House prices, financial cycles and business cycles: An Empirical Stock-flow consistent (SFC) model for the Danish Economy

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Since the Great Financial Crisis (GFC), the issue of financial imbalances has received a lot of attention in economic literature. In this regard, the build-up of financial cycles is considered to be a central element in understanding these financial imbalances. It is often argued that house prices are an important driver of the financial cycles in most countries, since there exists a strong relationship between house prices, the business cycles and financial cycles. Focusing on the Danish data since 1950, changes in house prices and the business cycles seems to be leading the financial cycles. In this paper we build an empirical SFC-model for the Danish economy to investigate the the different channels through which housing prices affect both the business cycles and the credit cycles, with specific focus on the period leading up to the latest crisis. We perform counterfactual analysis and attempt to understand the effects of a lower accepted debt-to-income ratio in the economy. While the effects in the short run seem as expected, the medium-run effects provide interesting insights.

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Introduction

The build-up of the Global Financial Crisis (GFC) and its consequences are well documented in the literature. In this regard, financial cycles usually driven by credit accumulation, have received a lot of attention in macroeconomic debates as reported by Grinderslev et al. (2017) and Borio (2014). The aggressive build-up of the financial cycles was believed to have set a perfect stage for the crisis. As shown in, e.g., Stremmel (2015) and Borio (2014), the financial cycles of several advanced countries peaked shortly before the crisis in 2007-2008. Countries where the peak of the financial cycle was high, the resultant crisis was also more severe. There seems to be consensus emerging on the argument that credit creation is important for the economy but too much credit can also damage the economy through various feedback channels, which can sometimes turn into a full-blown crisis. Credit growth is one of the central variables when discussing the dynamics of a financial cycle.

From a long term perspective, it has been argued that aggressive credit accumulation has made growth rates more fragile. That is, aggressive credit accumulation was the driver of high and persistent growth rates in the pre-crisis period, but this made the whole economic and financial system more vulnerable to a serious crisis. Due to the importance of financial cycles in understanding financial crisis and monitoring financial risks, it is imperative to examine how these cycles evolve over time and how do they affect the entire financial system. Despite the strong empirical evidence regarding the relationship between business and financial cycles, the theoretical foundation for understanding the build-up of a financial cycle and its subsequent impact on the real economy is weak. This is primarily due to the complex and innovative nature of the financial markets which makes its relationship with the real side of the economy very complex. At a broader theoretical level, the work of Minsky is considered to be the most appropriate in addressing the build-up of a financial cycle and identifying its impacts on the economy.

This paper is an attempt to identify the drivers of a financial cycle and understand the interdependence between financial and real variables in an explicit and rigorous manner. Doing so, however, requires understanding of the dynamics of a financial cycles as well as the transmission mechanism through which financial cycles can create a boom and bust. To do so, first, we investigate the dynamics of the Danish business and financial cycles using historical data since 1950. We then adopt a stock-flow consistent approach to model the Danish financial cycle and carefully capture its interlinkages with the real side of the economy. We then look at the pre-crisis scenario and perform counterfactual analysis to address the following question: What would be the potential status of an economy, if it accumulated lower credit and built-up a less extreme financial cycle prior to the crisis. That is, we attempt to create and discuss an alternative path of the economy and explore its dynamics. We do so by creating a scenario where the pre-crisis financial cycle, due to strict constraints on credit, has a lower peak than the actual financial cycle and study its implications on macroeconomic outcomes. Our findings suggest that a financial cycle of

lower peak leads to a boom and bust of lower amplitude, which is not surprising. However, the most interesting result is related to the post-crisis phase where we find that the post-crisis output is higher when the pre-crisis financial cycle was less extreme. We explain the underlying reason for this result and also discuss the policy implications of our findings.

The structure of the paper is as follows. In section two we provide stylized facts for Denmark from 1950 to 2020, which support our hypothesis. In section three we review the relevant literature, while in section four we present the structure of a Minskian empirical macroeconomic model for Denmark and the respective data. Section five is dedicated to the presentation of the simulation results. The penultimate section discusses the policy implications of our empirical finding, and the last section concludes.

House prices, Financial Cycles and Business Cycles in Denmark

While there seems to be consensus regarding the choice of keys variables for identifying business cycles (GDP), several variables have been suggested as indicators of financial cycles. In this presentation, financial cycles are expressed as credit cycles, following the tradition of Stremmel (2015), Borio (2014) and Grinderslev et al. (2017).

In the figures below, the development in all three time-series from 1950-2017 is presented in real terms:[4]

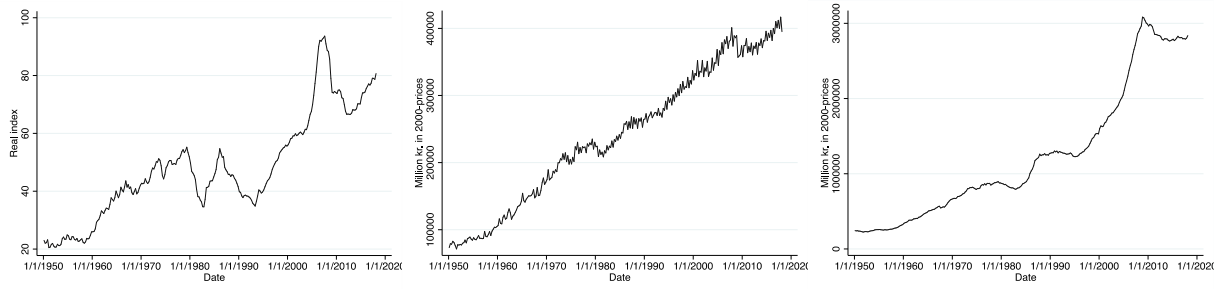

Figure 1: Real house prices (left), Real GDP (center) and Real stock of credit (right)

While the development in real GDP seems to follow a trend, the development in real house prices and real credit is far less linear. The accumulation of credit seems to be almost exponential with a few exceptions around 1980, the first years of the 1990s after 2009. Especially between 2000 and 2009 the increase had been steep, presumably due to the introduction of a new type of mortgage loans - delayed amortization[5] – in 2003. Apart from

[4] In real terms, the house price index is still at a lower level than before the latest crisis. In nominal terms however, the nominal house price index is at the highest level ever.

[5] In 2003 a grace period of maximum 10 years was introduced on Danish Mortgage loans, which allowed households to postpone installments.

the 1950s, the house prices showed a positive trend over the years, but three major falls can be identified in the figure: around 1980, from 1986 to 1993 and around the GFC. Since the crisis the real house prices have increased considerably and are about to approach the pre-crisis level.

In times of growth, the correlation between all three variables seems to be high. However, when, focusing on the three aforementioned episodes their relationship is not that straightforward. In the beginning of the 1980s, following the bust in the housing market and the economic crisis, the real stock of credit fell, pointing to a close connection between the variables under consideration. The crash in the housing market in the first half of the 1990s, did not result in a recession, though the stock of credit stagnated. This indicates a very close connection between house prices and credit, but not with real GDP. In the aftermath of the GFC house prices, GDP and the stock of credit fell, but whereas the house prices resurged afterwards, and GDP has been growing according to its long-term trend, the stock of credit has remained since stagnated at the same level. The current situation clearly constitutes a break from the long-term pattern.

Other interesting insights can be drawn by focusing on the cyclical deviations from the trend. Estimating the cycles of the time series using a HP-filter for real GDP, real house prices and real credit provide interesting insights. Cycles in house prices and credit have larger amplitudes, while the cycles of GDP seem to be comparatively shorter. This result is also suggested when looking at the autocorrelations, which are higher for house prices and credit rather than GDP.

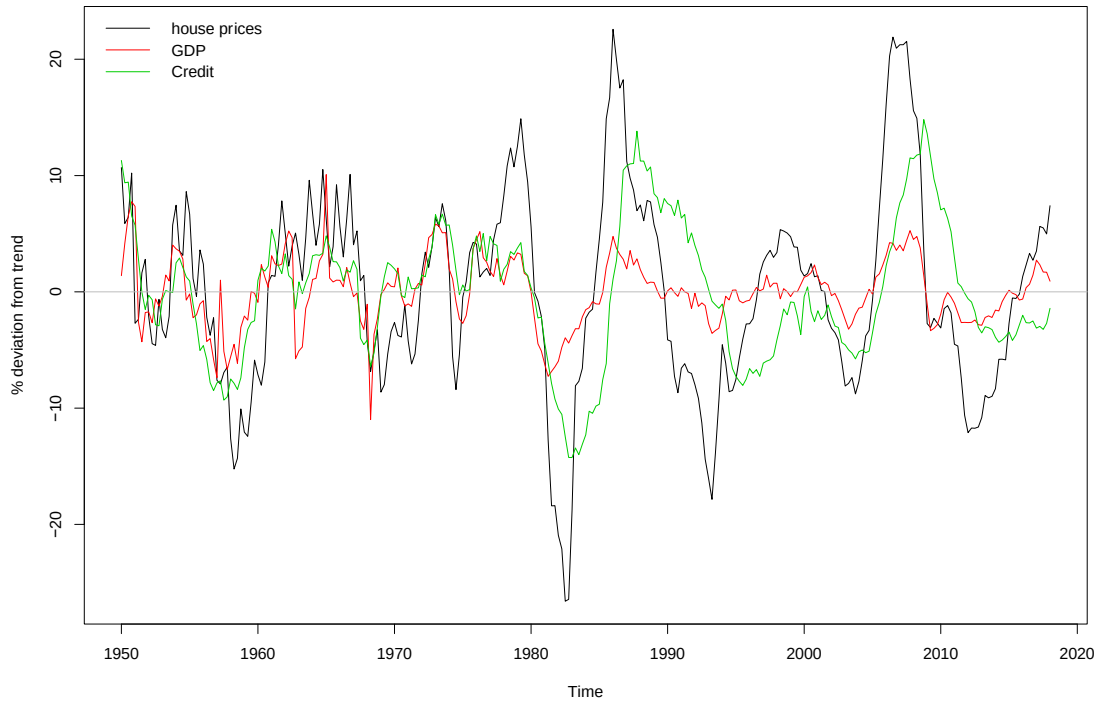

Figure 2: house price cycles, GDP cycles and credit cycles

Unsurprisingly, all three cycles co-move and are positively correlated, but it seems like the credit cycles lags the cycles of the two other components. This is confirmed by looking at the cross correlation among the three time-series, which indicates, that house prices and GDP are drivers of the credit cycles.

As stated above, both the amplitude and the length of the GDP cycles is much smaller than the amplitude of the other cycles, especially in the period after 1980 (see Figure 4). Before 1980, the cycles of GDP and credit were quite similar in magnitude. The house prices on the other hand deviated much more from their long run trend. Concerning the trough of the cycle, the house prices in the last half of the 1950s, were around 15% lower than their long run trend, while the deviation of GDP was around 5% and the deviation of credit about 10%. Looking at a peak instead, the house prices in the last half of the 1970s, were much higher than their trend value, while the levels of both credit and GDP were much closer to their trend values. Since the 1980 the amplitude of credit increased both absolutely and relatively to the amplitude of the GDP cycle. Two peaks of a credit cycle can be identified since 1980: i) in the end of 1980s and ii) around the GFC. In the end of 1980s, the upswing of the credit cycle lagged behind the upswing of house prices and GDP. The house prices fluctuated quite much. Their rapid fall in the early 80s was the result of low growth rates and the ensuing crisis in the Danish economy, which was aggravated by the second oil crisis in the late 1970s. In the middle of the 1980s, the house prices resurged, simultaneously with a rapid increase in domestic demand. Excessive demand resulted in a record high deficit on the current account and increased public and foreign debt, which in turn signified the change in the government's policy towards fiscal consolidation including tax reforms (e.g. the Potato diet), so as to cope with private consumption. On the positive side, the current account went into surplus, while both public and foreign debt were reduced. On the negative side, the demand dropped considerably, the level of unemployment increased rapidly and house prices started to fall up until 1993. Since 1993 a new era of tranquility can be identified in the Danish economy, with rapid fall in the level of unemployment, normal growth rates in real GDP, and increases in house prices and the demand for credit. In 2003, this phrase of tranquility was ensued by a boom in both business and financial cycles, until they burst in the GFC. Since then, the Danish economy has been stagnating. Until the last couple of years, when the level of real BNP is back to its long run trend level. At the same time the house prices have increased significantly and seem to be either at or above their long run trend[6]. The credit however has not increased since 2009, indicating a clear break in the long run relationship between house prices, business, and financial cycles.

All in all, there seems to be a high correlation between the three time-series, with the cycles of the house prices seemingly to leading the cycles of real GDP and the real stock of household credit. To analyze the effect of a shock to one of these components, their link must be well integrated into a formal macroeconomic model. But before doing so we first briefly review the relevant literature.

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[6] The result is depended on the choice of the value for λ in the HP-filter.

Literature Review

Our empirical results above are in line with several important findings of the literature: i) high correlation between house prices, GDP and credit, ii) house prices and GDP are leading credit cycles and iii) business cycles are shorter and smaller in amplitude as compared to cycles in house prices and financial cycles (see i.e. Borio, 2014; Grinderslev et al., 2017; Stremmel, 2015). A common feature for the aforementioned literature is the lack of theoretical foundations for the findings. Stockhammer and Wolf (2019) point out, that despite the role played by real estate prices in booms and busts, housing is an underestimated topic in macroeconomics and the political economy. In their review they conclude:

''What emerges from this brief survey of mainstream economics is a tension between a theoretical framework that, with its rationality and market clearing assumptions, is ill-suited to explain recent dynamics and crises emanating from the real estate sector and, at the same time, a dynamic empirical research program that bypasses the rigidities of the theoretical framework.", (Stockhammer and Wolf, 2019, p. 48).

Outside the general equilibrium methodology, Minsky has been recognized as one of the economists providing a theoretical framework for understanding cycles generated by the connection between financial markets and the real economy. In Minsky et al. (1995) authors argue that 'over a run of good times the liability structures of households and firms change so that ever larger proportions of their gross cash-flows (incomes) are prior committed to the fulfillment of obligations as specified in their liabilities.' In case of a drop of cash-flow, households will try to compensate by selling assets, which might lead to a 'serious decline' in the market price of both financial and capital assets. The fall in asset prices affects the net worth of households, which might adversely affect the demand for consumption and investment. This decline in demand can result in a collapse of income, employment, and asset prices. According to Minsky et al. (1995) the relative size of government demand vis-à-vis private demand is an important factor for the sensitivity of profits to investment.

Minsky et al. (1995) present a theoretical model in which financial instability is endogenous. The business cycle follows four phases: i) a recovery in which profits are increasing even as indebtedness falls, ii) a robust expansion during which profits increase as debts increase, iii) a boom in which indebtedness increases even as profits begin to fall and iv) a deflation phase in which both debts and profits fall. In Zezza (2008) the housing market is taken explicitly into account. In this model an increase in the expected house prices will generate a price bubble since the supply of house is inelastic. These capital gains boost the overall economic activity, through higher consumption and investment in housing (and thereby a fall in rate of saving). Rosser et al. (2012) employ a Minsky-Kindleberger perspective to discuss the nature of different bubbles from a historical perspective. According to their study, three types of bubbles can be identified. The authors

claim Minsky to be the one who identified and labeled the third type[7], which according to Kindleberger is the most frequent one. It is characterized by a rise in prices up to a peak after which the prices fall, panic arises and the economy crashes. In Nikolaidi (2015) house prices are integrated into the analysis, pointing out that their growth increases the net wealth of households, which results in higher credit and demand and house price inflation. From a Minskyan perspective this might result in a Ponzi-scheme, where a continues increase in house prices is critical in rolling-over debt. Dafermos (2017) integrates endogenous stock-flow norms into a Godley-Minsky inspired SFC-framework. In his model, the propensity to consume or invest in the private sector increases (decreases) when the target debt-to-income ratio increases (decreases), which generates fluctuations in the system. These endogenous norms vary with the economic activity and financial innovation. In periods with booms both the economic activity and the level of financial innovations is high, which has a positive effect on the targeted debt-to-income ratio and the consumption as well as investment.

In Nikolaidi and Stockhammer (2017) a survey of Minskian Models is carried out. The authors define a Minskyan model as a macroeconomic model with a focus on analyzing the interdependence between financial and real variables through channels identified by Minsky. They divide Minskyan models into two different types, with the first one characterized by a focus on debt and/or interest dynamics, while the focus in the second type is on asset price dynamics. Asset prices are typically being split into equity prices and real estate prices. As pointed out by Nikolaidi and Stockhammer (2017) real estate prices have only very recently been incorporated into the Minskyan framework. In these models, house prices are expected to play a central role in both cycles and instability (see i.e., Ryoo 2016).

The following model contributes precisely in this part of the literature. In particular, the underlying mechanism highlights the dual role of housing prices as drivers of demand and credit growth. For instance, a higher expected rate of return on houses boosts the demand for houses. In turn, it increases their price and, thus, reinforces the expectations regarding a higher rate of return. The aggregate demand is positively affected by both higher investment in the housing market and the wealth effect on consumption. At some point expectations are lowered due to the excessive increase of the stock-flow norm, wealth over consumption. This, feeds back negatively to the demand for and the prices of housing. The housing wealth to capital ratio moves procyclically. Once, the ratio is low, households are once again willing to take up investment in housing. At the same time, housing wealth functions as a collateral also in a procyclical manner. A higher housing wealth renders the credit constraints less binding. Credit growth boosts demand and price of houses. Gradually, the interest payments to the bank, or the leverage ratio, become too large. Households have difficulties in meeting their debt payment commitments. This affects the

[7] In the first type, the price rises in an accelerating manner before it crashes sharply. The second type is associated with a rise in price before a parallel decline happens (no need for a crash).

housing market negatively as the respective demand and prices drop. In this sense, a financial cycle is generated.

The Model

To explore the link between asset prices, business cycles and financial cycles, we adopt a Minskian-stock flow consistent (SFC) approach to modelling. The model is a modified version of the benchmark model presented in Byrialsen and Raza (2019). We use annual sectoral national account data from Eurostat covering a period from 1995 to 2016. The balance sheet and transaction matrices can be found in the Appendix along with the structure of the model. To confine the length of the chapter, the presentation of the model focuses on some important characteristics that extend the work of (our other papers…).

Model structure

Following the identification of Nikolaidi and Stockhammer (2017), we analyze the interdependence between financial and real variables through channels identified by Minsky. In a sense, the model presented here, can be seen as a hybrid model of several of the existing theoretical Minskyan models, as its focus is on both the debt and interest dynamics, as well as on assets price dynamics. The dynamics are identified within the model through different channels:

1. Debt and interest dynamics work through both the interest flows between sectors and the stock of debt, which affects both consumption and investment. The effect on consumption is formalized under the standard Keynesian consumption function. In terms of investment, a rule of thumb is applied, according to which households and banks evaluate the actual stock of debt compared to an 'targeted stock of loan'. This 'targeted stock of loan' is determined as a proportion of the disposable income can be interpreted as both households' willingness to borrow and banks' willingness to lend.
2. The actual stock of debt also affects the households' demand for credit, in the respective credit demand function.
3. Changes in house prices affect the aggregate demand through investment, since the ratio between the value of housing and the cost of producing houses provides financial incentives for building new houses. In addition, there is a wealth effect on consumption in the structure of the model.
4. Housing price inflation increases the value of the collaterals and, thus, the demand for credit.
5. Changes in equity prices affect both the portfolio decision and the financial wealth of households, which in turn have a wealth-effect on aggregate demand.

These channels enable us to investigate the linkages between asset pricing, business cycles and financial cycles, identified with changes in prices of houses, economic activity, and credit flows as well as the feedback mechanism in the model.

Since the model refers to Denmark, we assume away any impact of the domestic economic activity on international trade and capital flows, while the central bank is assumed to take any action necessary to maintain a fixed exchange rate. All domestic production takes place in the non-financial corporations (NFC). Changes in aggregate dem

and, and thereby in economic activity, reflect the business cycles. Total demand is given by the standard accounting identity:

$$Y = C + I + G + X - M \qquad \text{(Eq. 1)}$$

Y[8] represents total demand, C private consumption, I investment, X exports and M imports. Government consumption (G) is exogenous in this model. Exports are modeled as a function of relative prices and the weighted import of the trading partners, while imports are a function of relative prices and domestic private demand.

Following standard Keynesian theory, private consumption is a function of disposable income, one period lagged net wealth, while inertia is reflected in the lagged term of consumption.

$$\Delta ln(c_t) = \beta_i \Delta ln(yd_t) + \beta_i \Delta ln(nw^H_{t-1}) + \beta_i \Delta ln(c_{t-1}) \qquad \text{(Eq. 2)}$$

Two components of investment are endogenous: Investment of NFCs and households' residental investment. NFCs' investment is a function of the capacity utilization and the rate of capital accumulation in last period.

Investment from non-financial firms is a function of the capacity utilization and the rate of capital accumulation is last period.

$$\frac{i^N_t}{k^N_{t-1}} = \beta_i + \beta_i \frac{i^N_{t-1}}{k^N_{t-2}} + \beta_i \frac{y_t}{k^N_{t-1}} \qquad \text{(Eq. 3)}$$

The level of housing investment is determined by the incentive to invest in new housing, real disposable income, the accumulation of housing in last period and the difference between the current debt-to-income ratio and the 'targeted debt-to-income ratio' or leverage. The incentive to invest in new housing - known as Tobins q for housing - is usually defined as the ratio of house prices to construction cost (P^i). The argument is that an increase in the house prices relative to construction costs would induce investments in housing (Kohlscheen et al. (2018)).

Real investment (i^H_t) in fixed assets (housing) is as follows:

(Eq. 4)

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[8] Upper case letters represent nominal variables, while lower case letters represent real variable.

$$\left(\frac{i_t^H}{k_{t-1}^H}\right) = \beta_i \left(\frac{i_{t-1}^H}{k_{t-2}^H}\right) + \beta_i \left(\frac{P_t^H}{P_t^i}\right) + \beta_i \left(\frac{yd_t^H}{k_{t-1}^H}\right) + \beta_i \left(\frac{IBL_{t-1}^H}{k_{t-2}^H}\right) - \phi\beta_i (lev_{t-1}^h - lev_{t-1}^{tar})$$

The inclusion of real disposable income[9] makes demand for investment procyclical as it reflects an accelerator-mechanism. The procyclicality of investment is further reflected in lender's and borrowers' risk which in practice is the deviation between the actual and the targeted debt-to-income ratio.[10] Increases in disposable income result in a higher accepted stock of debt the households are willing to hold, but also to the one supplied by the financial institutions. In this sense, the paradox of tranquility is integrated in the model. A phase of tranquility therefore increases the accepted stock of debt of both households and banks. An increase in the house prices (P^H) motivates the households to invest more in construction, while an increase in the construction costs (P^i) would lower housing investment.The house price index is modeled as a function of the real stock of houses to real investment in housing ratio, which can be interpreted as an inverse rate of accumulation of houses, the economic activity and the lagged house price index.

$$P_t^H = \beta_i + \beta_i ln(P_{t-1}^H) + \beta_i ln(\frac{k_{t-i}^H}{i_{t-i}^H}) + \beta_i ln(y_t) \qquad \text{(Eq. 5)}$$

As described above, housing prices affect the demand for houses. At the same time, the economic activity (including investment in housing) affects housing prices. There is thereby a simultaneously feedback effect between the two variables as indicated in the literature. The stock of debt might affect both the demand for consumption and investment, but the decision to consume and invest also affects the demand for credit. On the financial side of the economy, the households take on loans to finance mainly investment in housing and allocate their wealth in either pension, equities or interest bearing assets following a modified Tobin portfolio allocation. The relative return of the different assets determines the allocation. The current debt-to-income ratiois modeled as a function of investment to disposable income ratio, the interest rate (representing the cost of borrowing) and the previous period debt-to-income ratio.

$$lev_t^h = \beta_i (\frac{IBL_{t-1}^H}{YD_{t-1}^H}) + \beta_i (\frac{I_t^H}{YD_t^H}) - \beta_i r_{L,t-1}^H \qquad \text{(Eq. 6)}$$

Following Minsky et al. (1995) investment is financed by internal funds as well as loans. An increase in the investment-to-income ratio is therefore expected to increase the demand

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[9] This behaviour is similar to the model proposed in Zezza (2008) where an increase in expected disposable income positively affects the demand for houses.

[10] To integrate a threshold into the model, the shift parameter ϕ is used. If the debt to income ratio in last period exceeds the targeted debt to income ratio, this parameter is equal to 1.

for credit. As the interest rate represents the cost of borrowing, an increase in the interest rate would affect the demand for credit negatively.

Estimation and simulation

Our model has several structural parameters which are estimated using annual Danish data from 1995-2016.[11] While our model selection for each equation is purely econometric in nature aiming to obtain statistically valid estimators, our choice of variables in every equation is purely theoretical as discussed earlier. Overall, we did not encounter any contradictions between our theoretical and empirical relationships, that are worthy of consideration.[12]

After estimating the structural parameters, we numerically solve the model to establish a baseline scenario. To evaluate the overall performance of our model, we compare the baseline scenario with actual data for the period 1995-2016. The overall performance of the model is satisfactory, as it is able to explain the macroeconomic dynamics of the Danish economy to a reasonable extent.[13]

Results and discussion

An important aspect of this simulation exercise is to investigate the linkage between house prices, business cycles and financial cycles within the model. The simulation of the model clearly reproduces this interdependence between these variables.

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[11] To estimate the equations, in most cases, we start our estimation by including 2 lags due to small sample. We then follow general-to-specific methodology and fit a parsimonious model. We also test for unit roots and account for any significant structural breaks in our estimations.

[12] The estimation results can be seen in the appendix.

[13] For a graphical evidence of this we refer to Byrialsen and Raza (2019)

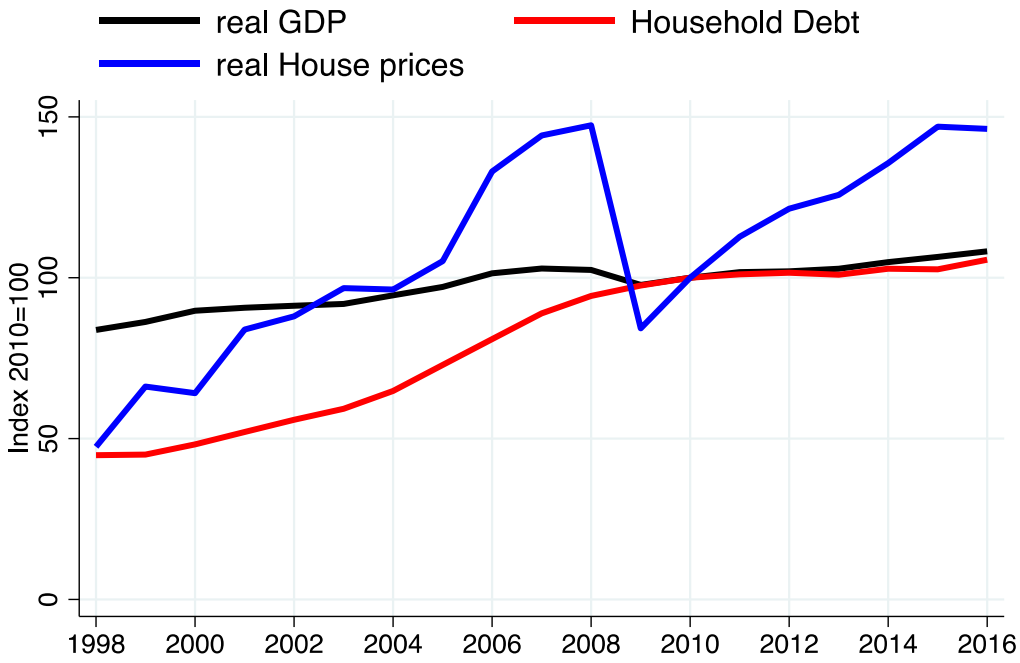

Figure 3: Simulated series for house prices, GDP and credit

Focusing on the period before the crisis, there was a bubble in housing prices, ensued by high growth rates in GDP and high household credit demand. From a Minskyan point of view, the period preceding the crisis can be seen as clear evidence of a tranquil state of growth, in which both banks and households were willing to increase the stock of credit. Its increase buoyed up demand for investment in housing and increased the associated prices. This bore a significant wealth-effect on consumption and investment and the demand for credit. Housing prices were inflated through higher aggregate demand. This positive correlation between housing prices, business cycles and financial cycles reinforces itself. In order to investigate these feedback mechanisms, the first scenario examines the evolution of business and financial cycles following a drop of the housing prices.

In the second scenario, we analyze the macroeconomic effect of a reduction in the accepted debt-to-disposable income ratio. The banks grant less loans and simultaneously households demand less credit. The implications of this change affect directly or indirectly, the households, the banks but also the government. From the perspective of the households, the fall in the accepted debt-to-income ratio reflects a drop in optimism or willingness to get further into debt. From the perspective of the banks, the drop in the accepted debt-to-income ratio illustrates a lower willingness to lend money and thereby reduce the risk for the banks (this can also be interpreted as applying credit constraints). Finally, the reduction in the debt ratio, can be initiated by new regulations made by the government aiming to stabilize the financial markets.

Shock 1: A drop in house prices

As presented in the literature, changes in house prices are expected to play a large role in explaining changes in the stock of household debt and the economic activity. To investigate the propagation of this mechanism, we introduce during the booming period 2003-2007 a negative shock in the house price index of 5 units. The shocks are considered as what-if scenarios, which take place as a counterfactual analysis.[14]

In the figures below we illustrate the development in housing prices, household debt and real GDP compared to the baseline scenario.

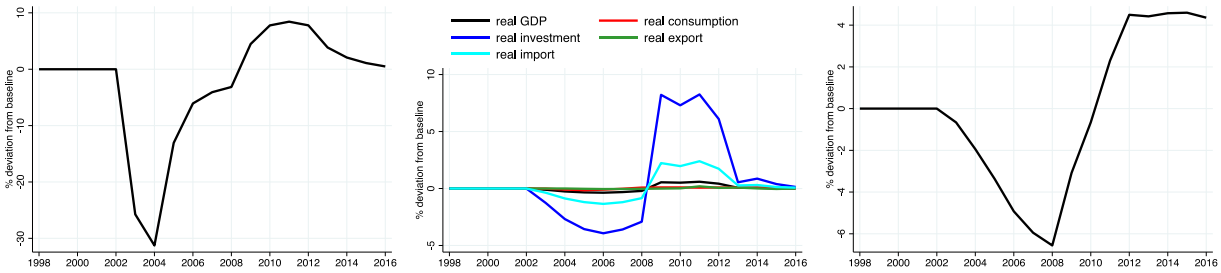

Figure 4: The effect on house prices (Left), demand (center) and credit (right)

The drop in housing prices affects aggregate demand through investment and consumption to a smaller extend. The negative effect on consumption comes as a result of a drop in the net wealth of the households, while the negative effect on investment is due to the drop of Tobins' q. The fall of both investment and consumption, reduces total demand, which necessarily implies a lower demand for imports. The drop in the overall economic activity feeds back into investment and consumption, which aggravate the initial effects (see figure 4). The lower demand for housing and lower economic activity exacerbates the initial shock to house prices as illustrated in figure 4. Finally, the lower demand for housing leads to a lower demand for loans, which reduces the stock of household debt (see figure 4).

In the period after 2009, during which the Danish economy was trapped in stagnation, the economy seems to perform better in case of Shock 1; between 2009-2012 the GDP is at a higher level as compared to the baseline. Similarly, housing prices are lower than the baseline scenario prior to 2009, but higher between 2009 and 2013. The drop in investment in this scenario is much more modest as compared to the actual fall. The relatively higher level of investment boosts the demand for credit, while since 2010 the stock of household debt in scenario 1 exceeds that of debt of the baseline scenario.

Following the Minskyan theory, large capital gains on housing before the crisis led to a high level of demand partly financed by new household credit, which further boosted housing prices, and the process reinforced itself. By reducing the level of housing prices before the

[14] The reader should be aware of the fact, that except from the discussed parameters, none of the exogenous variables or parameters are changed in the shocks.

crisis, both economic activity and credit was reduced, which confirms the Minskyan idea. The lower level of debt before the crisis resulted in a quicker recovery in the years after the crisis, both for investment and imports. Furthermore, housing prices increased faster in this scenario. However, the real stock of credit is higher in Shock 1 as compared to the baseline scenario.

The above insights imply that the stability of the macrofinancial system is critically dependent on the regulation of the credit and housing market. The financial and the business cycles are strongly interconnected with the fluctuations being triggered by capital gains in the housing market. The speculative behavior emanating from the financial gains out of the housing market generates booms and busts and debt dynamics. Policy makers need to reduce the sensitivity of the economy to the housing price fluctuations, so as to ensure the stability of the macrofinancial system.

Shock 2: A fall in the accepted debt-to-disposable income ratio

As seen in our baseline scenario and in scenario 1, a sudden drop in housing prices affects both the household credit demand and the economic activity. As reported in figure 4, there is a notable exception in this pattern from 2015 onwards. This exception might be explained by a change in the behavior of the economic agents, or a structural break. For this reason, we investigate the macroeconomic consequences of a reduction in the accepted debt-to-disposable income ratio. Note that, as mentioned above, this drop might be initiated by either the households, the banks or the government. To perform this shock, we fix the accepted debt-to-disposable income ratio to the same ratio as in 2003 for the period from 2003 to 2007.

In the short run, the lower accepted debt-to-income ratio reduces the demand for investment in houses. The fall of the residential investment reduces both the economic activity and the housing prices as seen in the figures below.

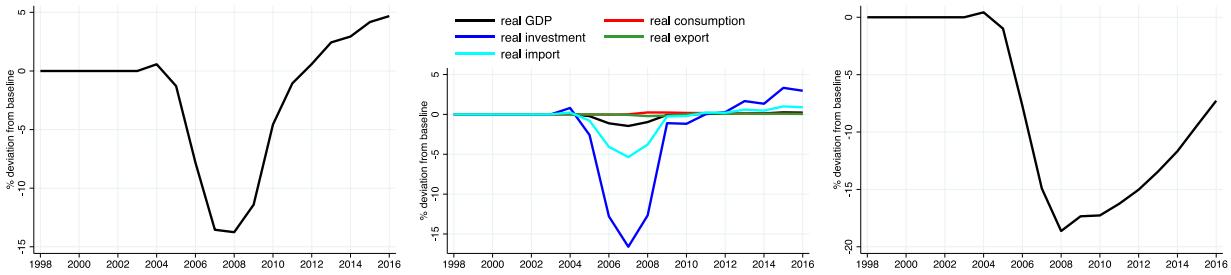

Figure 5: The effect on house prices (left), demand (center) and credit (right)

In the short run, a lower accepted debt-to-income ratio therefore has a braking effect on the economy as expected. Similar to the result from scenario 1, the medium-term impact seems surprising at a first glance, though the underlying mechanism can be well explained within the model. The fall in residential investment lowers both aggregate demand and the demand for credit. At the same time, the effect on the other financial assets in households'

balance sheet is indirect. There is a reallocation of wealth to other assets leading to an increase in the income of the households from capital gains (increase in the stock of financial assets and fall in the stock of debt). The rise of the disposable income results in higher consumption and aggregate demand. The positive effect in the medium term can also be reflected in the asset prices, where housing prices are higher than in the baseline.

From a Minskyan perspective, these results can be explained by a change in the risk behavior between the lender and the borrower. If the households and/or the banks were less willing to increase the level of credit in the system, the housing bubble and economic boom before the crisis would have been smaller, just like the recovery from the crisis would have been faster in an economy with less debt. This finding conforms with the one from Shock 1. Riskier behaviors tend to generate financial cycles and amplify their impact on the business cycles. Thereby, regulating the housing market and especially its financial aspects reduces the instability of the system and allows the economy to recover faster in the presence of negative shocks.

Conclusion

Since the GFC politicians and economists have focused on creating financial stability by focusing on medium-term target for specific ratios. From the perspective of this chapter, the focus on specific stock-flow norms becomes relevant. The interplay between housing prices, stock of credit and real GDP is key to understanding the linkages between financial and business cycles. For this reason, we have developed an empirical SFC model, applied to the economy of Denmark, in order to investigate cycles that were triggered by capital gains in the housing market. In this respect, the model introduced important Minskian aspects that were considered important for carrying our task.

Our empirical findings indicate that changes in the housing prices not only explain financial and business cycles but that the reduction of their impact on economic activity, via regulation of the housing market, renders the economy more prone to recover in the presence of a negative shock. Regulation can further stabilize the macrofinancial system by making households less risky in taking up more debt, or banks less willing to lend. In this respect, under a stricter macroprudential policy the Danish economy would be less susceptible to housing bubbles. Furthermore, our findings reflect to some extent the international experience. Despite the rather significant particularities and specificities of each economy, the burst of the housing bubble in the US, Greece, Spain and Ireland had similar effects to those provided by our analysis. The recent situation, however, is in contrast to the expectations where the house prices (and assets prices in general) have increased significantly, while the demand for credit among the households has stagnated since the crisis.

Balance sheet and transaction flow matrix

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Appendix

Table 1: Balance Sheet

	NFC	FC		G	H		W	$\sum$
		A	L		A	L		
Interest bearing (IB)		IBA^F	IBL^F		IBA^H	IBL^H		0
Net interest bearing (NIB)	NIB^N	NIB^F		NIB^G			NIB^W	0
Net equities (NEQ)	NEQ^N	NEQ^F			EQA^H		NEQ^W	0
Pensions (PEN)			PEN^F		PEN^H		$NPEN$	0
Financial net wealth (FNW)	FNW^H	FNW^F		FNW^G	FNW^H		FNW^W	**0**
Fixed assets (K)	K^N	K^F		K^G	K^H			K^T

Table 2: Transaction Flow Matrix

	NFC		FC		G		H		ROW		
	Current	Capital	Current	Capital	Current	Capital	Current	Capital	Current	Capital	$\sum$
Private Consumption	$+C$						-C				0
Government Consumption	$+G$				$-G$						0
Investment	$+I$	$-I^N$		$-I^F$		$-I^G$		$-I^H$			0
Exports	$+X$								$-X$		0
Imports	$-M$								$+M$		0
$[GDP]$	$[Y]$										
Taxes	$-T^N$		$-T^F$		$+T^G$		$-T^H$		$-T^W$		0
Gross Operating Surplus	$-B2^N$		$+B2^F$		$+B2^G$		$+B2^H$				0
Wages	$-WB^N$						$+WB^H$		WB^W		0
Capital Income	rK^N		rK^F		rK^G		rK^H		rK^W		0
Transfers	STR^N		STR^F		STR^G		STR^H		STR^W		0
Pension adjustments			$-CPEN^F$				$+CPEN^H$				0
Savings	$-S^N$	$+S^N$	$-S^F$	$+S^F$	$-S^G$	$+S^G$	$-S^H$	$+S^H$	$-S^W$	$+S^W$	0
Capital transfers		KTR^N		KTR^F		KTR^G		KTR^H		KTR^W	0
Acquisitions - disposals of...		NP^N		NP^F		NP^G		NP^H		NP^W	0
Net lending		NL^N		NL^F		NL^G		NL^H		NL^W	0

Table 3: Estimates

$\Delta ln(c_t) = 0.37 * \Delta ln(yd_t) + 0.03 * \Delta ln(nw^H_{t-1}) + 0.46 * \Delta ln(c_{t-1})$
$\frac{i^N_t}{k^N_{t-1}} = -0.18 + 0.24 * \frac{i^N_{t-1}}{k^N_{t-2}} + 0.36 * \frac{y_t}{k^N_{t-1}}$
$\left(\frac{i^H_t}{k^H_{t-1}}\right) = 0.22 * \left(\frac{i^H_{t-1}}{k^H_{t-2}}\right) + 2.34 * \left(\frac{P^H_t}{P^i_t}\right) + 0.09 * \left(\frac{yd^H_t}{k^H_{t-1}}\right) - 0.01 * \left(\frac{IBL^H_{t-1}}{k^H_{t-2}}\right) - \phi * 0.003(lev^h_{t-1} - lev^{tar}_{t-1})$
$P^H_t = -6.44 + 0.41 * ln(P^H_{t-1}) - 0.05 * ln\left(\frac{k^H_{t-i}}{i^H_{t-i}}\right) + 0.46 * ln(y_{t-1})$
$lev^h_t = 0.88 * \left(\frac{IBL^H_{t-1}}{YD^H_{t-1}}\right) + 3.23 * \left(\frac{I^H_t}{YD^H_t}\right) - 1.55 * r^H_{L,t-1}$