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Household Consumption and the Housing Net Worth Channel in Ireland

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Abstract: The performance of the Irish economy varied considerably over the period 2002-2019, with a credit-led boom up to 2007 being followed by a sharp fall in economic activity and house prices in the following five years and then a recovery in both output and the housing market. This provides a valuable sample for investigating the relevance of the housing net worth channel to consumption developments. The evidence presented here indicates the channel being active in Ireland during the 2007-2012 downturn with a fall in house prices being associated with a decline in consumption. It does not have an impact outside that downturn. Accordingly, the results add to the international evidence of how an accumulation of household debt and a downturn in house prices has an adverse impact on consumption.

I INTRODUCTION

Since the Great Recession, a focus of macroeconomic research has been on the role that credit developments play in the economic cycle. This is particularly the case for the relationship between consumption and household wealth. Prior to the sharp downturn in economic activity in the late 2000s, studies such as Carroll and Kimball (1996), Case *et al.* (2005), Muellbauer (2007), and Campbell and Cocco (2007) had established that the marginal propensity to consume out of

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household wealth, and in particular housing wealth, had a positive value. The post-Great Recession literature has placed more emphasis on the role household debt played in the effect that changes in wealth had on consumption. In particular, the credit-driven housing net worth (HNW) channel has been shown to have a significant impact on such expenditure, as well as on other macroeconomic variables such as employment (Mian *et al*., 2013; Mian and Sufi, 2014; 2017; 2018).

The HNW channel recognises that when housing is the dominant source of household wealth, mortgage credit availability can influence how that form of wealth affects economic activity and in particular how a fall in house price effects a decline in consumption. Mian *et al.* (2013) estimate the elasticity of consumption with respect to shocks in housing net worth to be between 0.6 and 0.8 during the 2006-2009 downturn in the US economy. They also note that more levered households have a higher marginal propensity to consume and that "elevated private debt burdens are associated with economic downturns" (Mian *et al*., 2013, p.1688). Moreover, the marginal propensity to consume out of housing wealth is highest for durable goods and lowest for necessities such as food.

Mian *et al.* (2013), and other recent studies, such as Dynan (2012), Christelis *et al.* (2015), Le Blanc and Lydon (2019), and Baker (2018), have a cross-sectional focus and observe that differences in indebtedness across households or regions can affect the relationship between consumption and wealth shocks. Whether the relationship varies over time in response to the prevailing credit environment and whether positive or negative housing wealth shocks have differing effects has also been considered of late. Guerrieri and Iacoviello (2017), Hviid and Kuchler (2017) and de Roiste *et al.* (2021) show an asymmetrical impact on consumption depending on whether a positive or negative housing wealth shocks arises. De Roiste *et al.* (2021) emphasise how household indebtedness plays a critical role in this asymmetrical effect occurring. A precautionary savings effect or the credit collateral effect will determine how consumption responds to wealth effects with each dominating at different stages of the housing cycle. In the rising-prices phase of the cycle, the precautionary motive leads households to retain equity gains and consumption does not respond. In contrast, during a downturn in the housing market, the credit collateral effect is prevalent and indebted households reduce their consumption. Jones *et al.* (2018) note that the precautionary savings motive will be stronger when households are uncertain about their liquidity needs, and thus consumption will be more sensitive to credit developments.

This perspective on the relationship between housing wealth, credit developments and consumption points to the experience of the Irish economy over the past 20 years or so as the basis for a case study that may corroborate, or contest, the validity of the HNW channel and the related literature outlined above. As discussed in detail in the next section, Ireland stands out internationally for the variation in credit provision, house prices and housing wealth that it has experienced since the early 2000s. As one of the initial adopters of the euro in 1999, there was

a substantial increase in credit provided to Irish households during the first half of the 2000s.[1] This coincided with a sharp rise in house prices and high output growth rates. This persisted until 2007/2008 when economic conditions deteriorated, and Ireland then experienced a deep recession that lasted until 2012. A feature of that recession was a close to 50 per cent fall in the level of house prices between mid-2007 and end-2012. After 2012, the Irish economy saw a sustained improvement through 2019 with a recovery in house prices arising.

The rise, subsequent fall and then recovery in Irish house prices over the early 2000s to late 2010s period has occurred alongside a somewhat different sequence in credit developments. Rising house prices from 2000 through 2007 were accompanied by an increasing amount of household debt outstanding. The subsequent drop in house prices from 2008 to 2012 took place at the same time as a major interruption to bank lending was occurring. The recovery in house prices and broader economic activity since 2012 has taken place against a backdrop of household deleveraging and prudent lending practices. Housing wealth has had a large share (an average of 75 per cent) of Irish household wealth over the 2002-2019 sample period considered here, and household net wealth is more reliant on households' ownership of residential property compared to other Western economies (Central Statistics Office, 2020). Housing wealth has also been subject to much fluctuation since the early 2000s, reflecting house price and credit developments. These features suggest that Ireland can shed further light on how housing wealth effects and changing borrowing constraints tied to changes in the underlying collateral of the household affect personal consumption.[2]

In this paper, we then consider the impact of the HNW channel on personal consumption in Ireland.[3] In the next section, we review housing market, credit and economic developments since the early 2000s. We highlight how at the time that a sharp downturn in the Irish housing market took effect in 2007, household debt was at a historical high and above prudential norms. Consequently, we would expect *a priori* that changes in housing net wealth during this downturn could have had an impact on household consumption at that time, in line with the findings of Mian *et al.* (2013) for that late-2000s US recession. In Sections III and IV, we then assess the impact of the housing net worth channel on consumption and its components (durables, non-durables, and services) in Ireland during the period Q2 2002 to Q4 2019. We find that the channel has a significant impact on consumption during the 2007-2012 downturn; it exercises no influence outside of the downturn. Section V concludes.

[1] The introduction of the euro had a significant impact on credit provision to EU households with Mian and Sufi (2017) noting that it caused a positive credit supply shock in Europe.

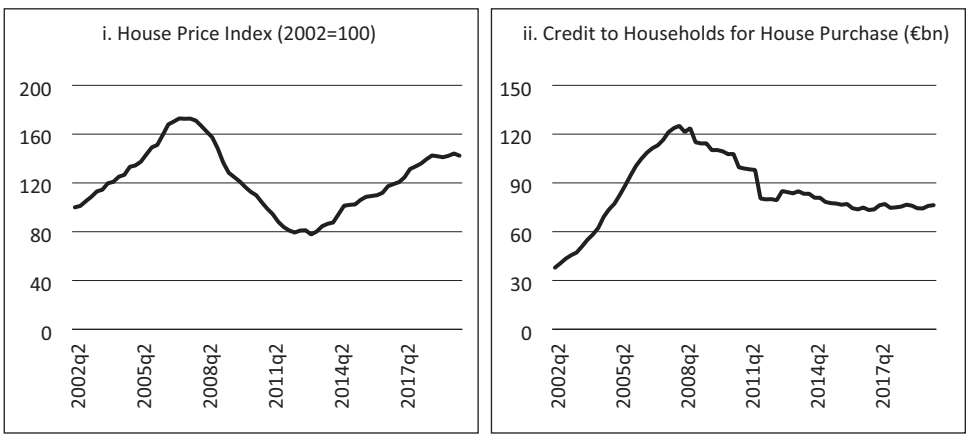
[2] The impact of the HNW channel on labour market developments in Ireland is considered in Cronin and McQuinn (2021a).

[3] A number of previous studies using Irish data have found a significant relationship between consumption and income levels (see McCarthy and McQuinn, 2017a; 2017b); however, these studies did not include the housing net worth channel.

II BACKGROUND

House prices in Ireland began to rise steeply in the early 2000s (Figure 1, panel i) in tandem with a substantial increase in credit provided to households for house purchase (Figure 1, panel ii).[4] This sharp rise in credit reflected both deregulation and liberalisation in Ireland (see Kelly and Everett, 2004) and the Irish retail banks being able to access additional funds from abroad following the adoption of the euro. These developments were a feature of European intermediation more generally with less regulation and greater financial innovation and cross-border lending occurring at that time (Le Leslé, 2012; McCarthy and McQuinn, 2017b). These changes allowed European financial institutions with a surplus of funds to lend to those in deficit. A consequence of the reliance on overseas funding in Ireland was a rise in the ratio of private sector credit to the domestic retail deposit base, to close to 240 per cent by Q3 2008 (Figure 2, panel i). Using household disposable income as a proxy for overall output (given the well-known issues of using Irish GDP for that purpose; see Lane, 2017; FitzGerald, 2018; 2020; and Honohan, 2021 for more on this), panel ii of Figure 2 shows the credit-to-output ratio experiencing a sharp increase through the mid-2000s, reaching a value of 10.2 in Q4 2008. Both the increase in this ratio and the gap that emerged between retail loans and retail deposits left the Irish economy vulnerable to a change in international financial conditions. When such a change occurred in 2007/2008, the vulnerabilities in the Irish financial system led to a steep downturn in economic and housing market

Figure 1: Housing and Mortgage Variables: Q2 2002 – Q4 2019

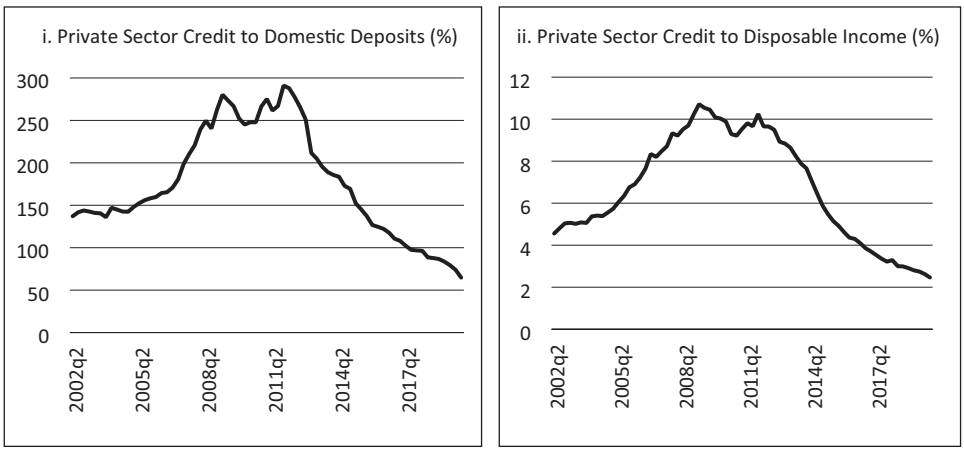


Source: Central Statistics Office; Department of Housing, Planning and Local Government; Central Bank of Ireland.

[4] The sources of all data are outlined in Appendix 1.

performance.[5] As Figure 1 shows, both house prices and credit outstanding to households for house purchase declined sharply from the late 2000s to about 2012. At the same time, there was a substantial bank deleveraging with the ratio of total private sector credit to domestic retail deposits falling.

Figure 2: Credit Market Variables: Q2 2002 – Q4 2019



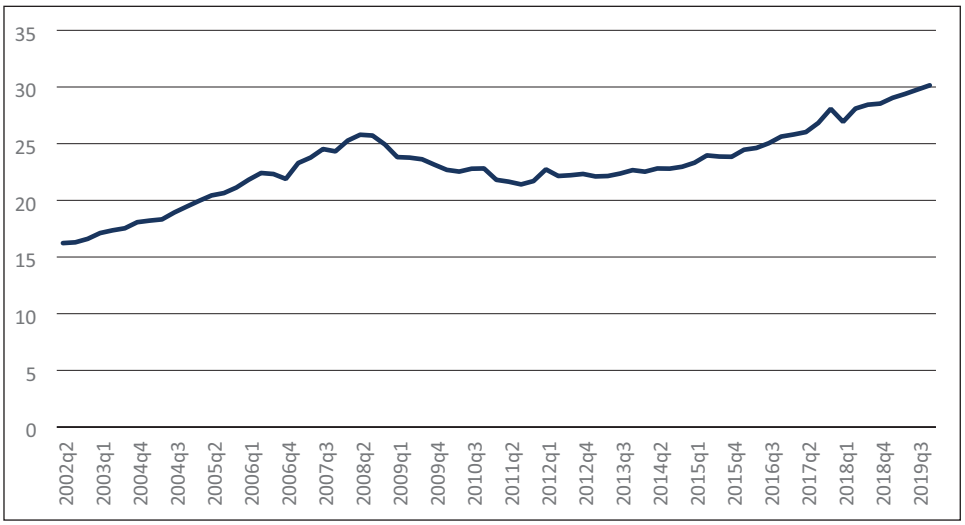
Source: Central Bank of Ireland; Central Statistics Office; authors' calculations.

Figure 3 plots household disposable income during the sample period. It rose steadily through the 2000s before reaching a high value in Q2 2008. Thereafter, in line with the broader performance of the Irish economy, it declined by some 15 per cent to Q3 2011. The Irish economy started to improve after 2012 with household disposable income rising steadily. House prices also began an upward trajectory but remained below mid-2000s levels. This recovery in the Irish economy occurred alongside little change in the value of mortgages outstanding and an ongoing reduction in the Irish retail banks' loans-to-deposits ratio. The ratio of private sector credit to total household disposable income also continued to decline to end-2019.

These three phases of the Irish economic performance from 2002 to 2019 broadly coincide with Antoshin *et al.*'s (2017) chronicle of the relationship between credit growth and economic developments in Europe since the introduction of the euro. They argue that during this period there was a gradual acceleration and boom (1999–2008), bust (2009–2011), and a sluggish recovery (2012–2017), with the earlier boom-bust episodes leading to restricted credit flows from 2012 onwards. Positive economic growth and housing market recovery in recent years coinciding with little new credit arising contrasts with the situation in the 2000s boom. In those

[5] Honohan (2010) takes the view that the scale of the Irish banking crisis that took hold in 2008 was principally owing to domestic determinants with policy failures on the part of the Irish retail banks and government contributing strongly.

Figure 3: Total Household Disposable Income (€ billion): Q2 2002 – Q4 2019



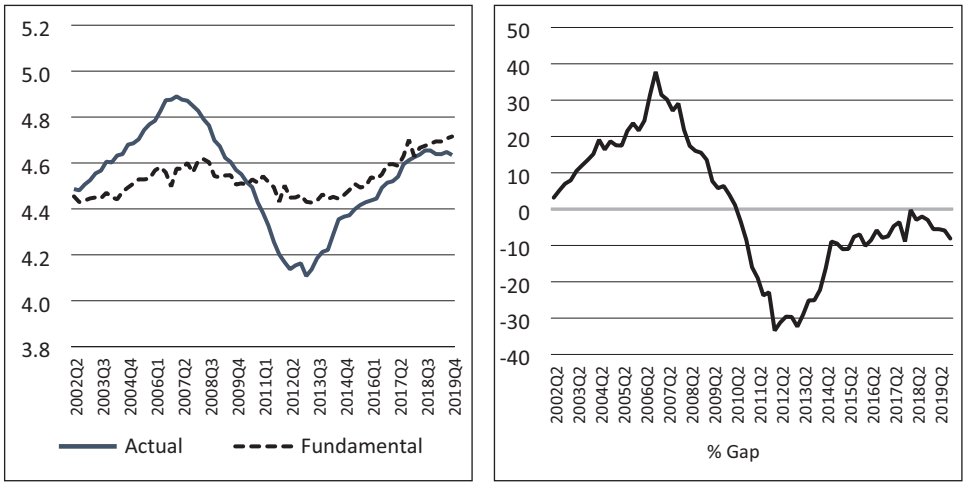
Source: Central Statistics Office.

earlier years, there was a link between credit growth and house price inflation internationally (Tsatsaronis and Zhu, 2004; Goodhart and Hofmann, 2008) and credit and house price booms were closely tied to one another (Cerutti *et al.*, 2017).

The link between credit growth and house price developments in Ireland's boom-bust experience between 2002 and 2012 was particularly acute. Using an inverted housing demand equation also employed by Kelly and McQuinn (2014), Cronin and McQuinn (2021a) provide measures of both actual and fundamental house prices, and the gap between them, in Ireland for the same sample period as is considered here, Q1 2002 – Q4 2019. Those series are plotted in Figure 4. While both were rising, the chart shows an increasing deviation between actual and fundamental prices during the 2000s. By Q4 2007, actual prices were almost 40 per cent above the estimated fundamental price. Subsequently, the drop in observed house prices was much larger than that in the fundamental price. Since 2014, both have moved broadly in line with one another. This sequence supports the development of a bubble in house prices occurring at time when excessive credit growth was happening in Ireland. House price developments have been more closely tied to fundamentals in recent years, a period marked by a lack of growth in household credit.

From the perspective of household wealth developments, the excessive use of credit in the Irish housing market during the early- to mid-2000s would have caused household wealth, and its housing component, to exceed sustainable values. Figure 5 shows both the housing wealth and financial wealth components of household wealth in Ireland. Except for a period between Q4 2011 and Q4 2013, housing wealth has had the greater share of total household wealth. During the

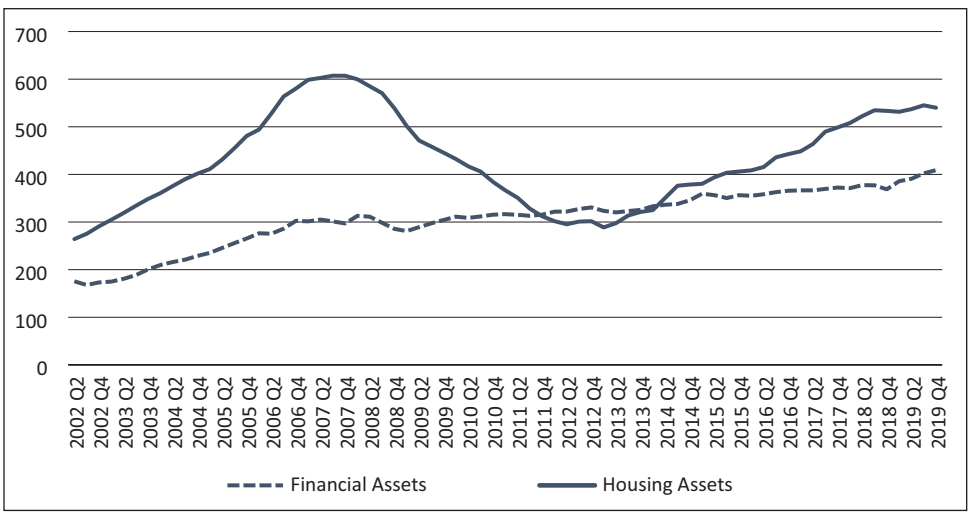
Figure 4: Actual and Fundamental House Price (logs) and Gap (%): Q2 2002 – Q4 2019



Source: Cronin and McQuinn (2021a).

2000s, housing wealth grew more quickly than financial wealth, reflecting house price growth at that time. Similarly, its value also declined as house prices fell between Q2 2007 and Q4 2012. While housing wealth subsequently rose, it, and house prices, did so at a more modest pace than during the 2002-2007 period.

Figure 5: Breakdown of Household Wealth into "Housing" and "Financial" (€ billion): Q2 2002 – Q4 2019



Source: Cronin and McQuinn (2021a).

III ECONOMETRIC ASSESSMENT OF THE CONSUMPTION-HNW RELATIONSHIP IN IRELAND

The link between personal consumption and housing wealth has been highlighted in the economics literature in recent years, most obviously in the housing net worth (HNW)-channel literature. That channel captures the effect on macroeconomic variables, such as consumption, from a shock to total household wealth that arises from changes in house prices. More formally, Mian *et al.* (2013) propose that the change in HNW between period $t-1$and t is captured as follows:

$$\Delta HNW_t = \frac{(\ln(P_t) - \ln(P_{t-1})) * H_{t-1}}{NW_{t-1}} = \frac{\Delta P_t * H_{t-1}}{NW_{t-1}} \quad (1)$$

where P is the house price, H is housing assets, NW is household net worth, and ΔP_t is used to represent $\ln(P_t) - \ln(P_{t-1})$. This variable, where the log change in house prices in t is multiplied by housing's share of household net wealth, H_{t-1}/NW_{t-1}, is intended by Mian *et al.* to emphasise the effect of changes in household balance sheets caused by changes in house prices on variables such as consumption. Net wealth at the end of quarter $t-1$ is defined as

$$NW_{t-1} = S_{t-1} + B_{t-1} + H_{t-1} - D_{t-1}$$

where S, B and D are the household sector's outstanding savings, bond holdings and debt levels, respectively. This captures the total household balance sheet. The Mian and Sufi variable ΔHNW_t then scales the change in house prices ΔP_t by the ratio of housing assets to household net wealth, $\left(\frac{H_{t-1}}{NW_{t-1}}\right)$.

We then examine the effect of changes in housing net worth on consumption in Ireland between Q2 2002 and Q4 2019 by means of the following regression equation:

$$\Delta \log C_t = \alpha + \eta\ \Delta HNW_t + \varepsilon_t \quad (2)$$

where C is total (nominal) personal consumption.

The regression is also estimated for three sub-categories of this aggregate: durables (d), non-durables (n), and services (s).

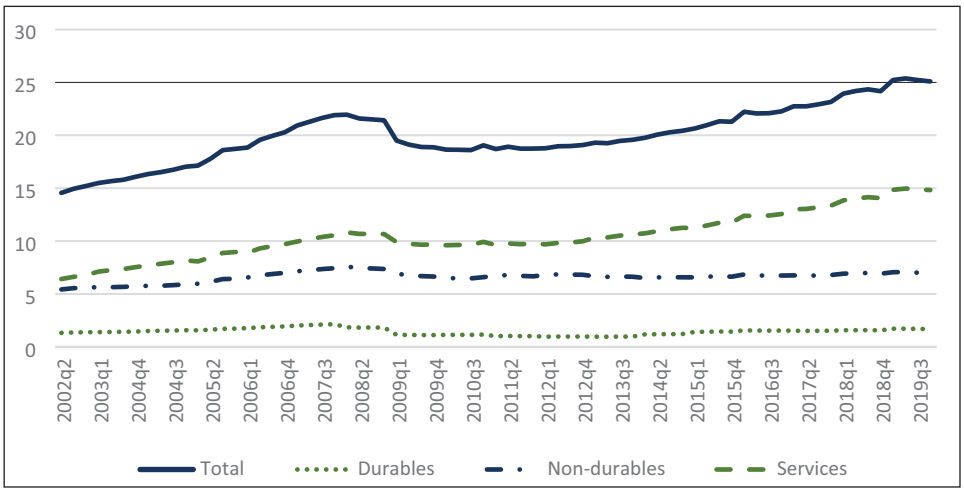
$$\Delta \log C_t^d = \alpha + \eta_d \Delta HNW_t + \varepsilon_t \quad (3)$$

$$\Delta \log C_t^n = \alpha + \eta_n \Delta HNW_t + \varepsilon_t \quad (4)$$

$$\Delta \log C_t^s = \alpha + \eta_s \Delta HNW_t + \varepsilon_t \quad (5)$$

Figure 6 plots consumption and its components on a seasonally-adjusted basis. Total consumption increased through the 2000s until Q1 2008 before declining thereafter as an economic downturn took hold. Among its sub-categories, both non-durables and services also peaked in that quarter, while durables started to decrease in the previous quarter. The drop-off in durables consumption was much larger than in the other two categories during 2008 and 2009. It remained the most depressed category of consumption expenditure for some time, only starting to rise once more in Q1 2014. The decline in the other categories of consumption expenditure was less pronounced. Non-durable consumption started to pick up from Q4 2010 and an improvement in services became apparent during the second half of 2012.

Figure 6: Household Consumption and its Components (€ billion, SA): Q2 2002 – Q4 2019



Source: Central Statistics Office.

The full-sample (Q3 2002 – Q4 2019) estimates of Equations (2) to (5) are reported in column (i) of Tables 1 to 4, respectively. The coefficient on Δ*HNW* is significant in all four cases. The coefficient on Δ*HNW* where the change in total consumption expenditure is the dependent variable is 0.384. The estimated coefficients on Δ*HNW* in the regressions for the three sub-categories of consumption differ somewhat from one another. The coefficient on services, at 0.383, is close to that of total consumption, while that on non-durables is lower at 0.259. The coefficient in the durables regression is much higher than in the other three at 1.094. As noted by Casalis and Krustev (2020), household spending on durable goods is that part of private consumption that is most sensitive to the business cycle. The period 2002–2019 witnessed pronounced fluctuations in economic conditions in Ireland that may have rendered the consumption of durable goods particularly volatile.

As a robustness check, we re-estimated Equations (2) to (5) by augmenting each with three control variables. The first, $Conshare_t$, represents the share of total employment accounted for by the construction sector. The rationale for including it is to control for construction's varying share of employment in Ireland over the sample period, and the potential this has to affect consumption. The other two control variables, the natural log of real household net wealth, ln ($realNW_t$), and the natural log of real total disposable income, ln ($realTDI_t$), capture the overall well-being of the household sector, which could also influence consumption notwithstanding the change in housing net wealth. Column (ii) of each of Tables 1 to 4 indicate these control variables have insignificant coefficients, while the coefficient on ΔHNW_t declines somewhat although it remains statistically significant.

In Appendix 2, we control for potential endogeneity between the dependent and independent variables using an instrumental variable procedure. The coefficient

Table 1: Dependent Variable: Change in Total Household Consumption

	$\Delta RHS_t = \Delta HNW_t$				$\Delta RHS_t = \Delta P_t$			
	(i)	*(ii)*	*(iii)*	*(iv)*	*(v)*	*(vi)*	*(vii)*	*(viii)*
Constant	0.006	0.651	0.011	0.720	0.006	0.755	0.015	0.608
	(3.34)	(1.72)	(3.472)	(1.91)	(3.28)	(2.02)	(4.612)	(1.58)
ΔRHS_t	0.384	0.283	0.122	0.023	0.279	0.192	0.061	0.001
	(5.46)	(3.08)	(0.906)	(0.168)	(5.06)	(2.75)	(0.65)	(0.002)
MDW_{0712}			0.603	0.651			0.511	0.491
			(2.79)	(3.02)			(3.15)	(2.95)
DV_{0712}			0.003	0.005			–0.007	–0.006
			(0.49)	(0.82)			(–1.81)	(–0.91)
$Conshare_t$		–0.016		–0.015		–0.019		–0.021
		(–1.13)		(–1.05)		(–1.33)		(–1.40)
In ($real\ NW_t$)		0.052		0.050		0.060		0.052
		(1.44)		(1.35)		(1.68)		(1.499)
In ($real\ TDI_t$)		–0.102		–0.107		–0.119		–0.099
		(–1.63)		(–1.694)		(–1.91)		(–1.643)
$\overline{R^2}$	0.294	0.299	0.350	0.368	0.263	0.280	0.349	0.347
DW stat	2.10	2.20	2.22	2.42	2.03	2.17	2.246	2.37

Source: Authors' estimations.
Note: t-ratios are in brackets, DW stat is the Durbin-Watson statistic.

Table 2: Dependent Variable: Change in Household Durable Consumption

	$\Delta RHS_t = \Delta HNW_t$				$\Delta RHS_t = \Delta P_t$			
	(i)	*(ii)*	*(iii)*	*(iv)*	*(v)*	*(vi)*	*(vii)*	*(viii)*
Constant	–0.0006	1.497	0.024	1.749	–0.001	1.792	0.029	1.423
	(–0.08)	(0.93)	(1.776)	(1.100)	(–0.07)	(1.12)	(2.011)	(0.879)
ΔRHS_t	1.094	0.890	–0.192	–0.340	0.801	0.615	–0.208	–0.326
	(3.68)	(2.26)	(–0.34)	(–0.57)	(3.49)	(2.06)	(–0.53)	(–0.74)
MDW_{0712}			2.916	2.989			2.088	2.17
			(3.271)	(3.283)			(3.069)	(3.09)
DV_{0712}			0.013	0.021			–0.005	–0.014
			(0.530)	(0.76)			(–0.32)	(–0.47)
$Conshare_t$		–0.071		–0.064		–0.079		–0.075
		(–1.15)		(–1.035)		(–1.29)		(–1.18)
In (*real* NW_t)		0.126		0.111		0.150		0.103
		(0.82)		(0.71)		(0.98)		(0.70)
In (*real* TDI_t)		–0.252		–0.263		–0.299		–0.228
		(–0.94)		(–0.98)		(–1.13)		(–0.89)
$\overline{R^2}$	0.153	0.135	0.251	0.238	0.139	0.124	0.226	0.217
DW stat	2.36	2.40	2.44	2.49	2.33	2.37	2.38	2.46

Source: Authors' estimations.
Note: t-ratios are in brackets, DW stat is the Durbin-Watson statistic.

values are broadly in line with those in Tables 1 to 4. In Appendix 3, we provide results for additional control variables. The results reported in it do not differ materially from those here.

An alternative regressor to ΔHNW_t, and as employed by Mian *et al.* (2013), is its change-in-house price element, ΔP_t, in in the right-hand-side columns of Tables 1 to 4. Columns (v) and (vi) of the tables then are as per columns (i) and (ii) but for the substitution of ΔP_t for ΔHNW_t. The coefficient on ΔP_t is in all cases significant but somewhat lower than the equivalent entries in columns (i) and (ii). In column (v) of Table 1, for example, the regression coefficient is 0.279 compared to that of 0.384 on ΔHNW_t in column (i).[6] The larger coefficients on the ΔHNW_t variable reflect the scaling variable having a value of less than one.

[6] In column (vi) of Table 3, the addition of the control variables renders the coefficient on significant only at the 10 per cent level of significance.

Table 3: Dependent Variable: Change in Household Non-Durable Consumption

	$\Delta RHS_t = \Delta HNW_t$				$\Delta RHS_t = \Delta P_t$			
	(i)	*(ii)*	*(iii)*	*(iv)*	*(v)*	*(vi)*	*(vii)*	*(viii)*
Constant	0.002	0.513	0.001	0.702	0.002	0.590	0.010	0.281
	(1.53)	(1.57)	(0.529)	(2.08)	(1.52)	(1.83)	(3.33)	(0.83)
ΔRHS_t	0.259	0.168	0.262	0.155	0.185	0.109	0.131	0.109
	(4.11)	(2.11)	(2.10)	(1.24)	(3.78)	(1.82)	(1.58)	(1.20)
MDW_{0712}			0.230	0.272			0.228	0.207
			(1.16)	(1.41)			(1.59)	(1.42)
DV_{0712}			0.009	0.011			–0.012	–0.015
			(1.55)	(1.95)			(–3.34)	(–2.45)
$Conshare_t$		–0.004		–0.012		–0.006		–0.018
		(–0.35)		(–0.92)		(–0.54)		(–1.41)
In (*real* NW_t)		0.042		0.062		0.048		0.054
		(1.34)		(1.87)		(1.56)		(1.77)
In (*real* TDI_t)		–0.078		–0.113		–0.091		–0.067
		(–1.45)		(–1.99)		(–1.70)		(–1.27)
$\overline{R^2}$	0.187	0.237	0.198	0.268	0.161	0.225	0.267	0.276
DW stat	1.41	1.63	1.47	1.79	1.371	1.62	1.59	1.78

Source: Authors' estimations.
Note: t-ratios are in brackets, DW stat is the Durbin-Watson statistic.

IV DOES THE *HNW* CHANNEL OPERATE ONLY IN A DOWNTURN?

Cronin and McQuinn (2021a) establish the housing net worth channel's influence on employment in Ireland occurring solely during the 2007-2012 downturn. As discussed above, the international literature also provides evidence that rising housing wealth – such as occurs when house prices are increasing and loose collateral constraints prevail – has little effect on consumption, but a decline in such wealth, including when there are tightening credit constraints, has a negative effect (Guerrieri and Iacoviello, 2017; De Roiste *et al.*, 2021). This suggests assigning a dummy variable, DV_{0712}, to have a value of one for the quarters from Q2 2007 to Q4 2012, and zero otherwise. In all bar three of those 23 quarters, the ΔHNW_t has

Table 4: Dependent Variable: Change in Household Services Consumption

	$\Delta RHS_t = \Delta HNW_t$				$\Delta RHS_t = \Delta P_t$			
	(i)	*(ii)*	*(iii)*	*(iv)*	*(v)*	*(vi)*	*(vii)*	*(viii)*
Constant	0.010	0.660	0.015	0.692	0.010	0.759	0.019	0.729
	(5.03)	(1.58)	(4.15)	(1.63)	(4.95)	(1.84)	(5.06)	(1.69)
ΔRHS_t	0.383	0.290	0.136	0.027	0.278	0.199	0.070	–0.013
	(4.91)	(2.84)	(0.90)	(0.17)	(4.59)	(2.58)	(0.66)	(–0.11)
MDW_{0712}			0.542	0.610			0.488	0.455
			(2.23)	(2.51)			(2.68)	(2.43)
DV_{0712}			0.002	0.003			–0.006	–0.001
			(0.28)	(0.43)			(–1.51)	(–0.06)
$Conshare_t$		–0.013		–0.011		–0.016		–0.013
		(–0.83)		(–0.65)		(–1.01)		(–0.77)
In (*real* NW_t)		0.041		0.035		0.049		0.037
		(1.04)		(0.85)		(1.24)		(0.96)
In (*real* TDI_t)		–0.095		–0.093		–0.110		–0.099
		(–1.37)		(–1.30)		(–1.61)		(–1.46)
$\overline{R^2}$	0.251	0.254	0.284	0.300	0.225	0.239	0.288	0.286
DW stat	2.33	2.42	2.46	2.64	2.28	2.39	2.51	2.60

Source: Authors' estimations.
Note: t-ratios are in brackets, DW stat is the Durbin-Watson statistic.

a negative value, reflecting falling house prices in the economic and housing slump of that period. Such a downturn is also the basis for Mian *et al.*'s (2013) assessment of the housing net worth channel in the US occurs, i.e. that the imbalances caused by a housing boom would subsequently see the decline in housing net worth values adversely affect consumption. Consequently, Equations (2) to (5) are re-specified and estimated as:

$$\Delta \log C_t = \alpha + \eta \Delta HNW + \theta(DV_{0712} * \Delta HNW_t) + \delta DV_{0712} + \varepsilon_t \quad (6)$$

$$\Delta \log C_t^d = \alpha + \eta_d \Delta HNW_t + \theta_d(DV_{0712} * \Delta HNW_t) + \delta_d DV_{0712} + \varepsilon_t \quad (7)$$

$$\Delta \log C_t^n = \alpha + \eta_n \Delta HNW_t + \theta_n(DV_{0712} * \Delta HNW_t) + \delta_n DV_{0712} + \varepsilon_t \quad (8)$$

$$\Delta \log C_t^s = \alpha + \eta_s \Delta HNW_t + \theta_s(DV_{0712} * \Delta HNW_t) + \delta_s DV_{0712} + \varepsilon_t \quad (9)$$

The results of the estimation of these regressions are found in column (iii) and (iv), where the multiplicative dummy variable is recorded as MDV_{0712}, the dummy variable as DV_{0712}, and the control variables are added in as per column (ii), of each of Tables 1 to 4.[7] Apart from some entries in Table 3, the dummy variable is insignificant throughout. With the exception of Table 3, the η coefficient in the other tables is now insignificant and the θ coefficient highly significant with a larger positive coefficient than is the case for η in columns (i) and (ii). The impact of changes in housing net worth on spending then arises solely during the 2007-2012 downturn for total consumption, durables and services. The same qualitative results arise across those tables when ΔP_t is used instead of ΔHNW_t in columns (vii) and (viii) of each table.

Consequently, the empirical evidence on the impact of housing net wealth on consumption in Ireland seems to tally broadly with what is reported elsewhere. The rationale offered in those studies (such as Hviid and Kuchler, 2017; De Roiste *et al.*, 2021) as to why an asymmetrical effect arises over the economic cycle also seems appropriate in the case of Ireland, given the description of housing and credit developments since 2000. It is that consumption (and savings) behaviour is influenced by either a precautionary savings effect or a collateral effect, and that one will prevail over the other at different stages of the housing cycle. The precautionary effect dominates during the upside of the cycle with households maintaining, rather than spending, their capital gains from the rise in house prices. When the cycle changes, the collateral effect has greater influence with over-indebted households being forced to constrain their spending. The results in the tables indicate that this effect worked strongly on services and, in particular, durables during the 2007-2012 housing market downturn in Ireland. Using US data, Kaplan *et al.* (2020) find that both initial housing exposure and initial leverage have little effect on non-durable expenditure.

V CONCLUSION

The Irish economy over the period 2002-2019 presents as a particularly interesting test case for assessing the impact of changes in housing net worth on consumption. Our results indicate that an accumulation of household debt and a decline in house prices had a significant impact on consumption. The housing net worth channel – the basis for examining the consumption-wealth relationship here – meant that the fall in house prices, and an attendant credit tightening during the 2007-2012 downturn, led to lower consumption. The channel had a more pronounced impact on durables than services. The channel can be adjudged not to have had an impact on consumption in expansionary or normal times.

[7] In columns of (vii) and (viii) of the tables, the multiplicative dummy variable is $DV_{0712} * \Delta P_t$.

These results are consistent with a decline in housing net wealth causing households to reduce spending due to credit constraints, as espoused by Mian *et al.* (2013) and supported by Cronin and McQuinn (2021b). The econometric evidence highlights the dangers of credit-led economic growth and policies that result in unsustainable expansions in household balance sheets. The results indicate that the channel has been inactive in its influence on consumption in Ireland since the economic recovery took effect in 2014. More importantly, there is no evidence of credit-led output growth in Ireland in recent years with substantial deleveraging occurring within the economy, including in the household sector, and the gap between actual and fundamental house prices remaining narrow by historical comparison.[8] Consequently, Ireland is better positioned now to cope with any fall in house prices that might materialise over the short- to medium term than was the case in the late 2000s.

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[8] For further details, see Cronin and McQuinn (2021a).

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APPENDIX 1: DATA SOURCES

Variable	*Source*
House prices[9]	Central Statistics Office; Department of Housing, Planning and Local Government[10]
Total value of housing assets	Central Bank of Ireland
Household net worth	Central Bank of Ireland
Credit and deposit data	Central Bank of Ireland
Household disposable income	Central Statistics Office
Consumer price index	Central Statistics Office
Total consumption and components	Central Statistics Office
Euribor interest rate	ECB Statistical Data Warehouse
Mortgage interest rate	Central Bank of Ireland
Consumer sentiment indicator	European Union (Newcronos)
Stock of mortgage credit	Central Bank of Ireland
Unemployment rate	Central Statistics Office

[9] House prices are expressed as an index, with Q1 1995 having a value of 100, and the mortgage interest rate is expressed in percentage points.

[10] We take the latest price level from the Department of Housing, Planning and Local Government (see https://www.housing.gov.ie/statistics for details) and we back-cast this with the official house price index from the Central Statistics Office.

APPENDIX 2: CONTROLLING FOR POSSIBLE ENDOGENEITY

It is important to account for potential endogeneity in the estimated relationships using instrumental variables. As noted by Mian *et al.* (2013), a single source of variation, which explains both house price movements and leverage accumulated by households, is required in considering this issue. Such a source of variation, however, must be largely orthogonal to other variables typically considered endogenous in terms of house price movements. In the context of the Irish residential market, we consider the mortgage interest rate as an appropriate instrument. Since the adoption of the euro, monetary policy and the setting of policy rates in the Irish economy is determined by decisions taken at the euro area level. Interest rates within the euro area are set by the European Central Bank (ECB) by reference to macroeconomic conditions within the euro area as a whole. Over the period covered here, Q2 2002 – Q4 2019, Irish economic performance typically differed from that of the larger euro area economies such as Germany, France and Italy. Therefore, variations in euro area interest rates can be regarded as being somewhat exogenous to Irish macroeconomic variables.

Over the period Q2 2002 to Q4 2019, ECB policy rates generally followed a persistent, downward path. The Euribor rate is based on the average interest rates at which a large panel of European banks borrow funds from one another and is considered to be the most important reference rate in the European money market. As noted by Honohan (2010), amongst others, the presence of such low interest rates in the euro area had a knock-on effect on residential mortgage rates in Ireland significantly fuelling domestic housing demand in the period up to 2008. Therefore, we choose the residential mortgage interest rate as the instrumental variable in what follows.[11] The Euribor and the domestic residential mortgage rate are plotted in Figure A.1. We also include a lag of the change in housing net worth variable as a second instrument.

In columns (ii), (iv), (vi) and (viii) of Table A.1, we present the results of the IV estimation of Equations (2) to (5), along with the results of a χ^2 over-identification test, for each of the four consumption categories. The OLS regression estimates of those equations, as contained in columns (i) of Tables 1 to 4, are included for comparison in the other columns. As can be seen from the previous tables, the OLS and IV coefficients are very similar in size and are all significant. In all bar the case of non-durables, the IV estimates are marginally larger than the OLS ones; this is also the case for similar estimates in Kaplan *et al.* (2020) and Mian *et al.* (2013). Kaplan *et al.* (2020) provide reasons why this could be the case; one possible reason is that the idiosyncratic variation in house prices is more transitory than the variation in the common component of house prices which is being isolated by the instrument.

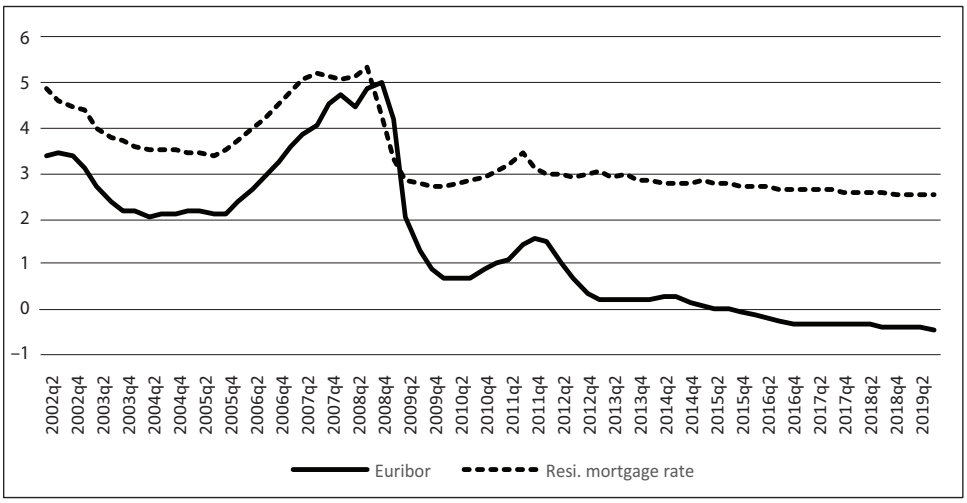
[11] As published by the Central Bank of Ireland. See https://www.centralbank.ie/statistics/data-and-analysis/credit-and-banking-statistics/retail-interest-rates for details.

Table A.1: Comparison of OLS and IV Estimations

	(i)	*(ii)*	*(iii)*	*(iv)*	*(v)*	*(vi)*	*(vii)*	*(viii)*
Expenditure category	*Total*	*Total*	*Durable*	*Durable*	*Non-durables*	*Non-durables*	*Services*	*Services*
Estimation procedure	*OLS*	*IV*	*OLS*	*IV*	*OLS*	*IV*	*OLS*	*IV*
Constant	0.006	0.006	–0.006	–0.001	0.002	0.002	0.010	0.010
	(3.34)	(3.10)	(–0.08)	(–0.17)	(1.53)	(1.389)	(5.03)	(4.787)
ΔHNW_t	0.384	0.421	1.094	1.219	0.259	0.249	0.383	0.409
	(5.46)	(4.49)	(3.68)	(3.06)	(4.11)	(2.993)	(4.91)	(3.949)
χ^2		1.221		0.087		4.914		2.056

Source: Authors' estimations.

Figure A.1: Euribor and Residential Mortgage Interest Rate (%): Q2 2002 – Q4 2019



Source: European Central Bank Statistical Data Warehouse; Central Bank of Ireland.

In Table A.2, we include the mortgage interest rate ($pcred_t$) in the standard OLS models (with those control variables used in Tables 1 to 4 also included) for consumption regressions to ensure that it is not a significant determinant of consumption, i.e. that it is orthogonal to the change in consumption. The table shows the coefficients on $pcred_t$ to be insignificant and the coefficients on ΔHNW_t being broadly unchanged from Table 1.

Table A.2: Estimates with the Residential Mortgage Rate Included

Expenditure category	*Total*	*Durables*	*Non-durables*	*Services*
Estimation procedure	*OLS*	*OLS*	*OLS*	*OLS*
Constant	0.583	1.064	0.241	0.500
	(1.518)	(0.622)	(0.695)	(1.139)
ΔHNW_t	0.298	1.054	0.218	0.341
	(3.19)	(2.708)	(2.764)	(3.409)
$Conshare_t$	–0.024	–0.660	0.015	–0.188
	(–1.45)	(–0.994)	(0.112)	(–1.103)
ln ($real\ NW_t$)	0.055	0.090	0.020	0.035
	(1.53)	(0.589)	(–0.728)	(0.900)
ln ($real\ TDI_t$)	–0.101	–0.160	–0.037	–0.071
	(–1.625)	(–0.633)	(–0.727)	(–1.098)
$pcred_t$	0.003	0.012	0.002	0.007
	(0.957)	(0.613)	(0.498)	(1.290)
$\overline{R^2}$	0.297	0.131	0.238	0.264
DW stat	2.244	2.410	1.603	2.494

Source: Authors' estimations.
Note: t-ratios are in brackets, DW stat is the Durbin-Watson statistic.

APPENDIX 3: ADDITIONAL CONTROL VARIABLES

In this appendix, we investigate the robustness of the results in the main body of the paper by the inclusion of other control variables in regression Equation (1). We substitute the change in the log of disposable income $d \ln (real\ TDI_t)$ for $\ln (real\ TDI_t)$. We do not substitute the change in the log of household net wealth for $\ln (real\ NW_t)$ as that first difference is highly correlated with both ΔHNW_t and ΔP_t (correlation values of 0.81 and 0.82, respectively). This is unsurprising as the latter exercise considerable influence over changes in household net wealth in Ireland. We then add the log change in a consumer sentiment variable $(d \ln (csi)_t)$, the change in the unemployment rate $(d(URX_t)$, and the log change in the mortgage stock $(d \ln (mstk_t)$.[12,13] In columns (i) and (iii), we introduce $d \ln (real\ TDI_t)$ and then add the aforementioned three additional control variables in columns (ii) and (iv). As Table A.3 shows, these additional variables do not materially affect the coefficients on the housing net worth and house price variables, which are similar in value to those in Table 1.

As a final robustness test, and to consider any dynamics in the relationship between consumption and housing net worth, we add four lagged values of ΔHNW and ΔP variables to the respective regressions for the change in total consumption expenditure. In both columns of Table A.4, it is the coefficients of the contemporaneous value of the household net worth and house price variables alone that are significant, with values similar to those in Table 1. This supports our initial specification.[14]

[12] The change in the unemployment rate is used in consumption studies using aggregate data and can serve as a proxy for income uncertainty (Aron *et al.*, 2012).

[13] The results are the same if the sentiment indicator is included in levels.

[14] Both left-hand-side and right-hand-side variables are specified in nominal terms in the HNW literature. Using inflation-adjusted variables does not affect the qualitative results here.

Table A.3: Dependent Variable: Change in Total Household Consumption

	(i)	*(ii)*	*(iii)*	*(iv)*
Constant	0.004	0.040	0.007	0.041
	(0.061)	(0.607)	(0.099)	(0.601)
ΔHNW_t	0.424	0.274		
	(6.165)	(2.862)		
ΔP_t			0.305	0.171
			(5.583)	(2.378)
$Conshare_t$	0.068	0.157	0.075	0.166
	(1.369)	(2.627)	(1.444)	(2.736)
ln ($real\ NW_t$)	–0.001	–0.007	–0.001	–0.008
	(–0.043)	(–0.701)	(–0.094)	(–0.708)
d ln ($real\ TDI_t$)	–0.249	–0.206	–0.246	–0.199
	(–2.782)	(–2.473)	(–2.659)	(–2.339)
d ln$(csi)_t$		–0.056		–0.056
		(–1.966)		(–1.948)
d (URX_t)		–0.014		–0.016
		(–3.248)		(–3.738)
d ln$(mstk_t)$		–0.038		–0.028
		(–0.754)		(–0.535)
$\overline{R^2}$	0.364	0.460	0.319	0.440
DW stat	2.167	2.394	2.062	2.377

Source: Authors' estimations.
Note: t-ratios are in brackets, DW stat is the Durbin-Watson statistic.

Table A.4: Dependent Variable: Change in Total Household Consumption

	(i)	*(ii)*
	$\Delta RHS_t = \Delta HNW_t$	$\Delta RHS_t = \Delta P_t$
Constant	0.006	0.006
	(3.172)	(2.870)
ΔRHS_t	0.303	0.201
	(2.482)	(2.130)
ΔRHS_{t-1}	0.029	0.024
	(0.206)	(0.225)
ΔRHS_{t-2}	0.073	0.065
	(0.536)	(0.629)
ΔRHS_{t-3}	0.142	0.109
	(1.022)	(1.031)
ΔRHS_{t-4}	–0.109	–0.075
	(–0.900)	(–0.799)
$\overline{R^2}$	0.296	0.255
DW	2.187	2.094

Source: Authors' estimations.
Note: t-ratios are in brackets, DW stat is the Durbin-Watson statistic.