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Home is where the debt lies: Mortgage debt and recessions over the past 130 years

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1. Introduction

In 1982 a book was published written by the American economist Hyman P. Minsky. From a current perspective the book carried an almost prophetic title: 'Can it happen again?'. The 'it' referred to the Great Depression of the 1930s, and the book was concerned with the circumstances of present-day societies and whether they were both institutionally and economically sound enough to avoid such a large-scale catastrophe from happening again. According to Minsky the real economy and the financial system are, contrary to what some economists have claimed, inextricably intertwined. Those that claimed otherwise "can only mislead and bear false witness as to how our world works" (Minsky, 1982).

Over the past years, Minsky's work regained attention, most noticeably his 'Financial Instability Hypothesis' (FIH) where the presumption 'stability is destabilizing' is centered around the idea that capitalist economies are inherently unstable. What this means is that economic agents experience a self-amplifying interaction between collateral value and credit. Loans finance investment, which will increase asset price values, thereby increasing collateral value allowing to take up additional loans. As this spiral continues and a general euphoria unfolds, optimistic expectations about future developments outpace the ability to pay and widespread difficulty to meet commitments ultimately leads to bankruptcies, causing the mania to turn into panic and to finally end in crisis (Knell, 2015; Bhattacharya et al, 2015). Both Minsky and Kindleberger (1978) were advocates of the view that over the course of history financial crises have repeatedly turned out to be credit bubbles gone bust.

Minsky's theory was mainly directed at instability caused by commercial activity. However, the premise of instability also holds for households. According to Jordà, Schularick and Taylor (2014) the last thirty years can be characterized by the rise of 'financialization'. This term describes increased income share of finance, rise in household debt and proportional growth of financial claims on the balance sheets of financial organizations. Mortgage credit in particular has been a source of financial deepening in advanced economies, as it constitutes the lion's share of private debt in many countries (IMF, 2017). Various central banks of both advanced and emerging market economies have warned for the current development of household debt-to-income ratios and its consequences in terms of financial stability risks (IMF, 2017). Banks in advanced countries have shifted their main credit operations from issuing business debt towards becoming real estate lenders. Where the lending portfolios of banks around 1900 consisted for around 30 percent of mortgage loans, it has currently doubled to around 60 percent. Moreover, an increasing share of supply in mortgage credit has been employed to finance existing housing, rather than newly built homes and buildings, and mortgage debt levels are rising faster than the underlying asset prices (Bezemer & Zhang, 2017; Jordà, Schularick & Taylor, 2014). This financial deepening has thus raised increasing concern over its sustainability and its potential of being a harbinger of financial instability.

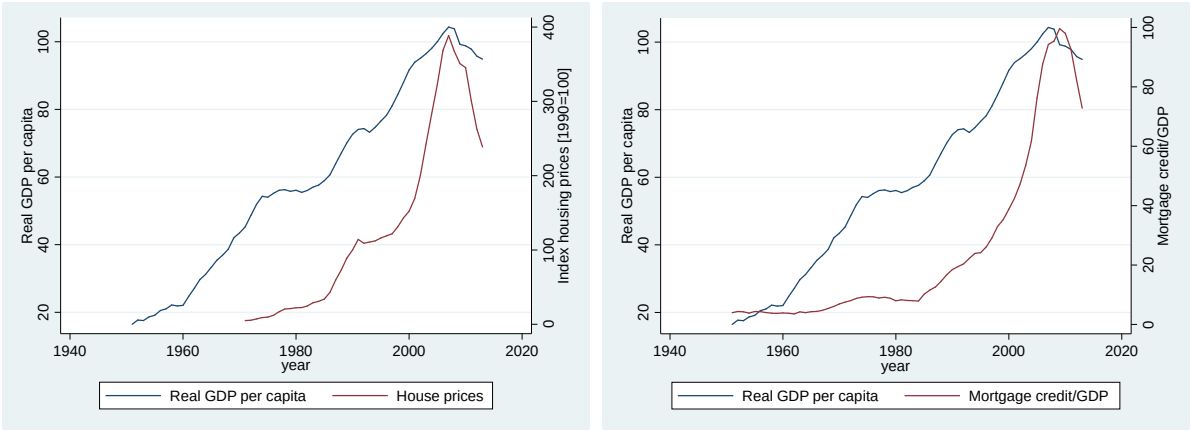

Figure 1.1: Left panel: growth housing prices and real GDP per capita in Spain. Right panel: Mortgage credit-to-GDP ratio and real GDP per capita in Spain. Source: Jordà, Schularick & Taylor (2016).

The raised concerns can be illustrated through developments in Spain. As can be seen from the left panel in figure 1.1, the peak of Spanish house price growth coincided with the start of the Great Recession, followed by a plummet of both GDP and house prices as a result of a bubble in the Spanish housing market. The right panel shows a steep build-up of mortgage credit after 1980 and a reduction in the levels of mortgage debt-to-GDP shortly after the crisis outbreak, which raises the question: which role did mortgage credit play in the inception of the crisis and its aftermath?

The development of mortgage credit, house prices and crisis from the previous example exhibits parallels with Minsky's theory. Stability allows for an increase in risk by investing in homes while accumulating debt. Accumulation of debt by households works its way up to a critical value of leverage, after which financial instability emerges. Previous studies have found increases in mortgage credit to increase the probability of economic crisis occurrence (Büyükkarabacak et al, 2010), and mortgage credit to have played a mayor role in the loss of GDP during the 2008 Great Recession (Mian & Sufi, 2010; Bezemer & Zhang, 2017). Others have found private credit to be detrimental to economic growth, as the amount of private credit build-up during the upswing determines the loss of GDP during the following economic downturn (Jordà, Schularick & Taylor, 2012; Bridges, Jackson & McGregor, 2017). Figure 1.2 exhibits the average increase of mortgage credit-to-GDP for 17 advanced countries over more than a hundred years and shows that not only Spain has undergone the above-mentioned rise of mortgage credit growth. As can be concluded, mortgage credit affects crisis occurrence and the magnitude of recessions. But does this increase of credit mean that mortgage debt over the course of the century increasingly left its mark on the economy in terms of increasing loss of GDP during economic downturns and an increase in their duration over that period?

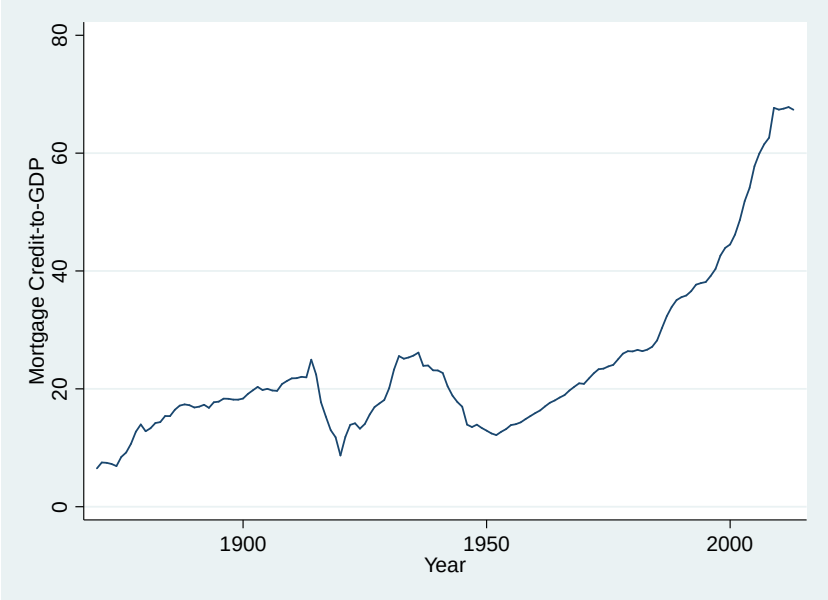

Figure 1.2: Development average mortgage credit-to-GDP 17 OECD countries 1870-2013. Source: Jordà, Schularick & Taylor (2016).

This research will be dedicated to answering the following question: "Has mortgage credit increasingly deepened and prolonged recessions over the past 130 years?" The following findings indicate that mortgage debt does provide economic growth, however, only up to a certain level, after which it reduces GDP growth. Furthermore, it will be shown that mortgage credit not only deepens and prolongs recessions, but also that these effects have increased over the past 130 years.

In providing an answer to the central question different empirical angles will be utilized. Firstly, the effect of the mortgage credit-to-GDP ratio on real GDP per capita will be examined by first performing an ordinary least squares (OLS) regression and then an instrumental variables (IV) regression to circumvent the found endogeneity issues. Moreover, the threshold ratio of mortgage credit will be calculated, which is the level of mortgage debt-to-GDP after which households are leveraged to such an extent that it negatively affects economic growth. It is expected that these findings will be in line with Minsky's FIH, as it indicates that mortgage credit does not contribute to economic growth limitlessly, but instead that excessive debt built up during a period of favorable economic conditions will lead to adverse outcomes. Moreover, the dataset will be divided into two samples, namely before and after World War II (WWII), to see whether the effect on growth of GDP has changed over time and whether the thresholds of the two time periods differ. As mortgage credit-to-GDP has risen after WWII, it can be expected that the influence of debt on GDP has increased as well.

Secondly, the relationship between mortgage credit-to-GDP and macroeconomic instability will be scrutinized, where macroeconomic instability will be measured as the standard deviation of growth in real GDP per capita. Again, an OLS- and IV-regression will be applied to deal with endogeneity, and the threshold value for mortgage debt-to-GDP, after which macroeconomic instability increases, will be

calculated. Furthermore, the two time periods before and after WWII will be compared to see whether mortgage credit has increasingly led to macroeconomic instability. Larger stocks of mortgage debt are expected to increasingly have led to macroeconomic instability post-WWII.

Finally, to examine the loss of GDP during recessions, the duration of recessions and the overall severity of recessions are affected by mortgage credit, OLS- and IV-regressions will be performed. The variables growth in mortgage debt-to-GDP and the build-up of mortgage credit (credit intensity) during the expansionary phase, which is the increase of debt from trough to peak, will be regressed on identified recession periods' loss of GDP from peak to trough. Additionally, mortgage debt-to-GDP growth will be regressed on the duration of recessions in years from peak to trough. Finally, a similar regression will be performed on a composite 'severity measure' to see whether recessions have been increasingly affected by mortgage credit over time. These findings will be in the spirit of Minsky, as excessive leverage built up during good times will reap increased adverse growth loss during economic downturns.

Whereas previous research limited its scope to the influence of mortgage debt on crisis probability, the influence of mortgage credit on recession depth on a fairly short time span, or applied a broader credit variable, this research has the potential to shed new light on the level of mortgage credit and its consequences in our present-day economies. If recessions have been increasingly affected by the growing mortgage debt-drivenness of our societies, policymakers may have to reflect on whether ever-increasing mortgage debt is a desirable development and whether that counteractive policies should be set in place to put a halt to increasing mortgage-debt accumulation.

The structure of the research is as follows: chapter two will discuss earlier empirical research and a theoretical foundation. Chapter three will discuss the data and the development of mortgage credit. Chapter four will present the empirical set-up and its results, and finally the conclusion will sum up the whole research, present the answer to the central question, discuss research limitations and explore policy possibilities.

2. The credit cycle, booms, busts and financial crises

The housing bubble and subsequent crisis of 2008 made macroeconomic thinking revisit the role of the credit and the financial sector within the economy. Over the course of economic history different strands of thinking have assigned varying roles to credit in terms of influence on economic decision-making and business cycle fluctuations. First, the real business cycle-view where economic decisions are independent from any form of money, as banks respond to aggregate output increases by increasing the amount of money supplied, just like output in any other sector in the economy. Therefore, money can be taken out of the equation in order to truly understand real business cycle movements (Mankiw, 1989). Opposing the real business cycle-view, Aikman, Haldane and Nelson (2013) state that credit "sows the seeds of subsequent credit crunches" and James Tobin (1989) calling excessive debt, in light of Minsky's Financial Instability Hypothesis, "the Achilles heel of capitalism".

In this chapter the increased concentration of credit will be evaluated and the empirical findings on the consequences of credit build-up will be discussed. Furthermore, several theoretical mechanisms underlying credit build-up and its effect on the economy will be assessed, narratives on historical crises will be examined and finally, the effect of private debt on instability of growth in GDP will be discussed.

2.1 Literature on mortgage debt, recessions and crises

A wide array of studies has been dedicated to the interconnection between credit and the macroeconomy. During the boom-phase, private consumption, private investment, credit supply, collateral values and stock values tend to increase and boost short-term economic growth. However, in the longer run its effect may turn in the opposite direction. From an assessment of previous literature on household debt and financial stability, it has come forward that especially advanced countries have experienced the medium-term effects of excessive household debt-to-GDP to be negative in terms of decrease in consumption, employment, house and equity prices and GDP (IMF, 2017). The following section will discuss a number of researches in order to assess mortgage credit, credit booms and busts and as to how they affect financial crisis occurrence. In appendix B an overview of the empirical researches discussed can be found with a succinct description of data, methods, variables and empirical results related to credit.

Credit and business are intertwined to such a degree that they can be expected to move in sync. However, apart from the business cycle, there is also the credit cycle, a wholly different type of species. Aikman, Haldane and Nelson (2013) observed credit cycles, which can be measured in terms of the variation in ratio of bank lending to GDP. The upswing of these cycles consists of the increase of credit supplied during economic expansion as a result of easy access to credit. The contractionary phase of credit as the cycle goes downwards is associated with tightening of credit which results from stricter lending standards and increased interest rates. Whereas the business cycle tends to complete over the course of two to eight years, the credit cycle fluctuates between eight and twenty years. Thus, the amplitude of the

credit cycle is around four times as large as those of business cycle fluctuations. Credit has been found to be a stronger determinant of economic crisis occurrence than broad money (Aikman et al, 2013; Büyükkarabacak, 2010). As to whether credit booms and busts that form the cycle influence the severity of a crisis, the authors provide evidence of a negative relationship between the credit-to-GDP build-up during the preceding boom and growth after the recession hits. An additional interesting finding concerns whether the merits in terms of GDP build-up during the expansion phase weigh up to the losses after the bust. The median cumulative loss over the years following the bust are over twice as large as the gains incurred during the build-up phase. However, the limitations are that no causal inferences can be found between bank credit and loss in real GDP, and only correlation based on trends in bank credit and real GDP. Therefore, results on bank credit and real GDP provide only an indication of the relationship.

Borio (2014) states in an assessment of previous empirical works that credit, along with property prices, can be considered to be the most useful variables to study the ties between credit cycles, business cycles and financial crises. As the credit cycle tilts, the peak of the credit cycle, when coinciding with the peak of the business cycle, tends to be a harbinger of systemic banking crises. In addition, recessions occurring whilst in the contractionary phase of the credit cycle tend to be increasingly severe compared to those during 'normal times'. In particular, credit deviations from trend are identified to be the most relevant indicator of impending financial crisis. These credit gaps can be considered a measure of leverage and therefore resilience to absorb losses, as exogenous shocks inducing credit constraints hit hardest when credit has built up to such an extent that borrowers are unable to service their debt and are forced to deleverage. The length and amplitude of the credit cycle are influenced by the financial-, monetary- and real-economy regime. For instance, after financial deregulation in the 1980s the length and amplitude of the credit cycle increased in developed economies, whereas prior to financial deregulation, business and credit cycles appeared to exhibit a similar length and amplitude.

By now, it has to some extent been determined that credit build-up or financial deepening may negatively affect economic performance. However, credit is a required link within the chain of establishing economic growth in a capitalist society. The question arises: when do debt levels become problematic, and when does financial deepening stop being conducive and instead becomes a drag on growth? Arcand, Berkes and Panizza (2012) find the relationship of financial deepening and growth to be non-monotonic and concave. Private debt therefore has a threshold value around 80 to 100 percent of GDP at which point the relationship with economic growth turns negative. Part of the explanation on the turn-around of the relation with growth can be found in the increased probability of economic crises for these levels of debt and in the appearance of increased instability of GDP growth, which will be discussed in section 2.4. Due to the GMM-estimation, results are robust to both heteroskedasticity and autocorrelation. Moreover, by instrumenting private credit, problems of endogeneity have been overcome as well. These are issues which will have to be taken into consideration in this research as well. First differencing accounts for country-specific heterogeneity, though year-specific heterogeneity remains unaccounted for. But results

found do imply a causal adverse effect of private credit on GDP. The threshold values found by the authors are comparable to those found by Cecchetti and Kharroubi (2012) who apply a pooled OLS with country-fixed effects and find the peak to be around 90 to 100 percent private credit-to-GDP ratio. Finally, using a dynamic panel threshold regression Law and Singh (2014) find a threshold values between 88 and 94 percent private sector credit-to-GDP ratio. Their study uses an orthogonal deviations transformation to correct for both heterogeneity and autocorrelation. Concluding, threshold values of private credit leading to adverse effects on economic growth can be found around 80 to 100 percent of GDP.

In earlier research Schularick and Taylor (2012) found an aggregate measure of credit to be a proper predictor of financial crises. Delving deeper into these findings, Jordà Schularick and Taylor (2012; 2014) narrow down the scope by looking at the effect of mortgage credit in instigating financial crises and comparing the consequences of credit-induced financial crises to normal recessions. By looking particularly at their effect on financial fragility over the course of the past 140 years by looking at the output losses during economic downturns. Firstly, concurring with the former mentioned study, mortgage credit seems have had a significant effect as a predictor of financial crises, which are defined by a cumulative output loss of around 9 percent in the years following the economic downturn. More specifically, the nature of the impact changed over the course of this period, as pre-WWII mortgage lending does not seem to significantly impact crisis occurrence, whereas post-WWII it takes on an increasingly important role by changing its prediction ability to highly significant (Jòrda, Schularick and Taylor, 2014). The second part is committed to studying debt-overhang through 'local projections' which are response functions which utilize propensity-score weighting regressions adjustments. Findings show excess debt to impede access to additional debt financing, thereby aggravating the economy's plummet during and path to recovery after a financial crisis. Whereas normal recessions exhibit positive growth again after two years of decline and an estimated cumulative loss of output of two to three percent, financial crises induce a path of declining GDP up to five years after the outbreak, cumulating up to an overall loss up to fifteen percent of output over these five years (Jòrda, Schularick and Taylor, 2014; Borio, 2016). The additional loss and slow recovery as a result of debt overhang is therefore evident. In particular, post-WWII mortgage debt has been assigned a central role in negatively affecting financial crises as opposed to non-mortgage lending having only a significant negative effect on pre-WWII recessions (Jordà, Schularick & Taylor, 2014). Unclear however, is whether the authors have taken serial correlation into consideration and how this affects their results, in contrast to endogeneity and heterogeneity issues which have been taken into account. Moreover, other than the dates of financial crises, the authors do not clearly explain what characteristics separate a financial recession from a 'normal recession. Finally, the authors do not expose a causal relationship between credit and GDP. Similar to the approach taken by Jordà, Schularick and Taylor, this present research will use the ratio of mortgage credit-to-GDP as the main independent variable of interest.

Looking at the change in composition of credit during the run-up of a 'bad boom' compared to booms which do not end up in crisis, Bezemer and Zhang (2014) show that the build-up of mortgage credit is three times larger than that of credit to non-financial businesses. Supply of credit does not always contribute to economic growth as, for instance, it can be used for speculative purposes in the real estate sector where credit finances transactions in financial assets, thereby contributing to inflating asset prices rather than productive investment such as building new homes (Bezemer, Grydaki & Zhang, 2016). What is unclear about the methods used is that even though country-fixed effects are included, there is no mention of serial correlation or year-specific heterogeneity. Furthermore, the measure of credit boom dummies is obtained by calculating the standard deviation of mortgage credit above its trend. Regressing growth in mortgage debt on credit boom occurrence, which is devised from the mortgage credit variable itself, is therefore likely to suffer from collinearity.

Even though thus far mortgage credit does seem to have an impact on financial crises, it is important to note that not all credit booms end up being financial crises. Dell'Araccia et al (2016) list positive correlation between years of credit booms and cumulative real GDP, until booms become too frequent. There are several elements which tend to increase the likelihood of a credit boom and which determine whether or not it turns into a 'bad boom'. Since the increasing financial liberalization of the 1980s, when regulatory control over lending rates, sectoral allocation of bank lending and restricting financial innovation was loosened, credit booms have become an increasingly frequent phenomenon. Particularly middle-income countries experienced credit booms, which aligns with the view that credit booms tend to happen within countries with relatively less developed financial systems. However, high-income countries have also faced credit booms, but less frequently so. From 1970 to 2010 the authors find one in three credit booms to be followed by a banking crisis and the largest banking crises to have been preceded by credit booms. Frequently observed boom inducing factors include financial liberalization, which tends to lead to financial deepening and capital inflows. In turn, these increase credit at the disposal of financial institutions. Other factors are favorable economic growth and domestic characteristics such as institutional quality, which consists employing macroprudential policy to ascertain financial stability. Moreover, a fixed or floating exchange rate regime and expansionary fiscal and monetary policy can create potentially favorable conditions for credit in terms of interest rates and demand for credit. Finally, the authors conclude that credit booms that turn into busts tend to be both larger and last longer, and more financial depth leads to a higher probability of a boom turning bad. The authors claim to not have found causal effects but rather correlations. Moreover, they have not taken potential endogeneity issues into account.

Research on indebtedness in the United States over the past 25 years shows that financial liberalization allowed households to increase their lending and achieve a more desirable life consumption path (Barba and Pivetti, 2009). Since the 1980s both the decrease in credit rationing and the decline in nominal and real interest rates allowed for easing of liquidity constraints for households (Debelle, 2004).

However, it is difficult to use this finding to accurately gauge whether rise in indebtedness in many countries can be explained by these two influences.

In a study on county-level in the U.S. using an instrumental variables regression between credit and economic growth, Mian and Sufi (2010) found household leverage growth to be the cause of drop in consumption, rise in unemployment, house price inflation and therefore to be one of the main culprits contributing to the severity of the 2008 recession. The recession was not only more severe in high-leverage counties, but also began at an earlier stage compared to counties with lower levels of leverage. Counties characterized by relatively large household leverage growth experienced larger default rates, increases in unemployment and drops in durables consumption, altogether an exacerbation in terms of severity and timing of the economic downturn (Mian & Sufi, 2010). Again, accounting for endogeneity in the relation between credit and economic growth has important implications for this research.

Mian, Sufi and Verner (2017) test whether the 'credit demand hypothesis', in which case there is a positive interaction between household credit and future income, against the 'credit supply hypothesis', positing additional household credit demand is driven by an expansion of the availability of credit, with the results in favor of the latter. Moreover, a household credit shock not only predicts a drop in GDP, but also an increase in unemployment. These effects are particularly pronounced in countries with a fixed exchange rate and which are faced with a zero-lower bound, underlining the ability to adjust monetary policy to deal with credit shocks. Additionally, the authors account for financial globalization in terms of the global household debt cycle, which mean that there is a strong negative correlation between increases in global debt and overall growth in global GDP. Point estimates found indicate that a standard deviation increase in global household credit reduces global GDP by 2.2% three years later. Countries' increase in household debt has therefore shown to exhibit spillover effects as consumer demand will fall, thereby negatively affecting trading partners' GDP by lowering demand for their exports. Therefore, household debt holds a more important role within the global business cycle than previously presumed. In addition, Aikman et al (2013) have found credit cycles to have increasingly synchronized across countries during the second half of the twentieth century. During the 2008 credit and consumption boom the lasting fiscal budget and current account deficits in the U.S. were primarily financed by the savings glut in Asia and countries within Europe. This explains the impact on their local banks when the U.S. housing bubble collapsed and illustrates the interconnection resulting from financial globalization (Borio, 2014; Bordo & Landon-Lane, 2013).

The determination of post-crisis severity depends on several factors. Firstly, the influence of household credit. Initially, household debt reduces saving and not only slows down, but also reduces economic growth, in contrast to business credit which stimulates economic growth (Japelli & Pagano, 1994). Additionally, not only the volume of household debt has increased relatively to other forms of debt, but more widespread mortgage debt, rather than concentrated like non-financial debt, increases the

repercussions of adverse debt-overhang effects (Bezemer & Zhang, 2017). Claessens et al, 2010) argue it is not necessarily the depth of financial deepening causing instability, but the degree and particularly the speed, of credit accumulation which poses problems. This will be taken into account as can be seen in the following section 4.1.3.

Secondly, trade and financial factors play a role in financial instability formation. The level of leverage within the national financial system, the growth of credit before the crisis and the level of current account deficit play their part in not only the depth, but also the length of recessions (Claessens et al, 2010; Agnello & Nerlich, 2012). Moreover, terms of trade deterioration will likely lead to banking crises due to producers of tradable goods facing inability to repay their loans (Büyükkarabacak, 2010). Finally, pre-crisis recession growth, real GDP per capita and trade openness are identified as sources of potential weak balance sheets (Bezemer & Zhang, 2014).

2.2 Theoretical economic dynamics of credit

Now the effect of credit on the economy has been reviewed in the previous section it is of importance to explain how these findings come to be. This section will be dedicated to the underlying theoretical framework of credit and its effect on the economy by discussing several models.

The interplay between the credit market and the real economy has been subject of research by Bernanke, Gertler and Gilchrist (1999). Their model incorporates credit market frictions to explain business cycle fluctuations and determine aggregate demand. Entrepreneurs fund investment through both wealth and through acquiring funds from capital markets. Frictions on capital markets resulting from shocks manifest themselves as information asymmetries, as the cost of gathering information and monitoring potential borrowers increases and poses a principal-agent problem for lenders, thereby increasing the real cost of lending. The agreed-upon amount of capital is dependent on the net worth of the borrower, thus the net worth of the entrepreneur signals whether the loan carries an acceptable expected default probability for the lender. The lender faced with the risk of lending demands compensation, which is the 'external finance premium', which is inversely related to net worth of the borrower. The limit up to which can be borrowed is dependent on the valuation of the entrepreneur's assets put up as collateral and is therefore susceptible for shocks in price. Borrowers' net worth is procyclical because it is dependent on prices and profits, whereas the external finance premium is anticyclical as premium demanded becomes higher as collateral falls. Herewith, the increase of the external finance premium after a shock reduces the amount of lending demanded, thereby reducing production, leading to lower prices, profits and collateral, in turn further inhibiting borrowers from lending. The amplification mechanism here is called the 'financial accelerator' as price shocks are disproportionately incurred by the economy as a result of the propagation by credit-market frictions. Shocks that are short-lived can therefore exert persistent and procyclical effects on the economy. The

problematic part is found in the loss spiral. As prices drop agents' collateral value decreases and their leverage ratio increases causing their net worth to decline faster than their gross worth (Brunnermeier & Oemke, 2013).

In addition to the previous findings on collateral, Kiyotaki and Moore (1997) expound on the transmission mechanism in which shocks to productivity reduce net worth, resulting in lowered investment expenditures. The amplification comes twofold, as investment not only drops within the period where the shock is incurred, but also reduces future net worth. As this decline in future value is anticipated this further depresses current collateral value and investment, thereby setting in motion an intertemporal multiplier of the shock. Additionally, the model exhibits fall in price of assets not only affects the entrepreneur, but also causes spillover effects leading other adverse effects in other industries.

The harm done by credit rationing leading to spillovers can thus lead to contagion. As prices of risky assets drop, prices of other assets from similar asset classes may drop as well due to them having the same liquidity funding constraint. As prices drop, investors try to insulate themselves from losses through flight to safety, dropping the risky asset through fire-sales and thereby further aggravating the price difference between the safe and risky assets (Brunnermeier & Oemke, 2013).

Taking a step beyond the impact of collateral, Eggertson and Krugman (2012) examine deleveraging following a shock. As debts limits deteriorate, agents are forced to reduce spending. Counterintuitively, falling prices do not induce additional demand, but as debt is denominated in nominal terms, the debt burden borne by debtors increases and further spending cuts are necessary, better known as 'Fisher debt-deflation'. The economy comes to find itself in balance sheet distress as excessive debt inhibits spending. A sufficiently large shock will force the economy towards a zero-lower bound interest rate, however, this will be insufficient to compensate for drop in spending as the economy finds itself in a liquidity trap. This liquidity trap poses a threat to economy as it thwarts both the nominal and real interest rate from lowering, thereby directing the economy towards a demand-driven recession (Korniek & Simsek, 2016). Concluding, tighter borrowing constraint contributes to deleveraging, in turn leading to liquidity traps and adverse economic conditions.

Up to this point several elements which lie at the heart of financial instability have been discussed, but what is their starting point? This is where Minsky and the FIH enter. The positive feedback effect between collateral and credit allow borrowers to increasingly finance their investments using debt. The perception of risk on these investments by both lenders and borrowers is built around expectations. Lenders' expectations become increasingly optimistic after successful endeavors which then become self-reinforcing. As expected cost of default decreases credit supply and portfolios are increasingly directed towards riskier projects with higher payoff. The perceived lower risk of default causes underpricing of risk by lowering lending rates, allowing borrowers to myopically increase their leverage regardless of the actual risk of default, in turn leading to higher default when negative results materialize (Bhattarcharya et al,

2011). Core to the FIH is borrowing to finance investment in non-productive investment, better known as 'Ponzi-speculation' on asset prices. Widespread optimism among investors creates an environment of irrational exuberance, which leads to amplified cycles of output, where the economy undergoes series of boom-bust cycles as the quantity of debt taken up during the upswing is larger than the ability to service debt resulting in financial instability (Keen, 2009). Therefore, prolonged perceived stability is conducive to instability, which is the central thesis posed in the FIH.

Most of the theoretical structures outlined in the previous paragraphs apply to household financing as well, albeit they revolve around lenders and borrowers in a setting of business investment. Putting up collateral to finance risky assets and being confronted with consequences of price swings applies to both households and business practices. As can be seen in figure 2.1:

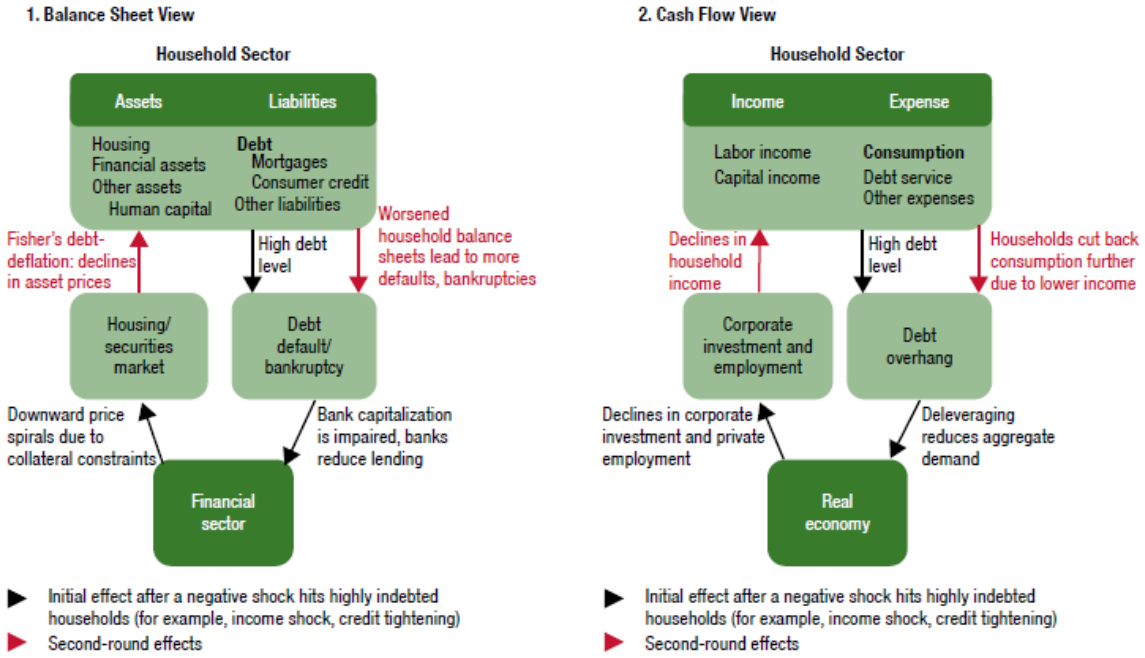

Figure 2.1: First and Second round effects households and financial sector on financial stability; Source: IMF (2017).

The interconnectedness of both household and financial sector balance sheets in figure 2.1 is evident and incorporates several of the previous theoretical outlines. The left-hand side shows how households' balance sheet problems, resulting from excessive debt after a shock, affect balance sheets in the financial sector, which in turn affects collateral thereby exacerbating household problems. The amplifying effect of excessive household debt as it reverberates throughout the entire system is insightfully depicted as a negative spiral. The right-hand side exhibits how excessive debt negatively affects consumption in turn affecting investment spending, again resulting in a negative spiral. These two views are not competing but rather complementing views in providing an overview of the transmission mechanisms of debt leading to financial instability.

2.2 Historical crisis narratives

Having become infamous through large scale fraud in speculation, well-known historical figures such as Charles Ponzi and Clarence Hatry may have not been the cause of crisis, but their names have become synonymous to speculative excess, its negative consequences and those periods of financial turndown - as can be seen from the term 'Ponzi-finance'. In the coming section a selection of crises and their common denominators will be discussed.

Every documented crisis has been in a sense unique and has been rooted in different sources that lead to financial instability. This poses a very difficult challenge for policymakers to anticipate what the culprits are for crises in the offing. There is, however, a commonality in the way crises take shape. To start off, a coarse division can be made between the run-up phase, the tranquil period allowing bubbles and imbalances to accumulate, followed by the crisis phase, where the built-up instability unravels and a full-blown collapse emerges. Interestingly enough, the period of abrupt transition to the crisis phase has been assigned the name the 'Minsky-moment'. The blueprint for the run-up phase can be found in the accommodative environment for asset price booms. A first ingredient is low asset price volatility, often combined with an innovation to rationalize the rapid price increases, for instance infrastructure, such as development of railroads in the U.S., new communication and information technology and financial innovation such as financial derivatives. Additionally, circumstances like accommodative monetary policy and rapid credit growth, potentially fostered by financial innovation, can give rise to explosive asset price behavior (Bordo & Landon-Lane, 2013; Brunnermeier & Oemke, 2013).

During the 1920s credit to U.S. households and businesses sparked a boom-bust in the real estate sector and eventually led to the Wall Street stock market crash of 1929. The Federal Reserve was concerned over these price developments and translated these concerns into tightening of the money supply. This led to banks passing through the increases of interest to indebted businesses and households. In addition, positions held in the financial sector were often highly leveraged. These circumstances led to fragility in the financial system, leading participants to reduce spending on consumption and investment thereby generating a level of deflation strong enough to endanger the financial system and economy as a whole (Eichengreen & Mitchener, 2003). Even though discussions on the causes of the Great Depression are still ongoing, ample credit supply has been attributed a serious role in the cause of this depression.

The U.K. experienced a large house prices and stock market boom in the beginning of the 1970s. An increase in broad money following the liberalization of the British financial sector shifted balance composition from households towards corporate and financial sectors. The funds were used to buy equities and properties, thereby driving up their price (Bordo & Landon-Lane, 2013). This resulted in first a stock market crash, followed by the real estate bubble going bust as well during the second half of the 1980s.

Another boom-bust episode with severe impact was in 1990s Scandinavia. In this case as well, a lending boom in the wake of the liberalization of credit markets led to a boom which was particularly pronounced in the real estate sector. The Scandinavian countries experienced large drops in output, abandoned their currency pegs, leading to devalued currencies and a rise in indebtedness of the banking sector which had large quantities of foreign currency denominated debt. Eventually, government had to provide liquidity to support the sector, and the Swedish authorities were forced to nationalized part of their banking sector.

Finally, Japan also experienced a similar financial crisis during that time. Expanding bank lending and monetary policy allowed for a boom on the property market, in turn leading to a stock market boom. In an attempt to curb the boom, the Bank of Japan tightened monetary policy to insulate the economy from the bubble inflicting serious damage, however, to no avail. Real estate served as collateral in many industries, firms had to deleverage and often went bankrupt. The monetary tightening eventually created a grave debt overhang problem, thereby triggering a full-fledged banking crisis. The time to resolve this banking crisis and its damage to the economy was such that it has come to be known as the 'lost decade' (Bordo & Landon-Lane, 2013; Brunnermeier & Oemke, 2013).

As to what triggered the advent of the 2008 Great Recession in the U.S., Mian and Sufi (2010) find increased household debt leading to inflated house prices to be the one of main contributors. Potential sources which increased access to mortgage credit were government programs to promote affordable housing, moral hazard of loans originators and distributors and large capital inflows. However, more importantly, their research points towards what lies at the heart of this system, the collateral feedback effect. The increase of house prices allowed for homeowners to lend additionally against their increased collateral value of home equity, as discussed in section 2.2. From 2002 to 2006, against every dollar of house price increase, homeowners borrowed 25 to 30 cents, thereby accounting for a large portion of the increase of debt over this period. After 2006 a deterioration of house prices combined with overindebtedness of households caused a sharp fall in consumption and a rise in unemployment. Mortgage defaults were the result of the combination of price decreases, deteriorated lending standards and the collapse of the securitizations markets, thereby amplifying the effects as households were unable to refinance. The group most prone to these adverse shocks have been found to be those in the lower region of the income distribution, whereas higher-income groups found themselves to be in a position to cope better with these shocks. This resulted in the highest debt-to-income ratios, the highest debt-servicing, and the highest debt-to-asset ratio for households around the low and middle-section of the income distribution (Debelle, 2004). The burden from downward cyclical fluctuations was borne mostly by these households as their asset holdings were relatively low, thus benefitting fairly limitedly from wealth effects during good times and were more susceptible to shocks to income during bad times (IMF, 2017).

In short: newly found flows of capital resulting from accommodative circumstances such as financial deregulation and favorable monetary policy allowed for credit accumulation. This combined with optimism on future prospects and asset price developments led to imbalances, finally ending up in economic downturns.

2.4 Macroeconomic instability, growth and crises

How does growth of GDP volatility (which will be referred to as 'macroeconomic instability' in the coming section) relate to actual GDP growth and crises? And can private credit induce macroeconomic instability which will lead to economic turndown? The coming section will discuss these issues.

Underlying the occurrence of macroeconomic instability, which is measured as the standard deviation of GDP growth, is the 'volatility paradox'. Brunnermeier and Sanninov (2014) explored through their theoretical framework the development of asset price volatility and leverage. The paradox explored is that the economy is susceptible to crises when exogenous risk is low, thus low asset price-volatility environments build towards greater systemic risk, which is line with the previous discussed FIH in section 2.2. Amplification of shocks in low asset price-volatility environments comes about as endogenous risk increases by taking on more leverage by investors. The moment an adverse shock occurs, excess leverage causes liquidity constraints and amplifies the shock finally giving rise to asset price-volatility resulting in crisis episodes with disinvestment, misallocation of resources and slow recovery (He & Krishnamurthy, 2012). Even though the paradox applies to asset price-volatility, the underlying mechanism can be expected to apply to macroeconomic instability as well, as explained in section 2.2.

Macroeconomic instability has been found to be negatively related to growth. Increased instability leads to uncertainty about future economic conditions as firms invest in an amount of technology in advance. Instability will lead to lower output and cause firms to have employed a suboptimal amount of technology. Therefore, macroeconomic instability induced uncertainty on future output will in turn lead to postponing decision-making (Ramey and Ramey, 1995). Aizenman and Pinto (2004) argue there are legitimate reasons to view macroeconomic instability and crisis as two sides of the same coin. Firstly, the difference between the two is mainly a matter of size. Large swings in output resulting in decline can be called crises. Secondly, they are driven by the same fundamentals. Finally, when discerning macroeconomic instability into a part driving normal business cycles and a part associated with crises, macroeconomic instability during crises has shown to have a lasting detrimental effect on long-term growth.

The role played by macroeconomic instability in relation to private credit has been examined through an instrumental variables regression by Easterly, Islam and Stiglitz (2001). Starting off, advanced economies experience fewer shocks and therefore have more financial depth. However, financial depth

leading highly levered positions of a critical degree may become the cause shocks. The relation between private credit and macroeconomic instability appears negative, thus increase of credit causes macroeconomic instability to reduce. However, the relationship between macroeconomic instability and private debt has been found to be concave and therefore a level of moderate financial deepening will allow for growth but will also increasingly foster macroeconomic instability after a threshold value is reached. The threshold value found by the authors is a private debt-to-GDP ratio of around 100 percent.

To sum up, private debt initially promotes growth by reducing macroeconomic instability. However, troubling ratios of debt lead to increased instability. In terms of crises, there is no one to one clear relationship between macroeconomic instability and crises. However, the two are akin to one another and private debt can play a role in their inception of both.

3. Financial development over 1880-2013

3.1 Data description

The data used to delve deeper into the relationship between mortgage credit, growth and recessions spans an astoundingly long time period. For the years 1880 up to 2013 the authors Jordà, Schularick and Taylor (2016) have assembled the 'Macrohistory dataset', a panel dataset which consists of yearly data for 17 advanced OECD-countries, based on a broad range of sources such as economic and financial history books and journals, central bank statistics and archives. Even though the time range is quite extensive, the number of variables included are sufficient to account for the macroeconomic developments over those years. The variable for economic growth is taken from the latest Madison Project database (Bolt et al, 2018). The last variable from a different source is growth terms of trade, collected from the Financial Crisis database (Bordo et al, 2001). However, these were only provided from 1880 up to 1997, therefore the remaining 16 years were collected from the OECD database (2018). Countries included are: Australia, Belgium, Canada, Switzerland, Denmark, Germany, Spain, Finland, France, Italy, Japan, the Netherlands, Norway, Portugal, Sweden, the United Kingdom and the United States. The two World Wars have been excluded from the dataset because of non-economic source of disruption to society. The dataset is strongly balanced.

The descriptive statistics can be found in table 3.1. Most noticeable are mean, minimum and maximum value of inflation (growth CPI), which can be explained by extreme values during the 1923 hyperinflation in the Weimar Republic. The mortgage-to-GDP-ratio will be used as a measure for household leverage as done by Bezemer and Zhang (2017).

Variable	Abbreviation	Nr. Obs.	Mean	S.D.	Min	Max
Mortage/GDP	mortgdp	1,914	26.26	24.67	0.091	139.05
Growth Population	growthpop	2,091	0.85	1.046	-25.23	26.49
Investment/GDP	investgdp	1,967	19.26	6.19	1.72873	38.89
Trade $(X + M/GDP)$	trade	2,067	43.89	33.94	1.29	297.39
Stocks	stocks	1,911	276.63	1096.54	0	14706.5
Growth broad money	growthmoney	1,983	7.93	23.95	-53.29	1009.29
Government Balance	gov_bal	2,027	-1.36	3.42	-2.52	2.01
CPI	CPI	2,091	40.12	51.97	0	217.94
GrowthCPI	growth_cpi	2091	51818400.7	2.34e+09	-19.42004	1.06e+11
% ***change Terms of Trade***	ToT	1377	0.14	5.47	-24.82	44.78
Growth real GDP/cap	growthgdppc	1,926	2.25	3.66	-24.47	18.24
SD Growth real GDP/cap	growthgdppcSD	1942	3.00	1.95	0.18	14.34
Exch rate SD	XR_sd	2,091	8.95	40.67	0	429.58
Curr Acc/GDP	cagdp	2,012	-0.48	4.23	-19.34	21.67
Severity Recession	severity	291	-2.60	9.29	-85.65	0
Amplitude Recessions	Amplitude	291	-1.29	4.34	-35.68	0
Length Recession	Length	291	1.95	1.16	1	6
Mortgdp_EXP	Δ%mortgdpEXP	291	1.88	8.45	-.14.17	65.47

Table 3.1: Descriptive statistics

3.2 Financial deepening over 1880-2013

The role played by credit within advanced economies has increased over the course of the twentieth century. Over the period between 1870 and 2010 the non-mortgage credit to GDP ratio has increased by a factor three and mortgage lending to GDP has grown by a degree of factor eight, where mortgage credit has made the most noticeable jump in the past forty years, as can be seen in figure 3.1. This spike in the second half of the twentieth century can largely be explained through the development of national housing policies promoting home ownership and the tax treatment of debt financing in terms of deductibility of interest (Jordà et al, 2014; IMF, 2017).

As noted by Schularick and Taylor (2009) during the so-called 'Age of Money' credit and broad money moved in tandem up to the Second World War. During the war, credit plunged, due to banks loaning money to finance war efforts. After the war, however, the relationship was disconnected, and credit started to increase relative to both GDP and broad money. Before World War Two, credit

development show differences in the countries within the sample, but after 1945 they all show the same rapid increase in credit, ushering in a new period the authors call the 'Age of Credit'.

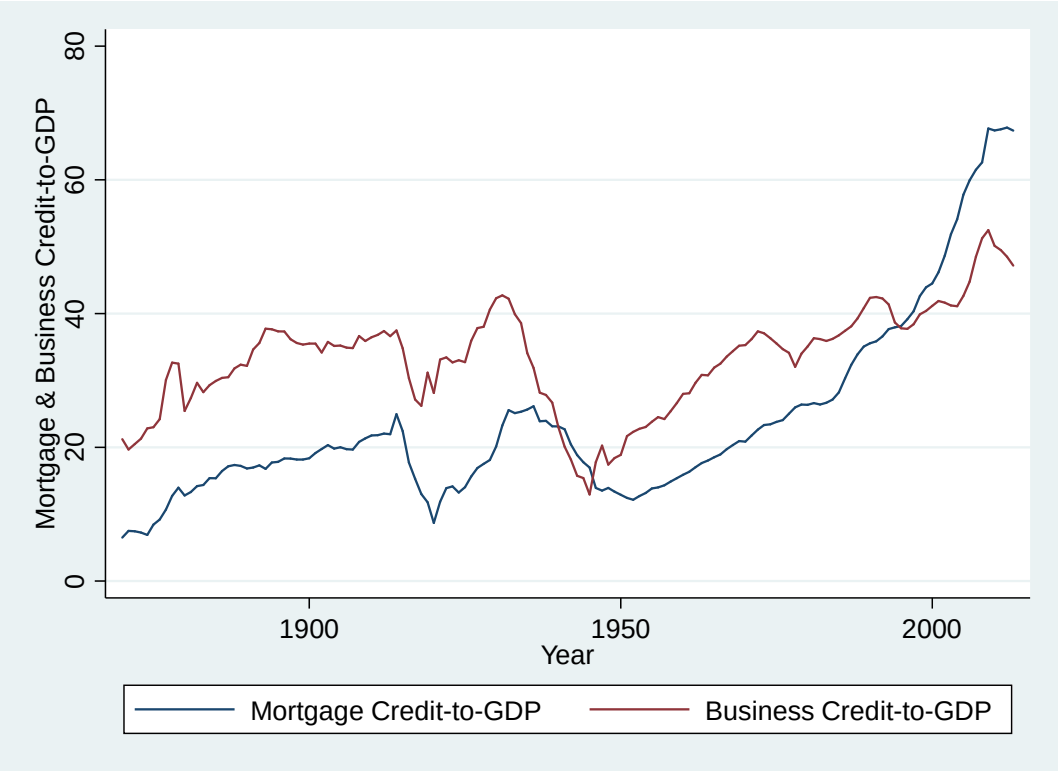

Figure 3.1: Average mortgage/GDP-ratio and business credit/GDP-ratio for 17 OECD countries. Source: Jordà, Schularick and Taylor (2016)

As can be seen from figure 3.1 business credit was during most of the twentieth century the largest credit-category. However, around the 1990s mortgage credit surpassed business credit and rose to unprecedented levels in a fairly short period. Figure 3.2 shows the mortgage credit development of the 17 OECD countries. The development varies per country, but noticeable is the rapid increase at the end of the twentieth century across several countries such as the Netherlands, Spain, Switzerland and Denmark. In countries which experienced a housing boom and bust during 2008, such as the Netherlands and Spain, a process of deleveraging took place as can be seen from the drop of mortgage credit-to-GDP post-2008, especially when considering GDP declined over that period as well. However, most countries have an ever-increasing ratio.

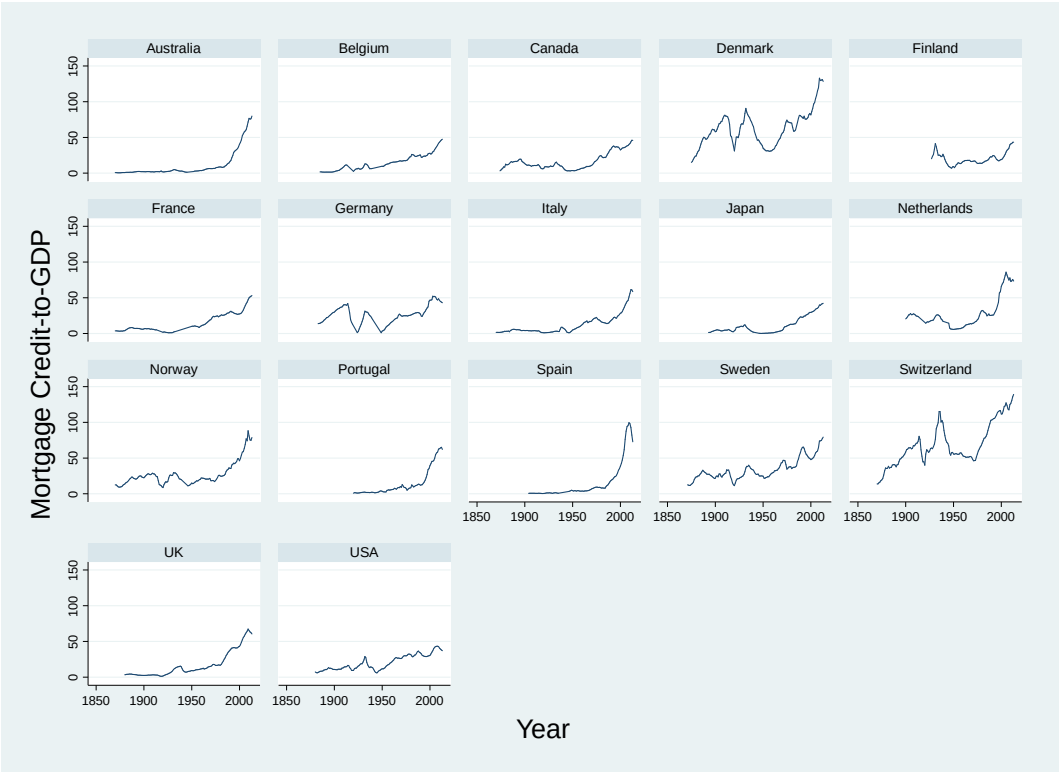

Figure 3.2: Mortgage-to-GDP-ratios 17 of OECD-countries 1870-2013. Source: Jordà, Schularick & Taylor (2016).

The bar graphs in figures a.1 to a.4 in appendix A give a coarse view of the average economic growth of GDP during the expansionary phases which proceed the downturns, the duration of expansionary phases in years, the loss of GDP during economic downturns and length of economic downturns in years. The panels are divided into four time periods: 'Before-WW1' ranging from 1880 to 1913, 'Interwar' ranging from 1919 up to 1939, BW which stands for Bretton Woods and ranges from 1946 to 1971 and After-BW which ranges from 1971 to 2013. In figure a.4, recession amplitude, which is the cumulative loss of GDP from peak to trough in the recession phase, shows that the average loss of GDP during the recession phase is the largest during the interwar period. However, compared to the BW-period, the depth of downturns during the post-BW has increased. As can be seen in figure a.5, mortgage credit during the expansionary phases preceding downturns takes flight after 1970, which could indicate a connection between mortgage credit growth during the expansionary phase and the loss of GDP during the downturn. However, to say credit growth led to deeper recessions is premature. Also, as of 1970, the length of downturns seems to have increased as compared to the BW-period as can be seen in figure a.2.

4. Empirical expositions and results

The coming chapter will elaborate on the methodology which will be applied to the relation between mortgage credit, GDP growth, macroeconomic instability and recessions. To untangle as to how mortgage credit affects growth and economic downturns panel regressions will be performed in various forms. The measure employed throughout the empirics will be the ratio of mortgage credit-to-GDP.

First, the relationship between mortgage credit-to-GDP and growth of real GDP per capita will be examined. Second, a closer look at the ratio of mortgage credit-to-GDP and macroeconomic instability will be taken, where the instability will be measured by the standard deviation of growth in GDP per capita. Both these regressions will have an overall regression and a comparison between a pre-WWII and post-WWII sample. Finally, a measure for recession severity alongside depth and duration will be constructed and the effect of mortgage growth and mortgage build-up during the expansive phase on recession severity will be examined.

4.1 Empirical expositions

4.1.1 Mortgage credit and economic growth exposition

The first regression used in this research is the following ordinary least squares (OLS) specification:

$$growthrgdppc_{i,t} = \alpha + \beta_1 mortgdp_{i,t} + \beta_2 mortgdpsq_{i,t} + \beta_3 X_{i,t} + \varphi_i + \phi_i + \varepsilon_{i,t} \quad (1)$$

Where $growthrgdppc_{i,t}$ is the growth of real GDP per capita for country i at time t, $mortgdp_{i,t}$ is the ratio of mortgage credit over GDP and $mortgdpsq_{i,t}$ is a squared term of the $mortgdp_{i,t}$-term. $X_{i,t}$ is a set of control variables, which are likely influence growth of real GDP per capita as well. The choice of control variables will be based on prior research. The terms φ_i and ϕ_i stand for country- and year-fixed effects, which will account for heterogeneity specific to countries and years. As can be seen in appendix A table a.1 column 1, the Hausman test rejects the null at 0.05-level and therefore fixed effects are included. The variable $\varepsilon_{i,t}$ is an error term, which contains the effects unaccounted for in the regression. The stock of mortgage-to-GDP ratio is chosen rather than the growth rate of mortgage-to-GDP as independent variable. This will allow for the quadratic relation to reveal the threshold value as discussed in section 2.1 and see which level of mortgage debt will induce adverse effects on growth in real GDP per capita, as done in previous research (Arcand, Berkes & Panizzi, 2013; Law & Singh, 2014; Cechetti & Kharroubi, 2012). Finally, the ADF-test in appendix A table a.3 column 1 rejects the null of non-stationarity, which will therefore not pose a problem of biased results.

There are, however, some challenges to overcome. Firstly, looking at table a.1 in appendix A, the null of no serial correlation is rejected. The resultant standard errors are thus correlated to one another and need to be corrected. Therefore, the first-difference approach in equation 2 will be used to circumvent the problems caused by serial correlation as compared to a fixed effects model which will cause inefficient outcomes (Woolridge, 2012). Secondly, the problem of endogeneity. As seen in previously examined literature, the relation between mortgage credit and real GDP per capita may suffer from reversed causality (Arcand, Berkes, Panizza; 2012; Mian & Sufi; 2010). Consequently, estimations performed by the first OLS-specification will end up negatively affected by a simultaneity bias. Therefore, an instrumental-variables regression (IV) will be performed to address the problem of endogeneity, as can

be seen in both equation 2 and 3. A Hausman-test provides a result of 0.0012, and therefore strongly rejects the null of no endogeneity. Mortgage credit will be instrumented using variables uncorrelated to the dependent variable, however, correlated to mortgage credit. As used by Arcand, Berkes and Panizza (2012), $mortgdp_{i,t}$ will be instrumented with up to four of its own lags. Finally, standard errors will be clustered around country panels to produce heteroskedasticity-robust standard errors. The IV-specification has equation (2) as second stage and equation (3) as first stage regressions. They look as follows:

$$\Delta growthrgdppc_{i,t} = \beta_1 \Delta mortgdp_{i,t} + \beta_2 \Delta mortgdpsq_{i,t} + \beta_3 \Delta X_{i,t} + \Delta\varepsilon_{i,t} \quad (2)$$

$$\Delta mortgdp_{i,t} = \delta_1 \Delta mortgdp_{i,t-1} + \delta_2 \Delta mortgdp_{i,t-2} + \delta_3 \Delta mortgdp_{i,t-3} + \delta_4 \Delta mortgdp_{i,t-4} + \Delta\xi_{i,t} \quad (3)$$

First differencing will allow for country fixed effects to be left out. Moreover, when looking at appendix A table a.2 column 2 the Hausman test does not reject the null and therefore year fixed effects will also be left out of the IV-regression in equation 2. The lags of $mortgdp_{i,t}$ have been chosen as instruments to instrument $mortgdp_{i,t}$ as a result of the theoretical framework. Collateral feedback effects allow for a self-increasing effect between debt supplied and increasing collateral. Therefore, the lags can be expected to serve their purpose well, as previous debt affects current debt through the collateral feedback effect. As we can see in appendix A table a.4 column 1 the point estimates hold up against 0.05 and 0.01-levels.

4.1.2. Mortgage credit and macroeconomic instability exposition

As noted in the review of earlier research, macroeconomic instability and crises do share common features. Reason to look deeper into the effect of mortgage credit on macroeconomic instability. Therefore, a second set of regressions will be performed. The baseline specification will be as follows:

$$growthrgdppcSD_{i,t} = \beta_0 + \beta_1 mortgdp_{i,t} + \beta_2 mortgdpsq_{i,t} + \beta_3 X_{i,t} + \varphi_i + \phi_i + \varepsilon_{i,t} \quad (4)$$

The dependent variable is macroeconomic instability. This variable is measured as the standard deviation of growth of real GDP per capita and has been computed as a rolling regression over a ten year-horizon. This horizon has been chosen following ECB (2011) and Antinolfi and Brunetti (2016) their calculations of standard deviation of GDP growth. Again, $mortgdp_{i,t}$ and its squared term $mortgdpsq_{i,t}$ will be included in concurrence with the earlier literature on macroeconomic instability and private debt (Easterly, Islam & Stigliz, 2000; Silva et al, 2014). The Hausman test in table 1.3 column 3 appendix A is rejected, therefore, fixed effects will be included and an ADF-test rejects the null of non-stationarity, which again will not pose problems. As can be seen in appendix A table a.1 column 2, we again encounter serial correlation. Moreover, we found previous studies to have instrumented $mortgdp_{i,t}$ due to simultaneous

causality. A Hausman-test rejects the null of no endogeneity at 0.045. Therefore, the following first-difference IV-regression will be performed:

$$\Delta growthrgdppcSD_{i,t} = \beta_1 \Delta mortgdp_{i,t} + \beta_2 \Delta mortgdpsq_{i,t} + \beta_3 \Delta X_{i,t} + \phi_i + \Delta\varepsilon_{i,t} \quad (5)$$

$$\Delta mortgdp_{i,t} = \delta_1 \Delta mortgdp - i_{i,t} + \Delta\xi_{i,t} \quad (6)$$

$mortgdp_{i,t}$ in equation 6 will be instrumented with the average value $mortgdp_{i,t}$ of all other countries in the panel excluding country i. Choosing $mortgdp - i_{i,t}$ as an instrument can be explained through the global debt cycle by Mian, Sufi and Verner (2017). Foreign private debt levels are correlated with those in country i and will therefore be a suited instrument. Appendix A table a.4 column 2 shows that the instruments are significant at 0.01-level, thereby concluding that the variables are fit to be used as instruments. Moreover, country-fixed effects are dropped because of the first-differencing. However, a look at the Hausman test in table a.3 column 4 in appendix A shows that that the null is rejected. Therefore, year fixed effects ϕ_i will be included.

4.1.3. Mortgage credit and recession amplitude, length and severity exposition

The third and final specification is related to the depth and length of recessions. Following the method used by Bezemer and Zhang (2017), Claessens et al (2010) and Jordà et al (2014), recession periods are identified in the following manner. First, the algorithm by Bry and Boschan (1971) is used to identify the downturns of economic cycles, as this method has been considered "the closest algorithmic interpretation of the NBER's definition of recessions" (Jordà, Schularick & Taylor, 2014). These cycles are identified by looking at the local peak and trough in real GDP per capita data. Herewith, downturns are identified, and using these identified peaks and troughs we define their amplitude and length. Amplitude is the reduction in real GDP per capita from the identified peak, up to the trough. Moreover, the length is the number of years from peak to trough. A composite measure for recessions called 'severity' will be made as follows: $Severity_{i,t} = (Amplitude_{i,t} \cdot Length_{i,t})/2$, making it a measure for recessions as the surface of a triangle. This means the larger the value of severity, the larger recessions are in both loss of GDP and duration and therefore recessions can be considered to be more severe. This measure is chosen to compare the found results on recessions to those from previous researches which also employed the severity-measure. The regressions for these three will look as follows:

$$Length_{i,t} = \beta_0 + \beta_1 growthmortgdp_{i,t} + \beta_2 X_{i,t} + \varphi_i + \phi_i + \varepsilon_{i,t} \quad (7)$$

$$Amplitude_{i,t} = \beta_0 + \beta_1 growthmortgdp_{i,t} + \beta_2 X_{i,t} + \varphi_i + \phi_i + \varepsilon_{i,t} \quad (8)$$

$$Severity_{i,t} = \beta_0 + \beta_1 growthmortgdp_{i,t} + \beta_2 X_{i,t} + \varphi_i + \phi_i + \varepsilon_{i,t} \quad (9)$$

The variable of interest in these regressions is $growthmortgdp_{i,t}$, which is the growth of mortgage credit-to-GDP. This measure has been chosen instead of stock of mortgage credit-to-GDP to look at the implications of speed of mortgage credit build-up in the period preceding recessions. The Hausman test for endogeneity provides a value of 0.14, therefore no endogeneity is assumed in 7, 8 and 9. However, the Woolridge test in table a.1 appendix A indicates that there is serial correlation, but first differencing is not possible due to dispersed recession datapoints. Therefore, since the results on the Hausman-test were near the critical value of 0.10, an IV-regression with kernel robust errors will be performed to overcome the serial correlation and to compare to the results found by OLS. $growthmortgdp_{i,t}$ will be instrumented with a four-year lag of $mortgdp_{i,t}$ and $mortgdp-i_{i,t}$. From the results in table a.4 column 3, we can see that the instruments are well suited. Moreover, Table a.3 in appendix A shows that the Hausman test rejects the null, therefore, time- and country-fixed effects will be included.

In a second round of these regressions, $growthmortgdp_{i,t}$ will be replaced by $growthmortgdpEXP_{i,t}$ which is the increase of mortgage credit to GDP during the expansion phase, the growth of the mortgage credit-to-GDP ratio from trough to peak, preceding the recession phase. In terms of credit build-up, this credit variable reflects the size of credit intensity during the boom phase. Regressions will take the following form:

$$Lenght_{i,t} = \beta_0 + \beta_1 growthmortgdpEXP_{i,t} + \beta_2 X_{i,t} + \varphi_i + \phi_i + \varepsilon_{i,t} \quad (10)$$

$$Amplitude_{i,t} = \beta_0 + \beta_1 growthmortgdpEXP_{i,t} + \beta_2 X_{i,t} + \varphi_i + \phi_i + \varepsilon_{i,t} \quad (11)$$

$$Severity_{i,t} = \beta_0 + \beta_1 growthmortgdpEXP_{i,t} + \beta_2 X_{i,t} + \varphi_i + \phi_i + \varepsilon_{i,t} \quad (12)$$

A Hausman test on endogeneity gives a value of 0.03 this time, therefore equations 10, 11 and 12 will be subjected to an IV-regression. $growthmortgdpEXP_{i,t}$ will be instrumented with a lag of four years and the measure $mortgdp-i_{i,t}$. As opposed to the IV-regressions in the previous sections, due to the limited and dispersed recession datapoints a first-difference approach is not feasible. Therefore, the regressions have been performed using kernel robust errors to account for serial correlation. Moreover, errors are clustered around both country and year as crisis episodes tend to cluster in time (Barrell, Karim & Macchiarelli, 2017).

4.2 Results

4.2.1 Mortgage credit and economic growth results baseline OLS

The results of baseline OLS regression (1) can be found in table 4.1. The first column shows results without any controls. The second column adds controls to the previous regression, which account for movement in $growthrgdppc_{i,t}$ and the third column adds $mortgdpsq_{i,t}$ to account for concavity. The standard errors are clustered around countries to account for the variation within countries.

The results found indicate that $mortgdp_{i,t}$ is significant in all three regressions, at the 0.1 and 0.05-level, respectively. Moreover, the squared term being significant confirms the expectations of a concave relationship. The control variables included in column 3 exhibit the same magnitude of point estimates as those found by Silva et al (2012) in their fixed effects OLS. Trade is also negative, small and insignificant. Government balance exhibit comparable coefficient to those of Silva et al and is also insignificant. Our mortgage credit-to-GDP variables contrasts their findings as ours is negative and the squared term is positive, whereas they find coefficient signs to be the other way around. This can possibly be attributed to the endogeneity of $growthrgdppc_{i,t}$. We move towards the second exposition which accounts for these caveats.

Dependent Variable: Growth GDP per capita			
	(1)	(2)	(3)
Mortgdp	-0.024 **	-0.018*	-0.038**
	(0.01)	(0.0087)	(0.015)
Mortgdp²			0.00017 *
			(0.000076)
Growth Pop		-0.164	-0.16
		(0.1806024)	(0.18)
Investmentgdp		0.071***	0.073***
		(0.029)	(0.021)
Trade		-0.0015	-0.00072
		(0.0013)	(0.0014)
Growth Stocks		-0.014**	0.014**
		(0.0049)	(0.0049)
Growth Money		0.11***	0.13***
		(0.031)	(.038)
Gov Balance		0.0125302	0.0076
		(0.029)	(0.028)
N	1938	1,603	1,603
R²	0.23	0.62	0.42
Country Year fe	Yes	Yes	Yes

Table 4.1: Baseline OLS regression: Standard errors are clustered around country. *: p-value<0.1; **: p-value < 0.05; ***: p-value < 0.01. World Wars excluded

4.2.2 Mortgage credit and economic growth results first-difference IV-OLS

As mentioned in section 4.1.1, the coming regressions are first-differenced to address serial correlation and endogenous variables are instrumented to avoid reversed causality. A Hausman test resulted in a value of 0.0012, therefore, $mortgdp_{i,t}$ can be considered endogenous. The choice of instruments poses two challenges in terms of requirements: correlation with the endogenous variable and no correlation with the dependent variable. The Sargan test and Kleinberg-Paap statistics in table 2 column 3 appear sufficient to conclude the chosen instruments are exogenous and the model is properly identified and the F-statistic indicates the instrument is strong.

Now the causal effect can be examined. As for the choice of an instrumental variables in the first-difference regression: the point estimates for both $mortgdp_{i,t}$ and $mortgdpsq_{i,t}$ are now highly significant. All the more so, as compared to the baseline specification, the point estimates' signs of interest have switched. The current coefficient signs now meet the expectations from prior research. A one percent increase in mortgage credit-to-GDP now significantly increases growth in GDP per capita by 0.5 percent. The coefficient found for the linear specification in column 2 is somewhat larger but comparable to findings for private credit-to-GDP by Rancière, Tornell & Westerman (2004). The point estimates of $mortgdp_{i,t}$ from the squared relationship are somewhat smaller but comparable in terms of magnitude when comparing the private credit-to-GDP GMM-coefficient found by Arcand, Berkes and Panizza (2012), but much larger than those found by Silva et al (2017). However, their coefficients found were insignificant in all IV regressions. Therefore, we can conclude that using an IV regression was the proper choice.

Comparing the IV to the baseline OLS, investment-to-GDP went from highly significant to insignificant. This could be explained through Mian and Sufi and Verner's (2017) findings on credit supply hypothesis from section 2.1, where credit supply shocks boost household debt and consumption rather than investment. Here, as mortgage credit increases, money is used to finance residential investment, rather than business investment. Mortgage credit in that sense 'crowds out' business investment.

An additional interesting finding is trade. Compared to baseline specification, trade turns from a small negative and insignificant point estimate to larger, highly significant and positive in the IV-regression. These findings could be explained through a link between mortgage credit and trade. An increased for mortgage credit could raise GDP, thereby boosting both demand for foreign good and increase exports.

The found quadratic relationship indicates that mortgage credit does positively affect economic growth, but only up to a critical threshold, after which the mortgage credit to GDP-ratio influence on growth turns sour. The mortgage credit-to-GDP threshold found through the first derivative is precisely 70 percent. This is somewhat lower than the thresholds found by Cechetti & Kharroubi (2012), Arcand,

Berkes and Panizza (2012) and Law & Singh (2014), though these studied have calculated their thresholds over a broader debt category, private credit-to-GDP. This threshold uses a narrower type of credit, mortgage credit, and therefore the lower result found can in fact be correct, as stocks of mortgage credit are lower than stocks of private credit.

Dependent Variable: ΔGrowth GDP per capita 1880-2013			
	(1)	(2)	(3)
$\Delta Mortgdp$	0.78 ***	0.50***	2.66***
	(0.24)	(0.15)	(0.35)
$\Delta Mortgdp^2$			-0.019***
			(0.0028)
$\Delta Growth\ Pop$		0.074	0.17*
		(0.13)	(0.10)
$\Delta Investmentgdp$		0.18	0.28
		(0.13)	(0.18)
$\Delta Trade$		0.16***	0.17***
		(0.06)	(0.065)
$\Delta Growth\ stocks$		0.015***	0.013**
		(0.0054)	(0.006)
$\Delta Growth\ Money$		0.077**	0.10**
		(0.037)	(0.044)
$\Delta Gov\ Balance$		0.11	0.088
		(0.077)	(0.099)
$Constant$	-0.56***	-0.40***	-0.82***
	(0.20)	(0.11)	(0.099)
N	1733	1591	1521
R^2	-0.26	-0.089	-0.47
$First\ stage\ F - statistic$	22.15	17.93	12.93
	(0.00)	(0.00)	(0.00)
$Kleinberg - Paap\ Underidentif.$	9.368	9.339	13.60
	(0.05)	(0.009)	(0.008)
$Sargan$	0. 29	0.79	0.79

Table 4.2: IV-OLS First-Difference estimates 1880-2013. Standard errors are clustered around country. ΔMortgdp instrumented with own lags up to 4 years. *: p-value<0.1; **: p-value < 0.05; ***: p-value < 0.01. World Wars excluded.

When comparing the two time periods in table 4.3, we come across question-raising results. The $mortgdp_{i,t}$ term seems to have decreased in magnitude in column 3 and remain as significant compared to pre-WWII in column 1, even though the stock of mortgage debt-to–GDP has substantially raised. An increase of one percent in mortgage credit-to-GDP pre-WWII leads to a 1.43 percent growth in GDP per capita, whereas post-WWII this is 0.27 percent growth in GDP per capita. This could lead to believe that mortgage credit has reduced in terms of contributing to economic growth. A possible explanation

could be that the increase in mortgage credit has been used to finance either already built housing or real estate speculation, rather than newly built homes. Where the newly built homes lead to an increase in jobs in construction, for example, financing existing housing mainly affects inflating house prices. The threshold value pre-WWII is 57 percent, whereas post-WWII it has become 81 percent, which is closer, however, still lower than the thresholds found in the discussed literature at the beginning of this section. The increase in threshold means economies have over time been increasingly able to accommodate larger stocks of mortgage debt without incurring negative growth. One possibility is the regulatory supervision and insurance schemes. After 1945 macroeconomic policies were increasingly installed, such as increased banking supervision and a deposit insurance ensuring financial stability (Schularick and Taylor, 2009). These prudential measures could contribute to safeguarding the economy from destabilizing activities, therey allowing for economic growth while coping with larger stocks of mortgage debt.

The coefficient of growth of money declined after WWII from a 0.28 percent to 0.047 percent increase of GDP growth after a one percent increase of broad money, which possibly hinges on the development of monetary arrangements. Before the 1970s both the gold standard and the Bretton Woods system allowed only for very little elasticity in currency supply to increase along with growth of the economy. Because currencies were directly linked to gold, which was limited in supply, or linked to gold via the dollar (Eichengreen, 2003). After the abandonment of Bretton Woods in 1971 the money supply shifted from either gold or dollar backed money towards fiat money (Jordà, Schularick & Taylor, 2014). Broad money increased unprecedentedly in all countries in our sample, as illustrated by broad money supply in the U.S. in figure a.6 in appendix A. Therefore, scarcity of money pre-1945 would lead money increases to have a larger impact on economic growth than post-1945.

The findings from these regressions reflect the theoretical foundations discussed in section 2.2. Figure a.7 in appendix A shows that house prices have steeply increased rather comparable to mortgage credit in all 17 countries, possibly indicating the feedback effect. The existence of the threshold value indicates the adverse effects resulting from this collateral feedback-effect. The build-up of mortgage credit as collateral values rise grows up to the point of the threshold value. Afterwards, over-indebtedness leads to inability to service debt, resulting in lowering consumption and a decline in economic growth. This is also in line Minsky's FIH. Increasing leverage during optimistic times as collateral values rise, but then a reduction in economic growth as the peak of optimism is surpassed, suggesting a loss-spiral leading to drop in consumption.

Dependent Variable: ΔGrowth GDP per capita 1880-2013				
	(1) 1880-1939 FD-IV	(2) 1880-1939 FD-IV	(3) 1946-2013 FD-IV	(4)1946-2013 FD-IV
$\Delta Mortgdp$	1.43**	5.92**	0.27**	1.93**
	(0.69)	(1.05)	(0.08)	(0.31)
$\Delta Mortgdp^2$		-0.052***		-0.013***
		(0.015)		(0.0026)
$\Delta Growth\ Pop$	-0.32	-0.29	0.12	0.19**
	(0.49)	(0.37)	(0.085)	(0.077)
$\Delta Investmentgdp$	0.31	0.63*	0.14	0.091
	(0.49)	(0.37)	(0.10)	(0.10)
$\Delta Trade$	0.19	0.28	0.16***	0.16***
	(0.14)	(0.17)	(0.049)	(0.05)
$\Delta Growth\ stocks$	0.029	0.018	0.012**	0.01*
	(0.048)	(0.027)	(0.0045)	(0.0048)
$\Delta Growth\ Money$	0.22**	0.28**	0.039	0.047*
	(0.11)	(0.14)	(0.024)	(0.24)
$\Delta Gov\ Balance$	0.19	0.077	0.12**	0.10
	(0.25)	(0.28)	(0.059)	(0.082)
$Constant$	-0.42**	-0.67**	-0.31***	-0.81***
	(0.17)	(0.17)	(0.087)	(0.13)
N	472	472	1047	1047
R^2	-0.20	-0.84	-0.22	-0.39
$First\ stage\ F - statistic$	93.76	3.69	28.67	12.19
$Kleinberg - Paap\ Underidentif.$	7.15	9.85	10.63s	11.42
	(0.05)	(0.02)	(0.01)	(0.00)
$Sargan$	0.68	0.15	0.41	0.28

Table 4.3: IV-OLS first difference estimates 1880-1939 and 1946-2013. Standard errors are clustered around country. ΔMortgdp instrumented with own lags up to 4 years. *: p-value<0.1; **: p-value < 0.05; ***: p-value < 0.01.

Concluding, the impact of mortgage credit has in fact decreased over time, rather than the expected increase as the share of mortgage debt-to-GDP increased after WWII. Another result from the first-difference regression indicates that mortgage credit has a positive influence on economic growth, however, not limitless. In accordance with other research, when mortgage debt surpasses an upper limit the influence on economic growth becomes negative. However, the found threshold is somewhat smaller compared to other research. This could be as a result of mortgage debt being a narrower debt category than private credit used in those researches. The findings concur with the theory, where accumulation of debt provides economic growth, however, at a critical point the built-up credit poses a threat after negative price shocks as collateral value drops, causing consumers to cut spending and finally negatively affecting economic growth.

4.2.3. Mortgage credit and macroeconomic instability results baseline OLS

Now turning to the second dependent variable of interest, macroeconomic instability. Again, macroeconomic instability has been computed as the standard deviation of growth in real GDP per capita. The baseline regression in table 4.4 column 2 shows a one percent increase of mortgage debt-to-GDP to reduce macroeconomic instability with 0.016 percent at the 0.10 percent significance-level. When adding the squared term, both coefficients of $mortgdp_{i,t}$ become insignificant. However, as showed in section 4.1.2. this regression is likely to suffer from endogeneity. Therefore, a correction will have to be made.

Dependent Variable: SD Real GDP growth per capita 1880-2013			
	(1)	(2)	(3)
$Mortgdp$	-0.0227028**	-0.01634*	-0.0134519
	(0.0086187)	(0.0081895)	(0.0157665)
$Mortgdp^2$			-0.0022199
			(0.0091268)
Trade		0.001727	0.0017287
		(0.0120303)	(0.0119775)
$GrowthMoneySD$		0.0137857***	0.0138497***
		(0.0031128)	(0.0031485)
ToT_sd		-0.0766592**	-0.0767546**
		(0.0309262)	(0.0310802)
XR_sd		0.00000329	-0.00000289
		(0.0000107)	(0.0000111)
Gov_Bal		0.0077307	0.0084197
		(0.0203778)	(0.021703)
$Growthgdppc$		0.060707	0.0610225
		(0.0171466)	(0.0168934
$Constant$	0.0414433***	0.0313774**	0.0311173**
	(0.0093526)	(0.0116683)	(0.011595)
N	1849	1342	1342
R^2	0.4980	0.6433	0.6434
$Country\ Year\ fe$	Yes	Yes	Yes

Table 4.4: OLS estimates 1880-2013. Standard errors are clustered around country and heteroskedasticity robust. *: p-value<0.1; **: p-value < 0.05; ***: p-value < 0.01

4.2.4. Mortgage credit and macroeconomic instability first-difference IV-OLS results

A Hausman test on endogeneity results in a value of 0.045 and therefore the OLS-regression suffers from endogeneity, therefore, an IV-regression will be applied. The regressions in table 4.5 have $mortgdp_{i,t}$ instrumented with the average $mortgdp_{i,t}$ value of all other countries in the panel excluding country i observed. The Kleinberg-Paap statistic shows that the model properly identified and the F-statistic shows that the instrument is strong. The regression in column three has found to have turned the $mortgdp_{i,t}$

coefficients significant at the 0.05 and 0.01-percent level, with the mortgage debt-to-GDP threshold value around 82 percent. Comparing with the earlier found results, however, the signs exhibited by $mortgdp_{i,t}$ and $mortgdpsq_{i,t}$ are the opposite as to what was expected from the literature. In these researches the linear term was negative and the squared term was positive (Easterly, Islam & Stiglitz, 2000; Silva et al, 2017; Dabla-Norris and Srivisa, 2013). This is surprising, as summary statistics on both growth of GDP and standard deviation of growth of GDP resemble the levels of the variables in the previous studies. The summary statistic for mortgage credit-to-GDP is somewhat smaller than private credit-to-GDP, but close. To illustrate the data, the standard deviation of GDP for the U.S. is shown in figure a.8 of appendix A, where macroeconomic instability increases where it is expected to increase: around the World Wars, the Great Depression of the 1930s and the Great Recession of 2008. Moreover, it is relatively low and stable around the Great Moderation of the 1980s. The linear regression in column 2 of table indicates that a one percent increase of $mortgdp_{i,t}$ would lead to 0.068 macroeconomic instability, which is in terms of magnitude comparable to the linear coefficient of Dabla-Norris and Srivisa (2013), however, their coefficient is negative instead of positive.

As the standard deviation of money growth increases by one percent it significantly increases the standard deviation of GDP growth by 0.038 percent. This could indicate that a more variability in monetary policy can lead to macroeconomic instability, meaning relatively stable monetary policy contributes to macroeconomic stability. Moreover, as the government balance increases by one percent, macroeconomic instability decreases by 0.23 percent. This could indicate that anticyclical fiscal policy by governments can help reduce macroeconomic instability. Finally, as the standard deviation of the exchange rate increases it leads to an increase in macroeconomic instability. This indicates that a stable currency promotes the stability of economic growth.

When comparing the two time periods in table 4.6, the post-WWII mortgage credit variables turn significant. The linear regression in column 3 points out that a one percent increase in $mortgdp_{i,t}$ increases macroeconomic instability by 0.065 percent, contrasting pre-WWII where an increase led to a decline in volatility. Pre-WWII, both coefficients of $mortgdp_{i,t}$ in column 2 have the expected signs and are comparable to findings of Easterly, Islam, Stiglitz (2001) and Dabla-Norris and Srivisal (2013), however, they are insignificant. Post-WWII the signs of both credit variables are again the opposite from what is expected from previous research, indicating that there is an inverted U threshold at 86 percent mortgage credit-to-GDP rather than a U-shape bottom threshold after which macroeconomic instability increases as found in previous studies. Moreover, both variables are now highly significant. Comparing the linear regressions in column one and three, we see that mortgage debt-to-GDP changes sign to positive and highly significant after WWII, where a one percent increase of debt increases macroeconomic instability by 0.065 percent.

Dependent Variable: ΔSD Real GDP growth per capita 1880-2013			
	(1)	(2)	(3)
$\Delta Mortgdp$	0.066***	0.068***	0.23**
	(0.020)	(0.024)	(0.099)
$\Delta Mortgdp^2$			-0.0014**
			(0.0005))
ΔTrade		-0.01	-0.012
		(0.0067)	(0.0073)
$\Delta GrowthMoneySD$		0.026***	0.038***
		(0.0049)	(0.0061)
ΔToT_sd		0.039	0.040
		(0.027)	(0.028)
ΔXR_SD		0.0011	0.0017*
		(0.00076)	(0.00089)
ΔGov_Bal		-0.021*	-0.023*
		(0.012)	(0.013)
$\Delta Growthgdppc$		-0.0048	-0.0048
		(0.0047)	(0.0048)
$Constant$	-0.072	-0.073***	-0.097***
	(0.018)	(0.021)	(0.031)
N	1800	1302	1302
R^2	-0.0008	-0.0033	-0.0656
$First\ stage\ F - statistic$	34.58	39.57	30.64
	(0.00)	(0.00)	(0.00)
$Kleinberg - Paap\ Underidentif.$	12.01	12.769	9.369
	(0.0005)	(0.0004)	(0.0022)
$Year\ fe$	Yes	Yes	Yes

Table 4.5: IV-OLS First-Difference estimates 1880-2013. Standard errors are clustered around country and heteroskedasticity robust. ΔMortgdp instrumented with average mortgdp other countries panel excluding country i. *: p-value<0.1; **: p-value < 0.05; ***: p-value < 0.01

An interesting finding is the government balance. After 1945 the coefficient increases in size and becomes highly significant, where a percentage increase reduces macroeconomic instability by 0.33 percent. This would indicate that governments increasing either their revenue or cutting their spending has increasingly led to reduced macroeconomic instability, whereas it would be considered to be the other way around. Anticyclical measures in the form a lowered government balance should lead to reduced macroeconomic instability.

Furthermore, the point estimates of standard deviation of exchange rate were larger before 1939 and highly significant. This indicates that low variation in exchange contributed to macroeconomic stability, which can be explained through the pegging of many local currencies to the dollar at that time.

Dependent Variable: ΔSD Real GDP growth per capita 1880-2013				
	(1) 1880-1939 FD-IV	(2)1880-1939 FD-IV	(3)1945-2013 FD-IV	(2)1945-2013 FD-IV
$\Delta Mortgdp$	-0.076	-0.074	0.065***	0.31 ***
	(0.48)	(0.16)	(0.17)	(0.13)
$\Delta Mortgdpsq$		0.00023		-0.0018***
		(0.00089)		(0.00088)
ΔTrade	-0.079**	-0.073**	-0.00068**	-0.0019
	(0.035)	(0.032)	(0.004)	(0.0051)
$\Delta GrowthMoneySD$	0.021***	0.022*	0.19	0.028**
	(0.0058)	(0.013)	(0.0079)	(0.011)
ΔToT_sd	0.0073	0.0095	0.058*	0.071**
	(0.04)	(0.039)	(0.032)	(0.0324077)
ΔXR_SD	1.02***	1.05**	0.011	0.0018*
	(0.38)	(0.39)	(0.0008)	(0.0011)
ΔGov_Bal	-0.018	-0.017	-0.028***	-0.033***
	(0.052)	(0.053)	(0.0096)	(0.011)
$\Delta Growthgdppc$	0.00031	0.0013	-0.0047	-0.0045
	(0.0072)	(0.0069)	(0.0077)	(0.0088)
$Constant$	-0.0027	-0.01	-0.084***	-0.14***
	(0.026)	(0.027)	(0.019)	(0.054)
N	354	354	945	945
R^2	0.1012	0.1134	-0.0466	-0.4910
$First\ stage$	32.77	4.94	28.30	11.78
$F-statistic$	(0.00)	(0.03)	(0.00)	(0.00)
$Kleinberg-Paap$	3.791	6.299	11.60	6.775
$Underidentif.$	(0.1503)	(0.043)	(0.00)	(0.0092)
$Year\ fe$	Yes	Yes	Yes	Yes

Table 4.6: IV-OLS first-difference estimates for 1880-1939 and 1946-2013. Standard errors are clustered around country and heteroskedasticity robust. Δmortgdp instrumented with own four-year lag and the average Δmortgdp of all other countries in panel. *: p-value<0.1; **: p-value < 0.05; ***: p-value < 0.01

In terms of theoretical foundation, the results have shown that mortgage debt-to-GDP increases macroeconomic instability in a linear fashion. However, in terms the volatility paradox discussed in section 2.4, the results are conflicting with the theory. The theory states that increase in debt happens in a low macroeconomic instability environment up to the threshold value, after which instability increases, but what the quadratic results have presented was the other way around. Increases in $mortgdp_{i,t}$ increase macroeconomic instability up to 82%, after which instability decreases.

To sum up, findings indicate that mortgage credit does increase macroeconomic instability, most noticeably an increased highly significant influence after WWII. However, the findings are

puzzling as $mortgdp_{i,t}$ an $mortgdpsq_{i,t}$ exhibit opposite signs to those postulated the underlying theory and previous empirical work.

4.2.5. Mortgage credit, crisis severity, amplitude and duration

In this section, the scope is turned towards the impact on identified recessions. The three dependent variables introduced in section 4.1.3. will paint a picture as to whether credit growth and the intensity of credit booms have actually contributed to the amplitude and length of downturns. Amplitude is the loss of GDP per capita from the peak of the recession up to the trough and length is the number of years from the peak to trough.

Starting off, table 4.7 displays the impact of mortgage credit growth on downturns. Columns 1 to 3 show the results of OLS estimations. In terms of expectations, the signs show that mortgage credit does contribute to severity, amplitude and length. The impact on the composite measure severity is negative and significant, indicating that an increase in mortgage credit-to-GDP-ratio does deepen downturns. Moreover, the amplitude or depth of downturns seems to be significantly greater as the growth of mortgage credit-to-GDP ratio grows. A one percent increase in growth of mortgage credit-to-GDP deepens the accumulated loss of GDP during the recession by 0.13 percent. Finally, the length of downturns is extended by 0.04 years if mortgage credit increases by 1 percent, however, this point estimate is not significant. These results indicate growth of mortgage credit to actually have an impact on the depth of economic downturns. Other measures of credit do have a mitigation effect on crisis severity, length and amplitude but are not significant.

Even though the Hausman test indicated the null of no endogeneity was not rejected with 0.14, the Woolridge test did indicate that there was serial correlation. Therefore, to ascertain the results an IV-regression with kernel robust errors will be performed. The errors are clustered around both country and year as crisis episodes tend to cluster in time (Barrell, Karim & Macchiarelli, 2017). The results from column 4 to 6 confirm the previously found OLS results. The results are now all highly significant, where a one percent increase in growth mortgage debt-to-GDP lowers accumulated real GDP per capita loss with 0.20 percent, lengthens the recession by 0.077 years and increases the overall recession severity. These findings are smaller than those found by Bezemer & Zhang (2017) and larger than those found by Claessens et al (2010). However, both these studies only relate to the 2008 Great Recession. The results on severity are quite similar to those found by Bridges, Jackson and McGregor (2017), who find a percentage increase in household credit-to-GDP to lead to increased severity measure of -0.41 percent over three years following the recession, similar to the found -0.47 percent in this research. Therefore, it is safe to state that mortgage credit-to-GDP growth increases the depth, prolongs and increases the overall severity of recessions.

OLS & IV-OLS regressions Severity, Amplitude & Length						
Dep. Variables	(1) Severity	(2) Amplitude	(3) Length	(4) Severity	(5) Amplitude	(6) Length
	OLS	OLS	OLS	IV-OLS	IV-OLS	IV-OLS
growthmortGDP	-0.33***	-0.13**	0.037	-0.47 ***	-0.20***	0.078***
	(0.095)	(0.054)	(0.0093)	(0.084)	(0.058)	(0.025)
growthloans	0.12	0.046	-0.0184	0.154*	0.036	-0.012
	(0.000044)	(0.035)	(0.011)	(.083)	(0.027)	(0.012)
Initialgrowthgdp	-0.000044	0.000054	-0.00000046	0.00012	0.00014	-0.000039
	(0.00038)	(0.00018)	(0.000046)	(0.00039)	(0.00019)	(0.000056)
lnrgdppc	0.75	1.14	-0.32	-0.72	0.75	-0.13
	(3.46)	(1.33)	(0.35)	(3.00)	(1.33)	(0.37)
Trade	0.0076	-0.00071	-0.00076	-0.0013	-0.0042	-0.00015
	(.015)	(0.0062)	(0.0021)	(0.033)	(0.012)	(0.004)
Investment	0.56**	0.33	-0.057	-0.00054	0.39	-0.09***
	(0.25)	(0.088)	(0.019)	(0.00044)	(0.165)	(0.024)
growthmoney	0.23	0.088	-0.033	0.27**	0.10	-0.038
	(0.11)	(0.053)	(0.012)	(0.12)	(0.058)	(0.017)
growthCPI	-0.19	-0.093	0.034	-0.22	-0.14	0.054
	(0.16)	(0.083)	(0.017)	(0.17)	(0.098)	(0.026)
gov_bal	0.38	0.14	-0.0095	0.46	0.18	-0.012
	(0.28)	(0.16)	(0.026)	(0.32)	(0.13)	(0.027)
N	237	250	237	230	230	230
R2	0.62	0.58	0.60	0.24	0.0832	0.122
Country Year fe	Yes	Yes	Yes	Yes	Yes	Yes
SW F	-	-	-	7.456	6.784	7.328
Kleinberg − Paap Underidentif.	-	-	-	5.68	5.629	5.63
				(0.058)	(0.059)	(0.059)
Sargan	-	-	-	0.21	0.20	0.30

Table 4.7: OLS and IV-OLS estimates for 1880-2013. OLS Standard errors are clustered around country and IV-OLS standard errors are clustered around country and year to accommodate kernel robust errors and be robust to serial correlation and heteroskedasticity. growthmortgdp instrumented with four-year lag of mortgdp and the average mortgdp of all other countries in panel except observed country i. *: p-value<0.1; **: p-value < 0.05; ***: p-value < 0.01

Secondly, the intensity of the credit boom preceding the downturn. The alternative measure used in table 4.8 is the build-up of mortgage credit during the expansionary phase preceding the downturn, meaning the growth of mortgage credit-to-GDP from trough to peak in the expansion phase. Column 1 to 3 shows the credit intensity value to be insignificant. As previously mentioned, a Hausman test rejected the null of no endogeneity by 0.03, therefore, to bypass these issues an instrumental variables regression will be utilized. If we instrument the variable and use kernel robust standard errors, the point estimates in column 4 to 6 turn significant. Both amplitude and length coefficients of credit intensity are significant at the 0.05 level and significant at 0.10 for severity. A one percent increase of credit build-up during the expansion phase preceding the boom will therefore lead to a loss 0.15 percent of GDP during the downturn and will

additionally prolong the recession by 0.004 years. We can therefore conclude that the larger the build-up of mortgage credit, or intensity of the credit boom, during the expansionary phase, the deeper and longer the downturn following when the boom goes bust. Additionally, a percentage increase in business investment seems to significantly reduce the loss of GDP during the recession phase by 0.26 percent and reduce the length of recessions by 0.04 years. The results found for severity are comparable to those by Agnello and Nerlich (2012) for private sector credit.

OLS & IV-OLS Severity, Amplitude, Length and Credit boom intensity						
Dependent Variable:	(1) Severity OLS	(2) Amplitude OLS	(3) Length OLS	(4) Severity IV	(5) Amplitude IV	(6) Length IV
$\Delta\%mortGDPExpan$	-0.077	-0.049	0.012	-0.27*	-0.16 **	.0039**
	(0.087)	(0.034)	(0.0087)	(0.15)	(0.066)	(0.019)
$growthloans$	-7.55	-5.37	1.44	-8.75	-5.09	1.69
	(12.38)	(3.39)	(1.3)	(11.8)	(2.79)	(1.16)
$PrecrisisgrowthGDP$	-0.00016	0.000041	0.000018	0.00023	0.00019	-0.000038
	(0.00049)	(0.0002)	(0.00006)	(0.00041)	(0.00017)	(0.000054)
$lnrgdppc$	0.20	1.02	-0.054	-2.09	0.93	0.10
	(4.51)	(1.74)	(0.47)	(4.42)	(1.72)	(0.43)
$caGDP$	0.07	-0.043	-0.0066	10.27	-4.41	-1.08
	(0.36)	(0.11)	(0.029)	(35.85)	(14.72)	(3.10)
Trade	-0.0016	-0.008	0.00087	-1.94	-2.41	0.12
	(0.021)	(0.0092)	(0.002)	(5.38)	(23.95)	(0.57)
$Investm$	0.41	0.25***	-0.039	0.47	0.27**	-0.043**
	(0.29)	(.062)	(0.03)	(0.26)	(0.13)	(0.021)
$GrowthMoney$	0.24	0.11*	-0.037**	0.27	0.11	-0.032
	(0.13)	(0.06)	(0.013)	(0.13)	(0.063)	(0.014)
$GrowthCPI$	0.051	-0.026	0.011	0.12	0.012	0.0021
	(0.13)	(0.059)	(0.02)	(0.16)	(0.044)	(0.024)
Gov_bal	0.46	0.19	-0.027	0.52	0.22	-0.024
	(0.37)	(0.15)	(0.032)	(0.35)	(0.13)	(0.035)
N	217	250	217	191	221	191
$R2$	0.61	0.53	0.51	0.14	0.13	0.14
$Country\ Year\ fe$	Yes	Yes	Yes	Yes	Yes	Yes
$SW\ F-statistic$	-	-	-	7.94	4.66	7.94
$Kleinberg-Paap\ Underidentif.$	-	-	-	5.40	5.49	5.40
				(0.067)	(0.064)	(0.067)
$Sargan$	-	-	-	0.27	0.43	0.10

Table 4.8: OLS and IV-OLS estimates for 1880-2013. OLS Standard errors are clustered around country and IV-OLS standard errors are clustered around country and year to accommodate kernel robust to serial correlation and heteroskedasticity standard errors. growthmortgdpEXP instrumented with four-year lag of mortgdp and the average mortgdp of all other countries in panel except observed country i. *: p-value<0.1; **: p-value < 0.05; ***: p-value < 0.01

As can be seen in figure a.5 in appendix A, the growth of the credit intensity during expansionary (or boom) phases preceding recessions has been increasing over time, with the increase being particularly large during the post-BW era. Taken together with the results in table 4.8 and combined with the rapid rise in the mortgage to GDP-ratio, there are strong indications leading to believe that since the 1970s the build-up of mortgage credit has had an increased influence on both the depth, length and therefore overall severity of recessions as compared the years before. From this can be concluded that mortgage credit has deepened and prolonged recessions over the course of the examined 130 years.

Linking the findings to the theoretical foundations, we can clearly see the FIH in this instance. The additional build-up of mortgage credit during times of optimism, the expansionary phase preceding the recessions, leads to a greater loss of real GDP per capita and prolongs the recession. Higher leverage build-up as a result of favorable economic conditions and speculation on real-estate can be expected to induce greater risk and therefore reaps larger adverse effects in terms of GDP loss and duration of recessions. Particularly when looking at the effect of investment on recessions, a use of capital which does mitigate both the loss of GDP and the length of recessions, we can consider that mortgage credit at excessive levels is a risky investment leading to non-productive outcomes, whereas business investment does lead to desirable outcomes by contributing to economic growth. If we look at figure 3.2 in section 3, we can see that after the Great Recession erupted, economies which experienced housing bubbles such as the U.K., the Netherlands and Spain saw a drop in their mortgage credit-to-GDP ratio. This could illustrate the process of deleveraging by Eggertson and Krugman (2012), where the debt burden increased such from a drop in house prices that spending cuts became necessary, which is why the loss of GDP during the recession phase has been shown to increase as leverage, the mortgage-to-GDP ratio, increases.

5. Conclusion

This research has examined the evolution of mortgage credit over the past 130 years and its effect on economic growth and recessions. Current levels of mortgage credit have become reason for central banks to raise their concerns over the consequences of mortgage debt in terms of financial instability risks. The 2008 Great Recession has been an example of how mortgage credit can cause harm and have long-lasting consequences on economies. Taken into consideration that mortgage credit has been increasing over the course of time, one comes to wonder whether this was a one-time phenomenon, or whether over time mortgage credit has increasingly exacerbated economic downturns. Resulting, the following question has been at the heart of this research: "Has mortgage credit increasingly deepened and prolonged recessions over the past 130 years?". To answer this question, Hyman Minsky's Financial Instability Hypothesis has functioned as a guiding principle throughout this research. In concurrence with the hypothesis, results

have pointed out that as mortgage credit has rapidly increased over the past decades, it has in fact led to a greater decline in real GDP per capita during recessions and has contributed to their prolonging.

The sections of the empirical part of this research have provided results which direct towards a confirming answer on the central question. Firstly, mortgage credit-to-GDP has a positive increase on growth of real GDP. However, around a level of 70 to 80 percent of GDP, mortgage credit reaches a threshold value, after which growth of GDP turns negative. Moreover, after WWII, the extent to which mortgage credit promotes economic growth has decreased, compared to before 1945. This indicates that even though mortgage debt has strongly increased in size over the past decades, its contribution to economic growth has decreased over time.

Secondly, mortgage credit has been shown to increase macroeconomic instability. However, results did not match the expectations. Mortgage credit was expected to reduce macroeconomic instability up to a threshold value, after which it increases macroeconomic instability, but the relationship found was the opposite. Credit increased macroeconomic instability up to the threshold value, after which it reduced. Though these results were not as expected, other results have shown that mortgage credit has increasingly led to macroeconomic instability post-WWII.

Finally, the cornerstone of this research: recession severity, amplitude and duration. The results indicate that increased mortgage credit build-up during the expansionary phase has led to a greater decline in GDP during recessions, and to a longer duration of recessions. Moreover, as it has been shown that the credit intensity of expansion phases over the past forty years has been never greater, it can be concluded that mortgage debt has increasingly led to more severe recessions.

How do these findings relate to the theoretical foundation? House prices have increased at the same pace as mortgage credit over the past 40 years, leading one to believe that there is a collateral feedback effect that has allowed mortgage debt to increase to its current levels, and to have amplified the severity of recessions caused by mortgage debt. The found results clearly support Minsky's FIH. The increasing amount of mortgage debt taken up can be seen as optimism about the development of house prices during the stable period up to a limit, which is illustrated by both the existence of the threshold value for economic growth and the increased credit intensity during the expansion phase. However, the moment the threshold is reached and the boom turns bust, this optimism comes at the price of deeper and longer recessions. Therefore, the FIH is clearly supported by these results. Moreover, the deleveraging as a result of Fisher debt-deflation has to some extent been detected. The decline in GDP clearly has been a result of mortgage credit, and as shown from the mortgage credit-to-GDP ratios of countries which experienced a housing bubble during 2008, after the recession hit their mortgage debt-to-GDP ratios started to decline. This could have been the result of overly indebted households, faced with lowered collateral values, which were forced to cut consumption in order to deleverage, which has

led to the drop in GDP. Unfortunately, it has been difficult to find any signs on the tightening of credit constraints, which are an important factor in the amplification mechanism.

The 2008 Great Recession does not seem to be that far in the past. Yet, news on financial innovations such as collateralized debt obligations, which lay at the basis of the Great Recession, being brought back into circulation under a different name calls into question whether the lessons learned during the crisis are actually remembered. This is the critical point where policymakers ought to step in. The stimulation of increasingly financing housing through debt only should be put to a halt. Policies devised to increase home ownership through the deduction of interest on taxable income should be either restricted or abandoned. Alternatively, a mandatory minimum percentage of own equity required to put up in financing housing could serve as a measure to reduce excessive debt and reduce debt overhang when house prices drop. This research highlights the need for the adoption of these policies in order to curb further mortgage debt accumulation. This is especially so considering that politicians are not keen to end policies that encourage home-ownership. The fact that only a few years ago the issue of debt deductibility of interest in the Netherlands was a political taboo to the extent that politicians preferred calling it 'the h-word' (hypotheekrenteaftrek) out of reluctance of speaking out its name, is telling. Potentially, this research can contribute in persuading them to change their mind.

In terms of limitations, this research has focused only on the relationship between mortgage credit and economic growth. However, as can be seen from the theoretical foundation, there are other important links within the amplification mechanism which haven't been examined. The effect of mortgage credit on the decline in consumption or increase in credit constraints over this time period could be the object of future research. Moreover, the effect of the abandonment of interest tax deductibility policies on macroeconomic stability and recession severity would be important as well in terms of persuading politicians into doing so.

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Appendix A

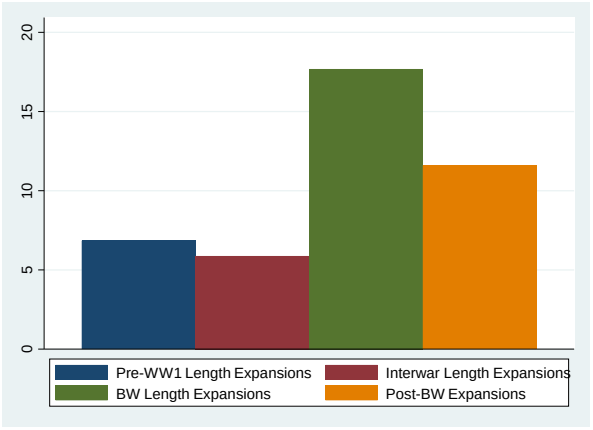

Figure a.1: Average length expansion phase. Source: Jordà, Schularick & Taylor (2016).

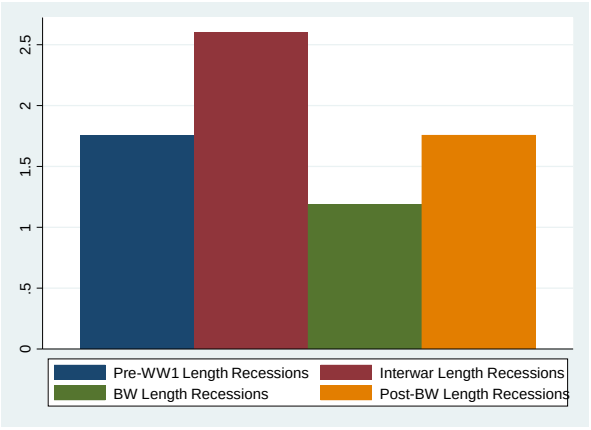

Figure a.2: Average length recessions. Source: Jordà, Schularick & Taylor (2016).

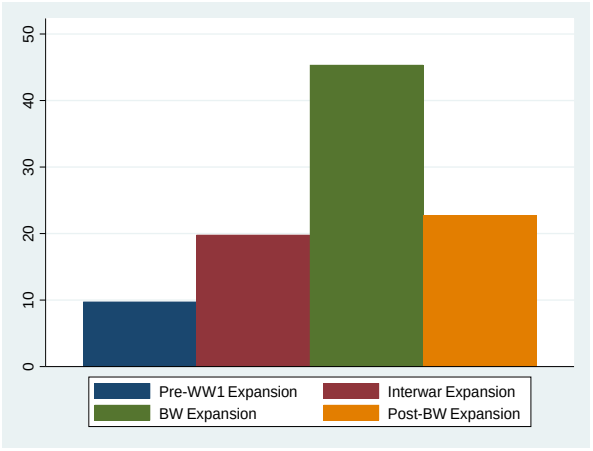

Figure a.3: amplitude expansion phase

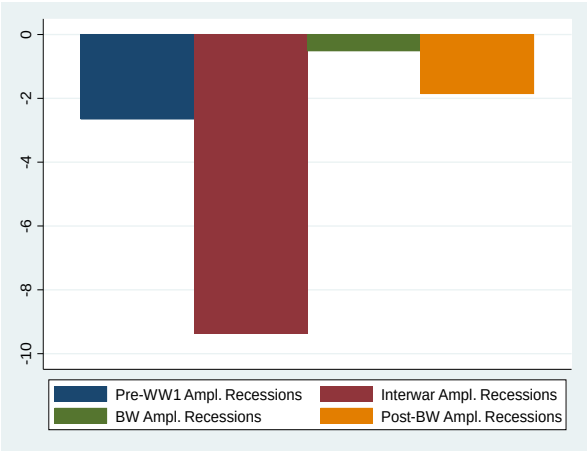

Figure a.4: Average depth recessions

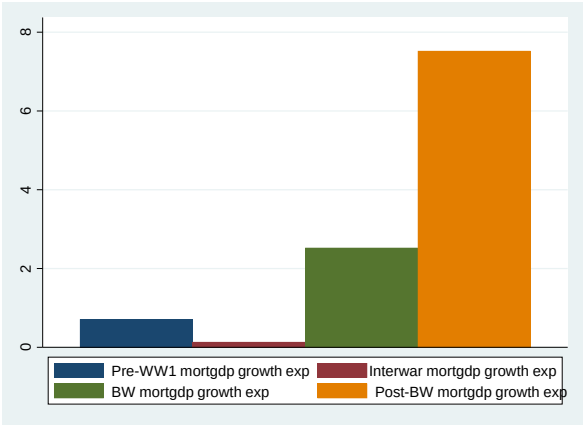

Figure a.5: Average mortgage credit intensity expansion phase. Source: Jordà, Schularick & Taylor (2016).

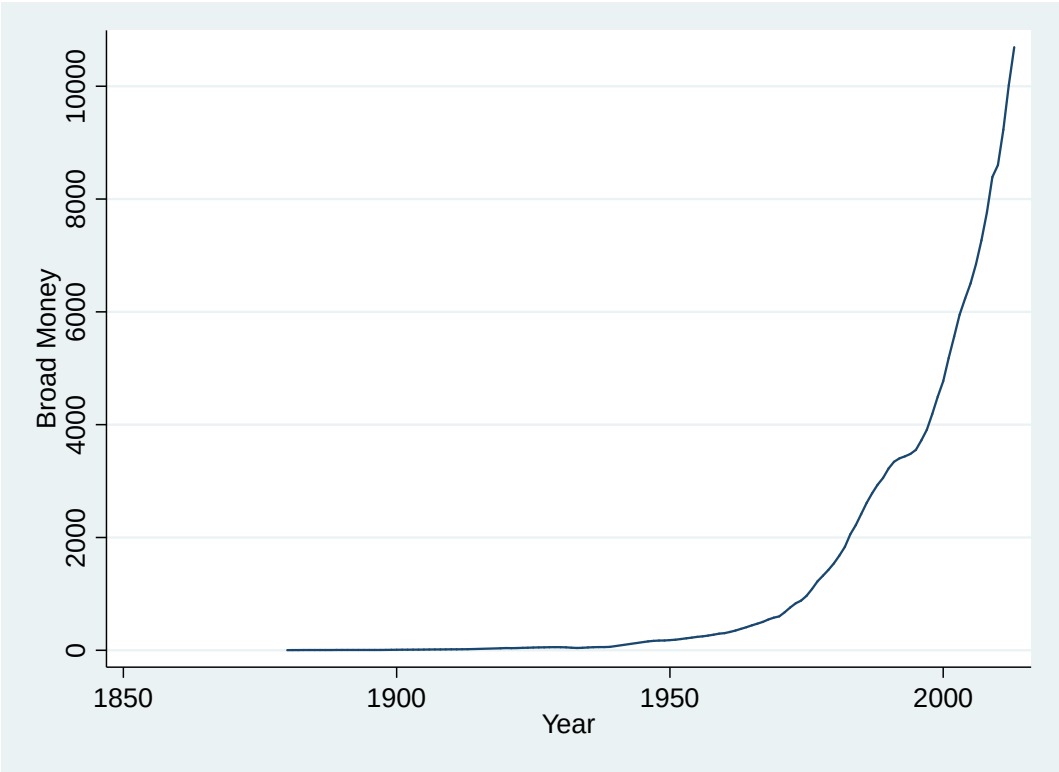

Figure a.6: Broad money U.S. Source: Jordà, Schularick & Taylor (2016).

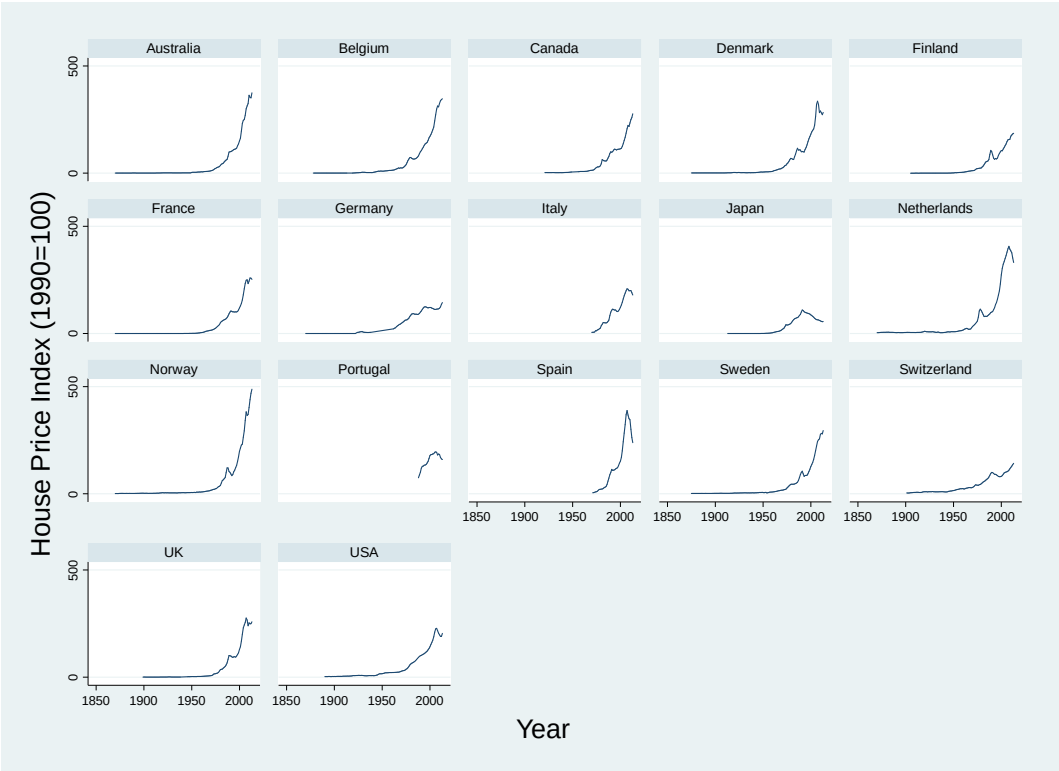

Figure a.7: House price index 1880-2013 (1990=100). Source: Jordà, Schularick & Taylor (2016)

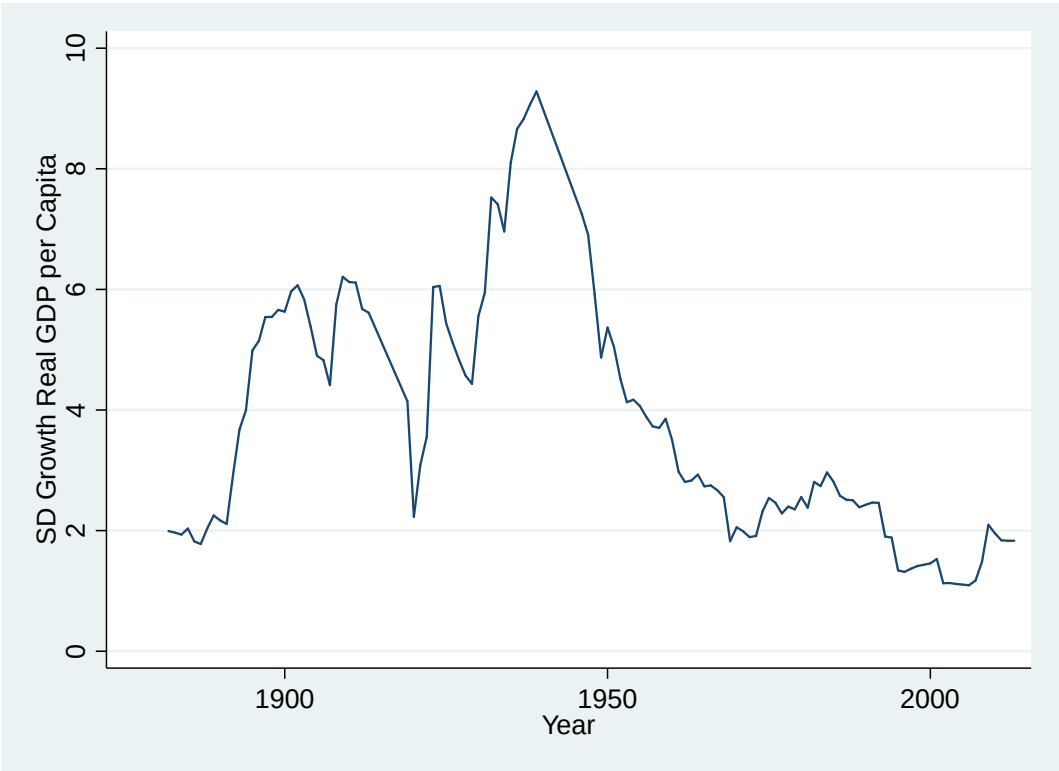

Figure a.8: Standard deviation of growth real GDP per capita. Source: Jordà, Schularick & Taylor (2016).

Woolridge Test	(1) Real gdp per cap.	(2) Macroeconomic instability	(3) Severity, Amplitude and Length
H0: no serial corr.	10.59	70.95	160.127
	(0.00)	(0.00)	(0.00)

Table a.1: Woolridge test for serial correlation

ADF Test	(1) Real gdp per cap.	(2) Macroeconomic instability
H0; non − stationarity	10.59	-5.8452
	(0.00)	(0.00)

Table a.2: Augmented Dickey Fuller test for cointegration

Hausman Test	(1) Real gdp per cap.	(2) Δ Real GDP per cap.	(3) Macroeconomic instability	(4) Δ Macroeconomic instability	(5) Severity, Amplitude and Length
H0: no FE	13.46	2.68	396.32	39.75	12.61
	(0.026)	(0.95)	(0.00)	(0.00)	(0.00)

Table a.3: Hausman test for fixed or random effects

	(1) Mortgdp	(2) Mortgdp	(3) Growthmortgdp	(4) GrowthmortgdpEXP
$\Delta Mortgdp\ (t-1)$	0.13***			
	(0.011)			
$\Delta Mortgdp\ (t-2)$	0.054***			
	(0.011)			
$\Delta Mortgdp\ (t-3)$	0.019**			
	(0.011)			
$\Delta Mortgdp\ (t-4)$	-0.022***		-0.43***	-0.19***
	(0.011)		(0.25)	(0.047)
$\Delta Mortgdp(-i)$		0.64***	-5.9***	-4.62***
		(0.035)	(0.99)	(1.01)
N	1074	1298	230	305
R^2	0.39	0.35	0.2849	0.57
First stage F	9.29	16.18	17.73	5.16
	(0.00)	(0.00)	(0.00)	(0.01)
fe	No	Year	Year & Country	Year & Country

Table a.4: First stage OLS statistics

Appendix B: Literature overview

Author(s) & year	Countries	Time span	Relationship examined	Key-variables used	Estimation Techniques and usefulness	Findings
Aikman, Haldane & Nelson (2013)	14 OECD-countries	1880-2008	Influence of fluctuations in bank loans on banking crises and GDP-loss	Bank credit-to-GDP ratio, banking crisis dummies (Bordo, 2001) and real GDP	Logit on bank crisis and sample trend growth rates compared to no-crisis counterfactual to assess loss in growth	1% increases credit/GDP, 0.18 pc-points increase probability banking crisis. Negative correlation growth bank credit-GDP 5 years prior to bank crisis and loss GDP post-crisis
Agnello & Nerlich (2012)	47 advanced and emerging economy countries	1970-2009	Bank credit on crisis severity (composite measure of length crises and loss GDP during crises)	Bank credit to private sector-to-GDP and severity ([length crisis x GDP decline during crisis]/2)	Quantile regression. Authors do not account for autocorrelation and homogeneity, which could pose caveat.	A 1% increase of bank credit during run up leads to increased severity ranging from -0.037 to -0.22.
Arcand Berkes Panizza (2012)	72 countries	1960-2010	The point of bank credit-to-GDP where output growth becomes negative	Credit to the non-financial private sector-to-GDP and	First differenced GMM estimation	Positive correlation between credit and GDP growth. With 1% increase of private credit ranging from 2.83% to 7.27%, but up to 80 to 90% of GDP, afterwards, growth turns negative
Beck, Lundberg & Majnoni (2006)	63 countries	1960-1997	Increase of growth of GDP volatility as private credit increases	SD growth GDP	OLS with country- and year-fixed effects. Hausman test pointed out there was no endogeneity in private credit and have corrected standard errors for heteroskedasticity.	An increase in private credit with 1% significantly increases volatility with 0.99% a the 010%-level.
Bezemer & Zhang (2014)	37 countries	1970-2012	Ability of mortgage credit-to-GDP to predict credit booms and busts	Mortgage credit-to-GDP and credit booms dummy variables	Multinominal logit regression. There are caveats in terms of serial correlation,	Mortgage credit increase by 1% increases probability boom-bust ranging from 0.16% to 0.27%.

					heteroskedasticity and collinearity.	
Bezemer & Zhang (2017)	51 countries	2003-2012	Mortgage credit effect on crisis severity (composite measure of length crises and loss GDP during crises)	Mortgage credit-to-GDP, years duration of crisis, loss of real GDP and 'severity'-measure	Bayesian Model Averaging and OLS. Time period too short to properly compare results with.	A 1% increase of mortgage credit leads to around 3.16 up to 3.86% significant increase severity, 2,78% up to 3.944% significant increase loss GDP and 0.341 up to 0.618 years increase length recession, however, insignificant.
Bezemer, Grydaki & Zhang (2016)	46 countries	1990-2011	Influence of private credit on growth GDP per capita	Non-financial private credit-to-GDP and growth of real GDP per capita	Fixed effects OLS and First difference GMM. Accounted for endogeneity, autorcorrelation, heterogeneity and heteroskedasticity, however, rather short time span.	Growth of private credit with 1% reduces real GDP per capita with -.013%, findings not significant however.
Bridges, Jackson & McGregor (2017)	26 countries	1970-2010	Household credit-to-GDP growth and recession severity	Growth household credit-to-GDP and recessions severity	'Local projections' impulse response function as used by Jordà Schularick and Taylor (2012)	A 1% increase in growth of credit increases recession severity by 0.41% over three years following outbreak recessions.
Claessens et al (2010)	58 countries	2003-2009	Effect of mortgage debt on loss in GDP and length of 2008 crisis	Mortgage debt-to-GDP, negative GDP growth and length recession in years	OLS with robust standard errors. Time span is rather limited to compare results with.	An increase of 1% in mortgage credit insignificantly prolongs crisis with 0.006 years and insignificantly amplifies real GDP decline by 0.001%.
Büyükkarabacak et al. (2010)	37 countries	1990-2006	Private credit as predictor of banking crises	Private- and household credit-to-GDP and banking crises dummies	Logit regressions	A 1% increase of household credit significantly increases probability of banking crisis with 0.083%, while private credit significantly increases probability with 0.057%

Chechetti & Kharroubi (2012)	50 advanced and emerging countries	1980-2009	Threshold value of private credit-to-GDP where growth of GDP turn negative	Private credit-to-GDP and	Country fixed effects OLS. Authors allow for heteroskedasticity, which could lead to	
Dabla-Norris & Srivisal (2013)	110 countries	1974-2008	Relationship between private credit and standard deviation of GDP growth and level of debt after which it increases instability	Private credit-toGDP, squared private credit-to-GDP and SD of growth GDP	OLS and GMM with country fixed effects. Serial correlation taken into account. Useful for comparison results.	A 1% increase of private debt reduces the standard deviation of GDP growth with 0.0032%. However, at 119% of GDP, private debt increases the standard deviation of GDP growth.
Dell'Arracia et al (2016)	125 countries	1970-2010	Identifying determinants of credit booms and counter policies		Multivariate OLS regression, however, not accounted for endogeneity. Only explored correlation, not causation.	Current account balance and trade openness significantly reduce household credit booms occurrence, whereas growth in real GDP and financial reform expedite household credit booms.
Easterly, Islam & Stigliz (2001)	170 countries	1960-1997	Growth of private credit influence on economic growth volatility and threshold value where credit increases volatility.	Private credit-to-GDP and SD of per capita growth rate GDP.	OLS and IV-OLS with fixed effects. Measures are corrected for heterogeneity and endogeneity, however, not for autocorrelation.	Growth in private credit with 1% found to reduce growth volatility with 0.00098%. If private credit reaches around 100% of GDP, additional credit increases growth volatility.
Japelli & Pagano (1994)	22 OECD and non-OECD countries	1961-1987	Household liquidity constraints effects to savings	Net savings rate to GDP, loan to value and growth	OLS and IV-OLS. Though unclear how heterogeneity, autocorrelation and heteroskedasticity are accounted for.	Growth in savings depends on liquidity constraint. A 1% increase in access to household credit significantly reduces net savings ranging from -0.17% to -0.2%. Further, a 1% increase LTV leads to a -.0033% to -0.036% reduction in GDP growth rate.
Jordà, Schularick & Taylor (2012)	14 advanced economies	1870-2008	Debt overhang as cause for slow recovery of economic crises	'Excess credit'(% increase of bank credit during expansionary	Local projections approach: an impulse response specification. Problem is that findings	A 1% increase of bank credit during expansion phase preceding crisis leads to accumulated 1.3% decrease in real GDP per capita 4 years after outburst crisis.

				phase before crisis) and real GDP per capita	are not to be interpreted as causal.	
Jordà, Schularick & Taylor (2014)	17 advanced economies	1870-2013	Relation between credit,financial crises occurrence and business cycle-dynamics. Moreover, show change in credit composition and bank balance sheets over time	Mortgage debt-to-GDP, banking crises dates for Luc & Laeven & Valencia (2008) and GDP per capita growth	Logit regression with country fixed-effects and response function called 'Local Projections-approach' which uses inverse propensity-score weighting regression adjustment.	A 1% rise in private bank credit prior to financial crisis leads to 0.7% lower per capita GDP growth if crisis starts, larger credit build-up is associated with deeper recessions and slower recoveries and marginal effects of mortgage credit more severe than non-mortgage lending. Moreover, shown through impulse response function, mortgage debt plays a key role in explanation slowdown of GDP growth from debt overhang post-WWII, as opposed to pre-WWII. A 1% increase in mortgage credit significantly leads to cumulated loss of 2.46% of GDP over 5 years post-crisis, whereas pre-WWII mortgage credit was not significant.
Law & Singh (2014)	87 countries	1980-2010	Find the threshold value where additional finance adversely affects GDP	Private sector credit-to-GDP and growth rate of GDP	Dynamic panel threshold regression and GMM	Threshold value for private sector credit found to be between 88% and 94%.
Mian & Sufi (2010)	540 U.S. counties	2002-2009	Effect of household leverage on consumption, house price, unemployment and consumer default and cause of recession.	Debt to income ratio,	IV-OLS	1% debt-to-income growth significantly explains 0.018% increase of unemployment 0.093% increase in default rate and 0.264% drop in car sales. Household debt was one of main triggers of 2007-2009 economic crisis.
Mian, Sufi & Verner (2017)	30 countries	1960-2012	Linkages between household debt and consumption, trade	Household debt-to-GDP ratio, real GDP growth	FE-OLS and Arellano-Bond GMM, therefore robust to heterogeneity,	A 1% increase in household debt-to-GDP associated with significant drop in advanced countries' GDP growth ranging

			and growth, in an international context.		heteroskedasticity and accounted for serial correlation.	from 0.211% to 0.371%, conditional on recessions does strong credit growth lead to deeper recessions, predicts collapse in global GDP during 2007-2012 and to external spillover effects. Household credit supply shocks important driver of economic fluctuations, both national and worldwide.
Rancière, Tornell & Westermann	83 countries	1960-2000	Relation between measures of credit and growth real GDP. Skewness of credit growth used as proxy for risk of propensity of systemic crises.	Credit growth, variation of credit growth, skewness of credit growth and growth real GDP.	OLS, IV and Arellano Bond GMM, so endogeneity and serial correlation are accounted for.	An increase in private credit—to-GDP with 1% increases GDP growth with 0.1785%
Ramey & Ramey (1998)	92 countries	1960-1985	Relationship between GDP growth volatility and GDP growth.	Standard deviation of growth GDP and growth GDP.	OLS with country and year fixed effects.	An increase in GDP growth volatility of 1% reduces GDP growth with -0.38% in advanced countries.
Schularik & Taylor (2015)	14 advanced countries	1870-2008	Relation between bank credit growth and banking distress	Bank credit-to-GDP and crisis data by Laeven & Valencia (2008)	OLS linear probability, Logit with country and year fixed effects. Not accounted for reverse causality, heteroskedasticity and autocorrelation.	Increase in bank credit-to-GDP increases probability of banking crises after WWII, whereas money was a better predictor pre-WWII.
Silva et al (2017)	52 countries	1980-2011	Relation between private credit and both GDP growth and growth of GDP volatility. Additionarly, the hump where private	Private credit-to-GDP, growth of GDP per capita and standard deviation of growth GDP per capita.	OLS with fixed effects and IV-OLS. Unclear whether authors took autocorrelation and heteroskedasticity into account. Moreover, point estimate for volatility seems to be suspiciously	No significant effect of private credit on GDP growth found if a squared term of credit is included, but only a linear credit term leads to a significant point estimate of 0.03% as credit increases with 1%. GDP growth volatility significantly where 1% increase linear credit decreases volatility by 10.35% and squared credit term increases

			credit induces negative growth.		large compared to Easterly et al (2001) and Beck et al(2006)	volatility by 1.27%. The threshold where credit increases growth volatility is estimated between 48% and 117% private credit-to-GDP.