

The greater incidence of buoyant price levels is suggestive of common international developments in likely determinants of house prices over this period. Across many countries macroeconomic factors were highly conducive to house price growth. Income growth was strong and relatively stable, while monetary conditions, especially after certain exchange rate volatility in the early 1990s, were also benign. Crucially, this combination of low interest rates and continued improvements in living standards increased the ability of households to finance higher mortgage levels with resulting upward pressure on house prices.

Simultaneously, many countries were experiencing greater degrees of financial innovation, which enabled financial systems to extend increased levels of credit, in particular, to households. One of the most significant developments in international banking finance over the past 15 years has been the extent to which financial institutions have been able to fund credit provision outside of their deposit base. Traditionally, in many countries, the amount of credit provision was directly related to the level of deposits within the financial system. However, the emergence and subsequent increase in the use of alternative sources of funding enabled credit institutions to secure funds from elsewhere and, consequently, respond, on a much more aggressive basis, to perceived lending opportunities. In the case of the mortgage market, this increased level of credit was extended through a variety of different channels - increased loan-to-value ratios, greater income fractions being facilitated and mortgage lengths of greater duration.

In this paper using loan level data from the entire mortgage books of the four main Irish financial institutions, we explicitly decompose house price movements in Ireland between the influence of easing credit conditions and the impact of standard macroeconomic variables.[1][2] In so doing, we can identify, over the period 2000 - 2011, the relative contribution of more liberal mortgage credit policies to house price inflation. We also, using a unique combination of regulatory prudential and survey data, estimate an indicator of mortgage credit supply in the Irish market, which we label the mortgage market credit indicator (MMCI). Therefore, controlling for household characteristics as well as market conditions, we are able to quantify the impact of changing credit standards in the Irish mortgage market. While studies such as Fernandez-Corugedo and Muellbauer (2006), Aron, Muellbauer and Murphy (2008) and Jansen and Krogh (2011)

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[1]These are Allied Irish Bank (AIB), Bank of Ireland (BOI), the Educational Building Society (EBS) and Irish Life and Permanent (ILP). As of mid-2012, these four institutions accounted for approximately 70 per cent of mortgage credit in the Irish market.

[2]This data was extracted as part of the ongoing prudential capital exercises (PCAR) undertaken by the Irish Central Bank.

have undertaken a similar type analysis at an aggregate, macro level, to our understanding, no study has examined credit conditions, in this manner, at the micro, household level. Understanding the determinants of credit conditions, is particularly pertinent at a time when a growing debate is centering on the relative contribution of financial innovation and fundamental economic factors to house price movements.[3] The particular issue of credit conditions and house prices fits within the broader question of fluctuations in credit policy and macroeconomic business cycles. In providing greater levels of credit, are financial institutions merely responding to increased demand in the real economy, or is the increase in credit more supply driven and, as a result, likely to fuel unsustainable levels of activity? Equally, in an economic downturn, is the contraction in credit often observed due to demand-side factors or more a supply-side consideration?

Amongst countries which experienced house price booms, the Irish case stands out. On average from 1995 until 2007 real Irish house prices grew by nearly 9 per cent per annum - the next highest country growth rate in the OECD was 7.6 per cent. During this time, the Irish economy experienced a period of sustained growth with living standards increasing substantially. Ireland, in the 1980s, witnessed negligible economic growth, an average unemployment rate of 14 per cent and high levels of personal taxation. The emergence of the so-called Celtic Tiger in the mid-1990s saw the size of the economy double over the period 1995 to 2005 with the total number of people employed in the country increasing by almost 50 per cent. Almost simultaneously, the Irish credit market experienced a considerable degree of financial liberalisation. This easing of credit standards was compounded by the ability of Irish credit institutions post-2003 to access international wholesale markets, thereby increasing significantly the supply of credit available. The already buoyant nature of the residential and commercial property markets provided considerable demand for this increased source of funding. Therefore, accurately delineating the effects of credit conditions and standard macroeconomic factors on house prices would appear to be particularly warranted in the Irish case. Furthermore, understanding the determinants of credit conditions is likely to be informative when considering house price increases in countries such as Spain, the UK and the US where financial markets are also considered to have been relatively liberal and innovative in the provision of credit.

The costs to the Irish economy of the aftermath of the property boom have been truly severe. Since 2007, Irish house price declines have been the most severe across the OECD.[4] Given that nearly 40 per cent of the total stock of Irish mortgages was issued between 2004 and 2007, when prices were at their highest, the sharp subsequent decline has given rise to a significant degree of negative equity being experienced by Irish households. When coupled with the sharp increase in unemployment experienced by the Irish economy post-2008, the possibility of substantial credit risk in the mortgage books of Irish banks was one of the main reasons for the financial crisis which engulfed the Irish banking sector. Consequently,

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[3]See, for example, the debate between Taylor (2009) and Dokko et al. (2011).
[4]By mid-2013, house prices had fallen by 50 per cent from the peak in mid-2007.

one of the major cornerstones of the 2010 program of support agreed between Ireland, the EU and the IMF was a significant commitment to deal with the degree of loan impairment on the mortgage books of Irish financial institutions.

Having access to the full population of loans for four of the largest financial institutions in a mortgage market clearly provides a number of empirical opportunities. In particular, it enables a complete characterisation of how house prices financed by the banking system evolved and as a result, the contribution of easing credit conditions to be evaluated. Thus, using this data, it is possible to identify the contribution to house price inflation of specific credit channels such as income fractions, LTVs and the tenure of the mortgage loan. Consequently, from a macro-prudential perspective, it enables the identification of the more influential measures available to policy-makers in tempering house price inflation. Similarly, with the significant fall in credit levels extended in the aftermath of the financial crisis, the estimated MMCI can indicate whether this contraction is due to shifts in the mortgage credit supply function rather than movements along the curve.

2   The availability of credit and the Irish mortgage market

In general, across most euro area countries total lending and, in particular, lending of housing loans increased substantially from the mid-1990s onwards. While the gradual easing of regulatory controls within certain countries certainly facilitated this increase, the role of market innovations and, in particular, the onset of cross-border lending between credit institutions was considerable. One of the most significant developments in this regard was the more widespread use of derivatives and repurchase (repo) agreements, which enabled financial institutions to better manage exchange rate, interest rate and credit risk. Lower risk resulted in greater use and a reduced cost of interbank lending, thereby, enabling institutions with a surplus of funds to lend to those in deficit. The importance of this development in increasing the depth of money markets is illustrated in ECB (2003) which finds that the volume of repo transactions (which reduce risk by collateralising loans) more than doubled in the EU between 2002 and 2003.

Consequently, the development of a deeper and more integrated bond market after the introduction of the euro increased the funding choices of European financial institutions by allowing the use of more market-based capital structures. Figure 1 illustrates the change in total lending to non-monetary financial institutions (MFIs), across the euro area, over the 10 year period 1997 - 2007. In total, when expressed as a percentage of GDP, lending increased by 40 percentage points. Concurrently, housing loans to households increased from 23 to 38 per cent of GDP. This sustained increase in lending was not accompanied by an increase in traditional deposits - these remained relatively stable as a percentage of GDP. Instead, this growing gap between loans and deposits was financed by increased use of market-based funding in the form of debt securities and borrowing on the money market. One such source of funding, which grew

substantially over time was wholesale deposits. Typically, the average size of these funds are much larger than retail deposits and clearly, within the euro zone, the abolition of exchange rate risk between countries greatly facilitated the use of this funding across member countries.

It's noteworthy that one of the main differences between mortgage markets in the euro area and the United States and to a lesser extent the United Kingdom over this period was the continued dominant role played by depository institutions. For the United States in particular, the house price boom was financed by the expansion of specialised non-depository lending institutions that were mainly responsible for the provision of riskier mortgages amongst lower-income borrowers. The originate-to-distribute (OTD) model of mortgages was also a distinguishing characteristic of the American market. While there is a considerable degree of difference across European mortgage markets, the proportion of securitised mortgages is much less relevant a feature.

At the same time as these mortgage finance developments, macroeconomic conditions across Europe were highly conducive to growth in asset prices. While the great moderation since the mid-1980s had resulted in considerably benign monetary regimes across the OECD, the instigation of the single monetary area provided additional stability for member countries from the mid-1990s onwards. Additionally, living standards in terms of GDP and disposable income growth across many countries were experiencing consistent improvement. Therefore, mortgage affordability, as measured by the combination of income and interest rates, had improved significantly resulting in housing demand rising substantially across many euro area countries. There is no better example of the confluence of these two factors than the case of Ireland.

Ireland's adoption of the euro in 1999 helped to reinforce the global integration of its local financial market with those of the other original members of the euro area. One of the outcomes of these developments was much lower real interest rates in Ireland in a context of higher real growth. The already positive economic environment of the "Celtic Tiger" combined with low interest rates, population dynamics and fiscal incentives promoting home ownership, proved to be a very favourable one for both the rapid growth in credit and the escalation in property prices in Ireland.

The Irish credit market had, since the mid-1980s, been experiencing considerable financial deregulation and liberalisation, involving the removal of credit and interest-rate controls. Table 1 summarises the main developments from the mid-1980s to the present.[5] However, the most profound development in the provision of credit, from an Irish perspective, was the increased ability of Irish banks, post-euro, to attract deposits from non-residents. Given the build-up in demand side pressures in the Irish economy throughout the late 1990s, Irish financial institutions availed substantially of the increased funding available within the euro area. Overall, the combined effect was to increase the elasticity of the supply of credit to the household sector. The consequence of such a flatter supply curve was that financial institutions were able

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[5]An exact chronology of the control and subsequent liberalisation of the Irish credit market is discussed in detail in Kelly and Everett (2004). See, in particular, Box 1 pgs 96 and 97, which illustrates the building and dismantling of controls over the period 1973 to 1999.

to increase the amount of lending to the household sector with little upward pressure on the interest rate. However, this flatter supply curve, inevitably, lead to a substantial increase in debt levels within the Irish economy.

Figure 2 details the source of funding for Irish resident credit institutions from 2001 onwards along with the difference between credit extended and the deposit base in the Irish financial system. The rapid increase in debt securities issued by Irish credit institutions post-2003 can, especially, be observed. The resulting substantial gap between lending and deposits underpinned the vulnerability of the Irish banking sector to the severe distress observed in these markets during the financial crisis.

The net consequence of the increase in mortgage credit can be observed in Table 2. The total value of mortgages issued increased threefold between 2000 and 2005. The total number of new mortgages went from just under 50,000 in 1995, to 80,000 in 2000 and to over 120,000 mortgages by 2005. The average size of a mortgage also increased considerably over the period. In 1995 the average mortgage extended by an Irish credit institution was €54,094, by 2005, this had climbed to €231,206. Inevitably with such an expansion in credit, house prices increased substantially over the period. Between 2000 and 2007, prices rose by almost 65 per cent. The peak in house prices occurred in mid-2007 and since then the residential market has witnessed a substantial decline in activity as both housing supply and prices have fallen considerably.

3 Data and descriptive statistics

3.1 Overview of dataset

Two sources of data are used in this paper. The first source, which forms the basis of the bulk of the analysis in this paper, is a loan-level dataset collected by the Central Bank of Ireland as part of a Prudential Capital Assessment Review exercise, which assesses the potential capital requirements of the Irish banks under various stress scenarios. The dataset includes a snapshot of the entire residential mortgage books of four Irish banks at June 2012. Crucially, for the purposes of this paper, the dataset includes borrower and mortgage information from the point of loan origination as well as details on the value of the property on which the mortgage is secured.[6] This dataset, therefore, provides a unique opportunity to identify how residential property prices financed by the Irish banking system evolved and furthermore, to evaluate the contribution of changing credit conditions and standard macroeconomic variables to such developments.

However, as with most loan-level datasets, credit institutions rarely update this type of data with current economic information on individual borrowers. Given the extent of economic change experienced in Ireland in recent years, this information may have changed substantially since loan origination. Therefore, to

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[6]Further information on the loan level dataset are available in Kennedy and McIndoe Calder (2011).

complement the loan level data, the Central Bank of Ireland commissioned a custom designed household survey to capture the current economic circumstances of mortgagees in Ireland. This survey is the second source of information used in the current study.

The mortgage holders survey was conducted by IPSOS MRBI on behalf of the Central Bank of Ireland. The survey, which is representative of the entire mortgage books of the banks in the loan-level dataset, was administered to over 2,000 households all of whom are included in the loan-level dataset. Each individual's survey responses can be linked back to their corresponding mortgage information in the loan-level dataset, where the respondent gave permission for this linking to take place.[7] The survey was conducted over the period May 2012 to February 2013 with 97 questions, in total, being asked of participating households.

Table 3 provides an overview of the characteristics of the survey sample used in this study. We focus on the portion of the sample that allowed their survey responses to be linked to their loan-level data, so the sample size at this stage is 1,837. Among the sample, the largest portion of respondents are in the 35 to 44 year age group. The majority of respondents are married (83 percent), employed (85 per cent) and are relatively well educated, with over 40 per cent of respondents having a third level degree or higher. In terms of household composition, the average household in the sample comprises three persons (usually two adults and one child).

3.1.1 Cleaning of the loan-level dataset

At the end of June-2012, the four institutions in the loan level dataset had over 660,000 mortgage loans outstanding on their books, and accounted for 70 percent of the Irish mortgage market.[8] However, some of the outstanding loans are equity releases which were taken out some time after the original mortgage was secured and the property purchased.[9] Since our aim is to establish the impact of credit on the house price *at the time of purchase*, equity releases are excluded from the analysis. Furthermore, we drop those loans which have little or no information on the geographic location of the property on which the loan is secured. Since we do not have a full year of data for 2012, we also drop loans originated in 2012 from the dataset. A final cohort of loans removed are cases where information is missing on borrower income or the house price at the point of loan origination.[10] Table 4 shows the number of observations removed at each step of the cleaning exercise. The final dataset comprises 388,969 loan observations. Table 5 shows the distribution of primary loans by year of origination with the bulk of the loans being extended in the post-2004 period.[11]

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[7]The majority of the sample (88 percent) gave permission for this linking to take place.

[8]This vast figure is inclusive of securitised mortgages.

[9]We define the original mortgage as the first loan on a property and subsequent loans are deemed to be equity releases.

[10]In general, this applies to mortgages that were subsequently 'topped-up' after the house was purchased. In these cases, the responding bank reported only the latest value for these variables at the point of the subsequent loan rather than also reporting the relevant values at the point of origination of the main mortgage.

[11]While the data only contains information for those mortgages that are still being serviced, there is no evidence to suggest that there is any difference in credit quality between those mortgages which are still ongoing and those which have been paid off.

3.1.2 Data on credit instruments

Initially, we focus on the loan-level dataset and examine developments in the three main channels which a bank can use to increase the level of credit; the income fraction, the loan-to-value (LTV) ratio and the mortgage term. While the mortgage term and LTV ratio are readily available, the income fraction must be calculated for each loan in the dataset. To compute the income fraction, which captures the proportion of a borrower's gross income allocated to mortgage repayments, we use the standard definition of a mortgage annuity (B_t) as shown below:

$$B_t = \kappa Y_t \left(\frac{1 - (1 + R_t)^{-\tau}}{R_t} \right).$$ (1)

Where Y_t is borrower income at origination, R_t is the relevant mortgage interest rate, τ is the mortgage term and κ is the income fraction.[12]

Solving for κ, we can re-write equation 1 as follows:

$$\kappa = \frac{LTI}{\left(\frac{1-(1+R_t)^{-\tau}}{R_t} \right)}.$$ (2)

An estimate of κ (the income fraction) is calculated for each loan in the dataset. As it incorporates both interest rates and the loan tenure, κ is a more precise measure of mortgage affordability than the related and more popular loan to income (LTI) ratio. The concept is generally used as an indicator of mortgage market repayment stress (see Kelly, McCarthy and McQuinn (2012) for example).

3.2 Trends in credit instruments

In Figure 3 we plot the median values of the credit instruments across the four institutions for loans originating over the period 2000 to 2011. The charts provide a clear indication of the degree to which credit conditions in Irish institutions were eased during the period; all three credit instruments registered a marked increase for loans originating between 2000 and 2007 - the height of the housing boom. In the left panel the median value of κ is plotted across the four institutions. On average, income fractions increased from a low of 16 percent in 2000 to a peak of about 25 percent at the height of the housing boom in 2007. Thereafter, κ dropped to a sample low. In the middle panel of Figure 3 it can be observed that Irish banks also eased credit by offering higher LTV ratios to mortgages over time. For loans originating in 2001, the median LTV value was only 59 percent. At the height of the housing boom, this figure had increased to a high of almost 80 percent. Finally, in the right panel of Figure 3 developments in the term of the mortgage by year of loan origination can be observed. The median mortgage term increased from 20 years in 2000

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[12]The interest rate at point of loan origination is not available in the loan-level dataset. As a proxy, we use the CSO's quarterly average mortgage interest rate series.

to 26 years in 2007 onwards, before fluctuating thereafter.[13]

The trends observed in Figure 3 show a marked expansion in credit to households in Ireland, followed by a subsequent contraction from about 2008 onwards (apart from mortgage length). The loan-level data allow for a deeper exploration of these developments, assessing whether the average developments were concentrated among a particular type of borrower for example, or whether the developments were more widespread. This granularity of information is clearly of importance from a policy perspective; if credit expansions are concentrated among borrowers with high income or wealth, for example, then these borrowers tend to have more scope to respond to shocks relative to a situation where the expansion is greater for low income borrowers.

We divide the sample of loans into five groups, ranked according to their position in the borrower income distribution, and we plot developments in credit for each of these income quintiles (Figure 4).[14] The group labelled "Lowest" captures loans associated with borrowers in the bottom 20 percent of the income distribution and the group labelled "Highest" captures those in the top 20 percent of the distribution. The results in Figure 4 show that, while credit conditions were eased for all borrowers in the sample, the expansion in credit, worryingly, was most dramatic for those borrowers in the bottom 20 percent of the income distribution. For this category of borrowers, the income fraction for the median case rose by almost 14 percentage points between 2000 and 2008, to reach a peak of 32 percent (left panel of Figure 4). The corresponding increase for borrowers in the fifth income quintile was closer to 8 percentage points. Similarly, in the second and third panels of Figure 4, we see an increase in the average LTVs and mortgage term for all category of borrowers, with the increase being most pronounced for those borrowers in the lower income quintiles.[15]

One interesting issue is the degree of correlation across the different credit channels i.e. did borrowers tend, on average, to experience an easing of credit conditions across more than one mortgage channel? The relationship between these different credit channels has been noted, in particular, by Fernandez-Corugedo and Muellbauer (2006) and Campbell and Coco (2011). Fernandez-Corugedo and Muellbauer (2006) cite the possibility of a trade-off between these concepts being offered by mortgage providers - the income fraction could be increased when the loan-to-value ratio is reduced, thereby, keeping the overall risk exposure of the portfolio constant. Campbell and Coco (2011) argue that regulators and mortgage providers should think about combinations of these concepts rather than controlling these levers in isolation.

In Figures 5 and 6 we present scatter plots of median monthly income fractions against loan-to-value ratios and income fractions against mortgage terms for each of the five income groups defined in Figure

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[13]The increase in mortgage duration at the very end of the sample could be some mortgage modifications beginning to be offered by financial institutions in light of the growing mortgage arrears issue.

[14]Income refers to gross income at the point of loan origination. We express all income values in 2006 terms.

[15]It can be argued that changes in the Irish tax code during the early part of the 2000s reduced net taxes so disposable income actually rose more than gross. Therefore, an increase in κ may not have had as significant an impact on household affordability as what the gross figures suggest. Of course, the opposite is the case in the aftermath of the financial crisis when personal tax takes were increased.

4. From Figure 5, in general, there appears to be an upward sloping relationship between income fractions and LTVs, suggesting that the easing of these credit conditions is correlated. However, there is some evidence that the relationship is not as strong for those borrowers in the extreme income quintiles (the lowest and highest income groupings). On the one hand, this could be due to wealthier borrowers having other resources to draw on to support the purchase of their homes while less well-off borrowers did not have such resources. Or, it could reflect actual changes in supply side conditions for different borrower types. The results in Figure 6 show a similar pattern between income fractions and mortgage terms.

Next we assess developments in the credit instruments according to the type of buyer involved (Figure 7). We focus on three categories of borrower - first-time buyers, second-time buyers (or trade-up/down) and those who took out a mortgage to purchase a property for rental purposes (buy-to-lets). While credit conditions were eased for all borrower types, first-time buyers experienced the most dramatic change over the period, registering a 12 percentage point increase in κ between 2000 and 2008, (which rose from 17 percent in 2000 to a peak of almost 29 percent in 2008). The median LTV ratio for first time buyers increased from 72 percent in 2000 to a peak of 92 percent in 2006 while the median mortgage term for this category of borrower increased by almost 10 years, from a 25 year term in 2000 to 35 years in 2008.

In Figure 8 we examine trends in credit conditions according to the current arrears status of the mortgage account. We use information from June 2012 to define the arrears status and define three outcomes: no arrears, arrears outstanding at end-June 2012 to the tune of 90 or more days worth of mortgage repayments, and arrears amounting to less than 90 days worth of mortgage repayments at end-June. While there are some slight differences in the median κ value and the median mortgage term between accounts in arrears (of any amount) and those that are performing, the middle panel of Figure 8 points to more pronounced differences in the average LTV ratio of accounts by arrears status. The average LTV for the group of accounts that were in arrears by 90 or more days at end-June 2012 reached a peak of 80 percent, while those accounts that were performing at end-June 2012 had a peak average LTV of 76 percent in 2006.

One issue which attracted some comment during the growth phase of Irish prices was the more liberal loan amounts secured for individuals by mortgage brokers compared to traditional branch banking. Consequently, in Figure 9 credit conditions according to the institution responsible for granting the mortgage are plotted i.e. agents, institutional branches and mortgage brokers. The data in this chart are only available for one institution in the dataset and only for those loans originated by the end of 2010. Conforming with *a priori* expectations the graph suggests that broker originated loans were associated with a greater easing of credit conditions during the housing boom than loans obtained from a bank branch or mortgage agent. For example, broker originated loans had a median κ value of 19 percent for loans originated in 2000 while loans originated in 2007 had an average κ value of 28 percent. The respective figures for bank branch originated loans are 16 percent (2000) and 25 percent (2007). This difference in broker and non-broker originated loans is not unique to Ireland. Jiang et al (2011) observe that broker originated loans in the

U.S. are of a lower credit quality than non-broker originated loans and that broker originated loans are associated with a higher probability of default than loans originated by other institution types.

In summary, the loan level data show that credit conditions in Ireland eased considerably over the period leading up to the collapse in Irish house prices. Further exploration reveals that this easing of credit conditions occurred for all borrower types and income levels, though first time buyers and borrowers in lower income quintiles benefitted to a greater extent. An examination of credit conditions by current arrears status and across mortgage granting institutions points to some important differences among the groups, highlighting the need to monitor such developments. Extensive micro loan level data provides the perfect opportunity for this, where mis-alignments between various indicators can be highlighted and investigated in detail.

4   Empirical approach

While the previous section highlighted the extent to which credit conditions were eased for loans originating between 2000 to 2011, in this section the contribution of these credit developments, in addition to standard macroeconomic factors, to Irish house price growth is examined. We use the loan-level data to undertake a static, accounting-type analysis to examine this issue. The specific issue of causation between credit and house prices is then investigated in an econometric framework.

4.1   Static analysis: house price decomposition

To undertake the static analysis, we define house prices in terms of credit and macroeconomic variables. The standard house price P_t is usually comprised of a down-payment and the mortgage loan amount B_t. Expressing the down-payment as some fraction of the loan amount αB_t, results in the following expression for house prices;

$$P_t = \alpha B_t + B_t. \tag{3}$$

or

$$P_t = B_t \left(1 + \alpha\right). \tag{4}$$

Substituting in the expression for the mortgage amount from equation 1 yields a definition for house prices in terms credit and macroeconomic variables:

$$P_t = \kappa Y_t \left(\frac{1 - (1 + R_t)^{-\tau}}{R_t} \right) (1 + \alpha). \tag{5}$$

Taking logs (ln):

$$lnP_t = ln(\kappa) + ln(Y_t) + ln\left[\frac{1 - (1 + R_t)^{-\tau}}{R_t}\right] + ln(1 + \alpha). \tag{6}$$

the change in house prices $\triangle lnP_t$ is, therefore:

$$\triangle lnP_t = \triangle ln(\kappa) + \triangle ln(Y_t) + \triangle ln\left[\frac{1 - (1 + R_t)^{-\tau}}{R_t}\right] + \triangle ln(1 + \alpha). \tag{7}$$

The decomposition shown in equation 7 allows house price movements to be characterised in terms of fundamental factors such as the change in income levels and interest rates or credit conditions such as the income fraction and down-payment amount. This decomposition is undertaken for all loans in our dataset and the average value of the four different elements of this decomposition is plotted in Figure 10.[16] From the chart it is evident that both fundamental factors and changes in credit conditions have played an important role in affecting house price changes throughout the past decade. It is noticeable that changes in the income fraction appeared to play a very important role in stimulating house prices towards the end of the house price boom (in 2006 and 2007). As we saw earlier in Figure 3, at this time the median income fraction reached a peak of close to 25 percent. However, what is also highly apparent is that it is changes in the income fraction which appear to have played a very significant role in the fall in house prices post-2008. It indicates that financial institutions have been reducing income fractions quite significantly with a resulting strong downward pressure on house prices. Equally, however, it could also be a contraction in demand, which is causing a reduction in the κ. We explore this issue in the next section.

4.2 Estimating a mortgage market credit index (MMCI)

We now examine the determinants of the income fraction and the loan-to-value ratio.[17] In particular, we estimate the extent to which these credit channels were impacted by changes in credit standards in the Irish market over the period 2000 - 2011. This is done in a manner analogous to the estimation of the credit conditions indicator (CCI) by Fernandez-Corugedo and Muellbauer (2006). Namely, using information in two different micro data sources, demand-side factors such as income levels, interest rates, and other household specific characteristics are controlled for, while changes in credit standards are proxied by the use of year dummies. Therefore, like the CCI, the resulting indicator, generated via the dummies, can be thought of as the supply function for mortgage credit faced by Irish households.

The main demand-side variables specified for both credit channels are the household-specific house

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[16]In the Appendix, we compare the average house price and income level from the loan level dataset to published aggregates. We find that the loan level data closely match published sources.

[17]For the purposes of the models estimated, we mainly draw on the income survey information discussed in section 3, however, we also use information from the overall loan level dataset. For example, the data on the credit channels, house prices and income at the point of loan origination all come from the loan level data.

price-to-income ratios (p_i/y_i) and the mortgage interest rate (r_i), where both are recorded at the point of loan origination. In the case of the income fraction, the house price-to-income ratio is expected to exercise a positive impact on the size of κ as a high ratio puts pressure on potential homeowners to get the highest possible loan amount. However, in the case of the loan-to-value ratio, Fernandez-Corugedo and Muellbauer (2006) contend that the ratio should act in the opposite direction. Two reasons are advanced for this; one, a high house price, *ceterus paribus*, indicates a greater probability of a decline in house prices; secondly, in cases where high house price-to-income ratios exist, households are more likely to have higher income fractions. In such a case, lenders may be more cautious about offering a high loan-to-value ratio. For mortgage interest rates, in the case of both credit channels, a rise in rates is expected to increase the probability of mortgage default, so a negative sign is hypothesised.

Drawing on the income survey, we are also in a position to control for a number of household characteristics, which may also impact on the level of credit extended. We include dummies for the following considerations; whether the house purchased is a primary dwelling property (pdh), the number of contributors to the mortgage at the point of loan origination (num), whether the head of the household (HH) is a female or not ($female$), whether the HH is employed in the public sector ($public$), whether the HH is self-employed or not ($self$), whether the HH has savings or investments ($saving$), the educational attainment level of the HH ($ed-medium$ and $ed-high$), whether the HH has an additional mortgage ($addition$) and the age of the HH at the point of loan origination (age). In the case of the age variable, this effect should exercise a negative impact as households' attainment of the financial assets very often necessary to acquire a housing downpayment, typically, tend to increase with age. For the employment variables, anecdotal evidence about the Irish market would suggest that households, which are self-employed and working in the private sector, are likely to have greater difficulty in securing mortgage credit than those operating in the public sector. Also, one would expect that a higher level of educational attainment would lead to a greater amount of credit, via the two channels, being secured.

To capture the impact of changing credit standards, we specify year dummies for 2000 to 2010.[18] Table 7 presents the distribution of mortgage loans in the survey by year of origination. This can be compared with the distribution of loans across the entire loan level data in Table 5. For both credit channels, the following model is estimated:

$$cc_i = \beta_0 + \beta_1 \frac{p_i}{y_i} + \beta_2 r_i + \sum_{j=3}^{10} \beta_j control_{i,j} + \sum_{m=13}^{22} \beta_m \sum_{n=2001}^{2010} year_n + \epsilon_i. \tag{8}$$

where cc_i is either the loan-to-value ratio or the κ for household i, $control_i$ is the vector of controls and $year$ is the vector of year dummies for 2000 to 2010. The models are estimated on a cross-sectional basis and

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[18]The dummy for the year 2000 is excluded.

with a systems estimator.[19] The latter is used as we wish to test certain cross-equation restrictions. Results for both channels are shown in Table 8. In each case, the house price-to-income ratio is significant and has the expected sign. Amongst the household controls, in the case of both credit channels, the attainment of a higher level of education increases the level of credit secured, while the age of the head of household is, as expected, negatively related to the amount of credit obtained. For the κ channel, where the household has an additional mortgage and where the mortgage is for the primary dwelling house results in a lower amount of credit.

Turning to the year dummies, while the results are broadly similar across the two channels, there are some notable differences. For the LTV ratio, there appears to have been a significant increase in the credit supply function from 2005 onwards, while the function appears to have moved on a significant basis for κ through 2008 with a sharp fall in 2009 and 2010.[20] In Figure 11, based on the dummy coefficients in both regressions, the resulting mortgage market credit indicator (MMCI) for the two credit channels are presented. The difference between both channels for 2009 and 2010 is apparent; the MMCI estimated for κ indicates that the contraction in credit standards is every bit as large in 2010 as the liberalisation of standards during the boom phase.[21]

From a policy perspective, this difference across the two channels is quite notable and reinforces the case made by Campbell and Coco (2011) that regulators should pay attention to *both* the loan-to-value ratio and the income fraction in moderating the exposure of individual institutions to credit risk. This is particularly the case in an Irish context given the apparent importance of the income fraction as illustrated in Figure 10.

5 Conclusions

Up to the recent financial crisis, many countries experienced a sustained period of house price growth. In general, this was facilitated by a combination of benign macroeconomic conditions and greater availability of mortgage credit. The Irish case is a profound example of this; a small open economy enjoying sustained economic growth with a financial system to the fore in exploiting new international funding conditions. It is the extent of these changes which makes analysis of the Irish property market over the period 2000 - 2011 such a compelling study.

Courtesy of granular, micro level stress-testing of the four main Irish financial institutions conducted by the Central Bank of Ireland, detailed mortgage loan level data is now available for a significant proportion of the Irish residential property market. Using this information we calculate the contribution to Irish house

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[19]The nonlinear systems least square estimator in RATS is used - programs are available, upon request, from the authors.

[20]The omitted category is the year 2000.

[21]As a robustness check, we also estimate the system where the indicator is constrained to be the same across the two channels, however, the restriction is rejected at the 1 per cent level.

price movements over the period 2000 - 2011 of both fundamental economic factors and changes in credit policy.

It would appear that when Irish financial institutions were keen to increase the level of credit to the residential property market, they particularly availed of what we label the "income fraction" channel. Thus, for a given income level and mortgage interest rate, credit institutions were able to significantly increase the level of loans available by varying the income fraction. As well as being one of the main causes of price increases, variations in the fraction would appear to be one of the significant reasons for the sharp contraction experienced by Irish house prices since 2007. Thus, the fraction would appear to be highly pro-cyclical, fuelling house price increases in the upturn and exacerbating the decline in the downturn.

We also estimate an indicator of mortgage credit supply in the Irish market (MMCI). Controlling for demand-side factors amongst households, we estimate the changes in both the income fraction and the loan-to-value ratio. Our analysis suggests significant movements in the mortgage credit supply function during both the boom and subsequent downturn in the Irish market.

The greater availability of detailed loan level data offers a number of policy opportunities, particularly from a macro prudential perspective. Given the role played by property markets in the lead up to the recent financial crisis, a renewed debate has centred on the appropriate choice of options available to policy makers and more specifically, on the relative contribution of financial innovation and fundamental economic factors to house price movements.[22] A more efficient and precise calibration of influential macro prudential policy levers countering swings in the property market is now a much greater possibility with the availability of micro loan data.

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[22]See, for example, the debate between Taylor (2009) and Dokko et al. (2011).

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A   Comparison of aggregated micro and macro data

The loan-level data used in this paper are from four Irish financial institutions. For each loan account, income and house price data are available at the point of loan origination. To check the quality of the underlying data, we compare estimates of average annual income and house prices computed from the loan-level data to published data from other sources. The results suggest a close correlation between the series.

Figure A1 compares the loan-level house price estimates to the two main published series available for the Irish residential property market. The ptsb/ESRI house price series has predominantly been used to track house price developments in Ireland over the last decade. The index, which is based on data from one Irish bank, is a 3-month moving average hedonic series and is shown as the dotted line in the chart. The CSO residential property price index, shown as the dashed line, is based on monthly mortgage drawdown data from eight lending institutions in Ireland. The series is available for the period since 2005, and has only recently been published by the CSO. From the chart, it is clear that the house price series from the loan level data matches well to the aggregate published series.

It is more difficult to find a suitable published series to compare with the loan-level income data. The best option is to use the Survey on Income and Living Conditions, which is published annually by the CSO and tracks income and living conditions of different households in Ireland. However, the published data from this source refers to average income of all households in Ireland - those with and without a mortgage. If income levels among mortgaged households tend to differ from non-mortgaged households, then this may not be the most appropriate point of comparison. Furthermore, the data are only available since 2003. In Figure A2, we compare annual changes in household income from the two sources. While there are some clear disparities between the two series in the earlier part of the sample, both series are on a clear downward trajectory from 2007 onwards. Furthermore, there is a strong correlation between the two series, at almost 90 percent.

Table 1: Taxonomy of factors influencing Irish credit supply

1988 - 1999	2000 - present
Major relaxation of exchange controls.	Introduction of 100 per cent loan to value ratio (LTV) mortgages (2005).
Formal trigger mechanism for changes in retail interest rates suspended.	Introduction of tracker mortgages into the Irish market (1999/2000).
Limitations on FX borrowing by residents and IEP borrowing by non-residents removed.	Growing use of derivatives to manage risk.
Fixed-rate mortgages introduced by some banks for first time.	Mortgage securitisation.
Secondary liquidity requirement abolished.	Equity withdrawal and loan consolidation.
Reduction in primary liquidity ratio 8 to 2 per cent.	

Table 2: Summary of Irish Residential Mortgage Market Statistics: 1990 - 2012

Variable	Unit	1990	1995	2000	2005	2007	2012
Outstanding Level of Residential Lending	€ million	6,563	11,938	32,546	94,259	123,002	84,973
Total Value of Mortgages Issued	€ million	1,492	2,666	9,004	27,753	24,064	3,412
Average Mortgage Issued	€	42,856	54,094	111,355	231,206	271,154	184,113
Total Number of Mortgages Issued		34,812	49,288	80,856	120,037	88,747	18,532
House Prices	€	65,541	77,994	169,191	276,221	322,634	227,376
Housing Supply		19,539	30,575	49,812	80,957	78,027	8,428

Note: For all data except the outstanding level of residential lending, the observation for 2012 is quarter 2

Table 3: Demographic and economic characteristics of the survey sample, % of respondents unless otherwise stated

Variable		%
Age Group (years)	18-34	14.6
	35-44	39.9
	45-54	29.8
	55-64	12.6
	65+	2.7
Marital Status	Married / Couple	83.3
	Widowed/Separated	6.1
	Single	10.5
Work Status	Employed	84.5
	Unemployed	6.1
	Inactive	9.2
Education Status	Low	13.1
	Medium	43.6
	High	42.5
Household Composition	1 Adult, 0 kids	9.4
	2 Adults, 0 kids	16.0
	3+ Adults, 0 kids	7.4
	1+ Adults, with kids	60.0
	Undefined	7.2
Median Financial Data (€)	Income	55,000
	Current House Price	181,428
	Mortgage Outstanding	144,554
Negative Equity	% of Group	39.0
Any Arrears	% of Group	19.8
Has Savings/Investments	% of Group	56.7

Note: Where group totals do not equal 100%, the residual is accounted for by "don't know" or "refused" responses. Sample size is 1,837 except in the case of the current house price and negative equity; the sample sizes here are 1,808 and 1,795 respectively.

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Table 4: Loan-Level Data: Overview of Cleaning Exercise

Number of Loans	Total
Initial Observations	654,959
Non-Primary Loan	140,494
Missing Geographic Info.	820
Top/Bottom 1% of House P. Distribution	8,600
Missing LTV at Origination	38,708
Top/Bottom 1% of Income Distribution	7,243
Missing Income at Origination	56,987
Original LTV>100%	13,138
Final Dataset	388,969

Table 5: Loan Level Data: Overview of Primary Loans

Year of Origination	No. of Primary Mortgages (% of Total)
<2000	34,352 (8.83)
2001	11,449 (2.9)
2002	17,370 (4.5)
2003	23,997 (6.2)
2004	34,782 (8.9)
2005	47,536 (12.2)
2006	61,906 (15.9)
2007	57,396 (14.8)
2008	46,306 (11.9)
2009	27,685 (7.1)
2010	19,313 (5.0)
2011	6,877 (1.8)
Total	388,969

Table 6: Summary of Irish Residential Mortgage Market Statistics: 1990 - 2012

Variable	Unit	1990	1995	2000	2005	2007	2012
Outstanding Level of Residential Lending	€ million	6,563	11,938	32,546	94,259	123,002	84,973
Total Value of Mortgages Issued	€ million	1,492	2,666	9,004	27,753	24,064	3,412
Average Mortgage Issued	€	42,856	54,094	111,355	231,206	271,154	184,113
Total Number of Mortgages Issued		34,812	49,288	80,856	120,037	88,747	18,532
House Prices	€	65,541	77,994	169,191	276,221	322,634	227,376
Housing Supply		19,539	30,575	49,812	80,957	78,027	8,428

Note: For all data except the outstanding level of residential lending, the observation for 2012 is quarter 2

Table 7: Income Survey: Overview of Primary Loans

Year of Origination	No. of Primary Mortgages (% of Total)
<2000	11.3
2001	4.2
2002	5.4
2003	6.5
2004	9.1
2005	15.0
2006	14.1
2007	13.4
2008	10.2
2009	6.4
2010	4.5
Total	1,381

Table 8: Regression estimate results

Dependent Variable	κ		ltv	
	Coefficient	T-Stat	Coefficient	T-Stat
Constant	-2.49	-17.08	0.74	4.61
$(p/y)_i$	0.57	26.23	-0.43	-18.14
r_i	6.06	2.98	-1.65	-0.74
Controls:				
num	-0.03	-1.28	-0.03	-1.12
$female$	0.01	0.32	0.03	1.48
$public$	-0.02	-1.29	-0.02	-1.08
pdh	-0.07	-2.45	-0.05	-1.57
$self$	-0.01	-0.34	-0.05	-1.53
$saving$	-0.01	-0.54	-0.02	-0.90
$ed-medium$	0.01	0.18	0.02	0.56
$ed-high$	0.06	1.90	0.11	3.15
$addition$	-0.07	-2.06	-0.04	-1.19
age	-0.01	-6.99	-0.02	-15.31
Year dummies:				
2001	0.06	1.01	0.09	1.47
2002	0.09	1.46	0.11	1.76
2003	0.01	0.14	0.11	1.47
2004	0.01	0.21	0.11	1.46
2005	0.12	1.88	0.26	3.58
2006	0.10	1.72	0.24	3.68
2007	0.15	3.34	0.26	5.29
2008	0.12	2.61	0.17	3.52
2009	0.07	1.00	0.16	2.12
2010	0.01	0.15	0.15	1.85
		N = 1,381		

Note: The dependent variables and the house price-to-income ratios are logged, interest rates are in actual rates, while the rest of the variables are 0/1 dummies.

Figure 1

Loan to Deposit Gap: Euro Area

Legend:
— Total lending to domestic non-MFI
– – – Housing loans to households (right-hand scale)
···· Deposits from domestic non financial sectors
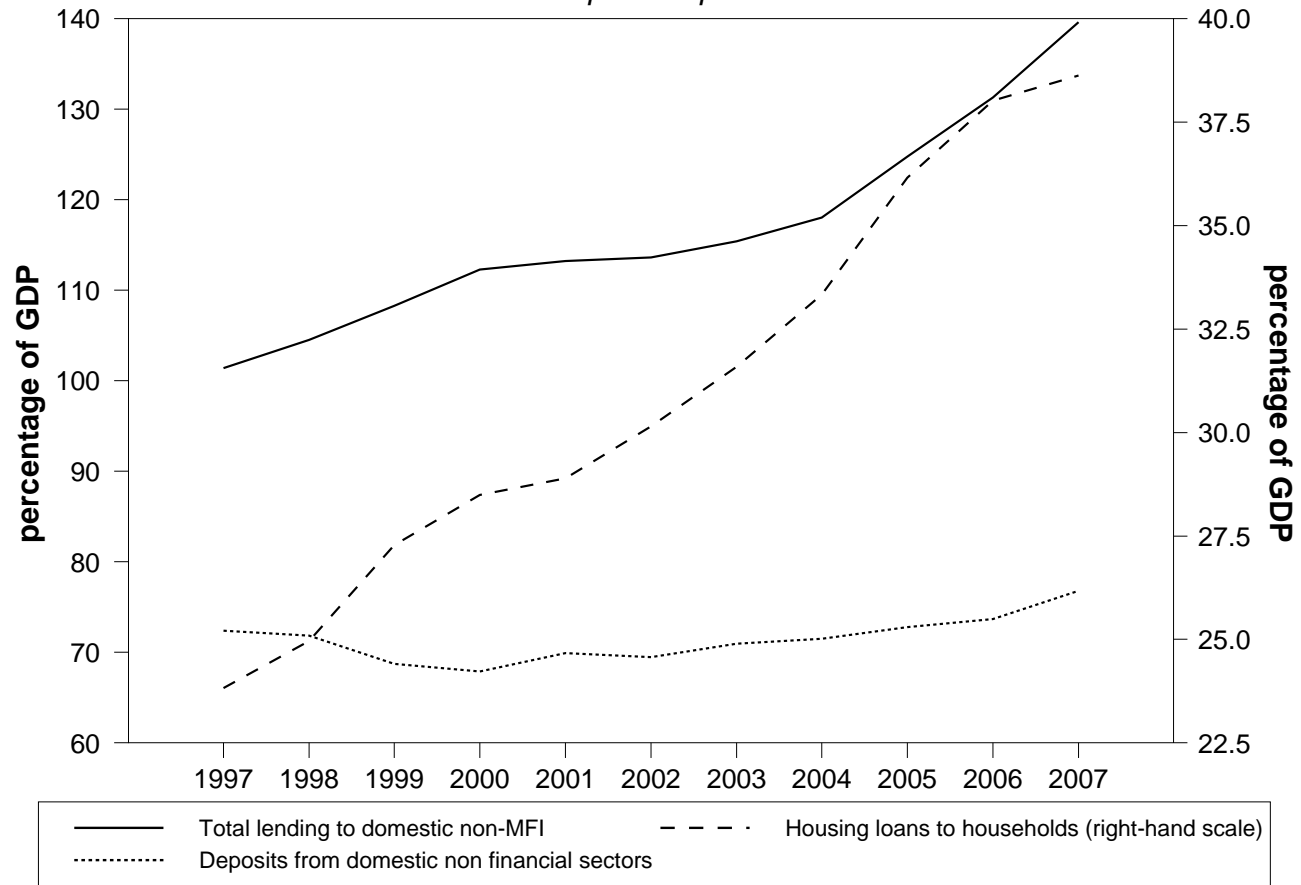
Figure 2

Funding of Irish Financial Institutions: 2001- 2010

Issuance of Debt Securities by Irish Mortgage Lenders

Private Sector Credit and Deposit Levels in the Irish Financial System
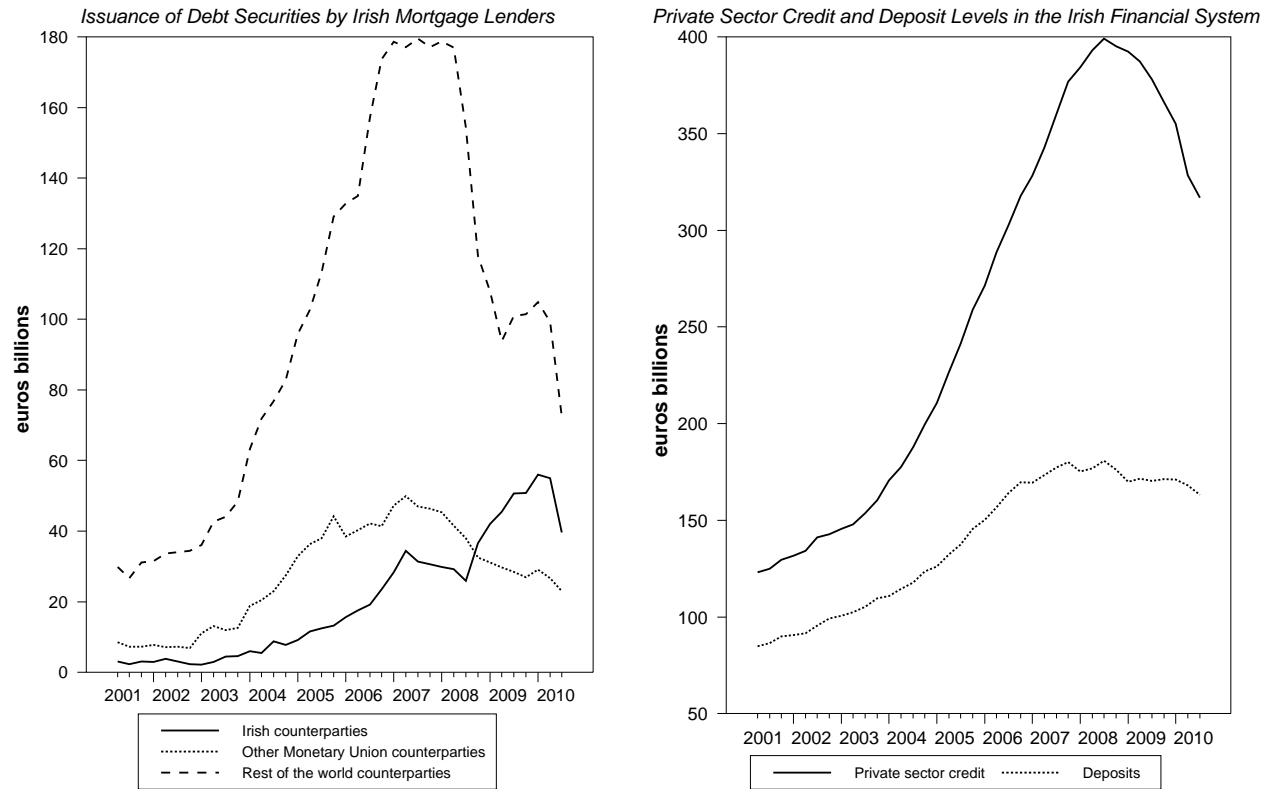
Figure 3

Change in Credit Conditions across the 4 Covered Institutions: 2000 - 2011
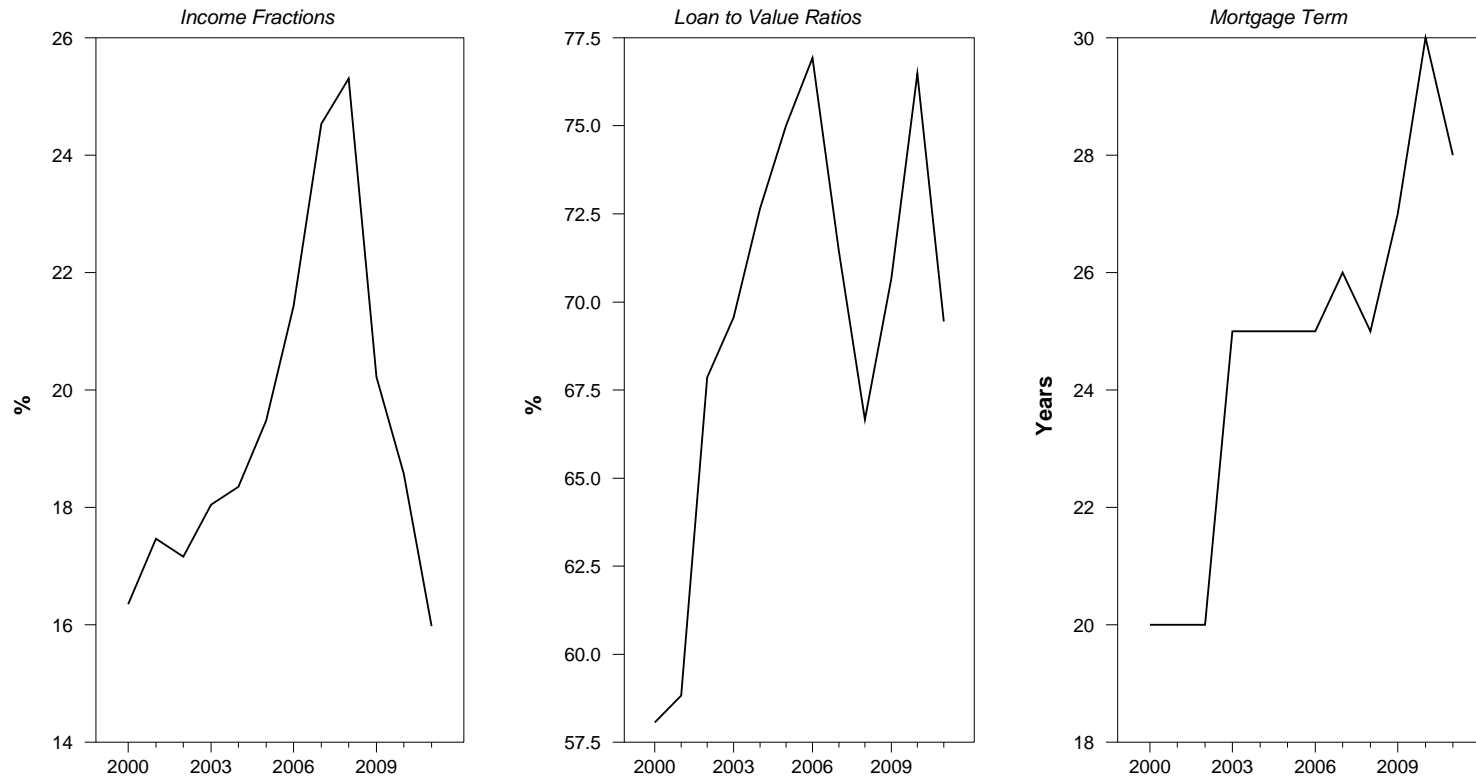
Figure 4

Change in Credit Conditions by Income Quintile: 2000 - 2011
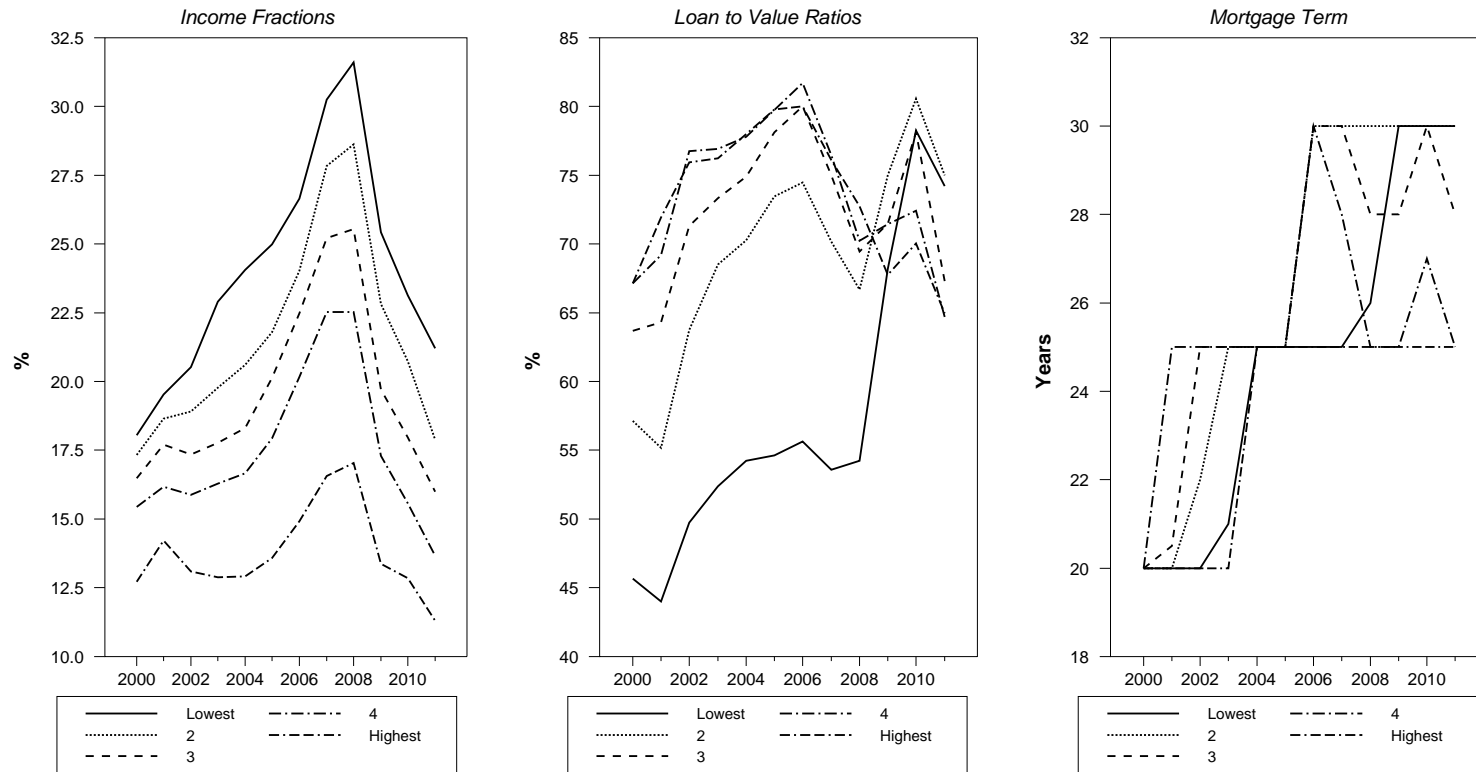
Figure 5

Income Fractions and LTV by Income Quintile
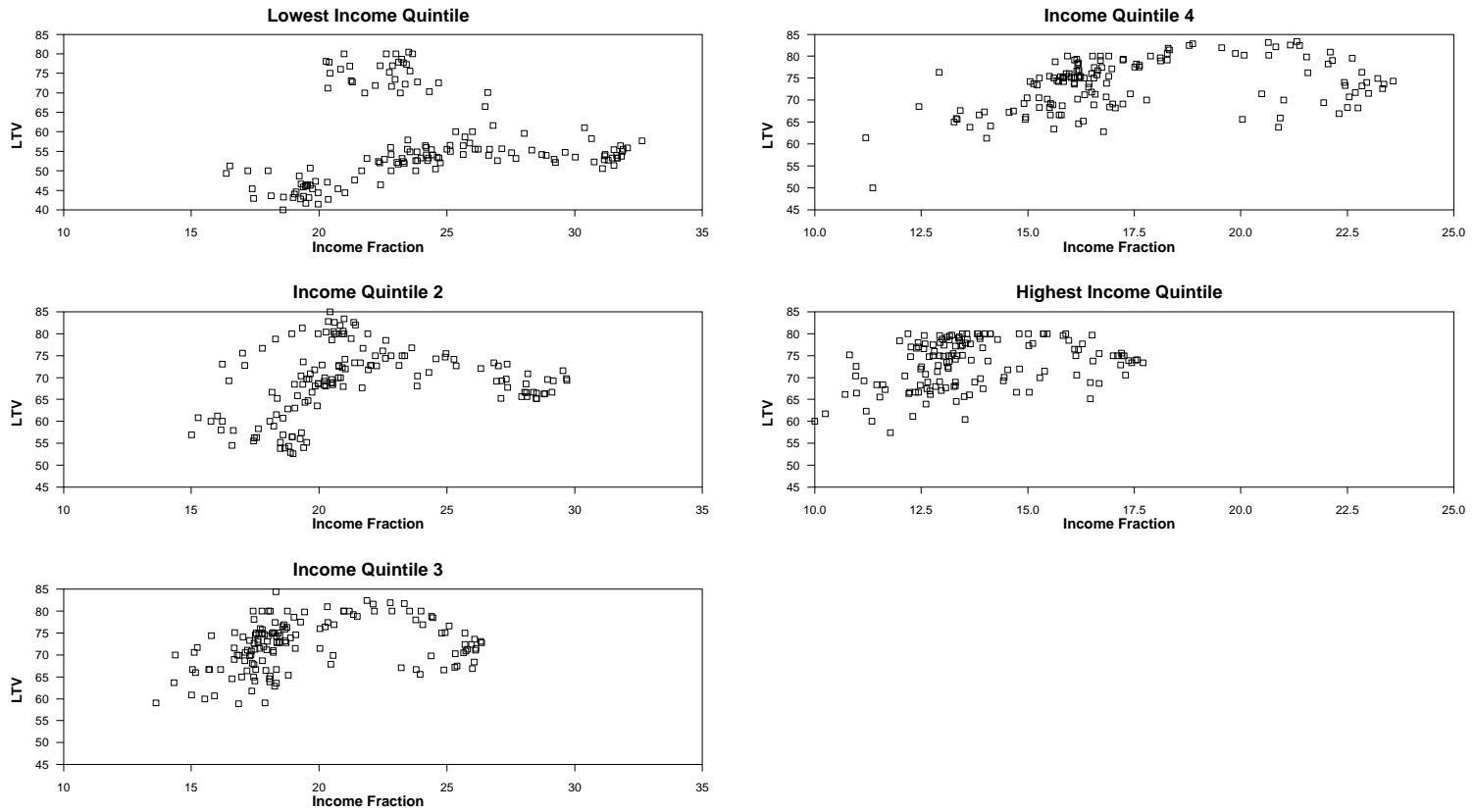
Figure 6

Income Fractions and Mortgage Term by Income Quintile
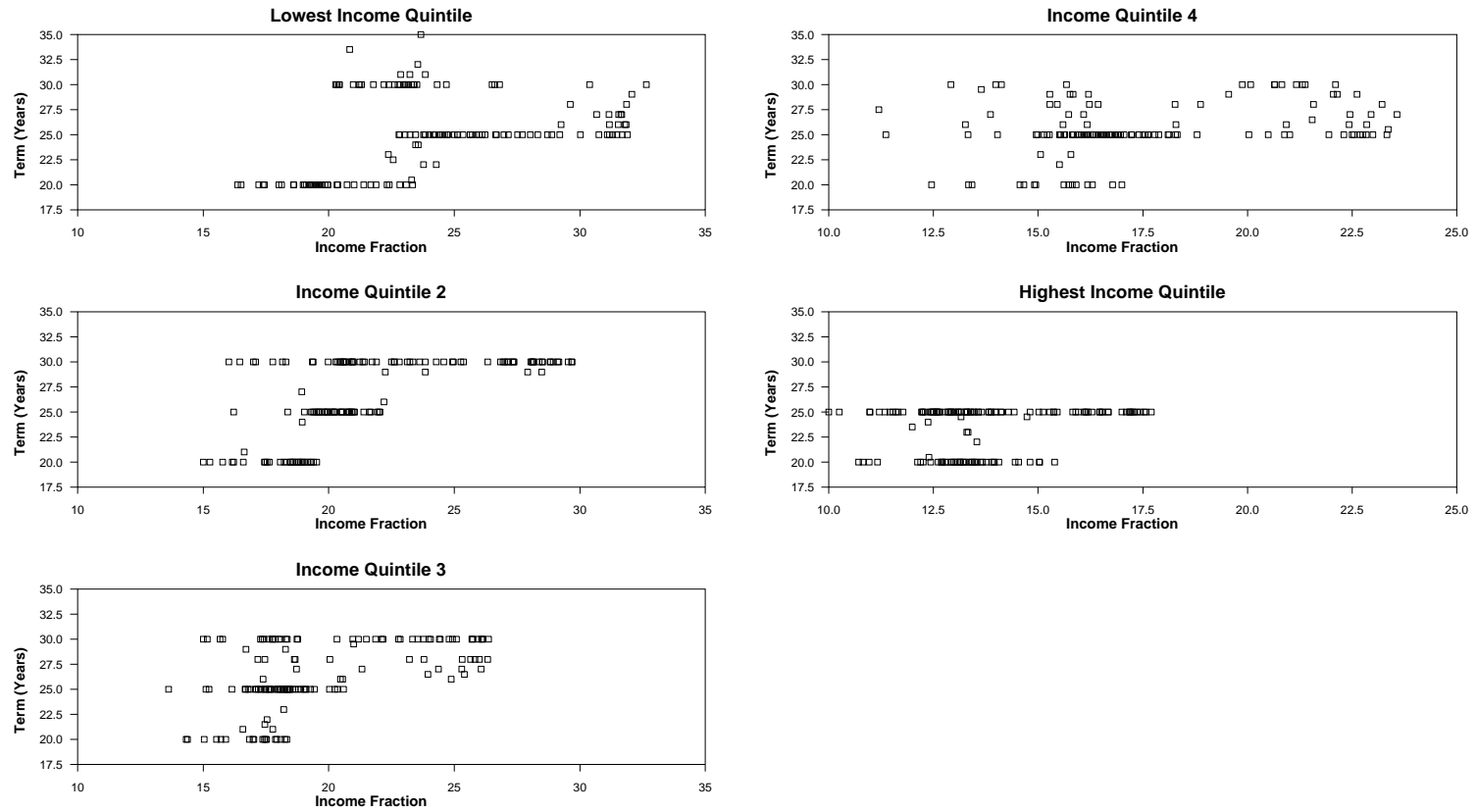
Figure 7

Credit Conditions by Buyer Type: 2000 - 2011
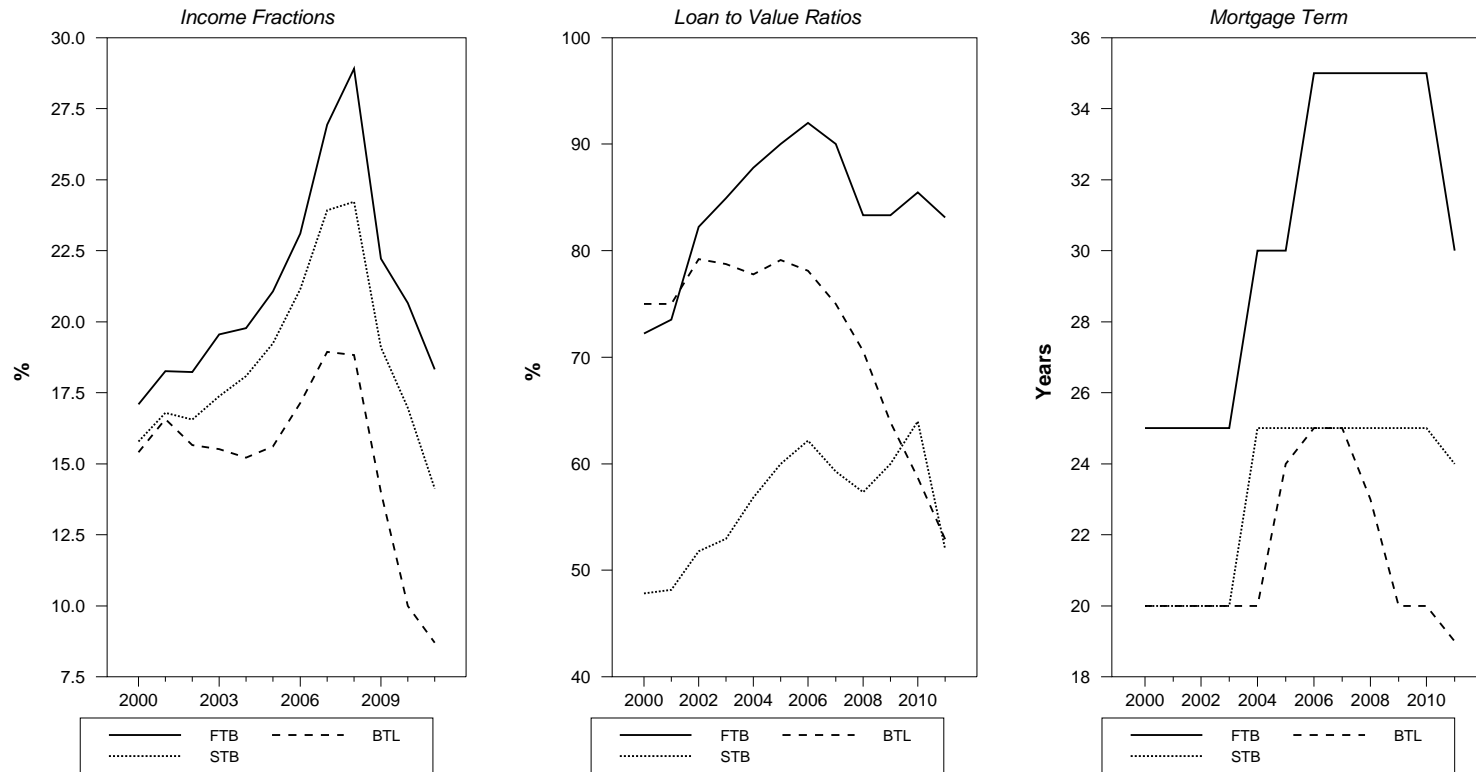
Figure 8

Credit Conditions by Arrears Status: 2000 - 2011
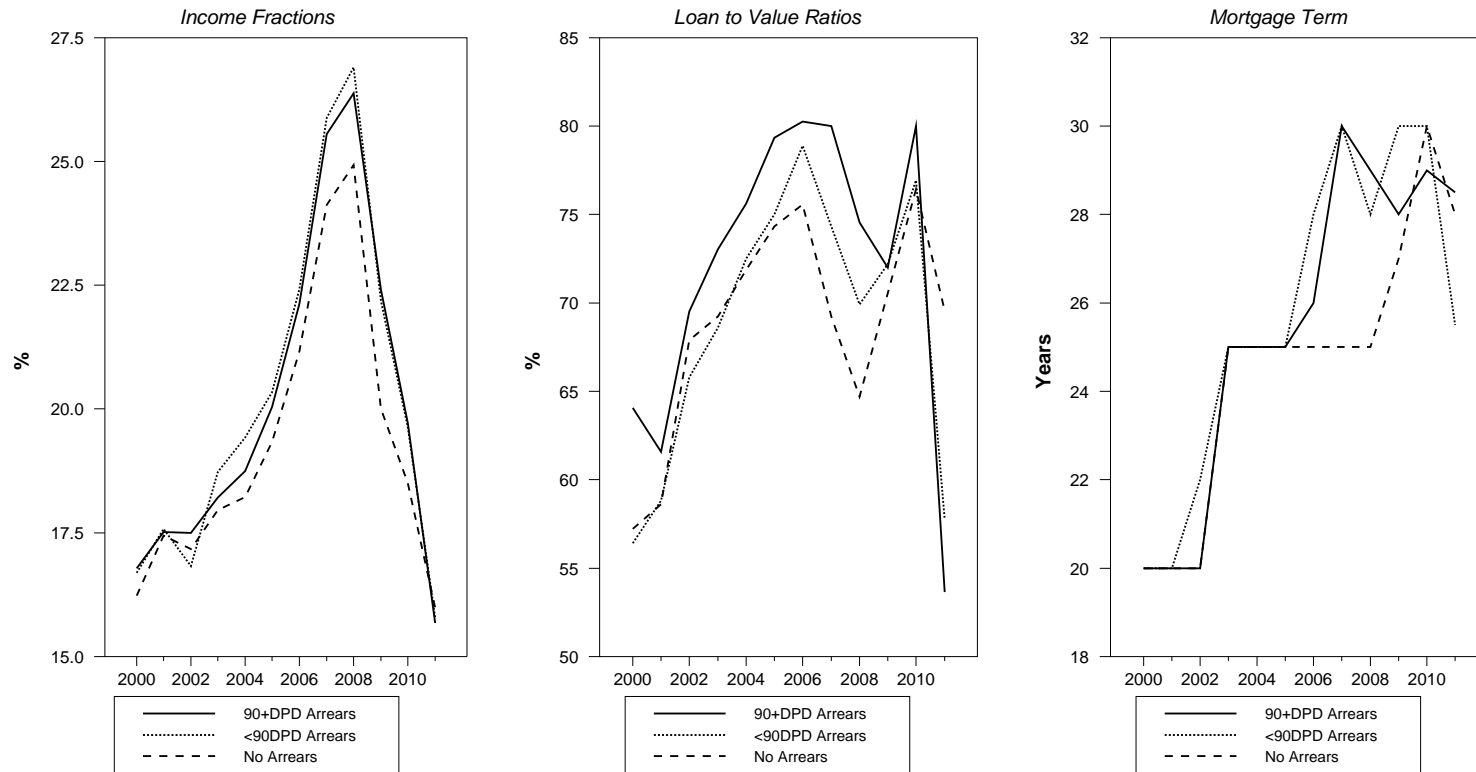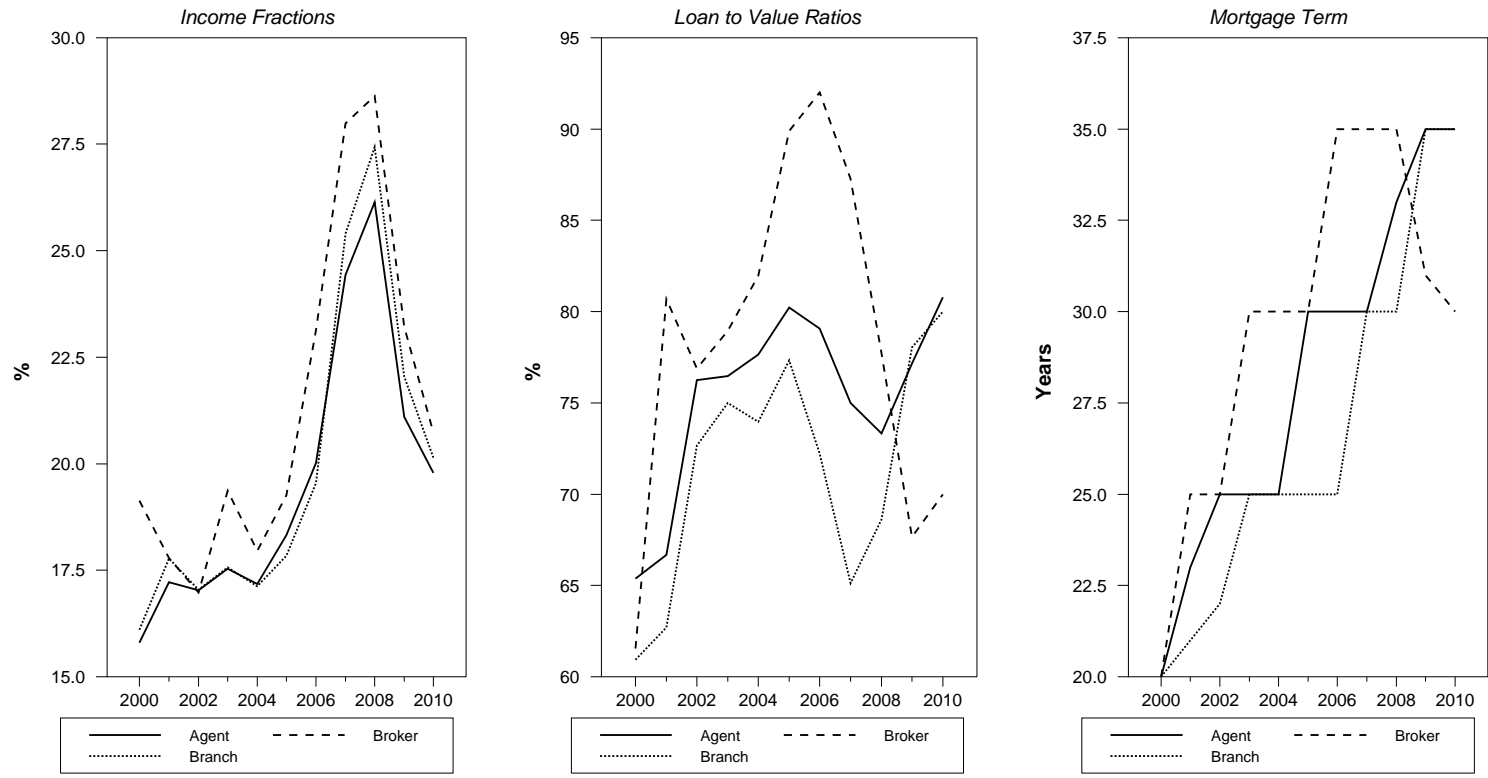
Figure 9

Credit Conditions by Source of Loan: 2000 - 2011
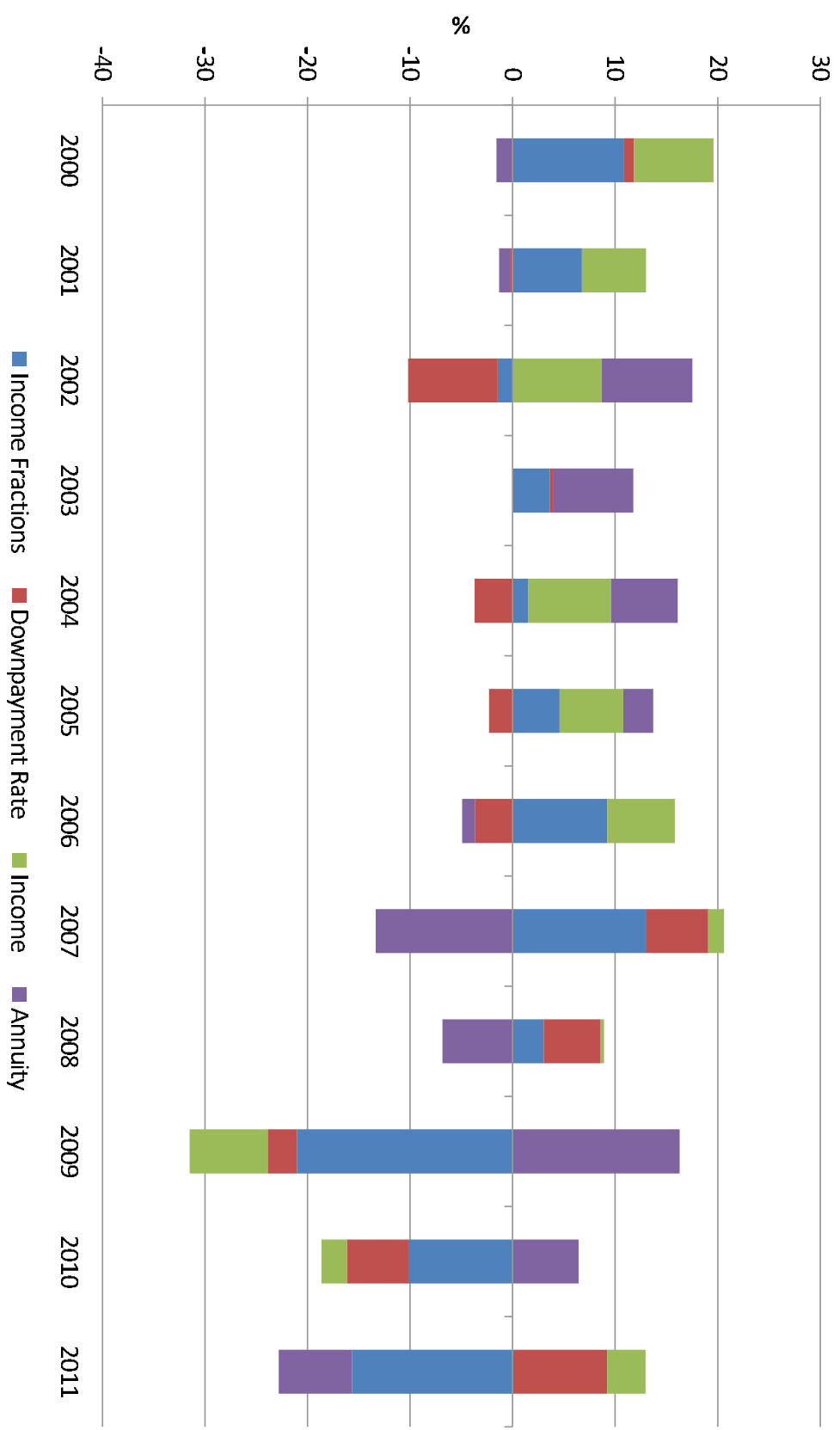
Figure 10

House Price Decomposition, 2000 - 2011

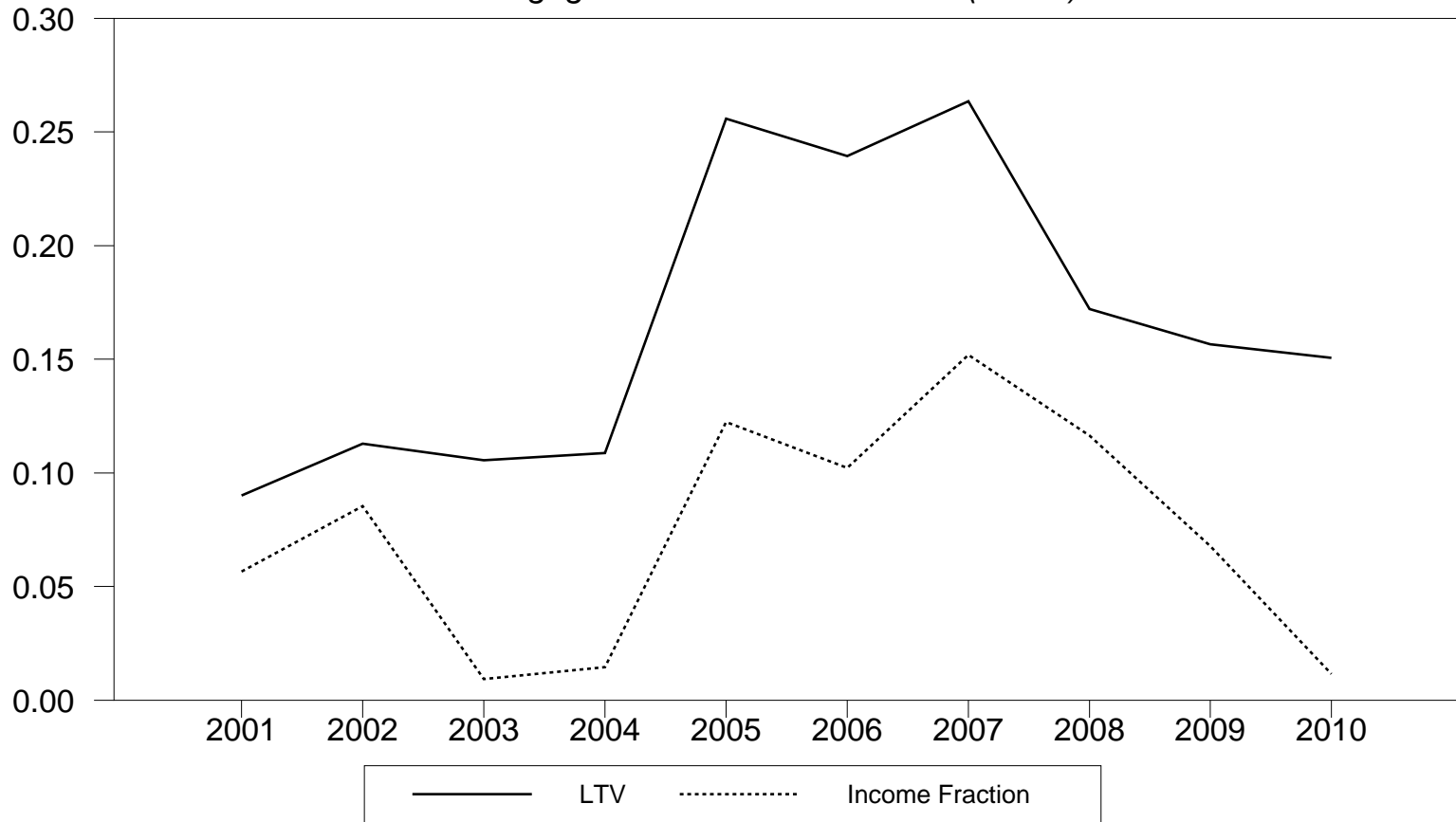Legend: Income Fractions, Downpayment Rate, Income, Annuity

Figure 11

Irish Mortgage Market Credit Indicator (MMCI)

Comparison of Year-on-Year Changes in Different Series
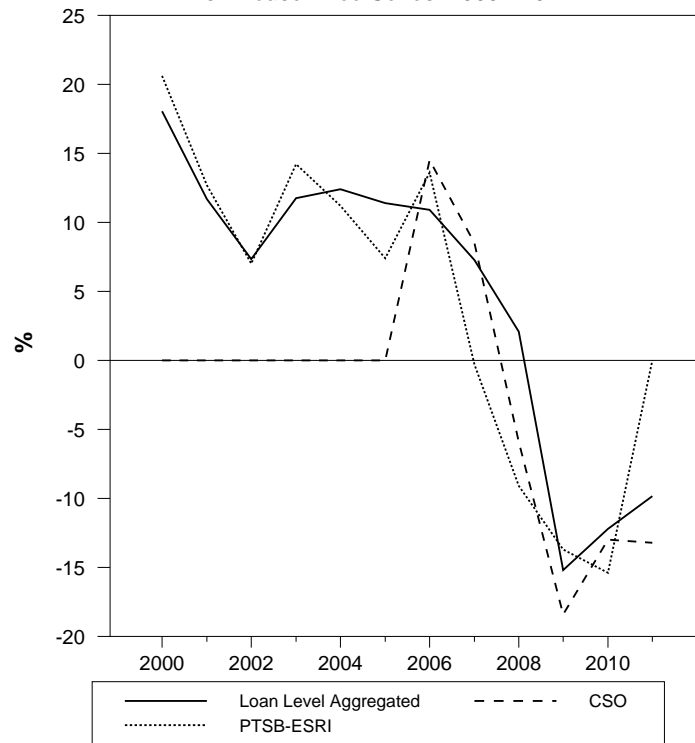

Figure A1

Irish House Price Series: 2000 - 2011

Figure A2

Income Series: 2004 - 2011