



Banc Ceannais na hÉireann
Central Bank of Ireland

Eurosystem

Economic Letter

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Vol. 2018, No. 5

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This *Letter* examines the ratio of new mortgage lending to household disposable income in monitoring cyclical systemic risk related to residential real estate lending. As the flow of new lending is more responsive to changing economic conditions than the stock of credit, this indicator may be beneficial in an early-warning context. We also examine the non-cyclical or structural determinants of the ratio in a cross-country setting to find that, as at end-2017, the actual level of the ratio in Ireland had converged to its estimated structural value. As a result, near-term developments in the volume of new mortgage lending warrants careful monitoring such that higher levels of activity are not accompanied by the emergence of excessive cyclical systemic risk.

1. Introduction

House price bubbles and bursts, unsustainable credit growth and systemic financial crises have often accompanied each other. Particular attention is now paid to indicators that can effectively gauge the build-up of systemic risk related to residential real estate and mortgage credit. Over the past decade the policy regime in a number of countries has also evolved to incorporate a macroprudential mandate, often with policy instruments that directly target residential mortgage lending.²

In this *Letter* we focus on measures of new mortgage lending activity which could inform macroprudential policy-makers' decisions in the broad context of the potential pro-cyclicality of mortgage credit.

Beyond the relative usefulness of the main indicator being examined - the ratio of new mortgage lending to household disposable income (NMDI) - we also consider the long-run structural determinants of the

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²In Ireland, for example, macroprudential limits on high loan-to-value (LTV) and loan-to-income (LTI) new mortgage loans have been in place since February 2015. See Cassidy and Hallissey (2016) for an overview.

ratio in a cross-country setting. The difference between the prevailing levels of NMDI and the estimate based on structural determinants can be considered to be related to cyclical drivers of the ratio.

We find that the NMDI ratio was at end-2017 broadly consistent with these structural determinants. As a result near-term developments in the level of new mortgage lending warrants careful monitoring so that higher levels of activity are not accompanied by the emergence of excessive cyclical systemic risk.

The *Letter* proceeds as follows: Section 2 motivates the analysis of new lending flows in the context of the literature and the experience of the most recent financial crisis; Section 3 describes our data and the methodology used in our empirical analysis to explore the structural determinants of new mortgage lending activity; Section 4 presents the results of the empirical analysis; and Section 5 concludes.

2. The relevance of new mortgage lending activity

It is common for estimates of the credit or financial cycle to focus on the stock of outstanding credit, and to consider this stock relative to a flow measure of economic activity as a means of assessing its sustainability. The standard estimates of the credit gap used for calibrating the Counter-cyclical capital buffer (CCyB) rate, for example, is derived from the deviation from a Hodrick-Prescott filtered trend of a broad measure of non-financial private sector credit relative to GDP.³ Lang and Welz (2017) show that in instances following an excessive expansion of the stock of credit followed by a financial crisis, the standard credit gap can have implausibly large negative values for a long period of time, potentially underestimating emerging cyclical systemic risks.

However the recovery in the flow variable GDP after such crises in the absence of a recovery in the stock of credit is itself not uncommon, irrespective of the filtering method of the standard credit gap. Abiad *et al* (2010) find that these credit-less recoveries are more likely to occur following significant banking crises, credit booms, and real-estate boom-bust cycles. Bijsterbosch and Dahlhaus (2015) also note that these events are relatively frequent, and particularly so when private sector indebtedness is high and the economy is reliant on foreign capital inflows. Meanwhile, Biggs *et al* (2009) argue that the phenomena of credit-less recoveries are due to a fundamental measurement inconsistency in comparing a stock (credit) relative to a flow (GDP) measure. They show that when one considers the net flow of credit with respect

³See Detken *et al*, 2014 and references therein for discussion of the standard credit gap as recommended for use by the European Systemic Risk Board in Recommendation ESRB/2014/1.

to GDP, the two series are much more highly correlated through the cycle, suggesting lending flows are more related to developments in economic activity than credit stocks.

When viewed in the context of the recent Irish experience, the use of credit flows when evaluating emerging cyclical systemic risks seems appropriate. At the time of writing all measures of economic activity (GDP, GNI*, employment, disposable incomes, etc.) have risen substantially from their troughs while the stock of non-financial private sector credit continues to contract.⁴

Data availability can restrict this focus on gross flows for private-sector credit, or indeed for household credit as a whole. However, such data has been available for drawdowns of new mortgage lending in Ireland and the United Kingdom for some years, while broadly consistent series can be constructed for other countries also. It is this measure for the value of new mortgage lending that we consider when evaluating the emergence of cyclical systemic risk. In Ireland, new mortgage lending has been consistently rising over recent years, with the annual rate of increase being 21 percent, 12 per cent and 29 per cent in 2015, 2016 and 2017, respectively.⁵

In the empirical analysis we examine the NMDI ratio in a cross-country setting to establish whether the prevailing ratio in Ireland is indicative of emerging cyclical systemic risk related to residential real estate lending.⁶ Before doing so, we consider the fundamental structural drivers of this ratio.

3. Empirical approach

In this section we discuss the data and the empirical approach to evaluating the NMDI ratio in comparison to its fundamental or structural determinants. While the focus of this *Letter* is on the experience in Ireland, we construct a panel of 16 European countries in order to exploit as much available information as possible to get robust estimates on

⁴GNI* adjusts the existing measure of Gross National Income for depreciation on foreign-owned domestic capital assets and the retained earnings of re-domiciled plcs. For further information see Irish Central Bank Quarterly Bulletin 2017 Q2, Box B.

⁵The data for new mortgage lending are taken from various sources: the Banking & Payments Federation Ireland Mortgage Drawdowns Report (Ireland); Bank of England Bankstats (United Kingdom); European Central Bank (ECB) MFI Interest Rate Statistics (remaining countries listed in Section 3). The data from the ECB refer to pure new loan volumes (excluding the impact of renegotiations), backcast where necessary using total new business volumes.

⁶Note that this indicator is not directly mappable to individual households LTI ratios, as it is based on National Accounts data.

the impact that the various structural factors we consider have.⁷ We then take the estimates for the NMDI ratio based on these structural factors and compare with the actual level of the ratio at a given point in time. The difference between the observed and the estimated NMDI based on structural determinants can be considered as the movements of NMDI that are more related to cyclical developments. Where prevailing levels of the ratio are above (below) that which is based on structural determinants it may be indicative of higher (lower) levels of cyclical systemic risk.

The level of new mortgage lending activity can reasonably be considered to be related to some of the fundamental factors that determine the level of housing demand and the supply of financial services. As such we draw on those literatures to inform our variable selection when examining the structural determinants of the NMDI ratio. Our choice of variables is also determined on the basis that we want to identify factors which should be less influenced by within-country cyclical dynamics than the new lending ratio itself. As a result we can be more confident that the difference between the observed and our estimated NMDI ratio is due to cyclical factors. It also reduces the potential for endogeneity biases in our estimates, as the structural determinants of the NMDI ratio considered here are less likely to be influenced by the NMDI ratio itself.⁸

Our independent variables, their sources, and the rationale for their inclusion is shown in Table 1. They include long-term natural real interest rates⁹, demographic factors, measures of institutional quality at the country level¹⁰, and a measure of the global financial cycle.

Our model specification in its entirety is:

⁷The countries included are Ireland, Austria, Belgium, Denmark, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, the Netherlands, Portugal, Slovenia, Spain and the United Kingdom. Data on household disposable income is taken from Eurostat. In the case of Hungary, Latvia and Lithuania, domestic demand is used instead of disposable income due to data availability.

⁸The use of a panel approach to estimation also has some benefits in this regard for individual country results.

⁹Model-based estimates of the short-term natural real interest rate could also be considered here, such as proposed in Laubach and Williams (2003).

¹⁰It could be argued that a well-functioning regulatory system restricts the flow of credit, and depending on the relative strength of that the coefficient on this indicator could be expected to be negative. However, the construction of the indicator itself by the World Bank would suggest that this institutional factor is more considered to facilitate appropriate private sector activity, which supports the prior expectation of a positive impact on NMDI. It is ultimately an empirical matter to determine.

Table 1 | Data sources

Variable	Source	Rationale for inclusion
Long-term Real Interest Rate	IMF: Rolling 10-year average of 10-year sovereign bond yields deflated by the consumer price index	The natural real interest rate is that which is consistent with the economy growing at its potential and should only change as a result of changes in structural issues such as changes in technology or population. We take this as a broad measure of the structural cost of finance, and it is expected that it is negatively related to the NMDI ratio.
Demographics	Eurostat: Share of the population between 20 and 44 years of age.	This representative share of the population is expected to drive the demand-side for housing transactions. This is age most likely to be first- and second-time home purchasers and given relative earnings to age are most likely to avail of mortgage products. As the share of this cohort in the population increases, it is expected that the NMDI ratio would also rise.
Institutional and Regulatory Quality Indicator	World Bank and IMF: Average of the World Bank Regulatory Quality Index (Kaufmann et al, 2010) and the IMF Financial Institutions Index (Sviryzdenka, 2016).	Both indices draw on substantial quantitative and qualitative sources to compile a single indicator to measure, respectively, the perceptions of the ability of authorities to design and implement appropriate policies and regulations to promote private sector development, and the depth, access to and efficiency of financial services provision. In essence, these institutional factors affect the ability of the financial system to provide sufficient levels of intermediation services to meet the demand for new mortgage lending and the capacity of regulatory infrastructure to support appropriate levels of financial service provision. It is expected that the indicator would be positively related with the NMDI ratio.
VIX	Federal Reserve Bank of St. Louis: Quarterly average of S&P 500 daily data	A proxy for common global drivers of financial flows not influenced by an individual country within the sample. Rey (2015) for example, characterises this cycle as a common tendency for risk aversion, with lower levels related to the upswing of the financial cycle. She proposes the VIX, which is an index derived from the 30-day implied volatility of the S&P 500, as an appropriate proxy for this common global cycle. The expectation is that higher levels of global risk perception would be related to lower levels of the NMDI ratio.

$$\begin{aligned}
 NMDIRatio_{it} = & B_0 - B_1 RealInterestRate_{it} + B_2 HouseholdFormation_{it} \\
 & + B_3 InstitutionalQuality_{it} - B_4 VIX_t + \alpha_i + \epsilon_{it}
 \end{aligned}
 \tag{1}$$

where for each country i we have observations across time t from 2003Q1 to 2017Q4. We use a standard country fixed-effects OLS specification (α_i) to account for time-invariant country characteristics which could reasonably be expected to influence the NMDI ratio across our sample.¹¹ This could include, for example, inherent preferences of households that may differ across countries but be stable over time. The preference for home ownership could be considered as an example. We have not included the actual home ownership rate itself in our specification as, at least in the Irish case, it may not be a good proxy for these preferences, being influenced by both preferences and cyclical issues such as the availability of housing.¹² Similarly, we have purposefully not included other variables that would reflect cyclical factors to a greater degree, such as housing supply, house prices, household indebtedness, or credit standards. To that extent, the error term ϵ_{it} above should be

¹¹The appropriate use of fixed effects is confirmed by a Hausman test. Details available on request.

¹²According to Census data from the CSO, the home-ownership rate has declined from 77.4 per cent in 2002 to 67.6 per cent in 2016.

considered to capture those cyclical dynamics in the NMDI ratio.¹³

In a second specification, we replace the VIX with time-fixed effects to account for all common factors across countries in each time period.

Table 2 presents summary statistics for the variables we have included for our entire sample and for Ireland specifically. The within-country variation for Ireland is lower than the entire sample for the new lending ratio, demographics and the institutional quality indicator.

Table 2 | Summary statistics

	Full Sample					Ireland				
	Max	Min	Mean	Median	Std. Dev	Max	Min	Mean	Median	Std. Dev
New Lending to Gross Disposable Income	62.26	0.38	10.48	6.52	12.74	35.35	1.83	12.92	6.13	11.40
Long-term Real Interest Rate	5.08	-0.07	2.23	2.21	1.10	3.53	0.69	2.43	2.71	0.93
Demographics	40.30	30.5	34.35	34.20	2.26	40.30	34.85	37.95	38.73	1.99
Institutional and Regulatory Quality Indicator	96.45	61.29	81.36	83.31	9.40	96.45	86.69	91.19	91.53	3.07
VIX	61.85	8.64	18.56	16.18	8.90	61.85	8.64	18.56	16.18	8.90

Note: Excluding observations at 1st and 99th percentiles

Our model is estimated in log-levels of seasonally adjusted data, except for the long-term natural real interest rate proxy, which is included in percentage points. Quarterly values for variables only available at an annual frequency are linearly interpolated.¹⁴ Estimating the model in level terms is only appropriate where all variables are stationary. In Table 3, we present results from a suite of panel unit root tests that confirm none of our variables contain a unit root such that estimating the fixed-effects OLS regression on the variables in levels is appropriate.

4. Estimation results

In this section, we present the results of our empirical analysis and focus on the comparison between the prevailing level of the NMDI ratio for

¹³The extent to which the more cyclically determined variables omitted from our specification are correlated with our structural determinants could pose endogeneity concerns. This may particularly be the case for credit standards. However we find that the correlation between our explanatory variables and a time series of the 75th percentile of originating loan-to-value ratios for most of the countries in our sample from Kelly *et al* (mimeo), to be quite low at no more than 0.3 in absolute terms, and as low as 0.002.

¹⁴The institutional quality and demographic variables are only available at an annual frequency. In the estimation, data for the institutional quality variable is held constant at its 2016 levels for 2017.

Table 3 | Panel unit root tests

	Inverse chi-squared(32)	Inverse normal	Inverse logit t(84)	Modified inv. chi-squared
New Lending to Disposable Income	123.89*** (0.00)	-7.70*** (0.00)	-8.45*** (0.00)	11.49*** (0.00)
Long-term Real Interest Rate	62.41*** (0.00)	-2.93*** (0.00)	-3.22*** (0.00)	3.80*** (0.00)
Demographics	111.71*** (0.00)	-6.81*** (0.00)	-7.44*** (0.00)	9.96*** (0.00)
Institutional and Regulatory Quality Indicator	81.55*** (0.00)	-4.50*** (0.00)	-4.74** (0.01)	6.19*** (0.00)
VIX	82.55*** (0.00)	-5.74*** (0.00)	-5.55*** (0.00)	6.32*** (0.00)

Note: This table presents output from the Fisher-type panel unit root tests proposed by Choi (2001) based on Augmented Dickey-Fuller tests. The null hypothesis is that all panels contain a unit root with the alternative being that at least one panel is stationary. ***, **, * denote significance at the 1%, 5% and 10% levels, respectively, indicating rejection of the null hypothesis, with corresponding P-values reported in parentheses.

Ireland and that which is based on the structural factors outlined in the previous section.

The coefficient estimates are presented in Table 4, and show that in the specification without time fixed-effects (first column) all explanatory variables are significant and enter with the expected sign. The most substantial effect comes through household formation and institutional quality, changes in which are found to have a more than proportionate positive impact on the fundamental estimate of the new mortgage lending ratio. The long-term real interest rate and the VIX are shown to have a smaller impact. Overall, almost 80 per cent of the variation in the NMDI ratio is explained by the observed and unobserved structural determinants, the latter captured by the country fixed-effects.¹⁵

We also estimate a second specification to account for all common factors across countries in each time period (time fixed-effects), as shown in the last column of Table 4. The inclusion of time fixed-effects reduces the coefficient estimates for the household formation and institutional quality indicators. This does not preclude the possibility of a common global financial cycle influencing the new lending ratio, but perhaps allows for broader common issues of relevance to be considered.¹⁶

Based on these coefficient estimates for the structural determinants in the last column of Table 4 we can derive fitted values of the NMDI ratio for Ireland. These estimates are presented in Figure 1, alongside the time series for the actual ratio.¹⁷ The fitted values are presented

¹⁵Due to the slow moving nature of the observed structural determinants, the impact of country fixed effects dominates.

¹⁶On examining the coefficients for the time fixed effects they tend to be more statistically significant when the VIX is declining, suggesting there may be more of a role in common conditions during the upswing of the financial cycle.

¹⁷We also present the equivalent output from the model which includes the VIX instead of time fixed ef-

Table 4 | Regression estimates of the structural determinants of the NMDI ratio

	Country Fixed Effects	Country & Time Fixed Effects
Constant	-29.66*** (-13.05)	-18.66*** (-5.33)
Long Term Real Interest Rate	-0.10*** (-4.79)	-0.14*** (-6.62)
Demographics	3.58*** (7.35)	1.97** (2.24)
Institutional and Regulatory Quality Indicator	3.45*** (6.34)	2.21*** (3.93)
VIX	-0.25*** (-5.53)	
Observations	960	960
Adjusted R-Squared	0.77	0.79

Notes: All variables expressed in natural logarithms except for the long-term real interest rate.

on the basis of the sample-wide intercept (panel fitted value) and the country specific intercept, which includes the Irish country fixed-effect (country fitted value). It is evident that in the build-up of systemic risk prior to the financial crisis of 2008, the NMDI ratio was far in excess of its estimate based on structural factors.¹⁸ The prevailing ratio had been consistently lower than its estimated structural value since mid-2008. Of more current relevance it can be noted that the NMDI level at end-2017 of 6.7 per cent, had converged to its fundamental country-specific estimated value of approximately 6.5 per cent.

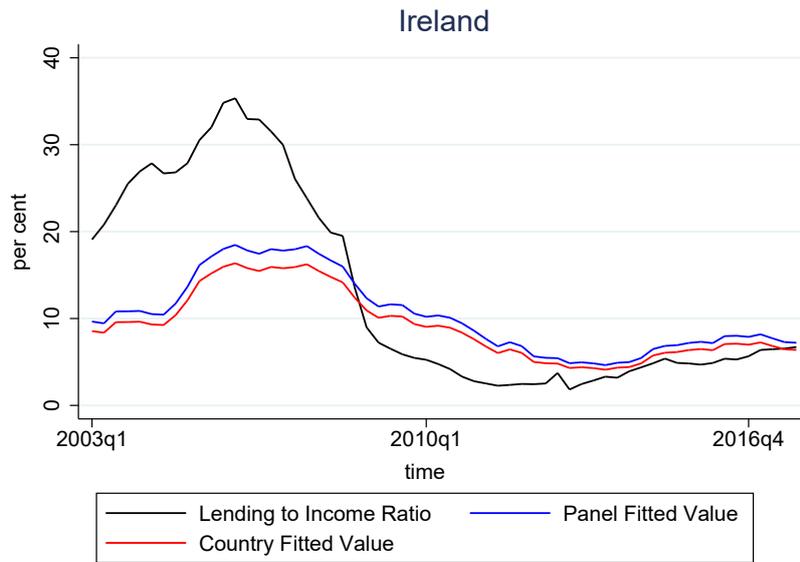
Using the results in first column of Table 4 we also conduct some rudimentary counter-factual analysis to highlight the relative role of the different variables in driving the estimated structural NMDI ratio in certain periods.¹⁹ Two distinct periods of interest for such counter-factual analysis are the build-up phase to the Irish financial crisis (2003-2006) and the period since the materialisation of the crisis (2009-2016). Considering the build-up phase, the counter-factual analysis suggests that developments in the VIX (the global financial cycle), institutional quality and demographic factors were the of greatest relevance (in that order) in driving the increase in the estimated NMDI. During the latter pe-

fects in Figure 2.

¹⁸The dynamics of new lending indicated the materialisation of this risk some quarters in advance of the developments in the stock of household credit.

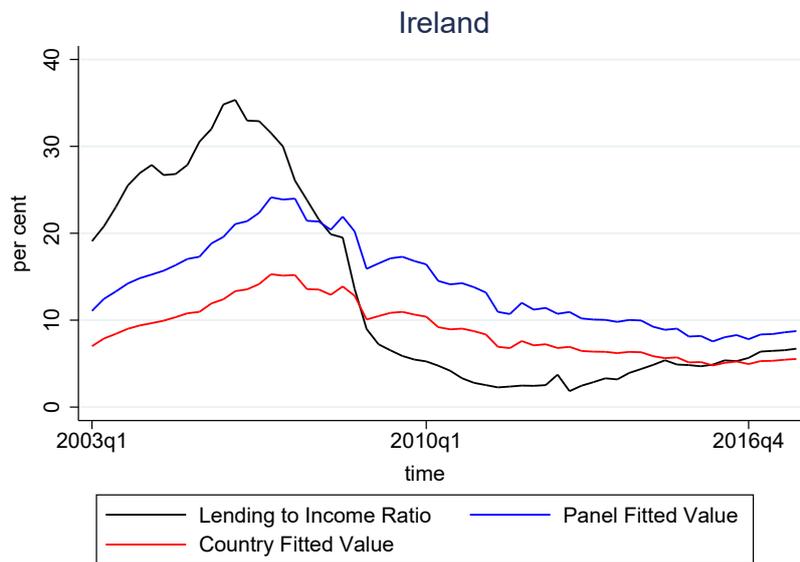
¹⁹To conduct the counter-factual analysis we consecutively hold one variable constant over the entire period of interest while allowing the other variables to vary as they actually did so during the period. The fitted estimate derived from each counter-factual is compared with the actual fitted estimate, and the larger the difference between the two, the more relevant the variable in question is for developments in the estimated NMDI ratio.

Figure 1 | Actual and estimated level of NMDI ratio (incl time fixed effects)



Source: Authors calculations. The estimated NMDI is derived from the model which includes country and time fixed effects (last column of Table 4.)

Figure 2 | Actual and estimated level of NMDI ratio (incl VIX)



Source: Authors calculations. The estimated NMDI is derived from the model which includes country fixed effects and the VIX (first column of Table 4.)

riod, however, while the relative impact of these three variables is similar they now go in opposite directions. Developments in the VIX since 2009 have provided upward momentum to the estimated NMDI ratio, whereas the decline in the institutional quality indicator and the demo-

graphic demand variable over the period has offset that upward momentum and contributed to the overall decline in the estimated NMDI ratio.

Overall, with the NMDI ratio currently having converged to the estimated value based on structural determinants, there is some evidence of emerging cyclical systemic risk related to the level of new mortgage lending activity. While the aggregate value of new mortgage lending, on this basis, could continue to increase without such systemic risk building up excessively, it does warrant careful monitoring. For example, if the annual growth in new mortgage lending continued through 2018 at the average rate of increase over the previous five years (circa 25 per cent) and household disposable income rose in-line with the latest forecasts from the Central Bank Quarterly Bulletin (3.5 per cent), then the NMDI ratio will be approximately 8 per cent by end-2018.

5. Conclusion

We have put forward a flow-consistent indicator of new lending activity as an additional measure to inform policy-maker judgment on emerging cyclical systemic risk related to residential real estate lending. This indicator, the ratio of new mortgage lending to household gross disposable income, presents some conceptual and practical benefits to evaluating the build-up of systemic risk.

On examining the NMDI ratio for Ireland, we have found that the level of activity in recent quarters has converged to that which would be suggested by its structural determinants. This suggests that mortgage activity should continue to be carefully monitored, such that significant increases above those levels seen in 2017 are not accompanied with the emergence of excessive cyclical systemic risk. The findings suggest that if new mortgage lending continues at its recent rate of increase relative to the expected growth in household disposable income, excessive cyclical risks related to mortgage lending may emerge.

Future extensions to this research could include the expansion of credit flow data to incorporate all credit advanced to private sector if the necessary data are available on a cross-country basis. Alongside this, a more detailed examination of the usefulness of the indicator in a cross-country uni- and multi-variate early-warning context would be informative.²⁰

²⁰See, for example, Lo Duca and Peltonen (2011). Preliminary analysis by the authors finds that the NMDI ratio peaked in advance of the stock of household credit in all but one of the countries in our sample in advance of the previous financial crisis, especially where that crisis was more related to a real estate bubble.

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