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House price cycles, housing systems, and growth models

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Abstract

The paper provides a framework for theorising the role of house price cycles in national growth models. We synthesise Minskyan approaches with comparative political economy (CPE) by arguing that institutions influence the extent to which countries experience what we call 'house price-driven growth models'. First, we argue that house price dynamics have been undertheorized in existing growth models analysis. Finance-led models can be properly understood only against the background of rising house prices that stimulate consumption through wealth effects and investment through construction. Second, we identify behavioural and Minskyan theories of housing cycles as suitable frameworks to theorise the impact of housing on growth. However, this literature does not provide an analysis of cross-country differences in housing cycles. Third, drawing on the CPE literature on housing systems, we argue that institutions such as homeownership rates and mortgage-credit encouraging institutions can explain differences in the intensity of housing cycles. We provide preliminary empirical support for this framework from a cross-country analysis. Our results show strong cross-country heterogeneity in the intensity of housing cycles. Countries with more intense house price cycles also tend to exhibit more volatile business and debt cycles. Homeownership rates and mortgage-credit encouraging institutions are positively correlated with the volatility of house price cycles.

Keywords: Post-Keynesian Economics, Comparative Political Economy, growth models, housing, house price cycles

JEL codes: E32, O57, R21, R31, B52

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1 Introduction

Housing markets and household debt and have received much attention in analyses of the 2008 Global Financial Crisis. Since then, specialised literatures have been growing in both comparative political economy (CPE) and heterodox economics that theorise unstable financial dynamics in the household sector. However, the extent to which household debt dynamics are linked to housing markets varies in these debates. In the growth models approach to CPE, housing sits within what is variably called the 'finance-led', 'debt-driven' or 'consumption-led' growth model (Baccaro and Pontusson, 2016; Ban and Helgadóttir, 2022; Reisenbichler and Wiedemann, 2022). For the USA, the UK, and Spain, the role of house prices and the construction industry as a driver of growth is widely acknowledged. However, the terms 'consumption-led' growth models and 'debt-led consumption boom' suggest a focus on consumption and its funding rather than on housing. Furthermore, many studies on other countries focus more on household debt rather than houses price cycles. In general, housing cycles do not form a core feature in the conception of these growth models (Wood and Stockhammer, 2020).

In heterodox economics, theoretical models of booms and busts in the housing market have been developed, drawing on behavioural and post-Keynesian/Minskyan approaches. In behavioural models, speculative economic actors are boundedly rational and prone to herd behaviour. Expectations about house price appreciation temporarily overshoot, leading to volatile cycles in house prices (Dieci and Westerhoff, 2012, 2016). In post-Keynesian and Minskyan approaches, asset price booms spill over to the real economy as they stimulate debt-financed private spending (Nikolaidi and Stockhammer, 2017). Booms thus come with a build-up of financial fragility that prepares the bust. While Minsky himself was mostly concerned with corporate debt and equity prices, more recent work has applied his framework to household debt and housing markets (Caverzasi and Godin, 2015; Ryoo, 2016; Zezza, 2008). While these models provide a rigorous explanation of the endogenous nature of cycles in housing markets and economic activity, they are relatively abstract and do not specify which countries or growth models are more likely to develop intense housing cycles. In particular, the focus has been on within-country rather than cross-country analysis.

A stream within the CPE literature studies varieties of 'residential capitalism', focussing on cross-country differences in housing institutions such as homeownership and household debt ratios (Schwartz and Seabrooke, 2008; Johnston and Kurzer, 2020). This literature argues that certain financial and housing institutions are conducive to mortgage credit expansion and can thus explain cross-country differences in the relevance of mortgage debt. However, this literature has not explicitly investigated the role of institutions for house price cycles as its focus is typically on debt and political outcomes.

This paper argues that while each of these streams of research contains important insights, due to their separation, these literatures individually fall short of providing a coherent account of the role of housing in growth models (henceforth GMs). We critically review the theoretical role of housing in the existing GM literature and conclude that it lacks a coherent foundation to theorise what we call 'house price-driven GMs'. Our contribution is, firstly, to provide a framework for integrating housing into the GM perspective, and, secondly, to provide some supportive cross-country evidence for this framework. At the theoretical level, we synthesise the Minskyan approaches to boom-bust cycles in housing markets with the CPE literature on

housing institutions. Our synthetic approach can be summarised as follows. First, house prices are central to the macroeconomics of growth processes and thus need to be a key feature of GM analysis. Second, house prices are driven by speculative behaviour that generates Minskyan endogenous cycles. House price dynamics affect consumption, residential investment as well as financial instability and thereby translate into business cycles. Third, we argue that housing institutions can explain cross-country differences in the intensity of such housing cycles. Drawing on the CPE literature on housing systems, we identify high homeownership rates and mortgage-credit encouraging institutions as country-specific factors that favour the emergence of house-price driven GMs.

We support our theoretical argument with empirical data from a cross-country dataset of 32 OECD countries. We employ turning point analysis to establish some stylized facts on house price cycles across countries. Our results suggest strong cross-country heterogeneity in the intensity of cycles. Countries with more intense house price cycles also tend to exhibit more volatile business and debt cycles. In recent decades, the intensity of cycles has become correlated with the growth contribution of investment, suggesting a role for residential investment. Finally, we present preliminary evidence that homeownership rates and, to a lesser extent, mortgage-credit encouraging institutions are positively correlated with the volatility of house price cycles, suggesting that institutional structures indeed matter for the relevance of those cycles across countries.

We conclude that the Minskyan approach provides a macroeconomic link between CPE analyses of housing systems and the growth models approach. Institutions determine the extent to which housing is treated as a speculative asset that favours unstable growth processes. This implies that political efforts to curb the cyclical dynamics of finance-led growth models should focus on the re-regulation of housing markets and of mortgage finance. Public housing can further reduce the share of housing available for speculation.

The paper is structured as follows. Section 2 critically reviews the role of housing in the GM approach and argues in favour of putting house price cycles at its centre. It then introduces behavioural and Minskyan approaches to speculative house price cycles. Finally, it links these approaches to the CPE literature on housing systems. Section 3 provides a concise statement of our framework for synthesising these approaches. Section 4 establishes some stylized facts on house prices dynamics across countries and provides preliminary evidence in support of our theoretical framework. Section 5 concludes.

2 Housing in growth models, heterodox macroeconomics, and CPE

2.1 Growth models: Debt-driven consumption-led growth or house price-driven growth?

Differences in growth dynamics across countries are a key topic in both CPE and Kaleckian macroeconomics. In the 2000s, CPE was dominated by the Varieties of Capitalism (VoC) approach (Hall and Soskice, 2001). VoC builds on neo-institutionalist theory and analyses how different institutional configurations can provide a comparative advantage to firms. It identifies institutional sources of microeconomic efficiency that allow different economic models to persist in a globalised world economy. Drivers of aggregate demand, in particular real estate booms and household debt, have not featured in first-generation VoC analyses due to its focus on corporate finance institutions and their implications for competitiveness.

In the early 2010s, Kaleckian macroeconomists developed the notion of "demand regimes" to capture country-specific macroeconomic regimes (e.g. Lavoie and Stockhammer, 2013a). In this approach, the formation of aggregate demand plays a key role, in particular through functional income distribution. Building on the model in Bhaduri and Marglin (1990), it was argued that demand regimes can either be wage-led or profit-led, depending on whether the stimulating effect of an increase in wage shares on consumption outweighs the potentially negative effect on investment. Lavoie and Stockhammer, (2013b) argue that in the neoliberal era, demand regimes are in principle wage-led, but due to falling wage shares, other growth drivers have taken centre stage: debt-driven and export-driven growth. Hein and Mundt (2013) identify export-driven GMs based on the respective contributions of net exports to GDP growth and for debt-driven models they use the growth contribution of private consumption combined with information on the change in borrowing by the household sector.

In 2016, Baccaro and Pontusson (2016) published a highly influential article that made the case for introducing Kaleckian macroeconomic analysis of demand regimes into CPE. They consider post-war capitalism as wage-led and the post-1980s as different forms of profit-led regimes. They analyse four country cases for the post-1980 period and distinguish between export-led (Germany and Sweden), what they call 'consumption-led' (UK), and a failed model (Italy). What defines these growth models is an institutional and political structure that favours a strong dynamism of a specific component of aggregate demand relative to the others. Baccaro and Pontusson (2016)'s "growth models perspective" has become widely used in CPE and inspired various follow-up studies (e.g. the edited volume by Blyth et al., 2022; Behringer and van Treeck, 2019; Hein et al., 2021; Kohler and Stockhammer, 2022; O'Donovan, 2021).

To understand the role of housing and house prices in the growth models approach, we must take a closer look at the analysis of debt-led growth models in the GM approach. The precise labels differ: Baccaro and Pontusson (2016) use 'consumption-led' growth, Hein and Mundt (2013) use the category of 'debt-driven consumption boom',[1] Lavoie and Stockhammer (2013b) speak of debt-driven growth. We want to highlight three theoretical weaknesses in these concepts: first, the question of whether consumption growth hinges solely on credit expansion or whether house price growth is a key factor in stimulating credit creation and consumption demand. Second, the question of how accurate it is to conceive of debt-driven GMs as predominantly consumption-led. Third, the question of cyclicality of the debt-driven model and of house prices in particular.

The first issue is about the determinants of consumption. Following Baccaro and Pontusson (2016) a wide range of CPE scholars use the term 'consumption-led growth models' (often with adding 'credit driven', e.g. Reisenbichler and Wiedemann 2022). In Baccaro and Pontusson (2016) as well as in Hein and Mundt (2013) this is based on a GDP growth decomposition that identifies consumption as the largest GDP component in terms of its growth contribution. However, for much of the institutionally oriented CPE literature causal chains in economic relations remain underspecified, thus there is some ambiguity about what drives consumption. For some authors (e.g. Reisenbichler and Wiedemann, 2022) it is clear that housing is central to credit growth and credit growth is central to consumption and economic growth. For others like Baccaro and Pontusson (2016), housing only features in a single

[1] Hein et al. (2021) speak of a 'debt-led private demand boom' to include the effects on private investment.

footnote, but through most of their analysis one could substitute ‘consumer credit’ for ‘household debt’.

In heterodox economics, causal relations are clearer as arguments are formulated as models that specify the relevant determinants. Below we will propose a Minskyan interpretation of the debt-driven growth model based on housing cycles. The main alternative to this (in heterodox economics) is the emulative-behaviour consumption theory. Emulative consumption posits that lower income households try to emulate the consumption levels of richer peer groups (Frank, 2014). For example, households may look to the income decile above their own. Microeconomically, that means that consumption not only depends on the household’s own income, but on the consumption (or income) of some reference group. Macroeconomically, it means that widening income inequality would lead to increasing consumption. It also means that some households will have to debt-finance their consumption. The theory is attractive to heterodox macroeconomists because it presents a feasible microeconomic alternative to mainstream economics and because it can explain some stylized facts of the US economy in the period before the Global Financial Crisis (GFC): rising income inequality paired with dynamic consumption growth and rising household debt. Kapeller and Schütz (2015) integrate the argument into a Minskyan model of consumer debt cycles and Behringer and van Treeck (2019) into a GM analysis of the United States. Belabed et al. (2018) develop the argument empirically in an open economy setting. Prante et al. (2022) present simulation results for a two-country macro model that effectively generates debt-driven as well as export-driven GMs. What all these models share is an understanding of the consumption-led GM as driven by consumer credit. They get by without mortgages and without a housing market.

The emulative consumption hypothesis is plausible in terms of its microeconomic analysis of consumption, but it is deficient as a theory of contemporary household debt. It may explain why households want to consume beyond their current income, but it does not explain why households would be confident in their ability to take on and service debt. Even if one grants that household are ignorant of the long-term financial implications of their consumption spending, the question arises why financial institutions would lend to households. Banks would only do so if the household can offer appropriate collateral. The most important financial asset of households is real estate and in fact most household debt is mortgage debt, not consumer debt. In short, emulative consumption behaviour can explain why households want to borrow more, but it cannot explain why banks are willing to lend to them. For that they need collateral, which establishes a centrality of house prices.

A second issue is the question of how central consumption growth is in ‘credit-driven consumption-led economies’. The origin of the concept of debt-led growth is the pre-GFC boom and, methodologically, GDP growth decompositions. Indeed, in that period in the USA and UK consumption growth constituted a large share of overall GDP growth. More generally, Ban and Helgadóttir (2022) identify a high share of consumption in GDP as a key characteristic of financialised GMs. However, this runs the danger of overstating the significance of consumption in the context of rising real estate prices. Investment seems to respond as least as strongly to changes in house prices as consumption (e.g. Stockhammer and Wildauer, 2016; Stockhammer and Novas Otero 2022). Investment is a smaller share in GDP than consumption (in advanced) economies, but it is also more volatile. In some economies, namely Ireland and Spain, residential investment has played an important role in the booms before the GFC.

The third issue is to what extent one regards house price cycles as due to specific circumstances or as systemic (endogenous) features. To illustrate, Reisenbichler and Wiedeman (2022, p. 236) write: "the very forces that bring about growth can also have destabilizing effects when financial actors engage in risk- taking behaviours, disrupt existing markets with new financial innovations, or exploit regulatory loopholes in pursuit of profit". This seems close to the position that financial crises are due exogenous shock. In contrast, a Minskyan approach, which we introduce more systematically below, argues that financial cycles are endogenous (Kohler and Stockhammer 2022).

In summary, the GM approach lacks a satisfactory explanation of the drivers of private demand in finance-led growth models. While emulative consumption may be a contributing factor, we argue that it cannot convincingly explain the rise of mortgage debt in many finance-led models, which is strongly linked to house price dynamics. We therefore posit that housing finance and house prices dynamics are central to understand debt-led GMs.

2.2 Heterodox macroeconomics: endogenous booms and busts in housing and economic activity

House price dynamics and their cyclical nature have received somewhat more attention in macroeconomics, both mainstream and heterodox. In the mainstream literature, the cyclicality of house prices has mostly been acknowledged in empirical research on 'financial cycles' (Borio, 2014; Claessens et al., 2012; Rünstler and Vlekke, 2018; Schüler et al., 2020; Strohsal et al., 2019). Three key stylised facts about financial cycles have been established. Firstly, credit and property prices follow each other closely, whereas equity prices exhibit more idiosyncratic dynamics; hence the financial cycle can best be characterised in terms of private credit and property prices. Secondly, the duration and amplitude of financial cycles is larger than that of conventional business cycles (i.e. cyclical changes in GDP). While conventional business cycles tend to last up to 8 years, the average length of financial cycles is roughly 16 years (Borio 2014). However, business cycles also exhibit a medium-term frequency that is closely correlated with financial cycles (Rünstler and Vlekke, 2018). Thirdly, recessions associated with house price busts are longer and deeper than other recessions (Claessens et al., 2012). Peaks associated with financial cycles are closely associated with systemic banking crises and recoveries associated with rapid growth in credit and house prices are often stronger (Borio, 2014). This suggests a strong link between property prices and economic activity.

What drives these financial cycles? Borio (2014, p.186) suggests that cycles are caused by endogenous forces such that `the boom sows the seeds of the subsequent bust'. However, the mainstream financial cycle literature has not yet put forward a coherent theoretical framework for modelling such endogenous cycles. The absence of a coherent theoretical underpinning for financial cycles may partly stem from the difficulty involved in modelling endogenous fluctuations within a neoclassical framework (Borio 2014). In a neoclassical world, housing markets do not generate endogenous boom-bust cycles. House prices are assumed to be determined by an arbitrage relationship between owner-occupied and rental housing (see Duca et al., 2021). In equilibrium, the rates of return (adjusted for costs) from owning and renting a house will be equal. House prices are then given by expected house price appreciation plus future rent income, discounted by the so-called "user cost" of housing (typically the sum of the interest rate, the rate of housing depreciation, and property-related taxes). If agents form rational expectations about future house prices, any shock will induce a fast adjustment of

house prices towards a stable path that leads the housing market back towards its fundamental equilibrium (see Dieci and Westerhoff 2016 for a neat discussion). While house prices may thus exhibit some temporary overshooting in response to shocks, there are no periodic cycles.[2]

The intrinsic stability of housing markets in neoclassical and New Keynesian models contrasts with behavioural and post-Keynesian/Minskyan frameworks. In these heterodox approaches, housing markets are a source of instability that can generate endogenous booms and busts – with severe spillovers to the real economy. This heterodox literature can broadly be grouped into behavioural and post-Keynesian/Minskyan approaches.

In behavioural asset pricing models, cycles are generated by the speculative behaviour of investors (Dieci and He, 2018; Hommes, 2006). Unlike in neoclassical models with a single representative agent, there is behavioural heterogeneity. Agents rely on simple behavioural rules (or heuristics) rather than rational expectations to anticipate future prices, and the prominence with which these rules are used changes over time. In a common setup, two types of rules are considered. Extrapolative rules assume that past trends continue and thus tend to destabilise price dynamics. Regressive rules expect prices to revert to their mean values. The interaction between these two types of expectation-formation rules is a key source of asset price dynamics.

Dieci and Westerhoff (2012) introduce such a mechanism into a simple housing model. The demand for houses is decomposed into real demand and speculative demand. Real demand is decreasing in house prices, but speculative demand is increasing in future expected prices. Expectations are then driven by the interplay of extrapolative and regressive rules. For house prices close to the equilibrium, the majority of agents are optimistic and expect further house price inflation. This leads to a boom during which house prices become overvalued. Construction responds to price increases. There is thus an interaction between demand and supply whereby (speculative) increases in house prices induce an expansion of the housing stock, which feeds back negatively into house prices via the real demand for houses. This will eventually induce some agents to expect a correction of house prices. As more and more agents switch to such regressive expectations, house prices embark on a downturn. Once house prices are close to their fundamental value, extrapolative expectations take over again and push prices below equilibrium. As a result of this interplay between extrapolative and regressive expectations as well as the housing stock, endogenous fluctuations emerge.[3]

While behavioural models offer rich analyses of endogenous cycles in housing markets, they typically do not analyse the effects of asset price cycles on aggregate economic activity. By contrast, post-Keynesian and Minskyan approaches consider the interaction of house price dynamics with private debt and business cycles (Caverzasi and Godin, 2015; Charpe et al., 2011, chap. 11; Ryoo, 2016; Zezza, 2008). Charpe et al. (2011, chap. 11) introduce a housing market into a high-dimensional Keynes-Metzler-Goodwin model. Housing dynamics are driven by the interplay of rent and the housing stock. During the boom, rising rents have expansionary effects on output via an increase in construction. It is assumed that worker

[2] Qualitatively similar results previal in more complex dynamic stochastic general equilibrium models, where fluctuations in housing markets are driven by exogenous shocks. For example, in Iacoviello and Neri (2010)'s estimated DSGE model of the US housing market, the 1998-2005 boom is mostly explained by technology shocks, while monetary policy shocks account for most of the subsequent bust.

[3] Dieci and Westerhoff (2016) provide an extension of this framework in which the equilibrium house price is derived from a user cost framework, facilitating the comparison of the behavioural with a neoclassical approach.

households consume in excess of their income, thus go into debt. The increase in debt over time depresses consumption, while the increase in the housing stock reduces the return on housing from rents, which reduces in residential investment. This brings the cycle to an end. However, house prices are not analysed explicitly.

Similar dynamics are at play in Zezza (2008)'s stock-flow consistent model with a housing market, where poor households can buy or rent houses from rich households. Poor households can also take out debt to finance consumption based on the emulation approach discussed above. Rich households invest in houses based on expected capital gains, forming extrapolative expectations. A shock to expected house prices triggers a sustained housing boom that stimulates residential investment. Through wealth effects, the consumption of rich households increases. This induces emulation effects by poor households who go into debt, which sows the seeds for the downturn.

Unlike these models, in which emulative consumption is a key mechanism, Ryoo (2016)'s model introduces a collateral channel into a Minskyan house price model. House price inflation relaxes collateral constraints and induces households to take on more credit to finance consumption. The build-up of debt during the boom ultimately weighs on consumption due to an increasing debt-service burden. To maintain their desired housing to consumption ratio, households reduce their demand for housing accordingly, which depresses house prices and brings the boom to an end. Collateral-based consumption effects can also be found in the stock-flow consistent model by Caverzasi and Godin (2015).[4]

The aforementioned models are all theoretical, which reflects a noticeable imbalance between theoretical and empirical work on housing in these traditions. While there are empirical studies in the behavioural approach, they have so far focused on stock markets (Chiarella et al., 2014; Lof, 2012; Hommes and in 't Veld, 2017) and foreign exchange markets (Westerhoff and Reitz, 2003; de Jong et al., 2010) rather than on housing. Gusella and Stockhammer (2021) provide evidence that house price dynamics are consistent with momentum trader models based on aggregate data for the USA, UK and France. Empirical work in the Minsky tradition is sparse and has focussed on household debt rather than house prices (Palley, 1994; Kim, 2016).

In sum, heterodox approaches highlight the intrinsic instability of housing markets. In behavioural models, house prices are prone to endogenous boom-bust cycles due to speculative behaviour. Post-Keynesian and Minskyan approaches theorise the effects of house prices on macroeconomic dynamics, either via residential investment (Charpe et al. 2011; Zezza 2008) or consumption through collateral constraints (Caverzasi and Godin 2015; Ryoo 2016). In this way, Minskyan approaches fill the gap in the theory of consumption-led GMs discussed in the previous section. However, a limitation of these macroeconomic theories is that they have little to say about differences across countries. Certain parameters will determine models' dynamics such as the existence and intensity of cycles, and these parameters indirectly capture structural features of the model economy.[5] The theoretical literature typically offers little discussion of country-specific factors, in particular what institutions, would influence the existence and

[4] Different from some of the literature discussed in the previous section, the emulation effect in their model impacts households desired consumption (and thus credit demand), but credit supply is based on the leverage ratio of household, which depends on house prices.

[5] In recent behavioural models, Martin et al. (2021), Martin et al. (2022), and Schmitt and Westerhoff (2022) examine the role of housing taxes, monetary policy, and rent controls, respectively, on the amplitude of their model's cycles.

intensity of housing cycles. This means these approaches cannot be readily utilised for comparative analyses.

2.3 CPE on housing institutions across countries

The CPE literature on housing often has a focus on distributional and political (rather than economic) outcomes, but also analyses cross-country differences in institutions such as homeownership rates and household debt levels (see Johnston and Kurzer, 2020 for an overview). While it has not explicitly analysed speculative behaviour in housing markets, it identifies institutions that shape different housing systems. We argue that it provides a useful resource to build an understanding of differences in housing cycles across countries and the role of institutions therein.

Early work in CPE focussed on the level of homeownership as a key characteristic of housing systems (Harloe, 1995; Kemeny, 1995). It was argued that regulated housing markets arose in the Nordic and European core countries, where governments invested in rent-controlled and abundant social housing, which in turn competed with the private rental sector to push up standards and disincentivised homeownership. By contrast, profit-based housing markets with high owner-occupier rates arose in Anglo-Saxon countries such as the UK, the USA, and Southern Europe, where governments were unwilling to provide a decent alternative to homeownership.

A seminal paper by Schwartz and Seabrooke (2008) combined the focus on owner-occupancy with the structure of housing finance. They distinguished between Liberal-market (e.g. UK and US), Corporatist-market (e.g. Germany and Denmark), Statist-developmentalist (e.g. France and Japan), and Familial (e.g. Italy and Slovenia) housing systems. Liberal-market systems are characterised by high owner-occupier rates and high mortgage-debt to GDP ratios. Corporatist-market systems also have high debt ratios but low owner-occupier rates. Statist-developmentalist regimes have both low debt ratios and low owner-occupier rates. In the latter two groups where homeownership rates are low, social rental plays a significant role. Finally, familial systems exhibit low debt ratios but relatively high owner-occupier rates. In contrast to the liberal system where home ownership is mostly mortgage-financed, familial systems rely more on family-inherited ownership.

A recent literature has deepened the focus on housing finance by identifying institutions that favour mortgage debt expansion. Schwartz (2008) argues that high homeownership rates and liberalised mortgage institutions, such as mortgage refinancing and securitization, determined whether the low interest rates prior to the GFC had effects on economic growth. Fuller (2015) focuses on nationally divergent institutions and policies on credit formation, highlighting five national institutions that explains cross country heterogeneity in household borrowing: interest rate restrictions; capital gains on the transfer of households' assets; a societies' acceptance of high debt levels (proxied by the typical loan-to-value ratio); mortgage subsidies; and the size and type of the secondary debt market. Van Gunten and Navot (2018) argue that heterogenous credit institutions, such as the length of mortgage maturity, type of interest rate, early repayment, equity withdrawal, capital market funding, tax subsidies and foreclosure rules explain the increase in mortgage debt beyond an expansion of homeownership. Ryan-Collins (2021) emphasises the role of government policies in stimulating private demand for houses through tax incentives (e.g. exemptions from capital gains taxes) and subsidies on mortgage-

financed house purchases as well as the privatisation of social housing (e.g. the famous Right-to-Buy legislation by the British Thatcher government).

Overall, the CPE literature draws attention to institutional determinants of cross-country differences in housing markets. While it does not offer a macroeconomic analysis of housing cycles, it highlights the prevalence of homeownership as opposed to rental markets as a key property that distinguishes different housing system. Furthermore, the emphasis on credit-encouraging institutions that enable mortgage-financed homeownership establishes a point of contact to the Minskyan literature in which credit expansion plays a key role in housing cycles.

3 Putting the pieces together: a framework for integrating housing cycles into growth models

Our discussion of these relatively independent strands of literature suggests that heterodox theories of cycles and the CPE literature on institutions can help develop a better understanding of the role of housing in GMs. We propose synthesising these approaches as follows.

First, house prices assume a central role as (unstable) growth drivers in finance-led GMs. The role of consumption demand in these models can only be properly understood against the background of rising house prices that stimulate consumption through wealth effects and provide the necessary collateral for an expansion of credit (Caverzasi and Godin 2015; Ryoo, 2016; Wood and Stockhammer 2020). In addition, house price growth stimulates residential investment and construction activity, thereby boosting aggregate demand beyond consumption (Charpe et al. 2011; Zezza 2008; Stockhammer and Wildauer 2016). We thus propose to speak of house price-driven GMs.

Second, based on the behavioural and Minskyan literature, house prices should be regarded as inherently cyclical. In periods of optimism, housing markets boom, and prices overshoot due to speculative demand (Dieci and Westerhoff 2012, 2016). Such episodes can drive economic activity for a sustained period of time but often come with a build-up of household debt (Caverzasi and Godin 2015; Ryoo, 2016). Once speculative actors start to anticipate a revaluation of houses, prices decrease, which tightens collateral constraints and makes the refinancing of mortgages difficult. This turns the boom into a bust where demand for houses collapses, prices fall, and households deleverage. Endogenous house price cycles are thus a key driver of cyclical growth dynamics.[6]

Third, drawing on the CPE literature on housing, we argue that cross-country differences in the presence and intensity of house prices are linked to housing institutions. While this is an area that requires further research, the existing literature helps identify an initial set of institutions that are potentially relevant for house price dynamics (Schwartz and Seabrooke 2008, Fuller 2015). First, the *homeownership rate* measures the prevalence of private homeownership as opposed to social housing and can be taken as a proxy for the size of the private market. A large private market for houses, populated by many individual actors with bounded rationality, increases housing turnover and creates incentives to regard houses as assets rather than shelter.

[6] Growth may indeed feed back into house price dynamics. House prices should thus not be conceived as entirely exogenous to economic activity. However, due to speculation, house prices have an exogenous component and can thus be regarded a growth driver.

Second, *easy access to mortgage credit* will enable the speculative dynamics highlighted in the Minskyan literature. If a substantial share of potential homebuyers were credit constrained or discouraged to take out mortgages due to regulatory barriers, debt-financed housing bubbles are much less likely to emerge.

Figure 1: Stylized representation of house-price driven growth model

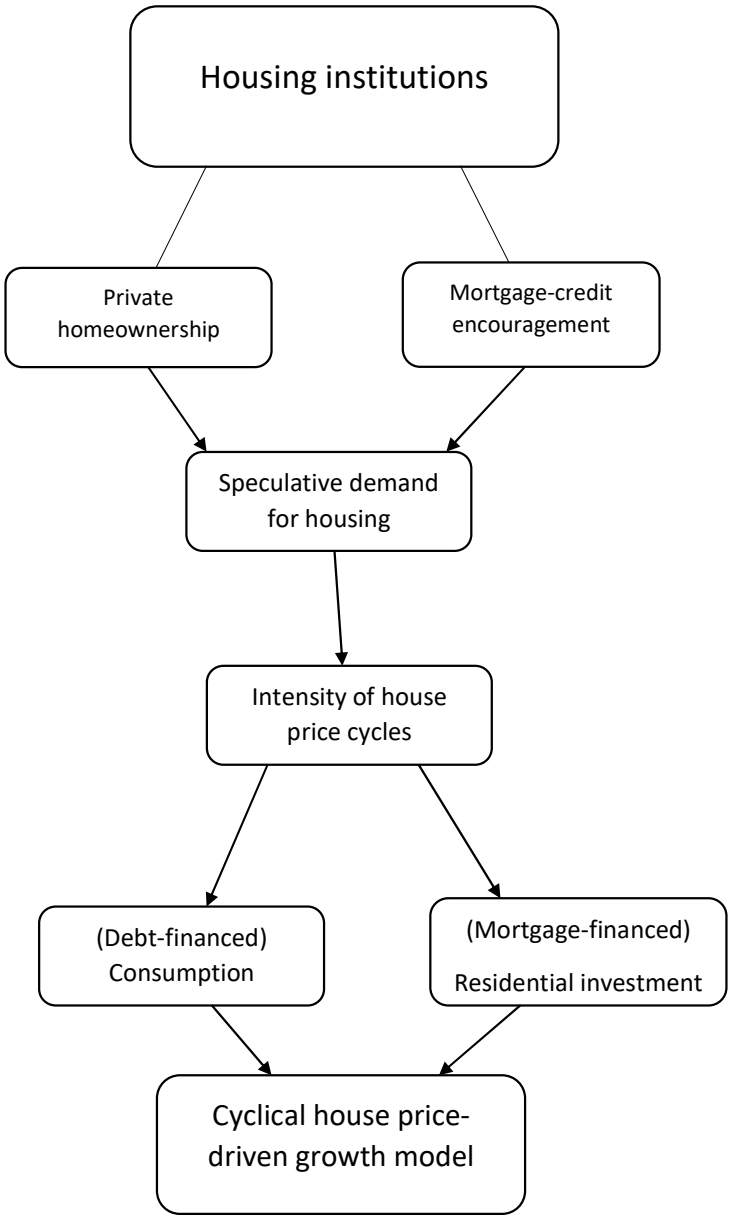


Figure 1 visualises our proposed framework. While admittedly rudimentary, such a synthesis provides foundations for a better understanding of why some countries are more likely to exhibit house price-driven GMs than others. In the following, we provide some preliminary empirical support for this perspective.

4 House price cycles, macroeconomic dynamics, and institutions: preliminary empirical evidence

4.1 House price cycles across countries: stylized facts

We start out by examining cross-country differences in house price cycles for an unbalanced panel of up to 32 OECD countries over the periods 1970 to 2019.[7] To study cyclical properties, methods such as frequency domain analysis (Strohsal et al., 2019; Schüler et al., 2020) or multivariate structural time series models (Rünstler and Vlekke, 2018) have been used in the financial cycle literature. A common approach has been to isolate cyclical components through a filter such as the Hodrick-Prescott filter or the log-difference (e.g. Drehmann et al., 2012; Borio, 2014; ECB, 2018; Strohsal et al., 2019). We rely on a simpler turning point algorithm that has the advantages of being non-parametric and not requiring any prior transformation of the relevant time series.

The turning point algorithm is based on Harding and Pagan (2002) and identifies peaks and throughs in a (logged) quarterly time series x_t, in our case the log of real house prices, based on several criteria. In essence, a 10-quarter window is chosen to date local minima and maxima in the time series, and only cycles with a length of at least 20 quarters are retained (see Appendix A2 for details). Such an algorithm, albeit imposing slightly different criteria, has also been used in Drehmann et al. (2012) and in Claessens et al., (2012).[8]

Once turning points have been identified in this way, the amplitude (in percent), the duration (in years), and the slope (amplitude over duration, i.e. percentage change per year) of a boom (bust) can be calculated. Table 1 presents average values for booms and busts over the full sample period (1970-2019). The average duration of a boom is close to 9 years, whereas busts are slightly shorter (around 6 years). A complete cycle thus has an average length of around 15 years. During a boom, real house prices increase by around 50% on average, and then fall by around 35% in busts. The higher amplitude of booms compared to busts reflects a secular trend in real house prices in many countries since the 1970s. The average slope, which is a measure of the intensity of cycles, is around 6.5% per year, with similar values for booms and busts. Compared to the amplitude, the slope is thus less affected by the trend component in house prices.

[7] See Appendix 1 for further information on the dataset.

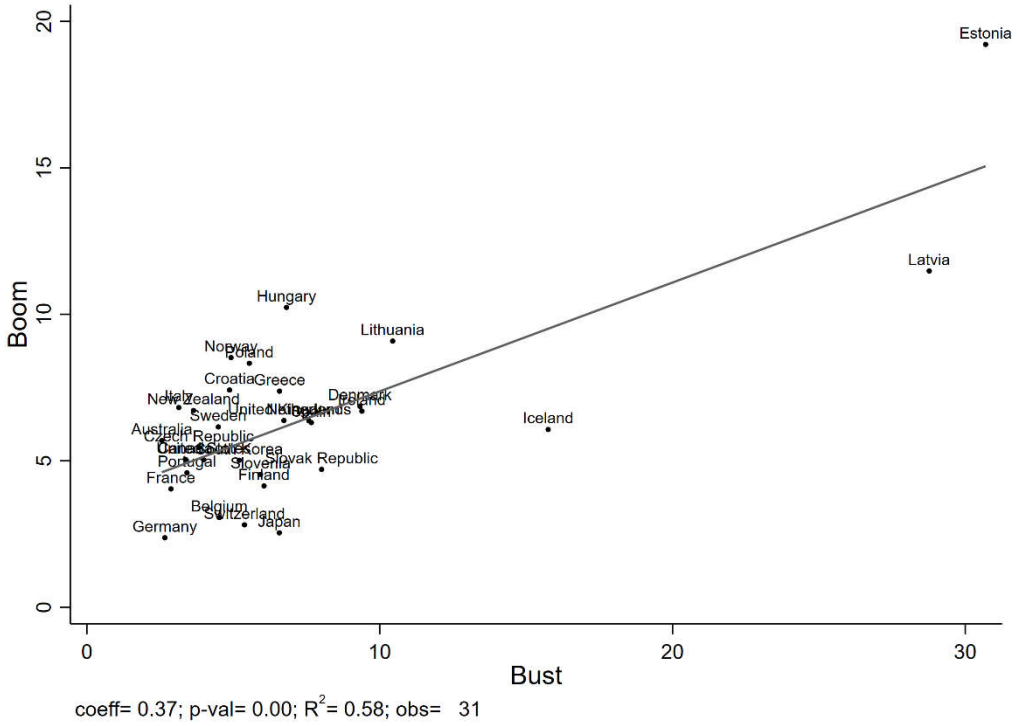
[8] Drehmann et al. (2012) impose a 5-quarter rather than a 10-quarter window to identify local peaks. We chose the longer period to focus on medium-term cycles. In addition, we add a further criterion to include truncated phases at the sample start and end to maximise the sample period. See Appendix A2.

Table 1: Average duration, amplitude, and slope of boom-bust episodes in real house prices, 1970-2019

	Duration (years)	Amplitude (% change)	Slope (% change per year)
Boom	8.7	50.3	6.3
Bust	5.7	35.3	7.4
Average	7.5	44.2	6.6

Notes: Slope: amplitude/duration. Based on an unbalanced panel of 32 OECD countries (see Appendix 1 for further details on the data).

Figure 2: Average slopes of booms in house price cycles against busts, 1970-2019



Notes: Slope: amplitude/duration (% change per year). See Appendix 1 for details on the data. When excluding Estonia and Latvia from the sample, the estimated coefficient is still positive and has a p-value of 0.08.

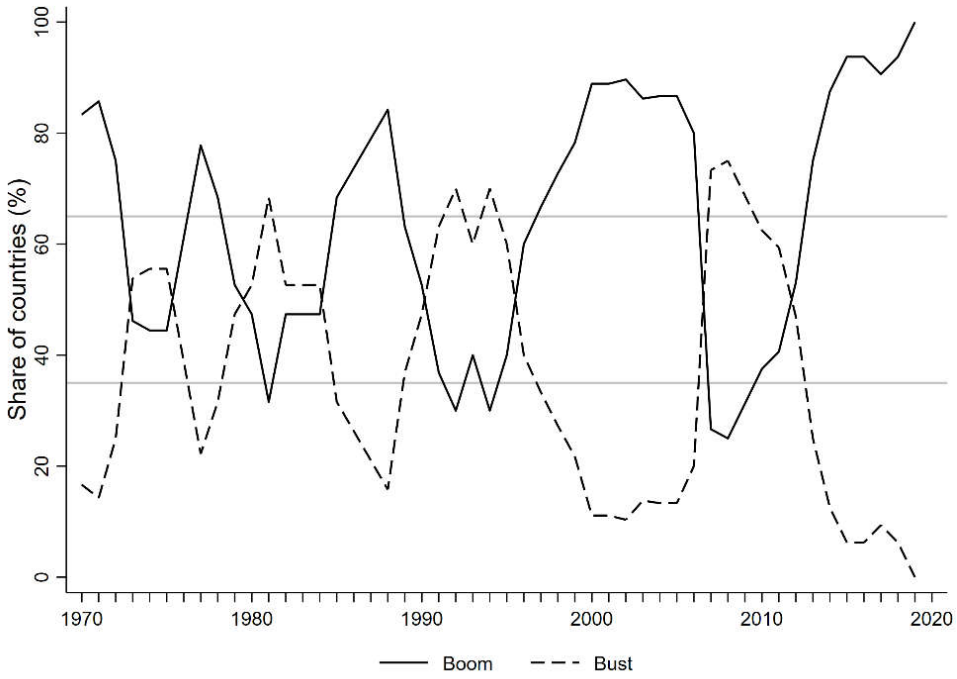
The slope of house price cycles is of particular interest as it is a key measure of their intensity. To assess the relationship between booms and busts, Figure 2 plots the slopes of house price booms against busts. The correlation is positive and statistically significant at the 1%.[9] Thus, intense booms are typically followed by intense busts, in line with the theory of endogenous

[9] The results are not driven by the extreme cases of Estonia and Latvia. When excluding those countries, the estimated coefficient is still positive and has a p-value of 0.08.

cycles put forth in the behavioural literature (Dieci and Westerhoff, 2012; Dieci and Westerhoff, 2016).

The unconditional probability for a country in our sample to be in a boom (bust) phase as identified by the turning point algorithm is around 65% (35%). Figure 3 displays the share of countries in the sample that are jointly in a boom (solid line) or a bust (dashed line). There are periods in which the share of countries in a boom phase exceeds 65% (represented by the upper horizontal line), implying that cycles are synchronised across countries during these periods. Notable episodes are a relatively synchronised boom in mid-1980s that ended in busts in the 1990s. For many countries, a long boom then began in the late 1990s that came to an end with the GFC. Since around 2013, many countries have embarked again on housing booms, with more than 90% of countries in our sample being in expansion mode since 2015. The years before the 2020 outbreak of the COVID-19 pandemic thus exhibited the most synchronised housing expansion since the 1970s, suggesting that a global house-price slump may be around the corner.

Figure 3: Share of countries in a house price boom or bust, 1970-2019



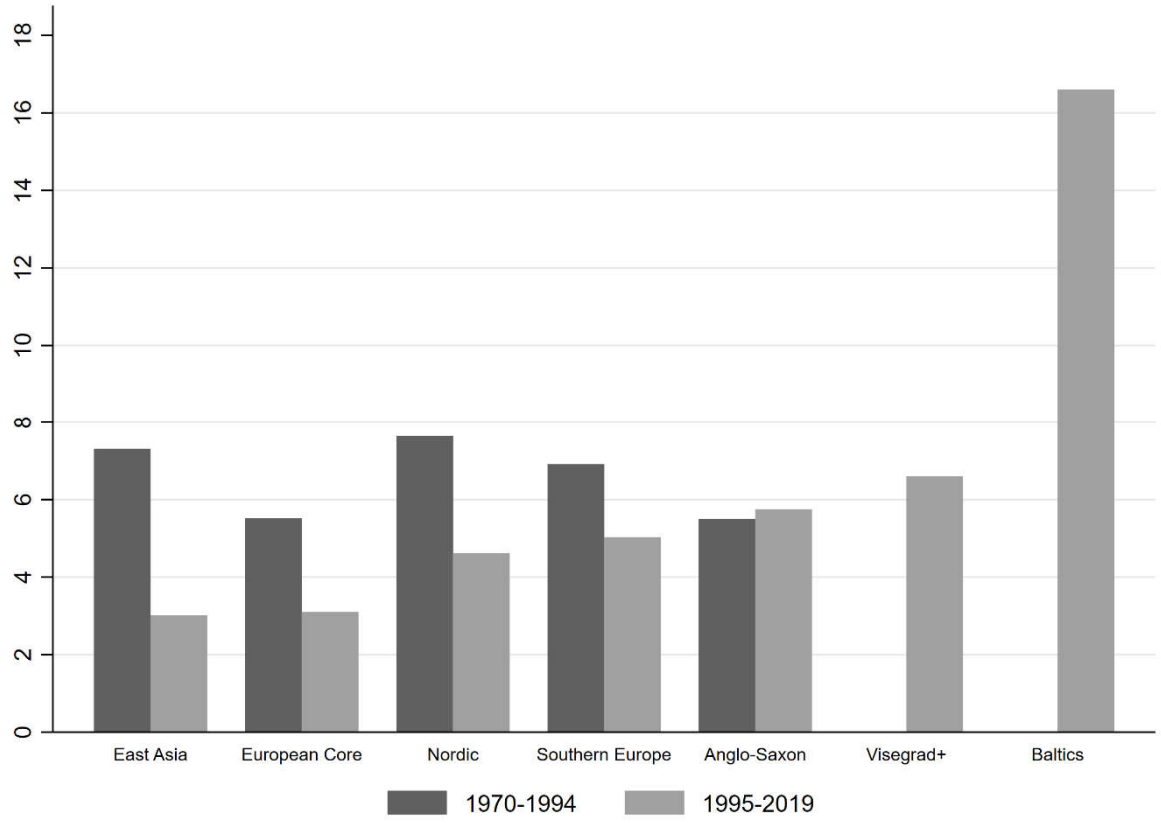
Notes: Horizontal bars represent the unconditional probability of being in boom (65%) or bust (35%) over the full sample period. Based on an unbalanced panel of 32 OECD countries (see Appendix 1 for further details on the data).

While there is some synchronicity in house price cycles across countries, especially around the GFC, there is also substantial heterogeneity. Most of the time, the share of countries in a boom (bust) is within the band given by the unconditional probabilities, indicating that in these periods, there is no strong cycle synchronicity. Indeed, several papers find that the synchronicity of house price cycles across euro area countries is considerably lower than it is for GDP and other financial variables (ECB, 2018; Schüler et al., 2020). This suggests that

housing cycles can be relatively independent across countries and shaped by country-specific factors.

Figure 4 shows cross-country differences in the average slope of house price cycles for different groups of countries.[10] We split the sample into two periods of approximately equal length (1970-1994 and 1995-2019) to assess changes over time and to account for the fact that for some countries (especially Eastern Europe), the series only start in the second period. We group countries, based on a mixture of geography and CPE analyses, into East Asia (Japan and South Korea), European Core (Austria, Belgium, France, Germany, the Netherlands, and Switzerland), Nordic (Denmark, Finland, Norway, and Sweden), Southern Europe (Greece, Italy, Portugal, and Spain), Visegrád+ (Czech Republic, Hungary, Poland, Slovakia plus Slovenia), Anglo-Saxon (Australia, Canada, Ireland, New Zealand, UK, and USA), and Baltics (Estonia, Latvia, and Lithuania).

Figure 4: Average slope of house price cycles by country group, 1970-1994 and 1995-2019



Notes: Slope: amplitude/duration (% change per year) of house price cycles, average over booms and busts. Bars are ordered ascendingly based on the values for the period 1995-2019. Slopes are dated at the end of an episode, e.g. a boom starting in 1990 but ending after 1994 will be included in the second period. East Asia: Japan, South Korea; European Core: Austria, Belgium, France, Germany, the Netherlands, Switzerland; Nordic: Denmark, Finland, Norway, Sweden; Southern Europe: Greece, Italy, Portugal, Spain; Visegrád+: Czech Republic, Hungary, Poland, Slovakia plus Slovenia; Anglo-Saxon: Australia, Canada, Ireland, New Zealand, UK, USA; Baltics: Estonia, Latvia, Lithuania. Croatia and Iceland not included in this chart. See Appendix 1 for more details on the data.

[10] Average slopes for individual countries are reported in Figure A1 in the Appendix.

In the first period (1970-1994), cross-country variation in the intensity of slopes was relatively modest. The Anglo-Saxon and Core European countries exhibited the lowest slopes (around 5.5% per year). The most intense house price cycles were found in the Nordic countries (Sweden being the exception), with average slopes of around 7.6%. This pattern changes substantially in the second period (1995-2019). While house price cycles did not uniformly become more intense, there is much greater variance across countries, partly due to the greater sample size, with slopes for individual countries ranging from less than 2% per year (Finland) to staggering 23% (Estonia) (see Figure A1 in Appendix 1). Country groups that exhibit moderate house price cycles comprise the European Core and now also East Asia as well the Nordic countries. Southern Europe on average has a lower slope but exhibits strong heterogeneity, with Greece and Spain undergoing substantially more volatile cycles than Portugal and Italy. The Anglo-Saxon countries experience more intense house price cycles in this period with an average slope of 5.7% per year. At the top are the countries at the eastern periphery of the European Union: the Visegrád+ countries and, exhibiting the most extreme cycles, the Baltics.

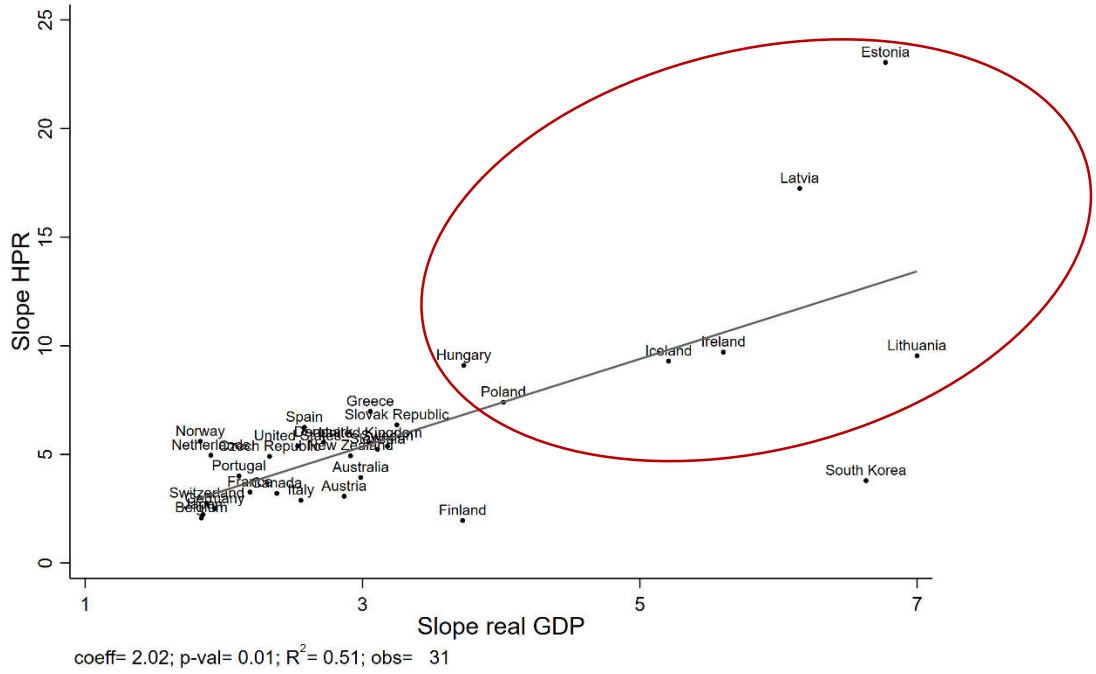
Overall, there is substantial heterogeneity in the intensity of house price cycles across countries, especially since the mid-1990s. Some country groups such as the European core have consistently exhibited relatively stable housing markets, whereas Southern Europe and Anglo-Saxon countries tend to have more volatile ones. Eastern Europe as a whole exhibits the most unstable house prices in recent decades, with slopes up to five times larger than in the European core.

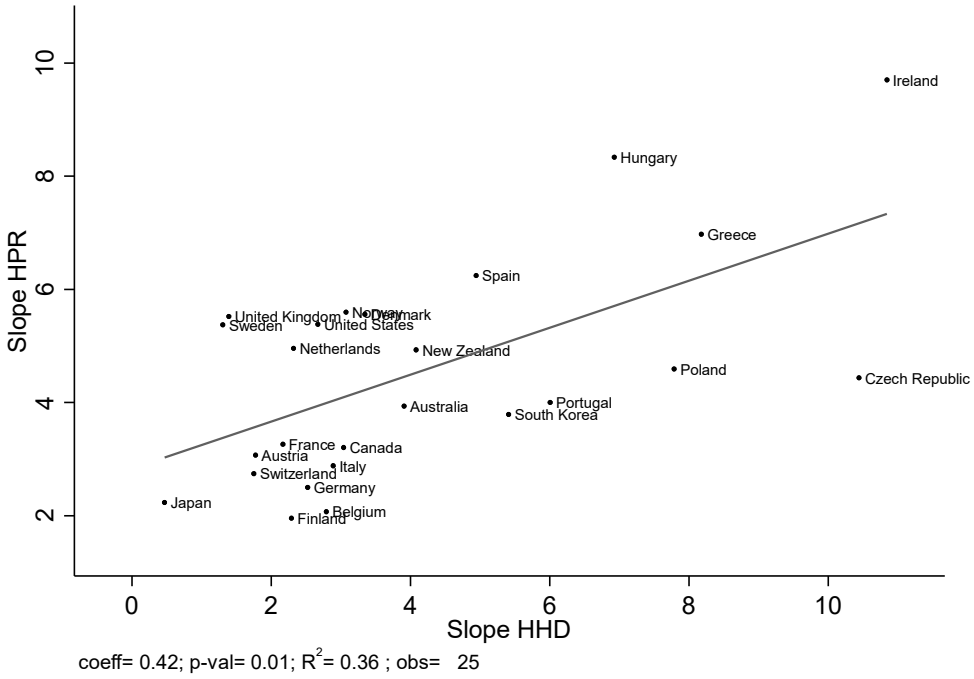
Taken together, the stylized facts presented in this section support the notion of regular boom-bust cycles in real house prices. Countries with more intense booms in house prices also undergo more intense busts. While house price cycles were strongly synchronised around the GFC, there are substantial differences across countries, not only in the timing of cycles but also in their intensity. In recent decades, Eastern Europe and Anglo-Saxon (as well as some southern European) countries underwent much more volatile cycles compared to the Nordic, Core European, and East Asian countries.

4.2 House price cycles and macroeconomic dynamics

The Minskyan approach implies that asset prices are closely correlated with business cycles via their effects on private demand and debt. To assess whether the stylized facts across countries are consistent with this prediction, Figures 4 and 5 plot the slope in house prices against several macroeconomic indicators. Importantly, the bivariate correlations visible in the scatter plots should not be interpreted as causal estimates of the effect of house prices on economic activity. Instead, they represent stylized facts whose consistency with the Minskyan framework is to be assessed. Even more relevant for our purposes is the ability of scatter plots to visualise country-characteristics which allows for a comparative analysis.

Figure 4: Average slopes of house price cycles (HPR) against slopes in real GDP and household debt to GDP ratio, 1995-2019





Notes: Slope: amplitude/duration (% change per year). *HPR*: log of real house prices; *real GDP*: log of real gross domestic product; *HHD*: household debt to GDP ratio. No *HHD* data for Iceland, Slovakia, Estonia, Latvia, Lithuania, Croatia, and Slovenia. See Appendix 1 for details on the data. When excluding Ireland, the coefficient is in the bottom panel is still positive and has a p-value of 0.06.

Figure 4 plots the average slope of house price cycles against the slopes in real GDP (upper panel) and the slope of the household debt to GDP ratio (lower panel) for the period 1995-

2019. Countries with volatile boom-bust cycles in housing markets, such as the Baltics, the Anglo-Saxon countries Ireland and the UK, and the Visegrád countries Hungary and Poland, also exhibit intense business and debt cycles.[11] These findings corroborate the Minskyan view that cycles in asset markets, in this case housing, are closely linked to cycles in economic activity and private debt (Ryoo, 2016; Zezza, 2008). Our analysis suggests that above all the Anglo-Saxon, Baltic, and Visegrád countries may be characterised as house-price driven growth models.[12]

4.3 House price cycles and institutions

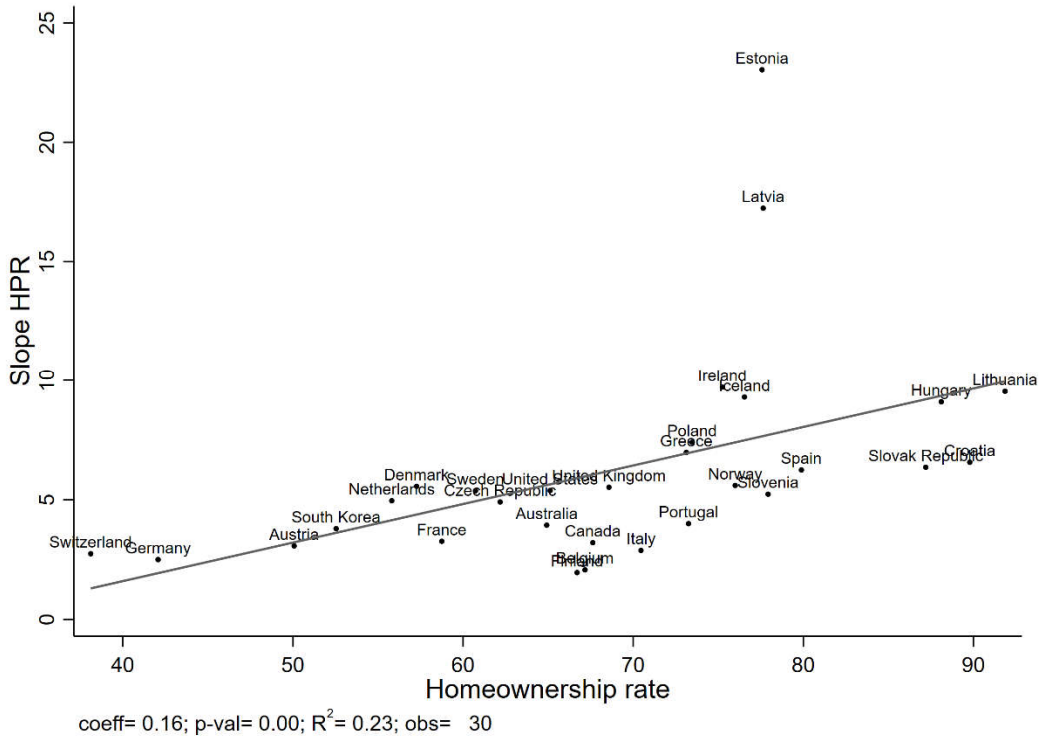
Based on the CPE literature on housing, we argue that institutions are likely to impact the relevance of these housing cycles across countries. Homeownership rates and financial institutions that encourage mortgage credit creation are the two most important ones highlighted in this approach (Johnston and Kurzer, 2020; Schwartz and Seabrooke, 2008; Fuller, 2015). Here we will focus on these two institutions without implying that they are the only relevant ones for housing cycles.

Figure 5 shows that the homeownership rate exhibits a remarkably tight relationship with the intensity of housing cycles. Countries with high homeownership rates, such as Ireland, Spain, and the Eastern European ones tend to exhibit much more volatile cycles than those with low homeownership rates, such as the German-speaking ones.

[11] The result with HHD are not driven by the extreme value for Ireland. When excluding Ireland, the coefficient is still positive and has a p-value of 0.06.

[12] Figures A2 and A4 in Appendix 3 further display the correlation between the average slope of house price cycles and the average relative GDP growth contributions of investment as well as construction. The relationship is positive and statistically significant, suggesting that residential investment may be a key driver of the relationship between house prices and economic activity, supporting the argument that finance-led GMs are not just driven by consumption but also by (residential) investment (Charpe et al., 2011; Zezza, 2008).

Figure 5: Average slopes of house price cycles (HPR) against average homeownership rate, 1995-2019



Notes: Slope: amplitude/duration (% change per year). See Appendix 1 for details on the data.

Figure 6: Average slopes of house price cycles (HPR) against mortgage credit encouragement index, 1995-2019

Notes: Slope: amplitude/duration (% change per year); Mortgage encouragement index is taken from Fuller (2015) and is based on interest rate restrictions; capital gains on the transfer of households' assets; the typical loan-to-value ratio; mortgage subsidies; and the size and type of the secondary debt market. See Appendix 1 for details on the data.

Figure 6 displays the link between cycle intensity and an index of mortgage credit encouragement developed in Fuller (2015). The index takes on higher values for countries with institutions that are more conducive to mortgage credit expansion, considering interest rate restrictions; capital gains on the transfer of households' assets; the typical loan-to-value ratio; mortgage subsidies; and the size and type of the secondary debt market. There is a positive and statistically significant link but the relationship is weaker compared to the homeownership rate, and the R-squared of 7% is rather low. Anglo-Saxon countries like the US, Ireland, and the UK exhibit high scores along with peripheral countries such as Iceland and Lithuania and also underwent intense housing booms in the last decades. By contrast, core European countries such as Austria and Germany exhibit more restrictive credit institutions. This suggests a potential role for mortgage-credit encouraging institutions, but further research is needed to assess the robustness of this relationship.

In sum, these two institutional factors alone certainly do not fully explain the cross-country variation in house price cycles, but they do provide elements of an answer to the question why some countries are more prone to develop unstable house-price driven GMs. First, countries with high homeownership rates and thus large private housing markets are more prone to

exhibit volatile housing cycles. Second, financial institutions conducive to mortgage credit expansion might further increase the volatility of cycles.

5 Conclusion

This paper has argued for assigning a central role to house price dynamics in the analysis of growth models. House price growth is key for debt-driven models, emulative consumption behaviour at best an amplifying factor. While the existence of booms and busts in housing markets has been noted previously, especially in the literature on finance-led growth models (Ban and Helgadóttir, 2022; Reisenbichler and Wiedemann, 2022), the key role of house prices as a cyclical driver of both consumption and investment has not been fully appreciated (Wood and Stockhammer 2020). Similarly, the CPE literature on housing has studied the varied rise of mortgage debt across countries but has not systematically analysed house price cycles, nor their implications for the growth models perspective (Johnston and Kurzer, 2020; Fuller, 2015; Schwartz and Seabrooke, 2008).

We have argued that behavioural and Minskyan approaches provide the missing link between the growth models approach and the CPE literature on housing (see also Stockhammer and Wolf, 2019). Behavioural approaches highlight the role of speculative dynamics in driving endogenous housing cycles (Dieci and Westerhoff, 2012; Dieci and Westerhoff, 2016). The Minskyan approach emphasises the relevance of such asset price dynamics for finance-led growth (Caverzasi and Godin, 2015; Charpe et al., 2011; Ryoo, 2016; Zezza, 2008). As housing wealth is now widely distributed (much more widely than other forms of financial wealth) and real estate is a commonly used collateral, housing has become macroeconomically important (relative to corporate debt and equity). Like other asset prices, house prices (in a liberalised economy) are prone to cyclical dynamics. Such booms and busts are not merely accidents, but a systemic feature of private housing markets.

Based on this integrated theoretical framework, we have proposed the notion of a house-price driven growth model. House price booms may drive growth for temporary episodes of around 8 years on average, after which deep busts follow that render this type of growth model intrinsically unstable. Our cross-country analysis showed that countries are not equally susceptible to these cycles. In recent decades, it was mostly Anglo-Saxon, some southern European and above all Eastern European countries that exhibited house-price driven growth models. By contrast, core European, Nordic, and East Asian countries are characterised by more stable housing markets. Institutions identified in the CPE literature on housing systems matter; arguably those that encourage speculative dynamics in housing markets. Countries with comparatively large private housing markets exhibit much more volatile house prices. In addition, less regulated mortgage markets may be more likely to undergo speculative bubbles. However, the exact role of housing institutions will require further research.

Our approach provides an understanding of why some countries are more likely to exhibit unstable finance-driven growth models that so far has been lacking in both the GM perspective and in heterodox macroeconomics. Combined with country studies from the CPE literature, this perspective brings in a role for policy. Bohle (2014, 2018) analyses the privatisation of the public housing stock in Estonia, Latvia, and Hungary as a key institutional change that created the environment for the spectacular housing bubbles these countries underwent in the years

before the GFC. High levels of private homeownership were accomplished via Right-to-Buy policies combined with tax exemptions that incentivised tenants to buy property. Similar developments took place one or two decades before in Iceland and Ireland (Bohle, 2018) as well as the US and UK (Reisenbichler and Wiedemann, 2022; Ryan-Collins, 2021). By contrast, most core European and some Nordic countries exhibit low homeownership rates and less volatile housing cycles, partly due to a greater role for social housing (Kholodilin et al., 2022).

The fact that institutions that favour housing cycles are the result of policy also implies that action can be taken to curb cycles. Ryan-Collins (2021) suggests a number of measures, such as imposition of a land value tax that disincentivises speculative purchases of land, tenant protection laws that make the rental market more attractive, and stricter macroprudential regulation of mortgage credit creation. In addition, an active policy of social housing or the promotion of non-profit housing associations can help transform housing from a speculative asset that generates macroeconomic instability into a good that provides shelter and stability.

What do our arguments mean for future research on finance-led growth models? Are all finance-led growth models house price-driven? The growth models approach provides institutionally and historically specific analyses of growth models. In this spirit, our argument is also historically contingent: in many advanced economies, house prices have been the key variable to understand finance-led growth over the past decades. In theory, one could equally imagine a share price-driven growth process (Boyer, 2000). However, in practice there is no evidence that the impact of share prices on aggregate demand is sufficiently large. How does our argument affect our understanding of the finance-led growth model? Is the house price-driven growth model only about cycles or does it also allow for sustained increases in house prices? We have argued that house price-driven models are not only prone to instability, they give rise to endogenous cycles. This, however, does not mean that movements in house prices are exclusively cyclical. Speculation may also give rise to a secular increase in the level of real house prices: by treating real estate as a financial asset class, new investors enter the housing market which increases housing demand and thus the price for housing. In addition, government intervention in the downturn of the housing cycle (e.g. by subsiding mortgage-financed housing demand) may reduce the amplitude of busts compared to booms. Whether a secular trend in house prices can constitute a stable long-run growth driver is a question that will require further research.

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Appendix

A1 Dataset

East Asia	European Core	Nordic	Southern Europe	Visegrád+	Anglo-Saxon	Baltics	Individual countries
Japan, South Korea	Austria, Belgium, France, Germany, the Netherlands, Switzerland	Denmark, Finland, Norway, Sweden	Greece, Italy, Portugal, Spain	Czech Republic, Hungary, Poland, Slovakia, Slovenia	Australia, Canada, Ireland, New Zealand, UK, USA	Estonia, Latvia, Lithuania	Croatia, Iceland

Variable definition	Variable abbreviation	Source(s)	Sample start	Notes
Real house price index (log)	HPR	Constructed from four datasources: (1) BIS (2) OECD (3) ECB (4) Palacin and Shelburne (2005)	1970, except for: AUT (2000), GRC (1997), ISL (2000), PRT (1988), ESP (1971), KOR (1975), CZE (2000), SVK (2005), EST (2002), Lat (2006), HUN (1999), LTU (1999), HRV (2002), SVN (2005), POL (2000)	(1) Use BIS data for all countries and periods where available; (2) For data where there is OECD data but no BIS data, extrapolate the BIS data back using the growth rates of the OECD series; (3) For Latvia and Czech Republic for years from 2000-2008 & 2000-2006 respectively, the data has been interpolated using the growth in the real house price level series in ECB data. (4) For Hungary, Estonia and Poland the data has been interpolated using annual Palacin and Shelburne (2005) data on residential property prices for the years 1999q1-2007q1, 2002q1-2005q1 and 2000q1-2005q1 respectively.
Real gross domestic product (log)	GDP	OECD Quarterly National Accounts	1995, except for: ITA (1996), NLD (1996), CZE (1996)	
Household debt (% of GDP)	HHD	BIS	1995, except for: AUT (1996), CHE (2000), IRL (2002), CZE (1996), POL (1996)	No data for ISL, SVK, EST, LAT, LTU, HRV, SLV
Relative average growth contribution of	RGRCONTR investment	OECD National Accounts at a Glance	1995, except for: BEL (1996), ITA (1996), NLD (1996), GRC	Constructed by dividing the average growth contribution over the period by the average

investment (% of GDP growth)			(1996), PRT (1996), ESP (196), CZE (1996), LTV (1996), HUN (1996), LIT (1996), SLV (1996), POL (1996)	GDP growth rate over the period. Values for 2015-2019 for IRL were dropped due to distortions in GDP. No data for HRV.
Relative average growth contribution of construction (% of gross value-added growth)	RGRCONTR construction	OECD National Accounts at a Glance	1995, except for: USA (1998), BEL (1996), CAN (1998), GRC (1996), ISL (1996), IRL (1996), PRT (1996), ESP (1996), SLV (1996), EST (1996), LAT (1996), HUN (1996), LTU (1996), SLV (1996), POL (1996)	Constructed by dividing the average growth contribution over the period by the average GDP growth rate over the period. Values for 2015-2019 for IRL were dropped due to distortions in GDP. No data for HRV.
Homeownership rate		Constructed from three data sources: (i) Homeownership rate from Kohl (2017, p. 20-22) Homeownership, Renting, and Society. Routledge; (ii) Homeownership rate from ECB SHI; (iii) Homeownership rates from OECD Affordable Housing Database	1970, except for: FRA (1975), GRC (1975), ISL (1990), PRT (1980), ESP(1980), SKE(1980), CZE(1980), SLV (1990), CRO (2016), SLV(1990), POL(2006)	(1) Take OECD data, (2) Construct another variable which splices ECB and Kohl data, (3) Linearly interpolate missing year for this new variable; (iii) Extrapolate back the OECD data back using the growth rates of this constructed variable
Mortgage credit encouragement index		Fuller (2015)	1990-2008	

A2 Turning point algorithm

Our criteria for identifying turning points are as follows:

1. Local peaks (troughs) are the highest (lowest) point in any consecutive period of 10 quarters going forward or back in time from that point. A local peak (trough) occurs at time t whenever $\{x_t > (<) x_t \pm k\}, k = 1, \dots, K$, where K is set to 10. In other words, a local peak (trough) is the highest (lowest) local point considering both the previous 10 quarters and the following 10 quarters.

2. Peaks and troughs must alternate. If a peak (trough) is consecutively followed by another peak (trough), the peak (trough) with the smaller (higher) house price value is dropped.

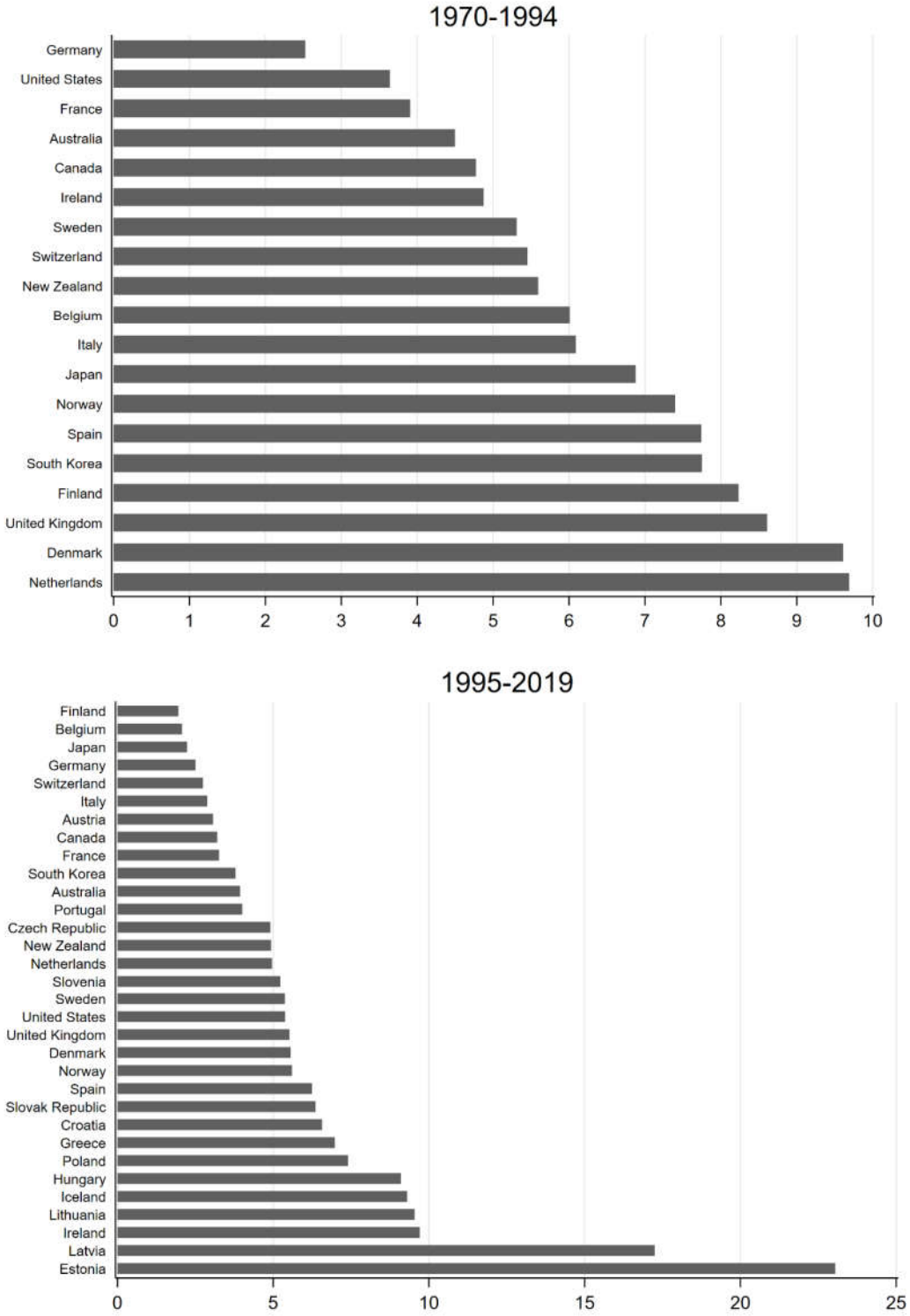
3. The length of a full cycle must be longer than 5 years (20 quarters). The length of a full cycle is defined as the number of quarters between two consecutive peaks (troughs). If the cycle is shorter than 5 years, the middle set of peaks and troughs are dropped, until the cycle is longer than 5 years. Step 2 is re-run to make sure that peaks and troughs alternate in the new set of peaks and troughs.

4. We further add the criterion that the phases at the beginning and end of the series are only included if they are longer than 5 years (20 quarters). The reason for this is as follows. As every house price series has both a beginning and an end, the first and last phases will be truncated. Truncation at the beginning of the cycle is caused by limited data availability, while truncation at the end is due to uncertainty over the future turning points of ongoing episodes. We include truncated phases only if they are longer than 5 years (20 quarters), as we only wanted to include substantial phases with long enough duration to properly estimate their intensities. If these phases are shorter than 5 years, we drop these datapoints.

A3 Further stylized facts on house price cycles

A3.1 Country-specific slopes of house price cycles

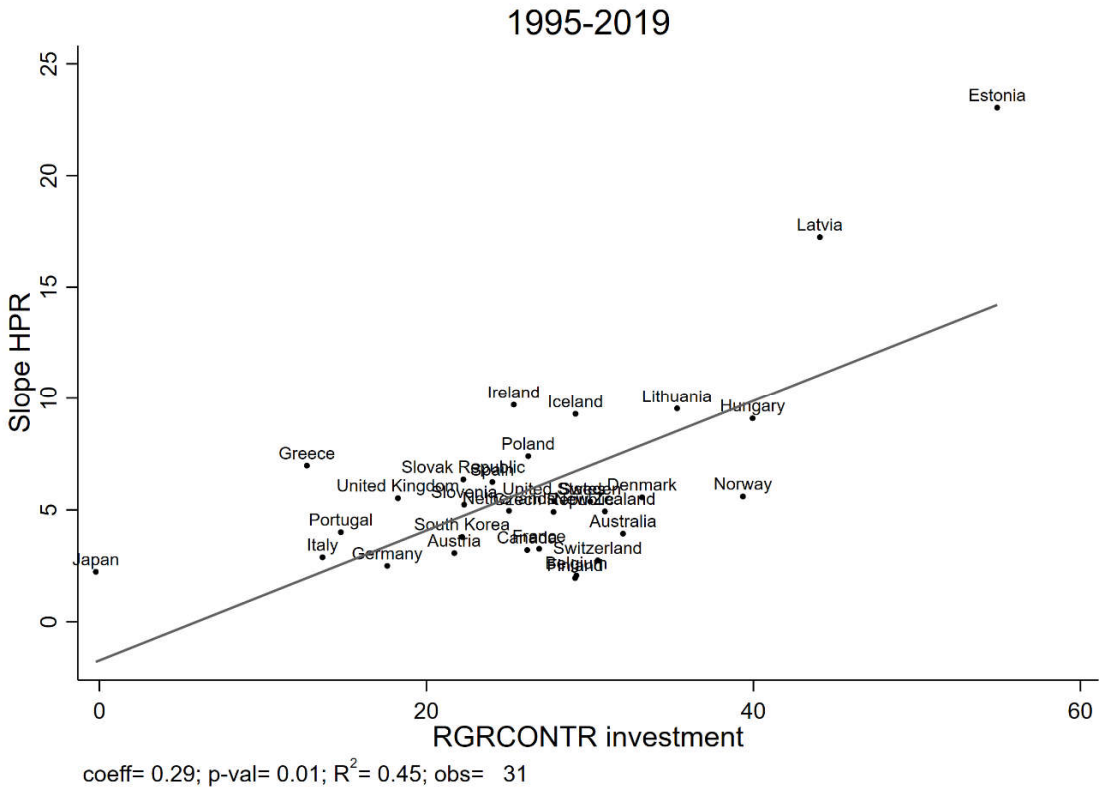
Figure A1: Average slopes of house price cycles by country, 1970-1994 and 1995-2019



Notes: Slope: amplitude/duration (% change per year); average over booms and busts. See Appendix 1 for details on the data. Slopes are dated at the end of an episode, e.g. a boom starting in 1990 but ending after 1994 will be included in the second period.

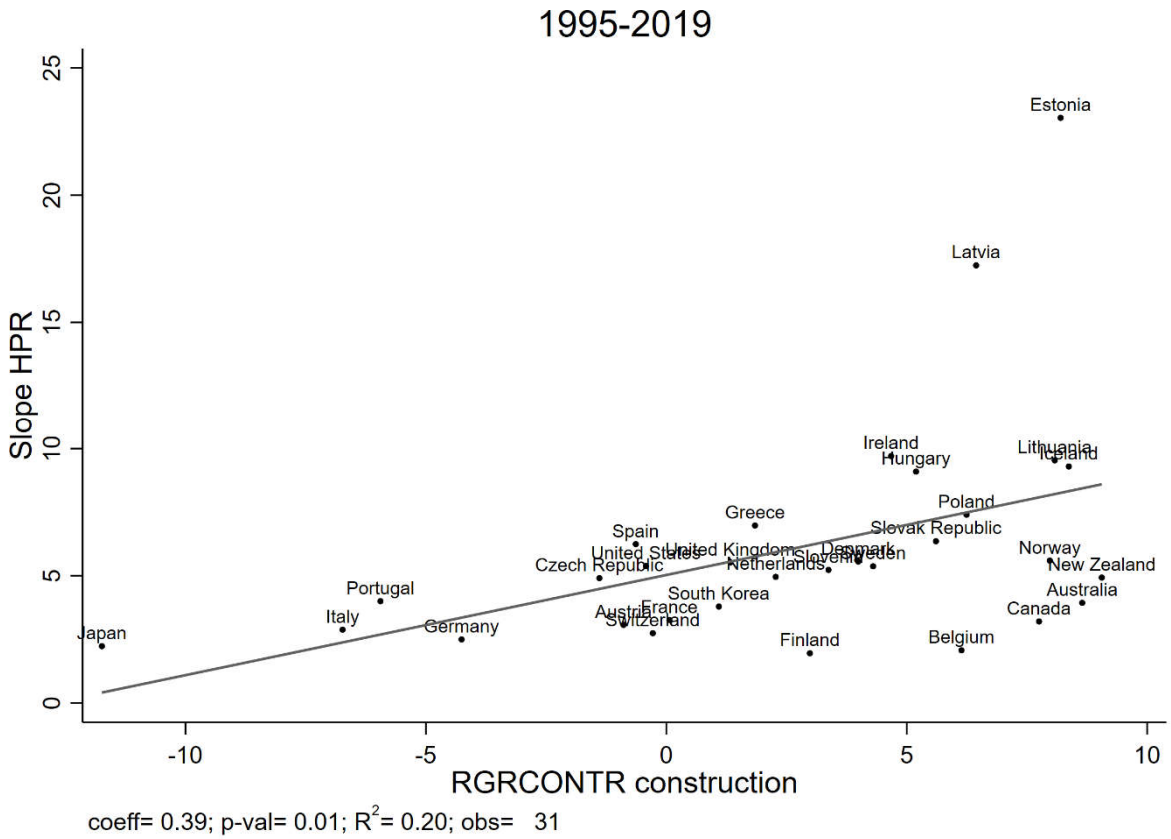
A3.2 Correlation between slope of house price cycles and growth contribution of investment/construction

Figure A2: Average slopes of house price cycles (HPR) against average relative growth contribution (RGRCONTR) of investment, 1995-2019



Notes: Slope: amplitude/duration (% change per year); *RGRCONTR*: relative growth contribution (average growth contribution over period over average GDP growth over period). See Appendix 1 for details on the data. Note that the average relative growth contribution of investment is calculated as the average growth contribution over the respective period divided by average GDP growth over the respective period. Thus, episodes where investment demand collapsed will reduce the average relative growth contribution of investment. The strength of the relationship is particularly remarkable in light of this.

Figure A3: Average slopes of house price cycles (HPR) against average relative growth contribution (RGRCONTR) of construction, 1995-2019



Notes: Slope: amplitude/duration (% change per year); *RGRCONTR*: relative growth contribution (average growth contribution over period over average gross value-added growth over period). See Appendix 1 for details on the data.

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