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Fiscal Policy as an Anchor in Household Debt Cycles: Evidence from Spain

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Abstract
This paper examines the relationship between Spanish GDP and household debt from a business cycle perspective, with a particular focus on the role of government spending. According to Minsky's Financial Instability Hypothesis (FIH), an over-indebted economy becomes highly vulnerable to exogenous shocks. Using a Vector Error Correction Model (VECM) that includes public expenditure, investment and household net worth as control variables for Spain over the period 1999-2017, the findings indicate that although the expansion of household debt favoured economic growth, there is not enough evidence to argue for a balance between household debt and GDP. Instead, while household debt bears much of the short-term adjustment toward GDP's long-run equilibrium, government expenditure emerges as the key determinant of the long-run equilibrium. Household debt mainly operates through short-run and error-correction channels, underscoring the importance of countercyclical fiscal policy as a key buffer during periods of household deleveraging.

Keywords: Household indebtedness, Economic growth, Minsky hypothesis, Government, Spain

JEL classification: C32, D14, E32, E44, O47

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1. Introduction

Over the past three decades, household indebtedness has taken centre stage in debates on macroeconomic stability and growth (IMF, 2017). Recent evidence for Spain shows that the composition and distribution of debt shape the sensitivity of consumption and residential investment to income and interest-rate shocks, as well as system-wide risks stemming from debt-service stress (ECB, 2022; European Commission, 2023a, 2023b; Banco de España, 2024; Greenspan, 2004). Micro-based studies using household finance surveys document that highly

leveraged households exhibit nonlinear consumption dynamics in downturns, consistent with debt overhang and tighter financial constraints (Sala & Trivín, 2024; Martín-Legendre, 2024). At the macro level, private leverage conditions fiscal multipliers and the transmission of monetary policy, suggesting that both the financial cycle and prevailing indebtedness shape policy effectiveness (Kim, 2023; OECD, 2025).

The Spanish economy enjoyed considerable prosperity from the beginning of the 21st century, especially during the period 1997-2007. At that time, economic growth was driven largely by rising household demand for residential investment and consumption of both perishable and durable goods. However, much of this spending was financed through bank debt, and when the great economic crisis began in 2007, this growth model became unsustainable.

Specifically, in 2007, the debt ratioreached 151% of household disposable income (IMF, 2017), unprecedented in Spain. This was driven by three simultaneous factors: (i) low interest rates at the start of the Economic and Monetary Union (EMU), which made it easier for households to access "cheap" credit (Estrada et al., 2009; García-Herrero & Fernández de Lis, 2008); (ii) intense competition among banks to attract new customers (Díaz-Serrano, 2015; Gual, 2009); and (iii) weakness in financial regulation and banking supervision by the monetary authorities (Baudino et al., 2023; Moral Moral, 2014). These developments fuelled a sharp rise in house prices, so households had to take on ever-higher levels of debt simply to purchase comparable housing assets and sustain the same level of real investment. More debt led to higher debt servicing, which in turn weakened future demand. When the housing bubble eventually burst - marked by market saturation and rising interest rates - GDP growth and employment began to decline due to insufficient effective demand. At the same time, households' forced savings for debt repayment were no longer offset by new borrowing, deepening the downturn (Javaloyes, 2018).

This slowdown in GDP growth, especially in the construction sector, made severe deleveraging necessary to reduce household balance sheets to reasonable levels. This, in turn, led to a tightening of credit conditions: on the demand side, households borrowed less as their job prospects worsened, reducing economic activity and the housing market in particular. On the supply side, banks restricted credit as the creditworthiness of prospective borrowers worsened (Febrero & Dejuán, 2009). This downward trend in indebtedness continued throughout the financial crisis, due to the reduction in consumer credit and house purchases. Nevertheless, mortgages continued to be the main factor of indebtedness for Spanish households, accounting for 76% of the total after the Great Recession (IMF, 2017).

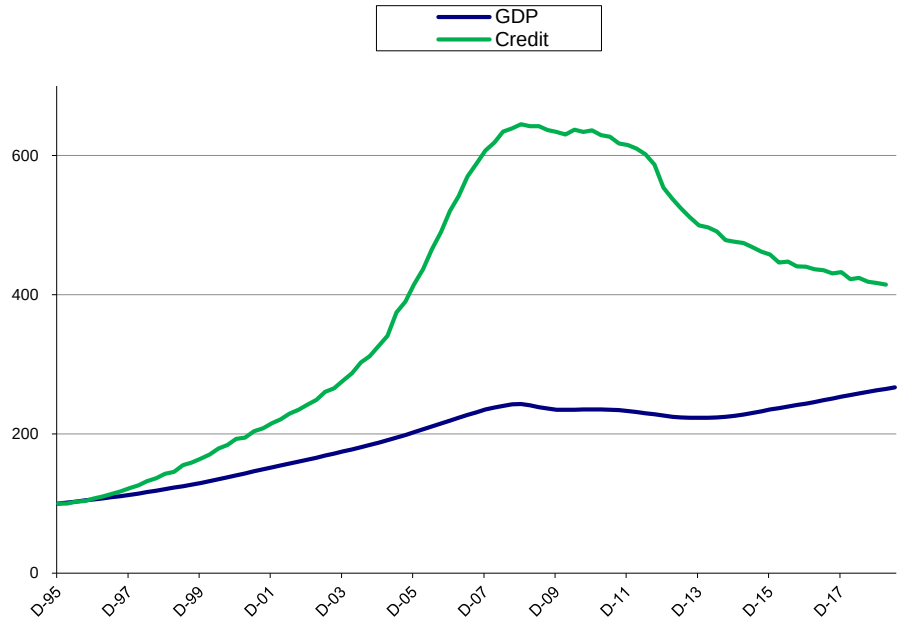
These credit boom-burst experiences of the early 21st century showed that the financial system – especially commercial banks with their capacity to create credit – plays a central role in economic cycles, supporting views such as those of (Werner, 2005) over the neoclassical "School of Rational Expectations," which treats cycles as exogenous.

The post-Keynesian economist Hyman P. Minsky (1975, 1986) through his well-known "financial instability hypothesis" (FIH) provides an excellent approach to the forces behind these endogenous cycles. Minsky argues that economic booms sow the seeds of future financial crashes and subsequent economic recessions. During prolonged expansions, balance-sheet structures transition from "hedge" to "speculative" and "Ponzi" financing, heightening system fragility and the probability of abrupt adjustments. Thus, in periods of prosperity, banks become more confident and relax credit conditions for firms and households in the form of lower interest rates, more flexible collateral requirements and longer repayment maturity periods. A similar behavioural mechanism was formalized more recently by Peón et al. (2015a, 2015b), who show that banks' bounded rationality and overly optimistic beliefs during booms reinforce credit expansion and amplify the financial cycle. Thus, while credit expansion can foster short-term economic growth, the subsequent over-indebtedness combined with increasing speculative financing can make the

financial system vulnerable to any external shocks, ending in a prolonged crisis (Taylor & O'Conell, 1985; Asada, 2001). Recent econometric research evaluates these mechanisms with sophisticated methods and higher-frequency data, finding support for Minskyan dynamics in contemporary credit-activity interactions (Phan, 2024).

Spain offers an interesting case study. Credit to households from 1999 to 2017 more than doubled relative to income in the 2000s (Figure 1). This fostered economic growth via housing investment and consumption until the 2008 bust triggered a long deleveraging and demand shortfall.

Figure 1 - Credit to households and firms. Spain, 1996–2017 (1996 base = 100)



Source: Peón & Guntín (2021)

Compared to other countries, such as the U.S, Spain's run-up was less about subprime securitization and more about bank-mediated credit with full-recourse, variable-rate loans. When interest rates reset and jobs vanished in a construction-heavy economy, defaults and unemployment surged despite relatively lower financial engineering. Besides, the policy response also differed: the U.S. combined faster bank recapitalization with earlier and larger fiscal and monetary support, which helped households to recover sooner and growth to rebound more quickly. By contrast, in Minsky's terms, Spanish households shifted from "hedge" to "speculative" financing as prices rose, and were forced back toward balance-sheet repair after the shock. Public spending briefly played the stabilizer role with fiscal stimulus in 2008 and 2009, but was later constraint by euro-area fiscal rules and sovereign-stress austerity, muting the countercyclical buffer and prolonging deleveraging.

As a result, key questions resurface about how the Spanish household credit cycle interacts with aggregate demand, financial vulnerability, fiscal policy and the likelihood of destabilizing episodes in the spirit of Minsky's FIH. Although Minsky extensively addressed the role of institutions and economic policy, some critics point out that the policy frameworks derived from FIH often become too generic (Shefrin, 2016). These criticisms point out that FIH focuses excessively on private debt while paying less attention to fiscal stimuli such as increased public spending or rising public debt (Ninomiya, 2022). Based on this, an important question to be addressed in this paper is whether Minsky's hypothesis provides a useful framework for incorporating these elements of the public sphere into the theoretical model.

Consequently, this paper seeks to analyse how the expansion of household credit may have affected the real economy during the period 1999-2017. The methodology employs Johansen cointegration techniques and a Vector Error-Correction Model (VECM), with public spending, business investment and household/non-profit net worth as control variables. special attention is given to the role of government spending in shaping the macro-financial nexus between household indebtedness and economic activity. Motivated by theories that link leverage cycles to business-cycle amplification and by FIH, the analysis also explores whether fiscal policy anchors long-run output while moderating the short-run effects of household debt.

Besides the relationship between household indebtedness and economic growth, this analysis addresses three questions:

(i) Does public spending form part of the long-run equilibrium relationship with GDP, over and above the effect of household debt?

(ii) How do error-correction dynamics allocate adjustment burdens across private balance sheets and output?

(iii) Are short-run interactions consistent with a fiscal stabilizer that cushions deleveraging?

The results found robust evidence that government expenditure is part of the cointegrating relationship with GDP, whereas household debt primarily influences short-run dynamics and the speed of adjustment. Thus, the contributions of this paper draws policy implications for countercyclical fiscal design during deleveraging episodes.

This paper contributes to the literature on household debt and macroeconomic performance by placing fiscal policy at the core of the debt–growth relationship. Using quarterly Spanish data (1999–2017) and a Johansen cointegration framework estimated through a VECM, we distinguish between long-run equilibrium forces and short-run adjustment dynamics in the household debt cycle. While existing studies often emphasize private leverage as the primary driver of macro-financial instability, our results show that government expenditure is a key determinant of the long-run equilibrium with GDP, whereas household debt operates mainly through short-run and error-correction channels. By explicitly controlling for public spending, private investment, and household net worth, we provide a cleaner identification of the balance-sheet and demand mechanisms and derive policy implications highlighting countercyclical fiscal policy as an anchor and buffer during household deleveraging episodes.

Following this introduction, this paper is organised around the following sections. Section 2 presents a literature review of the existing literature on the relationship between household indebtedness and economic growth. Section 3 describes the data used and introduces the formal theoretical model. Section 4 presents the results of the model based on the Minsky's FIH. Finally, a concluding section summarises the main contributions of the paper.

2. Literature review

The real business cycle (RBC) and dynamic stochastic general equilibrium (DSGE) in macroeconomic theories model the economy as if it were composed of a single optimizing household and firm reacting efficiently to real shocks, such as changes in technology or preferences (Kydland & Prescott, 1982; King & Plosser, 1984; Woodford, 2003). Within this framework, money and finance are treated as mere "nominal veils" over real activity, neutral in both the short and long run, and fluctuations are interpreted as equilibrium responses to exogenous real disturbances. Consequently, these models exclude any role for endogenous financial instability or crisis dynamics. After the Great Recession, mainstream macroeconomics began incorporating financial frictions and heterogeneity through extensions such as DSGE models with credit

constraints and Heterogeneous-Agent New Keynesian (HANK) models (Gertler & Kiyotaki, 2010; Kaplan et al., 2018). Although these revisions introduce mechanisms like the financial accelerator and distributional effects of monetary policy, they still operate largely within a rational-expectations equilibrium framework (Bernanke et al., 1999).

In contrast, Minsky's FIH presents a fundamentally different, non-equilibrium perspective: financial systems evolve endogenously toward fragility because periods of stability encourage risk-taking, leverage, and speculative behaviour, culminating in crises driven by the transition from hedge to speculative and Ponzi finance. Whereas RBC and DSGE models treat finance as a passive backdrop, Minsky's framework sees it as the central driver of macroeconomic dynamics, historical, institutional and inherently unstable. Some recent models attempt to merge Minskyan insights with DSGE or agent-based structures, but Minsky's vision remains conceptually distinct from the equilibrium-based representative-agent tradition. Thus, the FIH anticipates two key empirical regularities: on the one hand, debt-financed demand supports activity in the short-run; on the other hand, rising leverage and debt-service burdens erode future demand, amplifying downturns once credit conditions tighten (Nikolaidi & Stockhammer, 2017).

A large empirical literature links private credit, particularly household debt, to the amplitude of business cycles and the incidence of crisis (Schularick & Taylor, 2012; Eichengreen & Mitchener, 2003). Credit booms predict subsequent macroeconomic underperformance: beyond leverage thresholds, the marginal effect of debt on growth turns negative as debt overhang and balance-sheet repair depress demand (Borio, 2014; Mian, Sufi, & Verner, 2016; Lombardi, Mohanty, & Shim, 2017; Barbaglia, Manzan, & Tosetti, 2025). At the micro level, highly indebted households display stronger consumption sensitivity to income and interest-rate shocks, consistent with binding financial constraints and wealth-effect channels (Iacoviello, 2008; Flodén et al., 2021; Andersen, Duus, & Jensen, 2016; Sala & Trivín, 2024). At the macro level, these micro frictions translate into larger spending cuts in downturns, sharper housing corrections, and more pronounced multiplier effects when credit conditions tighten (Cynamon & Fazzari, 2016, 2017; Bezemer & Zhang, 2016; Bezemer et al., 2019). This duality, short-run stimulus versus longer-run drag, maps closely to the FIH and motivates models capable of distinguishing short- and long-run relationships, such as VAR/VECM frameworks (Perraton, 2016; Borio, 2014).

Despite Minsky's emphasis on institutions and policy, empirical studies often underplay fiscal dynamics. Government spending can shape both the steady state and the propagation of shocks through three channels. First, aggregate-demand effects in the sense of automatic stabilizers and discretionary outlays that affect incomes directly (Auerbach & Feenberg, 2000; Blanchard & Perotti, 2002; McKay & Reis, 2016). Second, expectations and crowding-in/out via public investment and stabilization that influence firms' and households' perceived income risk (Auerbach & Gorodnichenko, 2012; Nakamura & Steinsson, 2014; Ramey & Zubairy, 2018). Third, balance-sheet effects through taxes and transfers that alter disposable income, debt-service capacity, and net worth (Johnson et al., 2006; Parker et al., 2013; Mian et al., 2013). In economies with high household leverage, these channels interact with credit constraints and condition the effectiveness of multipliers and the recovery path (Eggertsson & Krugman, 2012; Bernardini & Peersman, 2018). Therefore, if fiscal variables are omitted, part of the impact of the fiscal stance may be wrongly attributed to household debt, which biases both long-run cointegration estimates and short-run dynamics (Blanchard & Perotti, 2002; Auerbach & Gorodnichenko, 2012). The inclusion of government spending as a core control explicitly addresses this identification issue and aligns with recent work showing that private leverage affects the size of fiscal multipliers and the speed of balance-sheet repair (Bernardini & Peersman, 2018; Mian et al., 2013; Nakamura & Steinsson, 2014). Household net worth is also central to understand how leverage translates into real outcomes (Kiyotaki & Moore, 1997; Iacoviello, 2005). Through collateral and wealth effects, asset-price swings alter borrowing capacity and consumption, making household net worth both a driver

and an outcome of debt-cycle dynamics (Campbell & Cocco, 2007; Mian et al., 2013). In addition, business investment transmits household shocks via accelerator mechanisms and financing costs: when deleveraging depresses demand, firms cut capital expenditures, deepening the downturn (Bernanke et al., 1999; Gilchrist & Zakrajšek, 2012). Controlling for household net worth and business investment in a VECM helps isolate the balance-sheet channel of households form the capital-accumulation channel, reducing omitted-variables bias in both the cointegrating relation and short-run dynamics (Johansen, 1991).

Prior studies for the U.S. and other advanced economies find positive short-run links from household credit to activity via consumption and residential investment, and negative long-run relationships between leverage and output once debt-service burdens accumulate (Palley, 1994; Kim, 2016; Mian et al., 2013; Jordà et al., 2013; Cecchetti et al., 2011). In this scenario, VECM specifications are especially useful when variables are non-stationary yet cointegrated, allowing separation of long-run co-movement from transitory dynamics and to quantify error-correction speeds (Johansen, 1991; Goodhart & Hofmann, 2008). Micro-macro evidence shows that household leverage boosts spending in expansions through collateral and wealth effects, but raises vulnerability to shocks as debt-service ratios rise, dampening consumption and prolonging downturns (Campbell & Cocco, 2007; Drehmann & Juselius, 2012; Mian & Sufi, 2014; Lombardi et al., 2017). Consistent with this, cross-country studies document that credit booms - especially mortgage credit - predict deeper subsequent recessions and slower recoveries, underscoring the value of explicitly modelling the long-run cointegration between credit, spending, and output in VECM frameworks (Jordà et al., 2013, 2016; Cecchetti et al., 2011).

Although several versions of this hypothesis have been proposed, much of the empirical evidence has been conducted in very general terms or with specific reference to the United States. Although similar trends can be observed elsewhere, there are features of the U.S. experience that differentiate it from trends in European economies. Spain offers a prominent case study since the pre-2008 economic expansion featured rapid credit growth intermediated largely by banks, with mortgage borrowing at variable rates pushing household leverage to historic highs (Banco de España, 2008; Banco de España, 2025). The subsequent bust combined a sharp housing correction with large employment losses concentrated in construction-related sectors, catalysing a protracted deleveraging (Bentolila et al., 2013; Garriga, 2010; Royo, 2020). Cross-country comparisons suggest the Spanish case was less about securitization and more about bank-balance-sheet intermediation under euro-area monetary conditions, with mortgage funding relying heavily on covered bonds and limited true-risk transfer (IMF, 2012; Banco de España, 2012). The policy mix also differed from, for instance, the United States: after an initial fiscal impulse in 2008–2009, euro-area fiscal rules and sovereign-stress dynamics constrained countercyclical space, plausibly prolonging deleveraging and demand shortfalls (European Commission, 2009a; European Commission, 2009b; Lane, 2012; De Grauwe, 2012). This background underscores the relevance of explicitly modelling the fiscal stance when estimating the macro effects of household debt in Spain.

3. Data and method

3.1. Data

The sample used to test Minsky's (1986) hypothesis on the relationship between household indebtedness and economic growth consists of quarterly data for the period 1999Q1-2017Q2. The sample ends in 2017 to keep a homogeneous, pre-shock period: from 2018 onward Spain enters a different macro-financial regime (e.g., tightening financial regulation and, soon after, the COVID-19 shock and extraordinary fiscal/monetary interventions) that would introduce major structural

breaks and distort the debt–growth relationship. Stopping in 2017 also ensures consistent measurement across series and maximizes comparability over the full cycle studied. The main sources of data were the National Statistics Institute (INE) and the Bank of Spain (BE) (see Appendix 1). In accordance with the theoretical analysis indicated above, we relate GDP (Y) and household indebtedness (HHI), using as the control variables: private investment measured by gross capital formation (I), public expenditure (G) and net worth of households and non-profit institutions (NWHH). All these variables have been deflated by the INE GDP deflator and are shown in logarithms to smooth the series and to obtain growth rates when calculating first differences.

The description of the variables used for the empirical study is shown in Table 1.

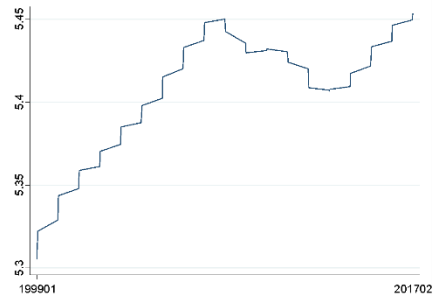
Table 1 - Statistical description of the variables

Variable	Obs.	Mean	Std. Error	Minimum	Maximum
LogY	74	5,404	0.038	5,305	5,453
LogHHI	74	3,763	0.157	3,402	3,915
LogG	74	2,667	0.066	2,536	2,748
LogI	74	3,028	0.038	2,932	3,080
LogNWHH	74	3,168	0.033	3,078	3,217

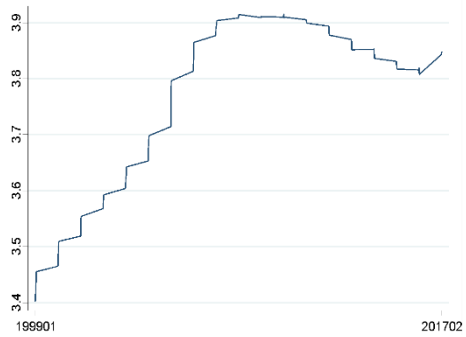
Figure 2 shows the scatter plot of the five main variables in levels: logY, logHHI, logG, logI and logNWHH. In all series, clear upward trends can initially be observed from 1999-Q01 to 2008-Q01. The high growth rates of output, household debt and house prices may be hiding the seeds of the Great Recession. However, with the arrival of the crisis, GDP showed its recessionary impact, dragging the rest of the variables with it. Finally, the economic recovery measured through the evolution of GDP (Y) can be seen from 2015-2016 onwards, when GDP began to recover to pre-crisis levels. A similar behaviour has been followed by public spending (G) throughout the period. This recovery phase has required, among other things, a notable fall in household debt (HHI) to levels that could be considered foreseeable in accordance with the path followed by this variable over time. Despite the foregoing, 2017 reveals the start of a period of incipient increases in the latter two variables. Instead, the gross capital formation (I) has maintained a stable recessionary path during the crisis period, with a clear change in trend from 2016 onwards. The net worth of households and non-profit organisations (NWHH) have shown a very similar trend to the one followed by the economic cycle, with large declines during the crisis and marked increases during the economic recovery.

Figure 2 - Evolution of model variables (in logarithms)

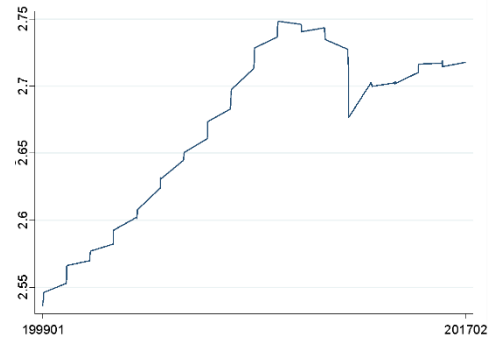
(a) Log Y



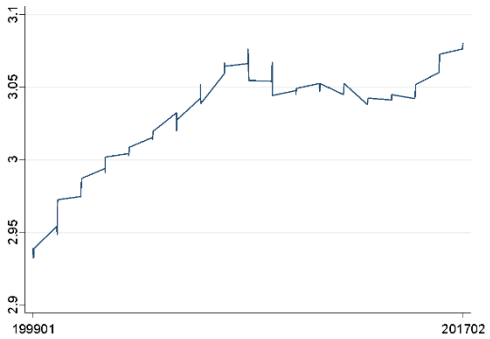
(b) Log (HHI)



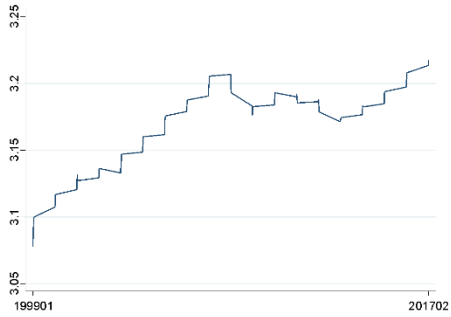
(c) Log G



(d) Log I



(e) Log NWHH



3.2. Methodology

According to the Keynesian theory, output is adjusted via demand; in particular, by that part of demand which is not induced but the autonomous component but proportional to the level of nominal output. Easy credit conditions enhance the autonomy of this part of aggregate demand. The equilibrium condition derived from the so-called Income-Expenditure model constitutes the cornerstone of the econometric model developed in this paper and is defined by:

$$Y = C + C_0 + I_r + I_f + G \quad (1)$$

where Y: level of output (GDP), C: induced consumption, C_0: autonomous consumption, I_r: residential investment, I_f: business investment and G: government expenditure. In turn, induced consumption is:

$$C = cY_d \tag{2}$$

where c is the average propensity to consume and Y_d=Y(1-t) is the disposable income of households, with t representing the tax rate.
Since our interest lies in the variables under the control of households, it is possible to group the terms contained in (2) as follows:

$$Y = \mu(F + Z) \tag{3}$$

where F=C_0+I_r and μ the Keynesian multiplier, expressed as μ=1/1-c(1-t).

Following post-Keynesian theory, F component is a function of the credit granted to households, given that almost 100% of residential investment is financed with mortgages:

$$F = f(HHI) \tag{4}$$

with HHI(.)/d(HHI)>0.

Rewriting expression (3) in the form of growth rate[1]:

$$g_Y = w_F g_F(HHI) + w_z g_z \tag{5}$$

where w (.) indicates the weight of the two sources of growth[6].

As discussed above, our interest is to understand the effect that such credit granted to households may have on economic growth (g_y). Thus, according to Minsky's FIH (1986), the following assumptions can be made:

(1) Credit expansion (household indebtedness, HHI) has a positive effect on GDP (short-term effect).
(2) Credit expansion is responsible for an increase in the household indebtedness (in the form of debt burden) which would have a negative effect on demand and GDP (long-term effect).
(3) Countercyclical fiscal policy is as a key buffer during household deleveraging.

Next, the appropriateness of the empirical specification for testing the Minsky's (1986) hypothesis (FIH) is considered. Since the cointegration relationship seems to be present, in the empirical part of the model an error-correlated vector model (VECM) is estimated to study the effect of household debt growth (HHI) on economic growth (Y). This model also has three control variables that could be considered as other determinants of economic. First, the growth of government expenditure (G) to identify the debt-growth nexus net of the fiscal stance. Fiscal policy moves output through automatic stabilizers and discretionary outlays (aggregate-demand channel), shapes credit conditions and expectations (crowding-in/out of private investment), and directly affects household balance sheets via taxes and transfers (income/wealth channel). Controlling for government spending therefore separates the macro-stabilization role of the state from the balance-sheet mechanics of households, clarifies the contribution of public spending to the long-run equilibrium with GDP and yields cleaner test of the FIH prediction that household leverage is expansionary in the short run but contractionary as balance sheets adjust. Second, business investment (I) as the main propagation channel from credit and demand to output (accelerator/Tobin's-q mechanisms). Household deleveraging suppresses spending and capacity utilization, which cuts firms' capital outlays and amplifies downturns. Controlling for business

[1] Note that the growth of component F (g_y) is a function of household credit.

investment (since co-moves with both HHI via credit conditions and expectations and Y) separates the balance-sheet channel of households from the real-side capital accumulation channel, clarifies crowding-in/out interactions with government spending, and improves identification of the FIH-consistent short-run vs. long-run effects in the VECM model. Third, as suggested by Kim (2013), a third control variable is added, the growth of household wealth or net worth (NWHH), which could be correlated with household indebtedness and the level of output through the well-known "wealth effect"[2].

Therefore, the multi-equation model to test Minsky's (1986) hypothesis would be as follows:

$$dY_t = \mu_{01} - \alpha_{01} + (Y_{t-1} - \beta_0 - \beta_1 HHI_{t-1}) + \gamma_{11} dY_{t-1} + \gamma_{12} dHHI_{t-1} + \varepsilon_t \quad (6)$$

$$dHHI_t = \mu_{02} - \alpha_{02} + (Y_{t-1} - \beta_0 - \beta_1 HHI_{t-1}) + \gamma_{21} dY_{t-1} + \gamma_{22} dHHI_{t-1} + \varepsilon_t \quad (7)$$

The long-run relationship is given by the cointegration equation Y_{t-1}-β_0-$\beta_1 HHI_{t-1}$. The differenced lagged variables dY_{t-1} and $dHHI_{t-1}$ capture the short-run dynamic effects and refer to the adjustment coefficients.

Following this model, a positive shock to household debt levels is associated with an increase in the GDP growth rate and, in turn, a positive shock to the latter is associated with an increase in the growth rate of household debt (Kim, 2016). Moreover, according to the Minsky hypothesis (FIH), shocks to household indebtedness in GDP are negative after a long period of time. To analyse the short-run and long-run relationship between household debt and GDP, an Error Corrected Vector Model (ECVM) is estimated followed by a series of specific diagnostics and tests used for multivariate time series analysis. These models are used to describe the data generating process of a set of time series for different variables. Because all variables are taken as endogenous, these models are able to characterise the simultaneous interactions that are transmitted over a given number of periods between a group of variables (Molina Díaz & Gantier Mita, 2016).

Before proceeding to define the VECM model, the Augmented Dickey-Fuller unit root test (AHHI) is performed to identify the stationary nature of the variables (Dickey & Fuller, 1979), as Stock & Watson (1989) argue that causality tests are very sensitive to the stationarity of time series, while Nelson & Plosser (1982) add that many macroeconomic time series are not stationary. Thus, a variable is stationary if its mean and variance are constant over time. In general, the absolute value of the result of the AHHI test statistics should be greater than the critical value for each variable studied. For further study, the variables are used in first differences when all variables become stationary for the first time, and, if necessary, second differences were applied to make them stationary.

Therefore, an analysis of the presence of a unit root in the data generation process can be performed through the Augmented Dicky-Fuller (AHHI) test. The AHHI equation can be written in general terms as:

$$\Delta Y_t = a_0 + \gamma Y_{t-1} + a_2 t + \sum_{i=2}^{p} \beta_i \Delta Y_{t-i+1} + \varepsilon_t \quad (8)$$

In this case, we will test the following hypotheses: H_0: $\gamma=0$ (unit root) vs H_1: $\gamma<0$ (stable or stationary root).

The structure of the VECM system incorporates feedback effects, as both dependent and independent variables can affect each other. In this sense, the choice of the number of lags for each of the variables is made using the F-test, the Akaike Information Criterion or the Schwarz

[2] The wealth effect (also known as the Pigou effect or real balance effect) is a term used to refer to the economic phenomenon of increased spending and, consequently, increased production, which accompanies the mere fact of believing oneself to be richer, whether or not wealth has objectively increased.

Criterion, among others. The first one tests as the null hypothesis that the additional (lagged) variables do not contain relevant information to improve the forecasts of the variable of interest, and the last two tests try to evaluate the extra coefficients (those corresponding to the variables with additional lags), so that the specification chosen will correspond to the one with the smallest criterion (Humérez & Jiménez, 1995). The choice of the number of lags is of great importance since, according to Gonzalo (1994), failure to specify the number of lags in a VECM model leads to serial correlation and increases the finite sample bias in the parameter estimates.

Next, to analyse the long-run relationship of the variables, we will proceed to analyse the Johansen (1988) multivariate cointegration test (see Johansen & Juselius, 1990). This test can be specified on the basis of a VAR model of order k, defined as follows:

$$y_t = A_i y_{t-1} + \cdots + A_k y_{t-k} + Bx_t + e_t \quad (9)$$

where y_t is a vector (nx1) of non-stationary variables I(1); x_t is a vector containing the deterministic terms; A_i is a (1 x n) parameter matrix and e_t is a white noise term.

After these previous steps, the specification of the vector error-corrected vector model (VECM) is formulated under the following expression (Magazzino, 2012), which allows us to define the first differences of a cointegrated random vector Y=(GDP, HHI):

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-k} + +Bx_t \quad (10)$$

where

$$\Pi = \sum_{i=1}^{k} A_i - I \quad (11)$$

$$\Gamma_i = \sum_{j=i+1}^{p} A_j \quad (12)$$

The number of cointegrating relationships lies between 0 and n-1; therefore, Johansen's procedure to test for the possible presence of cointegration focuses on the range of Π. Thus, the point at which GDP (Y) and household debt (HHI) are in equilibrium would be given by Π. If we are outside equilibrium and the system is stable, the two variables would then adjust back to the equilibrium path. If the presence of a cointegrating vector is verified, the VECM model will be estimated to observe the long-run relationship of the variables.

VECM models allow the study of short-run deviations from long-run relationships. Thus, the cointegration equation captures the long-run relationship in the sense that it is a time-invariant equilibrium relationship or "center of gravity". It represents the underlying correlation between the evolution of the pattern of two random variables whose linear combination becomes zero-order and can therefore be modelled in a form of error correction. In this sense, it should be noted that this is neither a long-run causal relationship in the sense usually understood in a cross-sectional database, nor in the sense of dimensionality used in time series analysis. Finally, the Lagrange multiplier (LM) test is applied to analyse the autocorrelation of the model's residuals.

According to the theoretical model, the interpretation of Minsky's (1986) FIH does not focus on whether the suggested equilibrium correlation between household indebtedness (HHI) and GDP (Y) is negative, but on the causal relationship between the variables. In the VECM modelling approach, causality is expressed by dynamics. Unlike VAR models, in which shocks are always temporary, cointegration may imply persistence (permanent shocks or disturbances).

4. Results and discussion

In this section a statistical analysis is carried out among the variables contained in the model. It contains an AHHI unit root test and the Johansen procedure to check for the possible presence of cointegration between the different variables. Then, the VECM model is presented.

One of the most crucial steps in the data analysis is to verify the assumption of stationarity, as it is essential to consistently apply the econometric techniques used in this empirical study. At the graphical level, once we have analysed the time series, the scatter plots (see Figure 2) and the correlograms (see Appendix 2), it seems clear that the time series are trending and non-stationary, i.e. they probably have a unit root. Thus, it is observed that the partial autocorrelation of the first lag of the variables in levels takes values close to unity while the autocorrelation function slowly approaches zero.

At the statistical level, this hypothesis of non-stationarity can be carried out by presenting the data series that test whether or not unit roots (AHHI test) exist in levels, first and second differences. As shown in Table 2, the results of the AHHI unit root test for levels, first and second differences show that the variables appear to be stationary or, in other words, stable, either in first or second differences. These results show that the variables analysed (logY, logHHI, logG, logI and logNWHH) are neither stationary nor random in levels. Therefore, in differences they are stationary series, i.e., all series are stochastic processes. Therefore, economic growth, household debt, government expenditure, private investment and net worth of households and nonprofit entities are suitable series to proceed to estimate a VECM.

Table 2 - Statistical unit root test (AHHI)

	Levels (AHHI)	2nd differences (AHHI)
LogY	-2.770	-3.481
LogHHI	-0.860	-8.855
LogG	-0.600	-9.425
LogI	-1.943	-13.467
LogNWHH	-2.557	-7.894
	C.V. MacKinnon 1%, 5%, 10%	C.V. MacKinnon 1%, 5%, 10%
	-4.099; -3.477; -3.166	-4.108; -3.481; -3.169

Note: Values are expressed with trend and constant.

Once we have verified that our variables meet the condition necessary to verify the existence of cointegration, the next step is to carry out this check, i.e. to observe the possible existence of a stationary linear relationship between the variables. To do so, it is necessary to specify how many lags should be included in the model. Following Nielsen (2006), our selection criterion is based on the comparison of the optimal choice according to the Final Prediction Error (FPE), Akaike's information criteria (AIC); Hannan and Quinn information criterion (HQIC); and Schwarz', Bayesian information criterion (SBIC). In our case, the selection of the optimal delay is based on the latter two criteria, under which we use two delays (see Appendix 3).

Then, to analyse the long-run relationship, we carry out the Johansen test (Johansen, 1988) with a linear time trend . Appendix 4 summarises the results of the test. As can be seen, we reject the null cointegrating relationship of zero for the two lagged case at a significance level of 5%. Therefore, the existence of a cointegrating vector between the variables is verified. Therefore, there is a long-

run relationship between them, and we can assume that household indebtedness (HHI) and GDP (Y) evolve jointly over time.

Finally, we must verify several crucial aspects to validate our model. In this sense, an important aspect of the model is to ensure the absence of autocorrelation of the residuals. To this end, the Lagrange multiplier test has been performed, the null hypothesis of which is that there is no autocorrelation. The result of the LM test shows that there is no residual autocorrelation and, therefore, the model is well specified (see Appendix 6).

When the variables are cointegrated, the VECM model can be estimated. In this model, we are interested in three types of parameters:

(a) the parameters in the cointegration equation;
(b) the adjustment coefficients (which indicate the direction and speed of adjustment when the system is out of its long-run equilibrium);
(c) the short-run coefficients.

The results of the estimation of the VEC model provide valuable information on these three fundamental aspects (see Appendix 5). Regarding the first aspect under analysis in this model, the integration equation is defined under the following parameters:

$$LogY = 2{,}89 - 0{,}01*logHHI + 0{,}35*logG + 1{,}15*logI - 0{,}60*logNWHH \quad (13)$$

Under an adaptation of the model presented in Kim (2016), we can observe that the long-run equilibrium relationship between our main variables of interest, household debt and GDP is not significant. However, the rest of the variables have been shown to be significant enough to justify a long-run relationship with real GDP. Thus, both public spending and investment are positively correlated with real GDP in the cointegration equation while household and non-profit net worth is inversely related to real GDP in the long run. At this point, it should be noted that the cointegration equation informs us about the equilibrium relationship or center of gravity to which potential deviations will be adjusted. Taking the case of public expenditure, it is reasonable to relate a model of error correction vectors to permanent and transitory consumption. In other words, fiscal policy is not merely cyclical noise since it helps determine the steady-state level of activity to which the system correct after shocks. This justifies placing government behavior at the core of the narrative on household indebtedness: even if debt itself does not pin down the long-run path of GDP, the fiscal stance does. However, it is not sufficient to provide a theoretical argument for an equilibrium relationship between household debt and GDP for the case of Spain from 1999 to 2017.

Regarding the second aspect, the error-correction (adjustment) coefficients that measure the speed of return to the long-run equilibrium are statistically significant, supporting the stability of the system. Joint long-run relationships indicate that GDP, household debt, public expenditure, and investment significantly (at the 5% - and in some cases 1% - level) help explain net worth. There is also suggestive evidence of a long-run relationship running from net worth, household debt, public expenditure, and investment to GDP, although significance is only at the 10% level. This implies that when the system deviates from equilibrium, the government-spending component forms part of the mechanism guiding the return to trend. Together with the result that excess household leverage triggers adjustment (via deleveraging) that spills over to GDP and net worth, the policy implication is clear: countercyclical fiscal policy can cushion deleveraging episodes by supporting aggregate demand while private balance sheets are repaired. In this sense, public expenditure operates as a shock absorber in the household-credit cycle. Therefore, even if household debt is not significant in the cointegrating vector, the variables' adjustment to disequilibria suggests that debt may be bearing a substantial share of the adjustment burden - so periods of excessive debt accumulation entail deleveraging that, in turn, affects GDP and households' net worth.

In relation to the third and last of the aspects to be considered in this model, short-term effects appear to be significant only in the following two cases. First, there is a short-term causal link from household debt to private investment (gross capital formation). Second, there is also a short-run causal relationship from household debt and GDP (independently) to household and non-profit net worth. Again, this result shows that household debt affects both private investment and private net worth.

In summary, we can see that household indebtedness in Spain has had an impact on economic growth; although it has been timid in the long term, it is very clear in the short term. Therefore, to a certain extent, it is possible to verify the fulfilment of Minsky's instability hypothesis according to which the relationship between household debt and GDP is positive in the short term and negative in the long term. In our case, the latter relationship has been shown to be non-significant, although the error correction parameters allow us to verify the relative importance that household debt has in the adjustment to long-run GDP equilibrium.

In this framework, the government's role is to lean against the financial cycle: during risk-off phases, fiscal expansion offsets the negative feedback from deleveraging to GDP and net worth; during risk-on phases, the composition and rules of spending can curb pro-cyclicality. There is a direct demand channel since the positive long-run coefficient on government spending is consistent with a durable aggregate-demand effect, public consumption and investment raise income paths that households and firms use to plan spending and borrowing. Likewise, there is an indirect crowding-in of private investment. Although short-run causality runs from household debt to business investment, the long-run system associates higher governments spending with higher GDP and trough equilibrium forces a more supportive environment for private capital formation. In deleveraging phases, public investment can keep utilization and expectations form collapsing, reducing the hit to business investment. On the other hand, the short-run links from household debt and GDP to households' net worth. Then, fiscal support that stabilizes GDP in downturns indirectly stabilizes net worth via incomes, asset prices and default risk, shortening deleveraging cycles. Besides, the significance of government spending in the long run suggests both built-in stabilizers such as taxes or transfer rules and medium-horizon discretionary spending (especially public investment) matter for the equilibrium path, not just for short-term smoothing.

These findings suggest several policy implications. Firstly, the countercyclical stance is warranted. Given significant error-correction and a positive long-run link from government spending to GDP, temporary fiscal support during deleveraging helps the system re-converge to its steady state with smaller output losses. Secondly, composition matters. Prioritize high-multiplier items such as public investment or targeted transfers with high marginal propensity to consume to reinforce the government spending to GDP long-run channel while limiting debt sustainability concerns. Thirdly, macro-financial coordination is needed. Pair fiscal measures with macroprudential tools that address the sources of leverage build-ups (e.g., loan-to-value or debt-service-to-income limits), while fiscal policy tackle the fallout when balance sheets adjust. Fourthly, protection of household and non-profit organisations net worth is required. Since household net worth is inversely related to long-run GDP in the cointegrating relationship, policies that stabilize disposable income and reduce forced assets sales (e.g., temporary mortgage relief during sharp downturns) can dampen the adverse feedback to growth.

Conclusions

This paper seeks to analyse how might the expansion of household credit have affected the real economy during the period 1999-2017, with a special focus on the role of government spending. Contrary to conventional cycle theories whose starting point is usually an exogenous shock on the

real side of the economy, this study is based on the post-Keynesian Minsky's FIH perspective considering crisis ignited endogenously in the financial sector that are exported to the real sector. According to these hypothesis, household credit expansion plays a double role in the real economy. On the one hand, it appears to be a source of economic stimulus in the short run by encouraging autonomous consumption and residential investment. On the other hand, however, it may have contractive long run effects on aggregate demand and output due to the rise of the burden of debt. Therefore, an over-indebted economy has proved to be extremely fragile to any possible exogenous shock. This theoretical approach and the previous empirical evidence on the significant increase in household indebtedness in relation to the real variables of the economy provide a clear motivation for this research. To this end, several control variables have been introduced into the model, such as public spending, gross capital formation and the net worth of households and non-profit organisations. Following Kim's (2016) motivation, it is analysed the short-run and long-run impact of household indebtedness on GDP, using multi-equational models that provide a relevant approach due to the bidirectional causality that may appear between the mentioned variables.

The empirical part of this study estimates an error-corrected vector model (VECM), showing the dynamic relationships between these variables without the need to impose exogeneity assumptions. Unlike previous studies (for instance, Kim 2016), this study does not attempt to estimate whether the suggested equilibrium correlation between household debt and GDP was negative but rather on the causal relationships between the selected variables. Causality is expressed through both short-run and long-run dynamics. Besides, the analysis presents special focus on the role of government spending. The results do not corroborate the Minsky's FIH whereby household indebtedness has a negative effect on long-run economic growth, revealing that there are other factors that may affect the consequences of exploding household debt. Also, this variable may be bearing part of the main burden of adjustment. Thus, periods of excessive debt accumulation imply an adjustment partly through household deleveraging which, in turn, may have implications for other variables; in this case, both GDP and household and non-profit net worth.

In relation to short-term causal relationships, several findings are achieved. First, there is a short-term causal relationship from household debt to private investment. Second, there is also a short-term causal relationship from household debt and GDP to household and non-profit net worth. Again, this result shows that household debt affects both private investment and private net worth. Moreover, while household debt is pivotal in short-run dynamics and in how the system adjusts back to equilibrium, public expenditure shapes the equilibrium itself. These findings make the government a central actor in managing household-debt-driven cycles: fiscal policy both sets the long-run anchor for GDP and softens the landing when private balances sheets unwind. Finally, although our study does not allow us to validate the Minsky´s FIH in a generic way for the Spanish case from 1999 to 2017, it does allow us to illustrate the dynamics of the GDP driven by demand and by the financial variables.

The lessons that could have been learned from the Great Recession do not seem to have taken hold in the overall behaviour of households, either in terms of precaution in their purchasing decisions or in investment. This scenario increases the likelihood of future financial crisis with serious effects on economic growth. Specifically, in Spain, assessments of private-debt sustainability and identification of vulnerable segments, particularly young mortgaged households, have gained prominence after the turn in the interest-rate cycle since 2022 (European Commission, 2023a; Banco de España, 2024). These diagnostics rely on indicators such as household debt-to-GDP, debt-service ratios, and interest burdens which have declined in the medium term after post-Great Recession deleveraging but have displayed pockets of vulnerability linked to recent rate hikes and the inflation surge of 2022-2023 (CEIC, 2024; CaixaBank Research, 2024).

Several policy implications can be drawn in line with the results obtained for the Spanish case. Given that household debt operates primarily through short-term adjustment dynamics and can amplify recessions during deleveraging periods, it is crucial to strengthen the stabilizing role of fiscal policy. In particular, a countercyclical design of public spending - supported by robust automatic stabilizers and, where necessary, discretionary measures - would help cushion the blows to economic activity and facilitate a less costly convergence to equilibrium. Furthermore, to reduce the probability and severity of future crises associated with the credit cycle, these actions should be coordinated with macroprudential instruments that limit excessive debt accumulation during expansionary phases and protect household net wealth during times of financial stress.

Finally, this analysis on the causal relationship between household indebtedness and economic growth presents several limitations. First, the single-country, macro time-series design constrains external validity and masks heterogeneity across households and debt types; aggregate measures of household debt and net worth cannot capture distributional vulnerability, nor distinguish mortgage from consumer credit. Second, while the VECM is well suited to separating long-run relationships from short-run adjustment, its results should be interpreted primarily as dynamic interdependence rather than fully structural causality, and estimates may be sensitive to specification choices (lag length, deterministic terms) and to potential structural breaks, particularly around crises and policy-regime shifts. Third, the fiscal variable is measured in aggregate, preventing conclusions about which spending components drive the long-run "anchoring" role. Future research should therefore (i) extend the sample and explicitly model regime changes (including the post-2018 period), (ii) disaggregate household debt and incorporate richer indicators of stress (e.g., debt-service ratios) and composition (mortgage vs. consumer), (iii) examine the composition of fiscal policy (investment, transfers, stabilizers) and fiscal constraints, and (iv) integrate additional macro-financial channels - interest rates, housing prices, credit conditions, and macroprudential instruments - possibly within nonlinear or state-dependent frameworks (e.g., threshold or time-varying models) and complementary identification strategies to isolate exogenous fiscal shocks.

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Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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Appendix

Appendix 1 – Model variables (1999Q1-2017Q2): statistical sources

Variables	Notation	Sources
Gross Domestic product (GDP)	Y	National Statistic Institute (INE)
Household debt	HHI	Bank of Spain (BE)
Public expenditure	G	National Statistics Institute (INE)
Business investment measured as Gross capital formation (GOS)	I	National Statistics Institute (INE)
Net worth of households and non-profit organisations	NWHH	Bank of Spain (BE)

Appendix 2 – Correlograms for Y, HHI, G, I, NWHH (1999Q1-2017Q2)

(a) Log Y

LAG	AC	PAC	Q	Prob-Q	Autocorrelation	Partial Autocor
1	0,7345	0,9622	41,567	0,0000	|-----	|--------
2	0,4717	-0,9015	58,950	0,0000	|---	------|
3	0,2331	0,1142	63,254	0,0000	|-	|
4	0,0000	.	63,254	0,0000	|	
5	0,0000	.	63,254	0,0000	|	
6	0,0000	.	63,254	0,0000	|	
7	0,0000	.	63,254	0,0000	|	
8	0,0000	.	63,254	0,0000	|	
9	0,0000	.	63,254	0,0000	|	
10	0,0000	.	63,254	0,0000	|	
11	0,0000	.	63,254	0,0000	|	
12	0,0000	.	63,254	0,0000	|	
13	0,0000	.	63,254	0,0000	|	
14	0,0000	.	63,254	0,0000	|	
15	0,0000	.	63,254	0,0000	|	
16	0,0000	.	63,254	0,0000	|	
17	0,0000	.	63,254	0,0000	|	
18	0,0000	.	63,254	0,0000	|	
19	0,0000	.	63,254	0,0000	|	
20	0,0000	.	63,254	0,0000	|	
21	0,0000	.	63,254	0,0000	|	
22	0,0000	.	63,254	0,0000	|	
23	0,0000	.	63,254	0,0000	|	
24	0,0000	.	63,254	0,0000	|	
25	0,0000	.	63,254	0,0000	|	
26	0,0000	.	63,254	0,0001	|	
27	0,0000	.	63,254	0,0001	|	
28	0,0000	.	63,254	0,0002	|	
29	0,0000	.	63,254	0,0002	|	
30	0,0000	.	63,254	0,0004	|	
31	0,0000	.	63,254	0,0005	|	
32	0,0000	.	63,254	0,0008	|	
33	0,0000	.	63,254	0,0012	|	
34	0,0000	.	63,254	0,0017	|	
35	0,0000	.	63,254	0,0024	|	

(b) Log HHI

LAG	AC	PAC	Q	Prob-Q	Autocorrelation	Partial Autocor
1	0,7438	0,9517	42,675	0,0000	|-----	|--------
2	0,4916	-0,4589	61,901	0,0000	|---	------|
3	0,2442	-0,1007	66,224	0,0000	|-	|
4	0	.	66,224	0,0000	|	
5	0	.	66,224	0,0000	|	
6	0	.	66,224	0,0000	|	
7	0	.	66,224	0,0000	|	
8	0	.	66,224	0,0000	|	
9	0	.	66,224	0,0000	|	
10	0	.	66,224	0,0000	|	
11	0	.	66,224	0,0000	|	
12	0	.	66,224	0,0000	|	
13	0	.	66,224	0,0000	|	
14	0	.	66,224	0,0000	|	
15	0	.	66,224	0,0000	|	
16	0	.	66,224	0,0000	|	
17	0	.	66,224	0,0000	|	
18	0	.	66,224	0,0000	|	
19	0	.	66,224	0,0000	|	
20	0	.	66,224	0,0000	|	
21	0	.	66,224	0,0000	|	
22	0	.	66,224	0,0000	|	
23	0	.	66,224	0,0000	|	
24	0	.	66,224	0,0000	|	
25	0	.	66,224	0,0000	|	
26	0	.	66,224	0,0000	|	
27	0	.	66,224	0,0000	|	
28	0	.	66,224	0,0001	|	
29	0	.	66,224	0,0001	|	
30	0	.	66,224	0,0002	|	
31	0	.	66,224	0,0002	|	
32	0	.	66,224	0,0004	|	
33	0	.	66,224	0,0005	|	
34	0	.	66,224	0,0008	|	
35	0	.	66,224	0,0011	|	

(c) Log G

LAG	AC	PAC	Q	Prob>Q	Autocorrelation	Partial Autocor
1	0,7459	0,9726	42,860	0,0000	|-----	|--------
2	0,4859	-0,9236	61,300	0,0000	|---	------|
3	0,2364	-2,1470	65,727	0,0000	|-	|
4	0,0000	.	65,727	0,0000	|	
5	0,0000	.	65,727	0,0000	|	
6	0,0000	.	65,727	0,0000	|	
7	0,0000	.	65,727	0,0000	|	
8	0,0000	.	65,727	0,0000	|	
9	0,0000	.	65,727	0,0000	|	
10	0,0000	.	65,727	0,0000	|	
11	0,0000	.	65,727	0,0000	|	
12	0,0000	.	65,727	0,0000	|	
13	0,0000	.	65,727	0,0000	|	
14	0,0000	.	65,727	0,0000	|	
15	0,0000	.	65,727	0,0000	|	
16	0,0000	.	65,727	0,0000	|	
17	0,0000	.	65,727	0,0000	|	
18	0,0000	.	65,727	0,0000	|	
19	0,0000	.	65,727	0,0000	|	
20	0,0000	.	65,727	0,0000	|	
21	0,0000	.	65,727	0,0000	|	
22	0,0000	.	65,727	0,0000	|	
23	0,0000	.	65,727	0,0000	|	
24	0,0000	.	65,727	0,0000	|	
25	0,0000	.	65,727	0,0000	|	
26	0,0000	.	65,727	0,0000	|	
27	0,0000	.	65,727	0,0000	|	
28	0,0000	.	65,727	0,0001	|	
29	0,0000	.	65,727	0,0001	|	
30	0,0000	.	65,727	0,0002	|	
31	0,0000	.	65,727	0,0003	|	
32	0,0000	.	65,727	0,0004	|	
33	0,0000	.	65,727	0,0006	|	
34	0,0000	.	65,727	0,0009	|	
35	0,0000	.	65,727	0,0013	|	

(d) Log I

LAG	AC	PAC	Q	Prob-Q	Autocorrelation	Partial Autocor
1	0,7487	0,9675	43,190	0,0000	|-----	|--------
2	0,4634	0,2468	60,032	0,0000	|---	------|
3	0,2089	0,7469	63,521	0,0000	|-	|
4	0,0000	.	63,521	0,0000	|	
5	0,0000	.	63,521	0,0000	|	
6	0,0000	.	63,521	0,0000	|	
7	0,0000	.	63,521	0,0000	|	
8	0,0000	.	63,521	0,0000	|	
9	0,0000	.	63,521	0,0000	|	
10	0,0000	.	63,521	0,0000	|	
11	0,0000	.	63,521	0,0000	|	
12	0,0000	.	63,521	0,0000	|	
13	0,0000	.	63,521	0,0000	|	
14	0,0000	.	63,521	0,0000	|	
15	0,0000	.	63,521	0,0000	|	
16	0,0000	.	63,521	0,0000	|	
17	0,0000	.	63,521	0,0000	|	
18	0,0000	.	63,521	0,0000	|	
19	0,0000	.	63,521	0,0000	|	
20	0,0000	.	63,521	0,0000	|	
21	0,0000	.	63,521	0,0000	|	
22	0,0000	.	63,521	0,0000	|	
23	0,0000	.	63,521	0,0000	|	
24	0,0000	.	63,521	0,0000	|	
25	0,0000	.	63,521	0,0000	|	
26	0,0000	.	63,521	0,0001	|	
27	0,0000	.	63,521	0,0001	|	
28	0,0000	.	63,521	0,0001	|	
29	0,0000	.	63,521	0,0002	|	
30	0,0000	.	63,521	0,0003	|	
31	0,0000	.	63,521	0,0005	|	
32	0,0000	.	63,521	0,0008	|	
33	0,0000	.	63,521	0,0011	|	
34	0,0000	.	63,521	0,0016	|	
35	0,0000	.	63,521	0,0022	|	

(e) Log NWHH

LAG	AC	PAC	Q	Prob>Q	Autocorrelation	Partial Autocor
1	0,7259	0,6941	40,536	0,0000	|-----	|--------
2	0,4579	-0,1326	56,971	0,0000	|---	------|
3	0,2263	-0,1719	61,027	0,0000	|-	|
4	0	.	61,027	0,0000	|	
5	0	.	61,027	0,0000	|	
6	0	.	61,027	0,0000	|	
7	0	.	61,027	0,0000	|	
8	0	.	61,027	0,0000	|	
9	0	.	61,027	0,0000	|	
10	0	.	61,027	0,0000	|	
11	0	.	61,027	0,0000	|	
12	0	.	61,027	0,0000	|	
13	0	.	61,027	0,0000	|	
14	0	.	61,027	0,0000	|	
15	0	.	61,027	0,0000	|	
16	0	.	61,027	0,0000	|	
17	0	.	61,027	0,0000	|	
18	0	.	61,027	0,0000	|	
19	0	.	61,027	0,0000	|	
20	0	.	61,027	0,0000	|	
21	0	.	61,027	0,0000	|	
22	0	.	61,027	0,0000	|	
23	0	.	61,027	0,0000	|	
24	0	.	61,027	0,0000	|	
25	0	.	61,027	0,0001	|	
26	0	.	61,027	0,0001	|	
27	0	.	61,027	0,0002	|	
28	0	.	61,027	0,0003	|	
29	0	.	61,027	0,0005	|	
30	0	.	61,027	0,0007	|	
31	0	.	61,027	0,001	|	
32	0	.	61,027	0,0015	|	
33	0	.	61,027	0,0021	|	
34	0	.	61,027	0,003	|	
35	0	.	61,027	0,0042	|	

Appendix 3 – Delay selection criteria for the VECM model

Selection-order criteria

Sample: 1999q1–2017q2 Number of obs 64

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	895.307				5.7e-19	-27.8221	-27.7556	-27.6534
1	1307.84	825.07	25	0.000	3.1e-24	-39.9326	-39.5339	-38.9206
2	1369.1	122.52	25	0.000	1.0e-24	-41.0657	-40.3348*	-39.2104*
3	1402.43	66.664	25	0.000	8.2e-25*	-41.3261	-40.263	-38.6275
4	1428.97	53.078	25	0.001	8.4e-25	-41.3742	-39.9788	-37.8323
5	1449.53	41.114	25	0.022	1.1e-24	-41.2353	-39.5078	-36.8501
6	1466.01	32.96	25	0.132	1.7e-24	-40.9691	-38.9093	-35.7405
7	1487.71	43.399	25	0.013	2.6e-24	-40.8659	-38.4739	-34.7941
8	1517.93	60.434	25	0.000	3.4e-24	-41.029	-38.3047	-34.1138
9	1591.03	146.2	25	0.000	1.5e-24	-42.5322	-39.4757	-34.7737
10	1648.75	115.45*	25	0.000	1.6e-24	-43.5548*	-40.1661	-34.953

Endogenous: logY logHHI logG logI logNWHH
Exogenous: _cons
Note: Final Prediction Error (FPE), Akaike's information criteria (AIC); Hannan and Quinn information criterion (HQIC); and Schwarz', Bayesian information criterion (SBIC).

Appendix 4 – Delay selection criteria for the VECM model

Johansen tests for cointegration

Trend: constant Number of obs. = 72
Sample: 1999q1 - 2017q2 Lags = 2

maximum rank	Parms	LL	eigenvalue	trace statistic	5% critical value
0	30	1486.9173		106.7163	68.52
1	39	1517.3248	0.57029	45.9012*	47.21
2	46	1531.0794	0.31755	18.3919	29.68
3	51	1537.6572	0.16699	5.2365	15.41
4	54	1539.9778	0.06243	0.5951	3.76
5	55	1540.2754	0.00823		

maximum rank	Parms	LL	eigenvalue	max statistic	5% critical value
0	30	1486.9173		60.8151	33.46
1	39	1517.3248	0.57029	27.5093	27.07
2	46	1531.0794	0.31755	13.1554	20.97
3	51	1537.6572	0.16699	4.6413	14.07
4	54	1539.9778	0.06243	0.5951	3.76
5	55	1540.2754	0.00823		

Note: * indicates rejection of the null hypothesis of less than a cointegrating relationship at the 5% significance level.

Appendix 5 –VECM Stata output model for Y, HHI, G, I and NWHH

Vector error-correction model

Sample: 1999q1 - 2017q2	Number of obs. = 71
	AIC = -41.23415
Log likelihood = 1527.812	HQIC =-40.42306
Det (Sigma_ml) = 1.40e-25	SBIC = -39.19455

(a) Cointegrating equations

Equation	Parms	chi2	P<chi2
_ce1	4	4528.885	0.000

Identification: beta is exactly identified

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
_ce1						
logY	1					
logHHI	0.0115085	0.0169944	0.68	0.498	-0.0217996	0.0448169
logG	-0.3543318	0.0404186	-8.77	0.000	-0.4335508	-0.2751128
logI	-1.155412	0.0969469	-11.92	0.000	-1.345424	-0.9653993
logNWHH	0.5980285	0.1337173	4.47	0.000	0.3359474	0.8601096
_cons	-2.889303					

(b) Adjustment parameters

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_logY	12	0.001189	0.9065	571.9681	0.0000
D_logHHI	12	0.007409	0.6937	133.6053	0.0000
D_logG	12	0.006621	0.3734	35.16118	0.0004
D_logI	12	0.005317	0.5812	81.86546	0.0000
D_logNWHH	12	0.002891	0.6252	98.4053	0.0000

(c) Long-term causal relationships

LogY

Variable	Term	Coef	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1	L1.	-0,0503685	0,0294837	-1,71	0,088	-0,1081555	0,0074184
logy	LD.	1,0508520	0,1451969	7,24	0,000	0,7662710	1,3354330
logy	L2D.	0,0546268	0,1717608	0,32	0,750	-0,2820182	0,3912718
logHHI	LD.	0,0276016	0,0212457	1,30	0,194	-0,0140391	0,0692424
logHHI	L2D.	0,0222901	0,0241313	0,92	0,356	-0,0250064	0,0695866
logG	LD.	-0,0369956	0,0238806	-1,55	0,121	-0,0838008	0,0098096
logG	L2D.	-0,0238077	0,0227856	-1,04	0,296	-0,0684667	0,0208513
logI	LD.	-0,0275465	0,0291254	-0,95	0,344	-0,0846311	0,0295382
logI	L2D.	-0,0300771	0,0242903	-1,24	0,216	-0,0776853	0,0175311
logNWHH	LD.	-0,0163965	0,0519284	-0,32	0,752	-0,1181744	0,0853813
logNWHH	L2D.	-0,0159510	0,0510134	-0,31	0,755	-0,1159355	0,0840334
_cons		0,0002614	0,0001804	1,45	0,147	-0,0000921	0,0006149

Log HHI

Variable	Lag	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
_ce1	L1	0,0126647	0,1837062	0,07	0,945	-0,3473929	0,3727223
logY	LD	1,6000240	0,9046894	1,77	0,077	-0,1731349	3,3731820
logY	L2D	-0,1421970	1,0702030	-0,13	0,894	-2,2397560	1,9553620
logHHI	LD	0,2411942	0,1323770	1,82	0,068	-0,0182600	0,5006484
logHHI	L2D	0,4412514	0,1503567	2,93	0,003	0,1465576	0,7359452
logG	LD	0,0567718	0,1487948	0,38	0,703	-0,2348607	0,3484042
logG	L2D	-0,1149189	0,1419721	-0,81	0,418	-0,3931791	0,1633413
logI	LD	0,2201120	0,1814786	1,21	0,225	-0,1355697	0,5757937
logI	L2D	0,0015266	0,1513477	0,01	0,992	-0,2951094	0,2981626
logNHWW	LD	-0,5945236	0,3235543	-1,84	0,066	-1,2286780	0,0396311
logNHWW	L2D	-0,4088042	0,3178531	-1,29	0,198	-1,0317850	0,2141763
_cons		0,0004270	0,0011239	0,38	0,704	-0,0017758	0,0026297

Log G

Variable	Lag	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
_ce1	L1	0,3224405	0,1641820	1,96	0,050	0,0006498	0,6442313
logY	LD	0,4883291	0,8085392	0,60	0,546	-1,0963790	2,0730370
logY	L2D	0,0234088	0,9564620	0,02	0,980	-1,8512220	1,8980400
logHHI	LD	0,0405691	0,1183080	0,34	0,732	-0,1913104	0,2724485
logHHI	L2D	-0,1226790	0,1343768	-0,91	0,361	-0,3860528	0,1406948
logG	LD	-0,1980222	0,1329809	-1,49	0,136	-0,4586601	0,0626156
logG	L2D	0,1126836	0,1268833	0,89	0,374	-0,1360032	0,3613703
logI	LD	0,1021727	0,1621866	0,63	0,529	-0,2157072	0,4200527
logI	L2D	0,0013725	0,1352625	0,01	0,992	-0,2637371	0,2664820
logNWHH	LD	-0,3279179	0,2891670	-1,13	0,257	-0,8946749	0,2388390
logNWHH	L2D	-0,5473435	0,2840717	-1,93	0,054	-1,1041140	0,0094268
_cons		0,0006549	0,0010044	0,65	0,514	-0,0013138	0,0026235

Log I

Variable	Lag	Coef	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
_ce1	L1.	0,6777943	0,1318339	5,14	0	0,4194046	0,936184
logY	LD.	0,3502803	0,6492362	0,54	0,59	-0,9221992	1,62276
logY	L2D.	-1,520635	0,7680144	-1,98	0,048	-3,025915	-0,015354
logHHI	LD.	0,0049052	0,0949983	0,05	0,959	-0,181288	0,1910984
logHHI	L2D.	-0,4337466	0,1079012	-4,02	0	-0,645229	-0,2222643
logG	LD.	0,1143567	0,1067803	1,07	0,284	-0,0949288	0,3236421
logG	L2D.	0,0389872	0,1018841	0,38	0,702	-0,1607018	0,2386763
logI	LD.	-0,0648393	0,1302317	-0,5	0,619	-0,3200887	0,1904101
logI	L2D.	-0,1097057	0,1086123	-1,01	0,312	-0,3225819	0,1031704
logNHWW	LD.	0,137002	0,2321937	0,59	0,555	-0,3180892	0,5920932
logNHWW	L2D.	0,2880034	0,2281023	1,26	0,207	-0,1590689	0,7350756
_cons		-0,000078	0,0008065	-0,1	0,923	-0,0016588	0,0015028

Log NWHH

Variable	Lag	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
_ce1	L1	-0,271556	0,0716841	-3,79	0	-0,4120542	-0,1310578
logY	LD	1,230908	0,3530191	3,49	0	0,5390032	1,922813
logY	L2D	0,4988834	0,4176041	1,19	0,232	-0,3196057	1,317373
logHHI	LD	0,150971	0,0516549	2,92	0,003	0,0497293	0,2522126
logHHI	L2D	0,0268905	0,0586707	0,46	0,647	-0,088102	0,141883
logG	LD	0,019916	0,0580613	0,34	0,732	-0,0938819	0,133714
logG	L2D	-0,0535911	0,055399	-0,97	0,333	-0,1621711	0,0549889
logI	LD	-0,1346959	0,0708129	-1,9	0,057	-0,2734865	0,0040948
logI	L2D	-0,0661598	0,0590574	-1,12	0,263	-0,1819101	0,0495906
logNWHH	LD	-0,1769067	0,1262542	-1,4	0,161	-0,4243604	0,070547
logNWHH	L2D	-0,0166461	0,1240295	-0,13	0,893	-0,2597395	0,2264473
_cons		0,0005543	0,0004385	1,26	0,206	-0,0003052	0,0014139

(d) Short-term causal relationships

Log Y

test (D_logY): LD.logHHI L2D.logHHI (1)[D_logY]LD.logHHI=0 (2)[D_logY]L2D.logHHI=0 chi2(2) = 3.43 Prob > chi2 = 0.1804	test (D_logY): LD.logG L2D.logG (1)[D_logY]LD.logG=0 (2)[D_logY]L2D.logG=0 chi2(2) = 3.05 Prob > chi2 = 0.2174

test (D_logY): LD.logI L2D.logI (1)[D_logY]LD.logI=0 (2)[D_logY]L2D.logI=0 chi2(2) = 1.77 Prob > chi2 = 0.4125	test (D_logY): LD.logNWHH L2D.logNWHH (1)[D_logY]LD.logNWHH=0 (2)[D_logY]L2D.logNWHH=0 chi2(2) = 0.17 Prob > chi2 = 0.9192

Log HHI

test (D_logHHI): LD.logY L2D.logY (1)[D_logHHI]LD.logY=0 (2)[D_logHHI]L2D.logY=0 chi2(2) = 4.47 Prob > chi2 = 0.1068	test (D_logHHI): LD.logG L2D.logG (1)[D_logHHI]LD.logG=0 (2)[D_logHHI]L2D.logG=0 chi2(2) = 0.92 Prob > chi2 = 0.6303

test (D_logHHI): LD.logI L2D.logI (1)[D_logHHI]LD.logI=0 (2)[D_logHHI]L2D.logI=0 chi2(2) = 1.75 Prob > chi2 = 0.4178	test (D_logHHI): LD.logNWHH L2D.logNWHH (1)[D_logHHI]LD.logNWHH=0 (2)[D_logHHI]L2D.logNWHH=0 chi2(2) = 4.35 Prob > chi2 = 0.1138

Log G

test (D_logG): LD.logY L2D.logY (1)[D_logG]LD.logY=0 (2)[D_logG]L2D.logY=0 chi2(2) = 0.60 Prob > chi2 = 0.7414	test (D_logG): LD.logHHI L2D.logHHI (1)[D_logG]LD.logHHI=0 (2)[D_logG]L2D.logHHI=0 chi2(2) = 0.84 Prob > chi2 = 0.6557

test (D_logG): LD.logI L2D.logI (1)[D_logG]LD.logI=0 (2)[D_logG]L2D.logI=0 chi2(2) = 0.47 Prob > chi2 = 0.7914	test (D_logG): LD.logNWHH L2D.logNWHH (1)[D_logHHI]LD.logNWHH=0 (2)[D_logHHI]L2D.logNWHH=0 chi2(2) = 4.38 Prob > chi2 = 0.1121

Log I

test (D_logI): LD.logY L2D.logY (1)[D_logI]LD.logY=0 (2)[D_logI]L2D.logY=0 chi2(2) = 4.58 Prob > chi2 = 0.1014	test (D_logI): LD.logHHI L2D.logHHI (1)[D_logI]LD.logHHI=0 (2)[D_logI]L2D.logHHI=0 chi2(2) = 17.28 Prob > chi2 = 0.0002

test (D_logI): LD.logG L2D.logG (1)[D_logI]LD.logG=0 (2)[D_logI]L2D.logG=0 chi2(2) = 1.19 Prob > chi2 = 0.5508	test (D_logI): LD.logNWHH L2D.logNWHH (1)[D_logI]LD.logNWHH=0 (2)[D_logI]L2D.logNWHH=0 chi2(2) = 1.74 Prob > chi2 = 0.4195

Log NWHH

test (D_logNWHH): LD.logY L2D.logY (1)[D_logNWHH]LD.logY=0 (2)[D_logNWHH]L2D.logY=0 chi2(2) = 29.03 Prob > chi2 = 0.0000	test (D_logNWHH): LD.logHHI L2D.logHHI (1)[D_logNWHH]LD.logHHI=0 (2)[D_logNWHH]L2D.logHHI=0 chi2(2) = 10.19 Prob > chi2 = 0.0061

test (D_logNWHH): LD.logG L2D.logG (1)[D_logNWHH]LD.logG=0 (2)[D_logNWHH]L2D.logG=0 chi2(2) = 1.19 Prob > chi2 = 0.5516	test (D_logNWHH): LD.logI L2D.logI (1)[D_logNWHH]LD.logNWHH=0 (2)[D_logNWHH]L2D.logNWHH=0 chi2(2) = 3.77 Prob > chi2 = 0.1521

Appendix 6 – Diagnostic tests: autocorrelation

Lagrange-multiplier effect

lag	chi2	df	Prob > chi2
1	32.5715	25	0.14213
2	39.7488	25	0.03094

Note: H_0: no autocorrelation at lag order.