Optimal Macroprudential-Fiscal Policy Interaction and Financial Stability

The Effects on Private Debt Deleveraging in Advanced and Emerging Economies

JOSEF SEBHATU
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Examiner Kristina Nyström
Supervisor Pontus Braunerhjelm
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Abstract
What is the optimal interaction between macroprudential and fiscal policy to foster financial stability? This thesis evaluates whether policy interaction can impact private debt growth. First, a model is built with borrowing constraints that illustrate the links between private and public debt dynamics. The derived hypothesis and theoretical predictions indicate that a tighter macroprudential stance is reinforced by prudential fiscal policies, conditional on the initial level of public debt and scope for countercyclical fiscal policies. Second, the hypothesis and theoretical predictions are tested by using a dynamic panel data model for a sample of 49 advanced and emerging economies over the period 2000-2013. Whilst the interaction term alone yields insignificant results, interesting inferences can be drawn of the findings within the context of existing literature. The suggestion is that there may exist two opposing effects associated with the interaction between macroprudential and fiscal policy on private debt. Moreover the outcome of this interaction is contingent upon the levels of public debt and private indebtedness.

Keywords: Macroprudential Policy, Fiscal Policy, Financial Stability, Private Debt.
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Abbreviations

**AEs** – Advanced Economies

**CAPB** – Cyclically adjusted primary balance

**DPD** – Dynamic panel data

**DSGE** – Dynamic Stochastic General Equilibrium

**EMs** – Emerging Economies

**GFC** – Global financial crisis

**SIFIs** – Systemically Important Financial Institutions
1 Introduction

“Unless we understand what it is that leads to economic and financial instability, we cannot prescribe make policy – to modify or eliminate it. Identifying a phenomenon is not enough; we need a theory that makes instability a normal result in our economy and gives us handles to control it.”
— Minsky, 1986

The moderation of systemic risk to financial stability is often galvanized on the grounds of alleviating the severe destructive effects of financial crises. Whilst the sentiment expressed by Minsky initially seems to be of guileless nature, even for those without any previous background in practicing economic theory, its absence precisely underlines our incapability to recognize financial crises. In the aftermath of the recent global crisis, policymakers have remedied some of these issues to financial stability, by using macroprudential policies more extensively. Macroprudential policies are often implemented on the credit intermediation process to avert the build-up of systemic risk, which is a source of financial instability. The increased implementation of these policies is not costless, particularly with regard to economic growth, but until now the benefits have offset the disadvantages. Yet the view of using these macroprudential policies alone to foster financial stability has recently been challenged by some empirical papers. The basis of this critique is that cultivating financial stability also necessitates considering the behaviour of other macroeconomic policies, specifically fiscal policy. The two papers most closely related to ours are Carvalho and Castro (2017) and Martin and Phillipon (2017) who use dynamic stochastic general equilibrium (DSGE) models to find that macroprudential policies are optimally combined with prudential fiscal policies for Eurozone countries and Brazil, respectively.

This thesis goes one step further by analysing the optimal interaction between macroprudential and fiscal policy to foster financial stability. Furthermore, in this case financial stability is proxied for by the total credit provided to the non-financial sector (private debt).\(^1\) The basic

\(^1\) As illustrated by the European Sovereign debt crisis, it would be ludicrous to claim that private debt growth is the only cause of financial instability. There are different factors that could impact financial stability but in this thesis private debt is used as the preferred proxy.
aim of this analysis is twofold. Firstly, to demonstrate that the link between macroprudential and fiscal policies depend on the existing policy regime, financial system and economic landscape. Secondly, to emphasize the importance of policy coordination, despite the associated short-run trade-offs to economic growth.

The analysis is realized by using two methods. First, Batini et al. (2015) model is extended by including a banking sector, a macroprudential authority. In addition, it is illustrated that the equilibrium loan market clearing condition and the government budget constraint can be used to reduce the model to one dynamic equation in private debt, macroprudential policy and fiscal policy. Second, this thesis use cross-country panel data in 49 advanced (AEs) and emerging economies (EMs) to test the derived hypothesis, and provide empirical evidence.

To entirely apprehend the findings from the model and understand private debt outcomes, it is useful to first consider the role of borrowing constraints. The assumption is that the borrowing constraints are binding, such that reduced public debt (government debt) has a crowding out effect on private spending (private debt). Thus, in accordance with the proposed Ricardian Equivalence, households facing these borrowing constraints are less likely to reduce their savings in response to a lowering of public debt (Barro, 1974). The lowering of public debt is equivalent to a decline in government bonds, creating a state where the supply of the latter does not exceed the demand by households. Impatient households and entrepreneurs are also subject to a collateral borrowing constraint (value of housing act as a collateral) that caps the amount of capital borrowed.

Banks are assumed to act as a financial intermediary between savers (patient households) and borrowers (impatient household and entrepreneurs). This results in impatient households and entrepreneurs purchase of housing and capital being contingent on patient households lending. The banks operations are also subject to the designated macroprudential authority time-varying capital requirements and fixed leverage requirements. The macroprudential authority consistently adjust these requirements to the existing credit gaps.

A benevolent government is included whose goal is to maximize the welfare in the economy. The imposed lump-tax contrary to the
lowering of public debt has a distortionary effect on output and capital. This is due to a decrease in public debt, reduces taxes and the inefficiencies caused by distortionary taxes. The monetary authority sets its policy rate according to a standard Taylor rule. Finally, the entire model reduces to one dynamic linear equation and the three variables of interest (i.e. private debt, macroprudential policy and fiscal policy). The main theoretical predictions from this reduction, is that private debt deleveraging not only is provisional on macroprudential policies but also on the nature of fiscal policy and the initial level of public debt. Therefore, the core hypothesis is as follows:

*Private debt deleveraging is associated with greater use of macroprudential and prudential fiscal policies.*

In the second part of this thesis, the core hypothesis is tested. A simple method to assess the implications of this hypothesis is using an ordinary least squares (OLS) estimator, but due to its limitations, the main empirical estimates are found using a dynamic panel data (DPD) model. Ceteris paribus, such a method ought to convey to what extent macroprudential policies in tandem with more prudential fiscal policies can reduce private debt. Nevertheless, there are at least two limitations with this approach: (i) the fiscal policy indicator proxied by the cyclically adjusted primary balance (CAPB) is not synonymous to direct changes in fiscal policies and consequently provide some difficulties in capturing the true effect in empirical estimations. (ii) the linear interpolation of missing data, particularly for a relatively short panel, as in this thesis’s, could result in over or underestimations of the variability in estimates.

The main empirical findings can be summarized as follows. First, the findings do not indicate the interaction between macroprudential and fiscal policies predict the change in private debt developments. Second, it is demonstrated that the baseline estimates are robust to: (i) the use of alternative samples; (ii) alternative specifications by the inclusions (e.g. exchange rate regime) of control variables.

The analysis contributes to at least two ongoing debates within the literature. (i) if there exist a causal relationship between macroprudential and fiscal policies in private debt deleveraging, (ii) the optimality of fiscal policy, and whether it can be more financial stability-oriented.
The remaining part of this thesis is organized as follows. Section 2 examines more closely the different macroprudential and fiscal policies at hand, and their conceivable relationship. Further, an overview is presented of financial stability and systemic risk, and the related literature. Section 3 develops the theoretical model and derives the main hypothesis, which is subsequently tested. Section 4 details the retrieved data and provide some stylized facts. Section 5 presents the empirical strategy. Section 6 presents the results, the identifying restrictions and robustness checks. Section 7 discusses the main empirical findings. Finally, Section 8 concludes.
2 Related Literature

This is thesis is closely related to three lines of literature: DSGE models with financial frictions (see Carvalho and Castro, 2017; Martin and Philippon, 2017), DPD models and the effectiveness of macroprudential policies in reducing household credit (see Akinci et al. 2015 or Cerutti et al. 2017 for recent studies), fiscal rules and the cyclicality of fiscal policies (see e.g. Alesina and Tabellini, 2005; Schaechter et al. 2012) and analyses of financial crises and measurement of financial stability, systemic risks (see e.g. Adrian et al. 2013; Borchgrevink et al. 2014).

2.1 Macroprudential Policy

As acknowledged in the previous section, macroprudential policies are governing instruments primarily levied on the credit intermediation process to ex-ante prevent the build-up of risk that threatens financial stability. Broadly speaking there are two, not mutually exclusive objectives of these policies (Claessens, 2014):

(i) The strengthening of financial systems resilience to widespread disturbances, in the provisioning of financial services, and hence lessens the effect of these disturbances impacting the overall economy.

(ii) To limit the build-up of financial systemic risk, arising from fluctuations in business and credit cycles over time, and from the degree to which financial institutions and markets are interconnected.

Notwithstanding, understanding the idea of macroprudential policy also involves distinguishing it from the objectives of microprudential regulation. Microprudential regulation aims to limit the distress of individual financial institutions, irrespective of their impact on the overall economy (Hanson et al. 2010). In contrast to macroprudential policy, microprudential regulation is best defined as guarding the interests of consumers, i.e. depositors or investors (Galati and Moessner, 2011).

Following Borio and Juselius (2013) these two financial supervisory frameworks can be distinguished from each other by likening portfolio securities to financial institutions in the economy. In this case, a
positive (monotonic) relationship is assumed between portfolio losses and the costs related to the real economy. The primary concern of macroprudential policy and microprudential regulation is the tail losses on the overall portfolio and each of the component securities, respectively. The macroprudential policy response is top-down. Initially a threshold is set for tolerable tail losses of the portfolio. Thereafter, the policy response is attuned by considering the individual marginal contributions of each security to the applicable measure of portfolio risk. In contrast, microprudential regulation setup is bottom-up, policy responses only ponder the risk of each individual security when attuned.

2.2 Systemic Risk and Financial Stability

The previous sub-section highlighted the features of macroprudential policy and its objectives. This is rectified by considering the potential channels and different market failures through which systemic risk may originate from, and clarify the concept of financial stability. As with Borchgrevink et al. (2014) the focus is on three types of market failures; pecuniary externalities, interconnectedness externalities and strategic complementarities.

2.2.1 Pecuniary Externalities

Pecuniary externalities occur when the activities of one agent influence the market price other agents face (Brinkman, 1999). For instance, the sale of one agent’s assets could influence the price of assets held by other agents, causing losses and reducing the welfare of the latter (Shleifer and Vishny, 1992). In economic theory with a frictionless market, the sole existence of pecuniary externalities does not fashion any welfare losses to the economy, but rather affect the distribution of wealth among agents (Brinkman, 1999).

De facto, markets are incomplete such that pecuniary externalities impact the real welfare of agents. Furthermore, borrowers and lenders are plagued by asymmetric information. Information gaps are typically solved by lenders requiring borrowers to pledge fixed assets (e.g. real estate) as collateral (Borchgrevink et al. 2014). This is an example of how global financial conditions could be tightened to
bridge the information gap, but also trigger the reversal of capital inflows, which exert downward pressure on asset prices and weakens balance sheets (Dávila and Korinek, 2016). Deflated asset prices and depreciated currencies lower collateral values and the borrowing capacity among agents (Brunnermeier and Oehmke, 2013). The repair of weakened balance sheets may invariably lead to depressed values for the assets being sold, limits on investment, and in extreme cases induce fire sales. In the event of fire sales, significant financial distress may be afflicted on multiple banks and trigger a credit crunch with severe consequences (Caballero, 2016).

Pecuniary externalities are also associated with overborrowing. The occurrence of a shock causes asset prices to fall, inflict losses on agents, and reduces their overall leverage. In some cases the above shock forces agents to sell their assets to comply with the current debt constraint, the greater these sales are, the more prices decline. The asset sales also lead to other agents becoming credit constrained and prompt the sales of their assets. Although agents recognize the risks and benefits related to private borrowing, they fail to acknowledge the general equilibrium effects on prices and other agents’ collateral constraint. Specifically, resulting in debt accumulation beyond the optimal level for the economy (Borchgrevink et al. 2014).

There are likewise instances of pecuniary externalities stimulating excessive maturity mismatches in the financial sector, i.e. overreliance on short-term debt (De Nicolo et al. 2012). In booms, short-term debt offers cheap means of financing bank activities, with low risk and attractive interest rate spreads between short-term debt and long-term assets. Borchgrevink et al. (2014) note that the occurrence of financial crises forces banks to sell assets at depressed prices to repay the short-term debt. The selling of assets dampens the price of similar assets held by other banks, which impact collateral values and the ability to access funding. Banks failure to acknowledge the effect of its own fire sales of assets on the liquidation value of assets held by other financial institutions is what causes the build-up of short-term debt and systemic risk.

2.2.2 Interconnectedness externalities
Increased interconnectedness can contribute to financial resilience under certain conditions but equally become a source of systemic risk for three reasons (Acemoglu et al. 2015). First, banks are likely to face similar types of risk due to correlation in portfolios (Allen and Gale, 2000). The period prior to the recent global financial crisis (GFC) serve as a good example of hazardous interconnectedness. During the GFC several global European banks activity included the purchase of U.S mortgage-backed securities by selling short-term paper in U.S. money markets (Adrian et al. 2013). These actions increased gross assets and liabilities in both the U.S and Europe, with no net flow. In addition, it largely explains why the subsequent subprime crisis had a greater impact on the European financial system rather than EMs, despite the former aggregately sustaining a current account surplus (Bayoumi and Bui, 2011; Shin, 2012).

Second, balance sheet interlinkages and correlated assets are prone to expose banks to indirect and direct contagion risks. Indirect contagion results from the previously stated pecuniary externalities, with the market value of other bank’s assets affected, even in the absence of direct exposure. Direct contagion relates to individual banks financial distress threatening other banks financial health (e.g. bank runs). Overall, contagion risks are difficult to eradicate, as the workings of the financial system is beyond individual banks control (Borchgrevink et al. 2014).

Finally, the third issue with increased interconnectedness is the expectations of spillovers. Spillovers primarily arise from asset price movements, bilateral interbank market exposures or feedback from the real economy (Bebchuk and Goldstein, 2011). In essence, financial distress among certain banks within the financial system raise concerns of other bank’s health. The concerns also influence banks prospects of obtaining funding and reduce the overall liquidity (Caballero and Simsek, 2009). Expectation spillovers are therefore concerning as it essentially exposes financial systems to contagion risks, adverse shocks and increase the possibility of “runs” in sound banks.

2.2.3 Strategic complementarities

The outline of interconnectedness externalities illustrated how financial intermediaries choose to correlate their risk, strategic
complementarities may explain why. Strategic complementarities refer to payoffs arising from agents increasingly adopting the same strategy and are often illustrated by bank runs. As distinguished by Diamond and Dybvig (1983), bank runs stem from a shift in expectations. Agent withdrawal deposits because of fears that others will commit the same action, i.e. consistent with expectation spillovers. Expectations of withdrawals of deposits forces banks to liquidate their assets (Borchgrevink et al. 2014). Similarly, to pecuniary externalities, extensive sale of assets depresses the price and increase the likelihood of solid banks defaulting. This leads to a rise in lending rates, since banks creditors demand a higher risk premium and restricts potential productive investments (Gale and Yorulmazer, 2013).

Strategic complementarities are additionally linked to governments implementing bailouts, in response to stern financial distress. The prospect of bailouts induces banks to engage in ex-ante maturity mismatches and correlated asset choice, as it maximizes the possibility of bank failures being of joint nature (Farhi and Tirole, 2012). Mutual risk engagement is motivated by capital markets treating individual banks more lenient, if adverse shocks impact the whole financial sector. Moreover, policymakers are less likely to intervene, if the adverse shocks only impact a minority of the existing banks. As previously alluded, correlated portfolios are much more likely to increase the financial system vulnerability to shocks. Banks are not only exposed to similar risks but the quality of their portfolios worsens, which builds systemic vulnerabilities that intensifies the downside of the financial cycle (De Nicolò et al. 2012).

The three stated market failures all contribute to the build-up of systemic risk and relates to Systemically Important Financial Institutions (SIFIs). SIFIs are institutions whose sheer size and interconnectedness, can force a government to ‘bail out’ the institution, hence imposing significant negative externalities on the public (Arnold et al. 2014).

2.2.4 Financial Stability

The objective of prudential policies such as macroprudential instruments is to help safeguard financial stability by mitigating the above discussed systemic risk. Still, in comparisons to price stability
and maximization of employment, no common consensus has been reached on how to define financial stability in the prevailing literature. The empirical literature demarcation of financial stability can be allocated into two groups (Galati, 2011). The first line of literature defines financial stability in terms of financial systems robustness to external shocks (see e.g. Padoa-Schiopna 2003; Allen and Wood, 2006). Others (see e.g. Schinasi 2004; Borio and Drehman, 2009a) express it with regards to financial systems resilience to internal shocks or exposure to normal-sized shocks.

This thesis follows Svensson (2016), in defining financial stability according to it fulfilling its three main functions (i.e. transforming savings into financing, offering risk management and transmitting payments) and resilience to disturbance that could threaten these functions. As stressed by Svensson (2016), the key to this definition is sufficient resilience to avert disturbances and lowering the chance of severe financial crises.

Before, providing more extensive analysis of the different macroprudential policies at hand, there is a need to clarify the measures of systemic risk and financial stability that vindicate policy intervention.

2.3 Systemic Risk and Financial Stability Monitoring

The measures of systemic risk can be divided into three areas (Adrian et al. 2013). First, financial market-based measures. Second, information retrieved from supervisory stress tests, utilized to provide forward-looking measures of financial institutions risk. Finally, network measures of the degree of interconnectedness within the financial sector.

Financial market-based measures largely rely on Conditional Value at Risk (CoVaR) indicators to estimate the degree of risk. CoVaR indicators measure the value at risk (VaR) of the financial system, provisional on institutions distress (Adrian and Brunnermeier, 2009). For instance, distressed insurance premiums can be used to measure the cost of insuring a firm against systemic-wide distress, by assessing the losses on financial institutions portfolios (ibid.). The aim of this measure is to directly disclose the relationship between financially
distressed institutions and the overall function of the financial systems. Although this measure has been widely used it is subject to some limitations. The first issue relates to the measure vulnerability to confounding effects of current levels of overall risk pricing (Adrian et al. 2013), as systemic risk indicators depend on stock prices or credit default swaps premiums, which reflect the varying market price of risk. Moreover, the probability of institutions relationship not altering during a financial crisis is very small.

Supervisory stress tests measures whether financial institutions capital level is satisfactory to endure shocks. Stress tests predominantly consider SIFIs, by comparing their loans and trading assets. This allows for the assessment of how individual firms are affected by shocks and spillovers to the financial system. More importantly, it reveals individual institutions ability to withstand simultaneous distress within the financial system. While stress tests in comparisons to financial market-based measures are not vulnerable to market pricing of risks, they fail to recognize feedback effects between the financial sector and the real economy, particularly if shocks are small (Adrian et al. 2013). The main advantage is that these tests are forward-looking. Forward-looking tests increases the possibility of underlining potential areas that are vulnerable to systemic risk, and aids policymakers in introducing ex-ante measures to strengthen the resilience of the financial system and prevent the occurrence of crises (Haldane and Madouros, 2012).

The valuation of assets could also indicate the robustness of the financial system. Assets whose valuation heavily depends on liquidity transformation, excessive leverage, maturity or lenient underwriting stands are more likely to cause defaults and thus initiate financial instability (Galati and Moessner, 2011).

### 2.3.1 Credit-to-GDP ratio

There has been extensive literature on the causes of financial crises, but the aftermath of the GFC also reshaped the analytical framework. In particularly, this reshape was provoked by the novelty of a severe crisis impacting countries with mature and highly sophisticated financial systems. The main theoretical shift involves assessing the financial cycle (i.e. economic fluctuations that stem directly from the financial system) as the factor that underlines the
build-up of systemic risk and thus grave financial crises (Arnold et al. 2014).

As the financial cycle is best characterized by the behaviour of private sector credit, credit-to-GDP ratios are often used as a source of financial stability. Credit-to-GDP ratios measure the ratio of total nominal private debt to total nominal output. In this case, private debt is defined as total credit provided by domestic banks to the domestic “private non-financial sector”, which includes non-financial corporations (both private-and public-owned), households and non-profit institutions serving households (BIS, 2017).

Contrary to equity prices, financial cycles exhibit longer cycles and tend to be more closely related to fluctuations in real GDP. For example, in the period between 2001-2008, each crash in equity prices was followed by a slowdown in economic activity, yet hardly impacted the financial cycle. Nonetheless, credit-to-GDP ratios continued to rise, before peaking and collapsing once the GFC took place. Drehmann and Tsatsaronis (2014) find that all post-financial liberalization financial cycles peaks tend to coincide with fully developed crises or severe financial strain.

The overlapping effect of the peaking of financial cycles and crises is often referred as the “paradox of financial instability”, with the financial system appearing the strongest when it is most fragile. Further, credit growth and asset prices are remarkably strong, and market prices, risk premia and volatilise unnaturally low, when the risk is highest (Arnold et al. 2014). In a boom risk patterns appear to be low, but could in fact signify aggressive risk taking, and only emerge as a concern with the occurrence of a crisis (Reinhart and Rogoff, 2009). Financial cycles lower frequency compared to traditional business cycles, also makes it a medium-term phenomenon that lasts for 16-20 years, rather than 8 years. Therefore, credit-to-GDP ratios have frequently been used as a benchmark indicator of banking crises and financial stability (see Borio and Drehmann, 2009; Allen et al. 2011). The measure is viewed as a proxy for the build-up of financial imbalances and aid policymakers in distinguishing between sustainable and unsustainable booms.

2.4 Macroprudential Toolkit
The scope of macroprudential policy is large, but the emphasis here is on the instruments that have been used more widely by policymakers and offers substantial empirical evidence. Lim et al. (2011) suggest that these instruments can be divided into two groups:

(i) **Borrower-targeted instruments** *(credit-related)*
caps on loan-to-value (LTV) ratios, caps on debt-to-income (DTI) ratios.

(ii) **Financial institution-targeted instruments**
- *Liquidity-related*, limits on foreign currency loans (FC), foreign exchange (FX) and/or countercyclical reserve requirements.

### 2.4.1 Borrower-Targeted Instruments

Credit-related instruments, such as LTV or DTI caps seek to restrict the extension of mortgage credit beyond a specific fraction of the value of housing collateral and the value of borrower’s debt relative to their monthly income, respectively (ESRB, 2015). The primary goal of the instruments is to prevent systemic risk originating from overheated housing markets, unsustainable household indebtedness, and risks associated with household credit during upswings of the credit cycle. Not surprisingly, LTV and DTI caps have been implemented more frequently in AEs, which is consistent with these countries having larger and more developed housing markets. The instruments were especially prominent during the boom phase of the mid-2000s and after the GFC in 2009 (Claessens, 2014).

In terms of the empirical literature (see e.g. Nabar and Ahuja, 2011; Igan and Kang, 2011; Wong et al. 2011; Struyven, 2015), LTV and DTI caps have been found to lower expected rise in house prices and postpone house purchase by property owners (i.e. potential speculators). LTV caps are also found to be more efficient in curbing household leverage, speculative incentives, and provide some welfare effects by enabling lower income households’ access to credit.

### 2.4.2 Financial Institution-Targeted Instruments
Policymakers have since the GFC increasingly adopted two liquidity-related instruments, FC limits and FX or countercyclical reserve requirements. FC limits restrict domestic banks currency liabilities and holdings of foreign currency denominated securities.

Understandably, this macroprudential instrument has largely been adapted in EMs, because of the tendency to experience greater exposure to volatile capital inflows and the resulting excessive credit growth (Galati and Moessner, 2011). The rise in volatile capital inflows and excessive credit growth can be attributed to developed economies low interest environment that provides cheap borrowing for non-financial corporations in EMs (Shin, 2012). This is reiterated by Chui et al. (2014) comparisons of the four-year period prior (2006-2008) and after the crisis (2009-2012), which found that in the latter private sector borrowing more than doubled foreign currency debt. FX or countercyclical reserve requirements sets a minimum threshold of the number of liquid assets banks must hold. The instruments also aid the accumulation of capital buffers and limits credit growth (Shin and Shin, 2011). Hahm et al. (2012) stress that in determining the appropriateness of introducing these instruments, policymakers ought to always consider the business cycle. Optimal outcomes are normally achieved, if reserve requirements are used countercyclically (increased during booms and decreased in downturns). Similarly, to FC limits FX and countercyclical reserve requirements are adopted more often in EMs. Lim et al. (2011) illustrates how Brazilian authorities hedged foreign currency borrowing by levying a 60 percent reserve requirements threshold on all domestic banks short-term debt in foreign currency, exceeding €3 billion or the Tier 1 capital (i.e. banks core capital).

Miscellaneous evidence is found for the use of liquidity-related instruments in the literature. FC limits lowers systemic risk arising from increased contagion within the financial system, only when it is combined with other measures, e.g. capital controls (Dell’ariccia et al. 2012). Whilst FX or countercyclical reserve requirements impact is comparable to interest rates in curbing credit growth (Cordella et al. 2014; Tovar et al. 2012). The shortcoming of these instruments is that they can only be applied on banks and may simultaneously encourage the build-up of systemic risk in other financial institutions (Hahn et al. 2012).
In the case of capital-related instruments, dynamic provisioning and countercyclical capital requirements are more likely to be adopted than other tools. Dynamic provisioning targets banks’ balance sheet by requiring the build-up of a buffer in booms, to cover rising specific provisions linked to loan delinquencies in downturns (Wezel et al. 2012). The implementation of dynamic provisioning stems from excess procyclicality. In booms the likelihood of facing adverse developments and financial instability rises, since borrowers and lenders indicate more optimism in pursuing risky investments and credit standards are lowered (Saurina, 2009). Although this type of measure was first introduced in Spain, it has since then been increasingly used in EMs. For example, Uruguay in 2001 introduced a dynamic provisioning fund that set a 3 percent limit on total loans (Wezel et al. 2012).

Countercyclical capital requirements can fulfil two functions (Morrison and White, 2005; Shleifer and Vishny, 2010). First, by providing an additional capital buffer during booms, to mitigate credit crunches in the event of a downturn. Second, higher capital requirements on financial institutions own capital have in certain cases the ability to depress credit-fuelled booms. The basic idea behind countercyclical capital requirements is that financial institutions in booms internalize the social cost associated with credit defaults or respond to higher costs on its own capital through charging a higher loan rate. Correspondingly, the relaxing of capital restrictions in downturns could absorb some of the credit losses, and above all alleviate some of the pressure on financial institutions deleveraging (ESRB, 2016). This lessening of pressure among financial institutions may in turn reduce the damaging effect from involuntary deleveraging on the real economy (Adrian et al. 2013).

The evidence from the literature (see Balla and McKenna, 2009; Fillat and Montoriol-Garriga, 2010) largely aligns with the targets of dynamic provisioning, as it is found to improve financial systems robustness during booms and ability to absorb credit losses in downturns. Some selective studies (see Lim et al. 2011; Peydró-Alcalde et al. 2011) also establish a positive externality on curbing credit growth from increased instrument usage. Capital requirements and providing additional capital buffers in booms, likewise is found to aid the mitigation of credit crunches in downturns (Catte et al. 2010). Catte et al. 2010 suggest that implementing capital buffers not only reduces systemic-wide risks in booms and helps bank lending
during downturns but lessens the need for government bail-outs. One evident limitation with capital buffers and/or requirements is that the lack of coordination between macroprudential authorities and central banks causes conflicting policies. Conflicted objectives and excessive use of monetary policy (interest rates) and capital requirements hinders the stability of key macroeconomic variables such as output and loans-to-output ratios (Angelini et al. 2012)

2.5 Fiscal Policy

In the aftermath of the GFC, concerns were raised of fiscal policy absenteeism as a post-crisis measure alongside prudential policies, e.g. macroprudential instruments. The concerns are mainly associated with the design of fiscal policy failure to consider financial cycles and having a more financial stable focal point (BIS, 2017). This absence is particularly unexpected, due to historical evidence illustrating that financial crises are strongly correlated with the weakening of public finances. Cordes et al. (2015) indicates that the recent crisis resulted in the largest weakening of public finances and undermining of credible fiscal policy since the end of World War II. Fragile financial systems have adversely impacted the balance sheets of banks’ sovereign debt holdings and reduces the scope for fiscal authorities to implement countercyclical policies (Bordo and Meissner, 2016). More importantly, it underlines the urge to develop a more financial stability-oriented fiscal policy.

2.5.1 Fiscal Rules and Financial Stability Interlinkages

Although fiscal policy has several objectives, this thesis exclusively focus on the four fiscal rules, that have been promoted extensively since the GFC to ensure financial stability (Schaechter et al. 2012):

(i) **Budget balance rules**, commonly identified as the overall balance, structural or cyclically adjusted balance, and balance “over the cycle”, which ensure that the debt-to-GDP ratio converges to a finite level.

---

2 Fiscal rules refer to long-lasting constraint on fiscal policy through numerical limits on budgetary aggregates.
(ii) **Debt rules.** establishes a precise limit or target for the current debt-to-GDP ratio (public debt). This type of rule is viewed as most effective in converging debt levels to set targets. Nevertheless, in cases when debt levels are below the set ceiling, diminutive supervisory is given to fiscal policy.

(iii) **Expenditure rules.** sets permanent limits on total, primary, current spending in absolute terms or growth rates. In some instances, these limits are set in percent of GDP. The rules have no direct association with the aims of debt sustainability, as they cannot restrict the revenue side. Only when combined with debt or budget balance rules, can these rules prompt fiscal consolidation, which is linked to sustainability.

(iv) **Revenue rules.** are implemented to set ceilings or floors on existing revenues. The goal is to enhance revenue accumulation and/or avert extreme tax burdens. As previously mentioned the rules are not directly associated with debt sustainability, because they do not constraint revenues.

All the stated rules fulfil an important function in determining how fiscal policy can foster a more financial stable environment. The empirical literature specifically differs between two approaches in assessing the content and formation of fiscal policy (see Kuzmenko et al. 2016). The first approach emphasizes budgetary rules influence on instilling fiscal discipline, inter-budgetary transfers, as well as the establishment and altering of mandatory payment orders. The second approach alludes to revenue rules and namely tax-orientated rules bearing on the mobilization of tax and non-tax revenues. In this sense, tax-orientated rules show similarities to fiscal policy, with both specifying the material foundation of relation between economic entities.

Acknowledging different fiscal rules could pave way for upholding more sound fiscal policies. However, to fully understand how fiscal policy can become more pre-emptive, there is a need to clarify the type of cyclical stance that AEs and EMs have historically followed.
2.5.2 The Cyclicality of Fiscal Policy

Alesina and Tabellini (2005) illustrated even before the GFC, that fiscal policy (e.g. taxes or government spending as a fraction of GDP) should remain constant over the business cycle. Christiano et al. (2011) and Nakata (2016) clarifies this understanding in theoretical frameworks using stochastic models with sticky prices. Their findings imply that countercyclical fiscal policies (i.e. raise in spending and/or reduction in taxes during booms and reverse in recessions) positively influence the economy's welfare. An example will demonstrate this understanding. Suppose that household face an adverse economic shock to income. Once households realise the shock, they respond by cutting spending and increasing savings. Thus, the government optimally respond by using expansionary fiscal policies to stimulate the economy. The scope for expansionary fiscal policies is also bigger in recent times, because of the prevalent low interest environment and less efficient monetary policy (Wu and Xia, 2016). The fulfilment of these economic conditions induces further use of countercyclical fiscal policy, which concurs with most of the existing evidence for AEs (see Lane, 2003; Fatás and Mihov 2009; Egert, 2010).

In contrast EMs demonstrate procyclical tendencies that can be explained by the proposed credit restriction hypothesis. EMs are less likely than AEs to smooth the business cycle because of limited access to borrowing from international credit markets during crises (Vegh and Vuletin, 2012). The restricted access complies with empirical findings from EMs in Latin America that procyclical fiscal policy is synonymous with severe recessions (Gavin and Perotti, 1997). According to Kaminsky et al. (2004) the determination of fiscal policy could also stem from international investors and institutions (e.g. World Bank) being less willing to finance countries that have unsustainable fiscal deficits, prompting “sudden stops”, i.e. slowdowns in private capital inflows. Talvi and Végh (2005) provide another explanation to why fiscal policy may be procyclical. The reasoning behind this explanation is that high variability in the tax-base for EMs creates large fluctuations in fiscal revenues and alters governments' incentives. Large fluctuations raise political pressure on governments to increase spending during booms, fuelling the lack of savings and contractionary fiscal policy in recessions (Calderón and Schmidt-Hebbel, 2008). Alesina et al (2008) offers a third reason for procyclical fiscal policy in EMs in a theoretical model by accounting for corruption in formation of fiscal policy. Rational voters distrust
corrupt governments with resources, and hence seek to benefit from expansionary fiscal policies, such as tax cuts during booms. The political pressure forces governments to adhere to the voters demands, and incur large fiscal deficits, leading to increased contractionary policies in recessions.

2.5.3 The Effectiveness of Fiscal Rules

Bergman and Hutchinson (2015) using a panel framework for 81 advanced, emerging and developing countries between 1985-2012 investigate the impact of fiscal rules on the cyclicality of fiscal policy. The empirical evidence support the claim that national fiscal rules in both AEs and EMs are very efficient in reducing the procyclical nature of fiscal policy, contingent upon being combined with governmental administrative efficiency. Comparable findings are found in Nerlich and Reuter (2016) study of budgetary rules implemented in EU countries improving governments’ fiscal space. However, in a recent analysis of Eurozone countries the results indicate that there is a trade-off between financial stability and fiscal rules when mistrust is directed towards the optimality of the monetary union. The mistrust not only deteriorate confidence in financial markets but reduces government’s ability to handle asymmetric shocks and sustain financial stability.

Countercyclical fiscal policy is found to be more widespread in AEs, but there are recent examples of EMs making rapid transitional movements. Chile is perhaps the greatest illustration of this transition. The government have since 2001 had a budgetary rule linked to the cyclical-adjusted fiscal balance (Frankel et al. 2013). This rule has contributed to temporary savings of high fiscal revenues during booms, which is part of the reasons why the country bounced back faster than some AEs after the GFC (Didier et al. 2012).

In summary, the suggestion is that fiscal rules can have a positive impact on countries welfare and financial stability, albeit only if certain conditions hold. Empirical evidence is limited but most of the literature focus is on budgetary rules, as it is deemed to have the largest impact on fiscal policy. This is one of the reasons that warrant the use of cyclical adjusted primary balances as a proxy for fiscal policy in the impending empirical estimations (see section 4.1.3 for more detailed discussion)
2.5.4 Fiscal and Macroprudential Policy

The empirical literature offers some indication of conceivable conflicts and interlinkages between fiscal and macroprudential policy. Cecchetti (2017) suggests that this overlapping effect stems from the organization of capital and liquidity regulation, the resolution regime (i.e. government created legal framework that resolves a failed bank in an orderly way so the financial markets do not collapse), and details of the tax code. Changes in capital requirements are likely to influence the attractiveness of banks holdings of sovereign debt. Consequently, a macroprudential authority that raises the risk weights on government bond holdings raises banks cost, government finances and reduces overall demand (Bridges et al. 2014). Liquidity related regulation such as FX or countercyclical reserve requirements also illustrate how demand for sovereign debt changes. In most cases “run-off rates” (i.e. set assumptions of liabilities) are used to distinguish liquid assets from high-quality liquid assets. Sovereign bonds are typically deemed to be high-quality liquid assets but changes in “run-off rates” or the definition of a liquid asset could alter the demand for government bond holdings, raising or lowering the cost for the latter (Gabor and Ban, 2015). Thus, alterations in macroprudential policy can have a profound impact on government financing. Above all, it signifies that fiscal authority’s ability to implement expansionary policies benefits from lowered capital and/or liquidity requirements, as it increases the attractiveness for banks to hold sovereign debt (Cecchetti, 2017).

Next, numerous cross-country evidence is presented with regards to private debt, macroprudential policy and fiscal policy. There is a whole range of individual literature to choose from, still, emphasis is on studies that distinguish the interlinkages between private debt and the policies in AEs and EMs.

2.6 Private Debt, Macroprudential and Fiscal Policy: Stylized Facts from Cross-Country Evidence

As outlined above, the primary aim of this thesis is to assess the optimal interaction between macroprudential and fiscal policy to foster financial stability in AEs and EMs. It has previously been
established (see section 2.3) that there are different methods available to measure financial stability; nonetheless the credit-to-GDP ratio (henceforth referred as private debt) closest aligns with the purpose of this thesis.

This thesis empirical analysis draws similarities from the non-exhaustive theoretical literature that identifies the existence of external shocks and sudden stops. These studies regularly model financial frictions to agents, such as banks and households absorbing too much systemic risk. Financial frictions include countercyclical capital buffers imposed on the banking sector or collateral constraints that respond to highly leveraged loans. The restrictions often reflect macroprudential authorities respond to the economy facing an adverse shock to financing.

Carvalho and Castro (2017) builds a theoretical framework based on the Brazilian economy by using a DSGE model with heterogeneous financial frictions and foreign capital flows. The analysis focus on the optimal policy mix response of macroprudential, fiscal and monetary policy rules to the business and/or the financial cycle. Their findings suggest that optimal fiscal policy should be anticyclical in the business cycle and slightly procyclical in the credit cycle, if macroprudential policy countercyclically reacts to the financial cycle. Martin and Philippon (2017) using a structural DSGE model assess how Eurozone countries would have fared during the GFC with different policies. They find that these countries would have fared better if prudential macroprudential and fiscal policy was used during the boom. The set-up of this thesis is similar to these papers, although there are several importance differences. Here it is demonstrated that the Batini et al. (2015) model can be reduced to one dynamic linear equation. This not only allows us to directly align the theoretical and empirical framework, but also warrants the use of a DPD model, which is more consistent with qualities of the retrieved data.

Our work is also related to several empirical papers that consider the effects of macroprudential policy on household credit (see e.g. Zhang and Zoli, 2014; Akinci et al. 2015; Reinhardt and Sowerbutts, 2015; Cizel et al. 2016; Kuttner and Shim, 2016). This literature emphasizes the prolific use of macroprudential policy in EMs and that overall tightening is associated with lower credit growth. More
recently, Cerutti et al. (2017) similar to the empirical framework in thesis, use data from the IMF and DPD analysis to assess macroprudential policies in 119 countries between 2000-2013. Their finding aligns with evidence from previous empirical literature, of more prominent use of macroprudential policies in EMs and the associated reductions in credit growth rates. Whilst the aforementioned papers demonstrate similarities to the chosen empirical approach here, albeit with a different focus. In the forthcoming empirical estimations, fiscal policy is considered as an additional factor to private debt deleveraging and the specific focus is on AEs and EMs.

Finally, this thesis is linked to the empirical literature that evaluates the relation between private debt and fiscal policy (see e.g. Jordà, 2005; Eggertsson and Krugman, 2012; Kaplan and Violante, 2014; Andrés et al. 2015; Bernardini and Peersman, 2015). The studies find that the government spending multiplier rise with private indebtedness, as expansionary fiscal policy not only crowds out private spending but also increases the spending of liquidity-constrained debtors. Klein (2016) estimates state-dependent impulse responses to exogenous innovations in government budget deficits using local forecasts in 12 OECD countries from 1978 to 2008. The evidence demonstrates that implementing contractionary fiscal policy in times with high level of private indebtedness leads to severe contractions in GDP and private consumption.

### 2.7 Sustainability Aspect

In regards to the sustainability feature of this thesis, the section in its entirety has illustrated how the consistent rise in financial sector and fiscal policy interaction increases the dependency between financial and fiscal stability. Specifically, the transition towards a sustainable setting need to more carefully reflect aspects related to environmental, economic and social development.

Although debt accumulation signifies means of fostering economic growth, the recent crisis has probed discussion of the associated long-term sustainability of it. The financial sector can merely be ascribed an indirect influencer on the environment e.g. through its lending activities. Yet, fiscal incentives at present tend to incite socially
excessive leveraging and financial risk-taking, rather than advocating financial stability. Long-term risks associated with the environment and overall green affluence are also currently being inadequately valued. These factors only contribute to distortions in capital allocation and the build-up of systemic risk, but also prove damaging to the natural environment.

The aftermath of the GFC has demonstrated the urgent need to align the aims of the financial system with the resilience and long-term objectives of the real economy. In particularly, increased attention has been given to ex-ante mitigation policies of market failures (e.g. macroprudential policies). However, provoking policymakers’ interest of fostering sustainability also involves understanding and monitoring fiscal stability, to limit the excessive interaction. If the purpose of a macroprudential authority is to pursue a change in the regulatory framework and safeguard the soundness and stability of financial institutions, it ought to consider what works against it. Therefore, macroprudential and fiscal policies are better viewed as complementary actions rather than the former bailing out the missteps of the other.

This thesis presents a theoretical and empirical framework that contributes to the limited literature of how macroprudential and fiscal policies can optimally be combined in AEs and EMs. It is important to note that despite that the objective of the presented work is to spark the interest of policymaker’s stance towards fostering more sustainable market developments, such increased interest can equally have a spillover effect on the behaviour of individuals. Policy interaction expands consumers’ transparency of what a sustainable profile entails, how it is measured and its limitations. In addition, it allows consumers to explore the genuineness of the financial sector market profile and increases the possibility of incorporating scenario analysis.

The increased cooperation between macroprudential and fiscal authorities are likely to involve some short-term trade-offs to economic growth especially during booms, mainly through setting constraints on private sector borrowing (Boar et al. 2017). Nevertheless, given that previous evidence suggest that costs are likely to be much larger with consistent disruptions to the functioning of the financial system and undermining of business confidence, policy intervention is merited.
3 Model

The model closely follows Batini et al. (2015) discrete time model of an economy populated by two types of households (patient and impatient). Both households consume and supply labor, but differ in their respective discount rates ($\beta^p > B^i$). Patient households face no borrowing constraint, sell private bonds to banks and invest in government bond holdings. Impatient households borrow from patient households and receive credit if the government choose to moderate the deleveraging in the private sector. In addition, impatient households adhere to a collateral borrowing constraint (e.g. value of housing act as collateral). Entrepreneurs produce an intermediate good following a Cobb-Douglas production function setup, using households labor and capital as inputs. As with impatient households, entrepreneurs’ borrowing is subject to a collateral constraint.

The significant departure from the original theoretical framework is that the model is reduced to one dynamic linear equation with the three variables of interest. In accordance with Alpanda et al. (2014) a banking sector and macroprudential authority is also included. The banks act as an intermediary between savers (patient households) and borrowers (impatient households and entrepreneurs) to finance the latter purchasing of housing and capital. Banks are also assumed to be monopolistically competitive, such that lending and deposit rates (investments in risk-free bonds) are set to maximize profits. One limitation in using this setup, is that banks are not allowed to default in equilibrium. Rather than merely assessing optimal leverage ratios, the banking sector is thus included to observe how these ratios interact with other key variables of interest over the business cycle. The macroprudential authority is assumed to be fully independent and set a time-varying capital requirement and fixed leverage requirements that bank must consistently conform to.

The model also includes a benevolent government (social planner) that seek to maximize the welfare in the economy. Further, there are two types of roles for fiscal policy. First, the reduction of dynamic inefficiency caused by individuals oversaving. Second, coordinating policy action alongside the macroprudential authority. To simplify matters, the government is assumed to finance its spending by imposing a lump-sum tax and new issues of government bonds (i.e.,
public debt). Finally, the monetary authority is assumed to be independent and set policy rates according to a standard Taylor Rule. The structure of the economy is described in detail below (see Appendix A for first-order conditions).

3.1 Patient Households

Patient households ‘\(i\)’ maximize their expected lifetime utility by choosing consumption, \(c_t\), housing holdings, \(h_t\) and hours of work, \(\ell_t\) subject to a budget constraint. The expected utility is given by:

\[
U(\{Z_t, h_t, \ell_t\}_{t=1,2,\ldots}) = \sum_{t=0}^{\infty} \left( \beta^t \right) E_t u \left( \ln Z_t(i) + \xi \ln h_t(i) - \eta \right),
\]

(1)

where \(\beta^t\) is the discount factor, \(\xi\) captures the housing preference parameter and \(\eta\) measures the elasticity of labor with respect to the real wage. The utility function, \(u(.)\) is continuously differentiable, strictly increasing, and concave in both arguments.

Since the level of consumption is denoted by \(c_t\) and \(\alpha \in (0,1)\), the habit persistent consumption can be expressed as:

\[
Z_t(i) = c_t(i) - \alpha c_t(i),
\]

(2)

Patient households face the following budget constraint (i.e., in real terms):

\[
c_t(i) + q_t \Delta h_t(i) + \frac{b_t(i)}{\pi_t} + \frac{b^G_t(i)}{\pi_t} \leq w_t(i) + \left(\frac{1+\tau_t}{\pi_t}\right) b_{t-1}(i) + \left(1-\Delta_t^G\right) \left(\frac{1+\tau_t}{\pi_t}\right) b^G_{t-1}(i) + \tau_t + \Xi_t,
\]

(3)

where \(\pi_t = P_t / P_{t-1}\) denotes the rate of inflation. Household expenditures include consumption, housing holdings and investments in risk-free private bonds \(b_t\), government bonds \(b^G_t\) discounted at the ex-ante expected haircut rate \(\Delta_t^G\) and a rebate made by the government in cause of default \(\Xi_t\). Household earnings comprise of the real wage \(w_t\), the gross return on the previous periods bond holdings and a lump-sum transfer \(\tau_t\) from the government. \(q_t\) is the real house price and \(r_t\) signifies the nominal interest rate.
3.2 Impatient Households

Impatient households ‘i’ maximize their expected lifetime utility by choosing consumption, $c_t^I$, housing holdings, $h_t^I$ and hours of work, $t_t^I$ subject to a budget constraint. The expected utility is given by:

$$U(\{Z_t^I, h_t^I, t_t^I \} _{t=1,2,...})E_t \sum_{t=0}^{\infty} (\beta^I)^t u \left( \ln Z_t^I(i) + \xi \ln h_t^I(i) - \frac{\eta^I(i)}{\eta} \right), \quad (4)$$

The habit persistent consumption is given by:

$$Z_t^I(i)=c_t^I(i) - \alpha c_t^I(i), \quad (5)$$

The budget constraint then reads as:

$$c_t^I(i) + q_t^I \Delta h_t^I(i) + \frac{(1+r_{t-1})b_{k,t-1}^I(i)}{\pi_t} + \frac{(1+r_{t-1})b_{g,t}^I(i)}{\pi_t} \leq w_{t+1}^I(i) + b_t^I(i) + b_{g,t}^I(i) + \tau_t^I, \quad (6)$$

and the collateral borrowing constraint:

$$(1+r_t)b_t^I(i) \leq m_t^I E_t [q_{t+1} h_t^I(i) \pi_{t+1}], \quad (7)$$

The expected utility of impatient households is discounted at the lower rate $\beta^I$ and include one alteration from patient households budget constraint. Earnings include borrowing from patient households and total credit received if the government choose to moderate deleveraging within the private sector, $b_t^I$ and $b_{g,t}^I$, respectively. The market rate $1 + r_{t-1}$ represent interest payments made to the government.

In a similar vein as Kiyotaki and Moore (1997) impatient households also face a collateral borrowing constraint in equation (7), where only a fraction of the retained housing value can be borrowed. $m_t^I E_t$ denotes the regulatory loan-to-value (LTV) ratio on mortgage loans.

3.3 Entrepreneurs
Following Iacoviello (2005) entrepreneurs of the economy produce the intermediate good \( y_t^E \) by using capital labor and real estate as inputs. The final good is attained by simply aggregating the production of intermediate goods using a Dixit-Stiglitz aggregator (Dixit and Stiglitz, 1977). The technology is given by a Cobb-Douglas production function:

\[
y_t^E = a_t^E \left[ k_{t-1(i)}^E \right]^\alpha \left[ \ell_t(i) \right]^{1-\alpha},
\] (8)

Production specialize as:

\[
y_t^E = a_t^E \left[ k_{t-1}^E \chi_t(i) h_{t-1}^{EP} \right] \left( t_t(i) \right)^{\sigma(1-\chi - \mu)} \left( t_t(i) \right)^{1-\sigma(1-\chi - \mu)},
\] (9)

where \( a \) is the technology parameter, \( k_t^E \) is entrepreneurial capital, \( h_t^E \) is the real estate input, \( t_t^{EP} \) and \( t_t^{EJ} \) is the supply of labor from patient and impatient households. \( \chi \) and \( \mu \) denotes the elasticities of output to capital and real estate. \( \sigma \) is the contribution of patient households to the labor share.

Entrepreneurs maximization of their expected utility only depends on the habit-adjusted consumption \( Z_{t+1}^E \) and the discount rate \( \beta^E \), and is given by:

\[
U(\{Z_{t+1}^E \} t=1,2,...) \sum_{t=0}^{\infty} (\beta^E)^t u (\ln Z_{t+1}^E(i)),
\] (10)

where the habit-adjusted consumption \( Z_{t+1}^E \) is given by:

\[
Z_{t+1}^E = c_t^E(i) - \alpha c_t^E(i),
\] (11)

The budget constraint for the entrepreneurs is given by:

\[
\frac{y_t^E}{X_t} = b_t^E(i) + b_{k,t}^E(i) = c_t^E + q_t \Delta h_t^E(i) \frac{(1+r_{t-1})b_{k,t-1}^E(i)}{\pi_t} + \frac{(1+r_{t-1})b_{k,t-1}^E(i)}{\pi_t} + w_t^{EP} \left( \pi_t \right)^E + w_t^{EJ} \left( \pi_t \right)^E + I_t^E.
\] (12)

---

3 More precisely, by combining the labor, housing, capital of patient and impatient households.
where the flow of funds is determined by entrepreneur’s ability to sell produced goods at markup $X$. $b_{t}^{E}$ and $b_{t-1}^{E}$ are the debt obligations towards private agents and credit they receive if the government choose to moderate deleveraging within the private sector (analogous to impatient households), respectively. $q\Delta h_{t}^{E}$ signifies the change in housing holdings and $I_{t}^{E}$ is the investment in capital goods.

The law of motion of capital can be expressed as:

$$I_{t}^{E} = k_{t}^{E}(i) \left(1-\delta\right) k_{t-1}^{E}(i),$$

(13)

Equation (13) above represents the investment in capital goods $I_{t}^{E}$, $\delta$ is the depreciation rate of physical capital.

Entrepreneurs are also subject to a collateral borrowing constraint that reads as:

$$(1+r_{t})b_{t}^{E}(i) \leq m_{t}^{E}E_{t} \left[q_{t+1}h_{t}^{E}(i)z_{t+1}\right],$$

(14)

where $m_{t}^{E}$ denotes the debt-to-income ratio (DTI), and entrepreneurial loans are bounded by the expected value of housing.

### 3.4 The banks

The banks “$j$” use deposits from patient households and their own capital to fund the lending of impatient households and entrepreneurs. Banks choose loans and deposits $d_{t}^{b}$ to maximize profits:

$$U\left(\left\{ d_{t}^{b}\right\} t=1,2,\ldots\right)E_{t} \sum_{t=0}^{\infty} (\beta^{\theta})^{t} \sum_{t} \sup \left[ d_{t}^{b}(j) \right] \text{P}_{t},$$

(15)

where the discount factor $\beta^{\theta}$ is marginally lower than patient households, ensuring non-negative flows to banks at the steady state (Iacoviello, 2013).

Subject to the balance sheet identity:

$$\frac{A_{t}(t)}{z_{t}} = \frac{b_{t}^{E}(t)}{z_{t}} + \frac{p_{t}^{E} b_{t}^{E}(t)}{z_{t}} + \frac{p_{t}^{E} b_{t}^{E}(t)}{z_{t}},$$

(16)
where $A_t$ denotes the bank's capital, $b_C^t$ is government bond holdings. Long-term loans nominal value that impatient and entrepreneur receive is represented by $P^I_t$ and $P^E_t$.

Bank’s cash-flow conditions is defined by:

$$d^b_{t(j)} + \frac{(1+r_{t-1})b^G_{t-1}(j)}{\pi_t} + (1+u^I_t)\frac{P^I_t b^I_t(j)}{\pi_t} + (1+u^E_t)\frac{P^E_t b^E_t(j)}{\pi_t} \leq \frac{b^G_{t(j)}}{\pi_t} + (\delta^I_t P^I_{t-1}) b^I_{t-1}(j) + (\delta^E_t P^E_{t-1}) b^E_{t-1}(j), \quad (17)$$

where $d^b_t$ is the dividends shareholders receive, $u^I_t$ and $u^E_t$ are the associated monitoring cost bank face by extending loans to households and businesses as follows:

$$1+u^I_t = \left[ \frac{(1-m^I_t)}{q^I_t} \right], \quad (18)$$

$$1+u^E_t = \left[ \frac{(1-m^E_t)}{q^E_t} \right], \quad (19)$$

where $q^h_t$ and $q^k_t$ are the prices of housing and capital that impatient households, entrepreneurs incur when housing $h^I_t$ and capital $k^E_t$ is purchased. Despite this setup refraining from including bank defaults per se, the above monitoring costs can be inferred as a share of defaulted funds (i.e. “adverse loans”)

The real net worth of impatient households $p^I_t$ and entrepreneurs $p^E_t$ is expressed as:

$$p^I_{t-1} = q^h_t h^I_t - P^I_t b^I_t, \quad (20)$$

$$p^E_{t-1} = q^k_t k^E_t - P^E_t b^E_t, \quad (21)$$

### 3.5 Monetary and macroprudential policy

The central bank is solely responsible for monetary policy. Monetary policy is realized by using a Taylor-type interest rate rule:

$$(1+r_t) = (1+r)^{1-\theta}R_t (1+r_{t-1})^{\theta R} \left( \frac{\phi_t}{\phi_{t-1}} \right) \left( \frac{\psi_t}{\psi_{t-1}} \right), \quad (22)$$
where $1 + r_t$ is the target *short-term nominal interest rate*, expressed as a function of the present policy rate and conforming to the smoothing component $\theta_R$ of the interest rate. Note that $\theta_\pi$ and $\theta_y$ reflects the relative weight of the output gap and inflation growth in the Taylor rule.

The macroprudential authority impose a countercyclical time-varying capital, fixed leverage requirement and caps on LTV ratios, that banks must consistently adhere to:

$$\gamma_t = \gamma + \omega\gamma \left( \frac{b_t}{y_t} - \frac{b}{y} \right),$$

(23)

$$m^l_t = m^l + \omega m \left( \frac{\rho b_t}{y_t} - \frac{\rho^l b^l}{y^l} \right),$$

(24)

where $\omega\gamma$ and $\omega m$ measures the reactiveness of each countercyclical macroprudential policy to existing credit gaps, $b_t = p^l b^l_t + p^l b^l$ denotes the market value of total bank credit.

### 3.6 Government

The government is assumed to be a benevolent social planner whose objective is to reduce the dynamic inefficiency caused by households oversaving and maximizing the overall welfare of the economy. Further, it is unable to commit to a long term fiscal plan and finance (exogenous) spending $g_t$ by issuing additional public bonds (i.e. public debt) $b_{t+1}^d = b^l_t + b^g_t$, the lump-sum taxes is denoted by $T_t$ (Grechyna, 2017). In accordance with Bi and Traum (2014) the government debt-to-GDP ratio can be expressed as $\partial_t = \frac{b^G_t}{y_t}$ and the probability of default is denoted by $\partial^*_t$. In the case of default, $\partial_t > \partial^*_t$ and the haircut rate $\Delta^G_t$ is applied.

Fiscal policy is chosen in each period, based on the inherited public debt and the state of the economy, which in turn defines the next periods policy choice, and so on (ibid.). The direction of policymaking is decided before households influence the variables they control. Hence, in any given period the optimal allocation of households
reflects the sensitivity to contemporaneous variations in fiscal policy. This effect of current fiscal policy on the anticipated future policy is considered in the government’s budget constraint that reads as follows:

\[ b^G_t = \left(1-\Delta^G_t\right)\frac{(1+r^G_{t-1})^h^G_{t-1}}{\pi_t} + \frac{(1+r^G_{t-1} - 1+r^G_{t-1})^{\text{int}}_{t-1}}{\pi_t} + g_t - T_t + \kappa b^{\text{int}}_{t-1} + \Xi_t, \quad (25) \]

where \( (1+r^G_{t-1} - 1+r^G_{t-1}) \) is the interest rate spread (i.e. the additional cost associated with issuing additional bonds \( h^{\text{int}}_{t-1} \)), \( \kappa b^{\text{int}}_{t-1} \) denotes the lump-sum transfer to patient households should government intermediation occur in the private sector, and

\[ \Xi_t = \Delta^G_t \frac{(1+r^G_{t-1})^h^G_{t-1}}{\pi_t} \] is the transfer made by the government such that sovereign default has no impact on the real debt level.

More specifically, taxes \( T_t \) is set according to a fiscal rule, which considers past taxes and public debt as follows:

\[ T_t = T_{t-1} + \xi_y \frac{h^I_{t-1}}{y_{t-1}}. \quad (26) \]

### 3.7 Equilibrium

Equilibrium conditions must satisfy the following equations.

The housing market clearing condition:

\[ 1 = h_t + h^I_t + h^E_t, \quad (27) \]

where \( h_t \) is patient households, \( h^I_t \) is impatient households and \( h^E_t \) entrepreneurs housing holding, that cumulatively represents total housing holdings in the economy.

Goods market clearing condition:

\[ y_t = c_t + c^I_t + c^E_t + I^E_t, \quad (28) \]

where \( y_t \) is the total output, \( c_t \) is patient households, \( c^I_t \) is impatient households \( c^E_t \) entrepreneur’s consumption. \( I^E_t \) is entrepreneurial investments.
and the loan market clearing condition:

$$0 = b_t + b_t^1 + b_t^E$$ (29)

where loan market clearing, requires that the risk-free private bonds of patient households, i.e., supply of loans equals the total demand of impatient households and entrepreneurs.

### 3.8 Policymaking Dilemma

An extensive part of this thesis is devoted to the claim that private debt, macroprudential policy, and fiscal policy are interrelated. To align the theoretical and forthcoming empirical framework, it is illustrated how the equilibrium conditions can be used to reduce the model to one dynamic linear equation with the three variables of interest. This allows us to assess how the interaction between the two policies influences private debt. In order to facilitate this analysis, the government budget constraint and loan market condition from equation (25) and (29) is used. For simplicity, government transfers in case of intermediation in the private sector or sovereign default are included as part of the aggregate fiscal policy toolkit.

To illustrate this, consider the following equations:

$$b_t^G = \frac{(1 + \gamma_t^G)b_t^G}{\tau_t} + \frac{(1 + \gamma_t^G - 1 + \tau_t)}{\tau_t}b_t^\text{int} + f_{P_t-1},$$ (30)

where the above equation demonstrates the relationship between interest rate spreads and the funding costs associated with expansionary fiscal policy $f_{P_t-1}$ represents the aggregate fiscal policy, expressed as $g_t - T_t$ in equation (25).\(^4\) In the current period the budget constraint is satisfied.

$$b_{t+1}^G = \frac{(1 + \gamma_{t+1})b_{t+1}^G}{\tau_{t+1}} + \frac{(1 + \gamma_{t+1} - 1 + \tau_{t+1})b_{t+1}^\text{int}}{\tau_{t+1}} + f_{P_t},$$ (31)

where $b_{t+1}^G$ is the government budget constraint in period $t + 1$. Assuming that fiscal policy is constant, the government now has to

\(^4\) The lump-sum transfer to patient households, $\kappa b_{t-1}^\text{int}$ and transfer in case of sovereign default, $\Xi_t$ are also included.
repay higher public debt. Therefore, following every increase in public debt, the government must to react by implementing contractionary fiscal policy.

\[ fp_t = \vartheta_d \varphi_t , \]  

(32)

where \( \varphi_t \) is the public debt (government debt-to-GDP ratio) in period \( t \).\(^5\) Fiscal policy is given by a fiscal rule reacting to public debt, parameter \( \vartheta_d \) denotes the reaction of government spending and taxes to changes in public debt.

The interrelation between private debt, macroprudential and fiscal policy can now be expressed as follows:

\[ fp_t = \zeta b_t + (\phi m_p \zeta b_t) \]  

(33)

where \( \zeta b_t \) denotes private debt. \( \phi m_p \) signifies the imposed aggregate macroprudential restriction as a response to changes in private debt.\(^6\)

Since the objective is to measure the relationship between private debt and the different parameters, equation (33) is rearranged:

\[ \zeta b_t = fp_t - (\phi m_p \zeta b_t) \]  

(34)

where the macroprudential authority responds to a rise in private debt by introducing time-varying capital requirement and/or fixed leverage requirement and caps on LTV ratios. In this case, aggregate macroprudential policy will reduce private debt and recapitalize banks, causing a decline in interest rate spreads. Furthermore, equation (34) also implies that deleveraging of private debt is reinforced by prudential fiscal policy. The nature of fiscal policy, in turn depends on the initial level of public debt. This leads us to the main hypothesis of this thesis:

*Private debt deleveraging is associated with greater use of macroprudential and prudential fiscal policies*

### 3.9 Summary and Predictions

\(^5\) \( \frac{(1+r_f^{t-1})\pi_t}{\pi_t} + \frac{(1+r_f^{t}-1+r_f^{t})\pi_t^{int}}{\pi_t} \) in equation (31).

\(^6\) The expression is obtained by simply adding equation (23) – (24).
The reduced model in the previous sub-section section derived some interesting results. The main finding is that macroprudential policy effectiveness in curbing private debt is reinforced if accompanied by prudential fiscal policy. In addition, the scope of fiscal policy is highly dependent on the initial level of public debt. This is analogous to Martin and Phillipon (2017) analysis, which states that larger build-ups of public debt tend to push interest rate spreads upwards and induce governments to substitute public debt for private debt, thereby undoing some benefits of macroprudential policy. In case of high public debt, macroprudential policy is optimally combined with prudential fiscal policy. The results are also in line with Carvalho and Castro, 2017, albeit for Brazil, an EM rather than AEs.

Although the findings from the model are interesting, they ought to be treated with a degree of caution before initiating the empirical analysis, as the model is unable to capture any country heterogeneity. Two predictions are drawn from the model that ties in with the stated hypothesis. First, the complementarity effect between macroprudential and fiscal policy is greater in countries that have a high initial level of public debt. Second, countries that consistently impose countercyclical fiscal policies are less likely to extensively use macroprudential policies to address private debt during booms.
4 Data

This section details the sources of the key variables and nature of the overall data sample. It commences by documenting the data for the private debt measure, as it dictates the sample size and the inclusion of countries. In what follows, the macroprudential policy data is carefully explained, as it involves a relatively novel survey process. Finally, the fiscal policy proxy measure and the control variables are defined, before presenting some stylized facts and limitations of the data.

4.1 Data Sources

4.1.1 Measuring Private Debt

Private debt data is retrieved from two sources: The Bank for International Settlements (BIS) and World Development Indicators (WDI) from the World Bank spanning from 2000 to 2013. BIS identify private debt by including borrowing from non-financial corporations, households and non-profit institutions serving households (BIS, 2017). The obtained series from the BIS includes 30 AEs and 8 EMs. As the data is quarterly based and particularly scare for EMs economies, two adjustments were made. First, data on private debt was modified to accord with the exogenous and control variables, such that it follows an annual structure. Second, since the retrieved BIS data excludes several EMs and Eurozone countries that joined the Economic and Monetary Union (EMU) after 2007, WDI data is supplemented. Importantly, both data sources rely on national statistical sources and measure private debt as a percentage of nominal GDP. The alignment of the two data series is therefore unlikely to provide any severe inconsistencies.

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7 The original series included 48 countries, but is restricted to 38 as this thesis focus on AEs and EMs.
8 This simply involved computing averages of the quarterly country data obtained from the BIS.
9 Including Estonia, Cyprus, Latvia, Lithuania, Malta, Slovakia, Slovenia, Bulgaria, Croatia, Ecuador, Iceland, Morocco, Peru, Philippines, Romania.
4.1.2 Measuring Macroprudential Policy

Data on macroprudential policy is obtained from the relatively novel Global Macroprudential Policy Instruments (GMPI) survey, which was carried out by the International Monetary Fund (IMF) in 2013-2014. The data is considered to be a suitable measure of macroprudential policy action, because it directly corresponds to information received from country authorities. The GMPI survey details a wide range of macroprudential instruments, 18 in total. Following Cerutti et al. (2017) the focus is on 12 of these instruments (see Table 1 for details). Since the aim of this thesis is to assess the optimal combined effect of macroprudential and fiscal policy usage on private debt in AEs and EMs, the final sample is constructed by collapsing the analysis into one aggregate index. The macroprudential index (hereafter MPI) is measured by using an indicator variable, where \( \text{ratify} \) equals to 1 if an instrument is being used during one year. Subsequently, the score of the 12 individual instruments is summarized to establish a baseline measure of policy use. Note that in constructing the MPI, the implicit assumption is that each instrument carry the same weight. Consequently, a greater summarized score of the index signifies larger use of macroprudential policies.
4.1.3 Measuring Fiscal Policy

The selection of the measure of fiscal policy is based on what the literature defines as the closest proxy for short-term effects and most likely to mirror the theoretical model. Cyclically adjusted primary balances (CAPB) as a percentage of potential GDP fulfil this function (Alesina and Ardagna, 2010), and the data is obtained from the IMF. This measure is defined as the difference between the overall fiscal balance including net interest payments, i.e. the fiscal
balance that would apply under current policies if actual output equals potential (ibid.). One advantage of this measure is that any changes in the overall fiscal balance is due to fluctuations in the business cycle is excluded. Further, the exclusion increases the likelihood of the overall fiscal balance changing due to discretionary policy and can be deemed the closest representations of a fiscal stimulus.

### 4.1.4 Control Variables

Related empirical literature points towards several country characteristics as conceivable determinants of private debt. To account for the occurrence of crises, a systemic banking crisis index from Laeven and Valencia (2013) database is included. Systemic banking crises are identified if (i) there are significant signs of financial distress within the banking system (e.g. bank runs and liquidations) and (ii) there are major government policy intervention due to damages in the banking system. In the pending empirical estimations, a simple indicator variable that takes on two values is added, depending on whether banking crises were present or not. The central bank policy rate from IMF’s International Financial Statistics (IFS) database is included to proxy the monetary policy rate. It is vital to note that the effect of monetary policy on private debt in the related literature is currently ambiguous (see Cizel et al. 2016). To test the robustness of our findings (see section 6), the prevalent exchange regime and the financial openness of countries are also accounted for. Specifically, Ilzetski et al. (2017) exchange rate index is included, which enables the estimation of de facto exchange regimes. While Chinn and Ito (2006) financial openness index describe the nature and magnitude of regulation on external account transactions.

### 4.2 Stylized Facts

The final sample consists of 30 AEs and 19 EMs (see Table 2) from 2000 to 2013. Table 3 presents the summary statistics for the variables of interest and control variables, for which Panel A refers to

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10. The cyclicity arising from automatic stabilizers is attenuated.
11. If not available, discount factors or repurchase agreements are used (also from the IFS).
AEs and Panel B EMs (henceforth also for figures). To enable comparisons between the two sub-groups and aid the interpretation of findings in forthcoming sections, the 25%, 50% and 75% percentiles are included. In general, AEs on average demonstrate considerably higher private debt growth compared to EMs, ranging from 145.6 to 80.6%. As expected the largest variation is found in the CAPB variable (henceforth fiscal policy). In particularly, this is evident for EMs with a mean value of 1.16% that is notably larger than the median (0.4%) and reflects the relationship between fiscal policy and output volatility. The other main variable of interest, i.e. MPI, shows greater mean values of instrument usage in EMs (2.29%) than in AEs (1.20%), indicating greater use of macroprudential policies in the former.

<table>
<thead>
<tr>
<th>Table 2: Country selection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advanced economies</strong></td>
</tr>
<tr>
<td>Australia</td>
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<tr>
<td>Austria</td>
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<tr>
<td>Belgium</td>
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<tr>
<td>Canada</td>
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<td>Cyprus</td>
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<td>Czech Republic</td>
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<td>Estonia</td>
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<td>Finland</td>
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<td>France</td>
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<td>Germany</td>
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<td>Hong Kong</td>
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<td>Ireland</td>
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<td>Israel</td>
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<td>Italy</td>
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<tr>
<td>Japan</td>
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<tr>
<td>Republic of Korea</td>
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<td>Latvia</td>
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<td>Malta</td>
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<td>Netherlands</td>
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<tr>
<td>New Zealand</td>
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<td>Norway</td>
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<td>Portugal</td>
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<td>Singapore</td>
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<td>Slovakia</td>
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<td>Slovenia</td>
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<tr>
<td>Spain</td>
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<tr>
<td>Sweden</td>
</tr>
<tr>
<td>Switzerland</td>
</tr>
<tr>
<td>United Kingdom</td>
</tr>
<tr>
<td>United States</td>
</tr>
</tbody>
</table>
A first visual overview (see figure 1) using the raw data of the relationship between the cumulative use of macroprudential policies (MPI) and private debt aligns with inferences derived from the summary statistics. AEs experienced faster private debt growth throughout the entire period of study but peaked with the GFC in 2009. In EMs private debt developments have been comparatively modest and abruptly declined after the GFC, before rising again. The overall suggestion is that the use of macroprudential policies has risen in response to increase in private debt in both sub-groups and especially after the GFC. Aggregate use of policies has been greater in EMs, which is hardly surprising given that less developed countries face greater exposure to financial risk and have less robust financial systems (Kuttner and Shim, 2016). The more prominent use of macroprudential policies in these countries could also be due to the trade-off associated with contractionary monetary policy. Such trade-offs include the intensifying of volatile capital inflows and currency appreciation further aggravating already fragile financial systems (Akinci et al. 2015).\footnote{It may also explain the recurrent use of RR_REV and FC instruments.} The rising trend in policy use for AEs on the other hand, may reflects efforts to lessen the impact of adverse developments within the financial system on the real economy (Galati and Moessner, 2011). One important element that has not

\begin{table}[h]
\centering
\caption{Summary Statistics}
\begin{tabular}{|l|c|c|c|c|c|c|}
\hline
Panel A: Advanced Economies & Mean & Std. & Pct.25 & Pct.50 & Pct.75 & N \\
\hline
Private debt growth (%) & 145.6 & 56.01 & 117.9 & 150.3 & 181.9 & 420 \\
MPI index (0-12) & 1.202 & 1.262 & 0 & 1 & 2 & 420 \\
CAPB (%) & -0.462 & 3.556 & -2.235 & -0.142 & 1.270 & 420 \\
Monetary Policy (%) & 1.718 & 2.434 & -0.0667 & 0.300 & 3.250 & 420 \\
Crisis (dummy 0-1) & 0.214 & 0.411 & 0 & 0 & 0 & 420 \\
Chinn-Ito Openness (index) & 0.926 & 0.178 & 1 & 1 & 1 & 420 \\
Exchange Rate Regime (index 0-8) & 2.690 & 3.584 & 0 & 2 & 3 & 420 \\
\hline
Panel B: Emerging Market Economies & Mean & Std. & Pct.25 & Pct.50 & Pct.75 & N \\
\hline
Private debt growth (%) & 80.67 & 50.02 & 42.80 & 60.92 & 112.8 & 265 \\
MPI index (0-12) & 2.287 & 1.995 & 1 & 2 & 4 & 265 \\
CAPB (%) & 1.157 & 4.817 & -1.942 & 0.397 & 3.095 & 265 \\
Monetary Policy,(%) & 7.303 & 12.80 & 3.250 & 5.400 & 8 & 265 \\
Crisis (dummy 0-1) & 0.215 & 0.412 & 0 & 0 & 0 & 265 \\
Chinn-Ito Openness,(index) & 0.375 & 1.319 & -1.195 & 0.0180 & 1.341 & 265 \\
Exchange Rate Regime (index 0-8) & 5.608 & 5.687 & 2 & 4 & 6 & 265 \\
\hline
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\caption{Macroprudential Instruments}
\begin{tabular}{|l|c|c|}
\hline
Instrument & Overall & Advanced & Emerging \\
\hline
LTV CAP & 20 & 22 & 17 \\
DTI & 16 & 8 & 27 \\
DP & 9 & 3 & 17 \\
CTC & 0 & 0 & 0 \\
LEV & 8 & 8 & 8 \\
SIFI & 1 & 1 & 2 \\
INTER & 28 & 21 & 38 \\
CONC & 55 & 43 & 71 \\
FC & 8 & 5 & 13 \\
RR REV & 4 & 0 & 10 \\
CG & 4 & 0 & 9 \\
TAX & 12 & 0 & 18 \\
Borrower-targeted & 29 & 24 & 35 \\
Financial institution-targeted & 65 & 53 & 82 \\
\hline
\end{tabular}
\end{table}
enjoyed much attention in the literature is how the continuous low interest rate environment has limited the range of monetary policy and covertly contributed to raising the propensity to exercise macroprudential policies (Orsmond and Price, 2016).
In terms of the type of instruments implemented, some degree of homogeneity exists between the two sub-groups (see Table 4). Concentrations limits (CONC) and limits on interbank exposure (INTER) is used in approximately 55 and 28% of the included countries, within the selected time period. Loan-to-value ratio (LTV) caps provide on exception, as it has been applied more often in AEs. This echoes the previously alluded greater vulnerability in housing sectors, related to more developed and larger mortgage markets. Contrary to AEs, EMs stand for the only implementation of FX and/or Countercyclical Reserve Requirements (RR_REV), limits on foreign currency loans (FC), limits on domestic currency loans (CG) and levy/tax on financial institutions (TAX). Enactment of these instruments reveals the concerns of systemic risk arising from large and volatile capital flows.

Figure 1 Private Debt % GDP and MPI 2000-2013.
As regards to fiscal policy (see figure 2), the first point to take away is that budget deficits (CAPB) are constantly greater in AEs. However, prior to the GFC, deficits in EMs have regularly increased at a faster pace in EMs prior to the GFC and declined more sluggishly after. The declining trend in budget deficits in both sub-groups since the GFC concur with Leigh et al. (2017) suggestion that contractionary fiscal policy in AEs are at least as likely to occur during downturns as in booms. For instance, the peripheral countries during the recent European sovereign debt crisis demonstrated that economic growth to some extent was fuelled by structural laxity and credit expansion (Abbas, 2011).

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Overall (%)</th>
<th>Advanced (%)</th>
<th>Emerging (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTV_CAP</td>
<td>20</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td>DTI</td>
<td>16</td>
<td>8</td>
<td>27</td>
</tr>
<tr>
<td>DP</td>
<td>9</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>CTC</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LEV</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>SIFI</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>INTER</td>
<td>28</td>
<td>21</td>
<td>38</td>
</tr>
<tr>
<td>CONC</td>
<td>55</td>
<td>43</td>
<td>71</td>
</tr>
<tr>
<td>FC</td>
<td>8</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>RR_REV</td>
<td>4</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>CG</td>
<td>4</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>TAX</td>
<td>12</td>
<td>0</td>
<td>18</td>
</tr>
</tbody>
</table>

Borrower-targeted 29 24 35
Financial institution-targeted 65 53 82
The first core aspect from the raw data is the juxtaposition of private debt and budget deficits continuously being greater in AEs, although rising at a greater pace in EMs before the GFC and declining relatively slower after. The second aspect is that the aggregate use of macroprudential policies is still greater in EMs but increasing faster.
in AEs. This variation, between the two sub-groups in the above presented summary statistics, included figures and tables create a clear delineation between the use of macroprudential and fiscal policies to address growth in private debt. Moreover, the different distribution of private debt and the degree of macroprudential and fiscal policy use provides support for the decision to study AEs separately from EMs. For this reason, aggregate analysis of the relationship between policy use and private debt is excluded from this thesis.

4.3 Limitations

The data suffers from three notable limitations. One potential shortcoming in our data collection is that some included countries in our overall sample are missing one or more years of data for the monetary and fiscal policy indicator. To address this concern, an arbitrary threshold is set to 6 years of missing data. Countries unable to fulfill this requirement are excluded. Linear interpolation is used to estimate the remaining missing information and assumes that monetary and fiscal policy in the missing period is the mean of the previous and subsequent year.

Another drawback is that the created MPI incapability to capture the intensity of policy actions and heterogeneity across countries. As an example, LTV caps are instruments that vary in their degree of implementation, in some countries they only cover households second mortgage and in other all of them (Reinhardt and Sowerbutts, 2015). The intensity of financial institution-targeted instruments (e.g. capital requirements) likewise is difficult to evaluate, because risk weights differ between countries. There are examples of literature that abstain from using the indicator variable approach (see e.g. Baker, 2013), which in theory offers a more comprehensive approach. Yet, de facto similar instruments are found to greatly differ in terms of intensity and results do not significantly deviate from the prevailing literature. Since the differences between the two empirical methods are expected to be trivial and the objective of this thesis is to assess the overall impact of macroprudential policy on private debt, it refrains from focusing on the intensity of individual instruments.
Finally, the fiscal policy indicator has two limitations. The first issue relates to empirical estimates becoming biased towards finding evidence of non-Keynesian effects (see e.g. Afonso and Jalles, 2014). The indicator could likewise suffer from reverse causality, as governments tend to purposely respond to accelerating growth in domestic demand, inflation and growing current account deficits by using contractionary fiscal policy (Morris and Schuknecht, 2007). To the extent that such economic booms are linked to current account deficits, they are accounted for in forthcoming regressions by the error term (Bluedorn and Leigh, 2011). In addition, any reverse causality from fiscal policy responding to economic developments would be reflected in the correlation between the regressor (i.e. fiscal policy indicator) and the error term. Whilst it cannot be claimed that the issue of reverse causality has been fully remedied, the use of DPD models go a long way of mitigating some of these discussed issues.
5 Empirical Strategy

5.1 Baseline regression equation

The static specification in equation (34) in section 3 is transformed into a DPD model by including the lagged dependent variable in the set of explanatory variables to account for time persistency and serial correlation over time.

The baseline equation is specified as follows:

\[ Y_{i,t} = \alpha Y_{i,t-1} + \beta (\text{MPI}_{i,t-1} \ast \text{Fp}_{i,t-1}) + \gamma \text{MPI}_{i,t-1} + \delta \text{Fp}_{i,t-1} + \delta X_{i,t-1} + \eta_i + \epsilon_{i,t} \quad (35) \]

where \( i \) and \( t \) index country and time period (\( i = 1, \ldots, I \) and \( t = 1, \ldots, T \), respectively; \( Y_{i,t} \) is the total private debt; the interaction term \( \text{MPI}_{i,t-1} \ast \text{Fp}_{i,t-1} \) measures the impact of fiscal policy on the behaviour of macroprudential policy. \( X_{i,t-1} \) is a set of country level controls; \( \eta_i \) is the country fixed effect, which considers non-time varying country specific conditions such as the level of economic and financial development and \( \epsilon_{i,t} \) denotes the stochastic error term that captures the effect of all omitted variables. The MPI is lagged by one year, as an immediate impact cannot be expected from adopting these policies. Lagging the controls also mitigate the possibility of simultaneity for when macroprudential policies impact real economic activity. The key hypothesis that is examined is whether \( \beta < 0 \) fiscal policy tightening reinforces macroprudential policy tightening. Table 5 details the regression variables.
Table 5: Regression Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Debt</td>
<td>Annual growth (%)</td>
<td>BIS Total Credit to Private non-financial sector where available, otherwise World Bank WDI.</td>
</tr>
<tr>
<td>MPI index</td>
<td>Macroprudential policy indicator (0 -12)</td>
<td>IMF, GMPI Survey.</td>
</tr>
<tr>
<td>Fiscal Policy</td>
<td>Cyclically adjusted primary balance (%)</td>
<td>IMF.</td>
</tr>
<tr>
<td>Monetary Policy</td>
<td>Monetary policy rate (%)</td>
<td>IFS Central Bank Policy Rate if available, otherwise Discount Rate or Repurchase Agreement</td>
</tr>
<tr>
<td>Openness</td>
<td>Index</td>
<td>Chinn-Ito (2006), higher value corresponds to greater financial openness.</td>
</tr>
<tr>
<td>Exchange Rate Regime</td>
<td>Index (0-8)</td>
<td>Ilzetzki et al.(2017), higher value corresponds to greater exchange rate flexibility.</td>
</tr>
</tbody>
</table>
6. Results

In this section the main focus is on the system GMM estimates, but OLS estimates are first reported. This is despite suspecting that OLS estimates are endogenous, which could arise from the existence of measurement errors, omitted variable bias, reverse causality and simultaneity.

6.1 Preliminary Results

Table 6 reports the OLS estimations. The specified regression equation (35) is estimated for each sub-group, excluding the country fixed effect. Columns (1) and (2) is estimated without the interaction term, but includes the control variables that have been regularly used in the literature. In Columns (3) and (4) the interaction term is included. The coefficient sign for the MPI is distinctive between the two country sub-groups. The MPI is positive and have an insignificantly effect on private debt in AEs. In EMs the effect is similarly insignificant but larger and negative. Differences are also found in terms of fiscal policy. The relationship between the fiscal policy indicator and private debt is not statistically significant. However, the coefficients have the sign expected from the theory, with AEs being more likely to run countercyclical fiscal policy in response to private debt.

Overall, the chosen controls demonstrate mixed results in explaining changes in private debt. The effect of experiencing a banking crisis is surprisingly positive, although insignificantly associated with private debt in both sub-groups, which diverge from recent empirical findings (see e.g. Cerutti et al.2017, Reinhardt and Sowerbutts 2015). Similarly, to Cizel et al. (2016) findings, the relationship between private debt and monetary policy is ambiguous, albeit insignificant. The coefficient sign for both AEs and EMs is positive but the size is greater in the former. Finally, in both country sub-groups lagged private debt is positive and highly significant. A one percent rise in lagged private debt is associated with a 1.02 and 1.01 increase in private debt. This signifies some level of persistence in private debt developments.
The inclusion of the interaction term still reports insignificant results for all other coefficients. However, the interaction term itself is positive and significant for AEs, a one percent rise in macroprudential and fiscal policy use is associated with a significant 0.27 percentage point increase in private debt. This goes against the key hypothesis; by signifying that fiscal policy tightening reduces the effectiveness of tightened macroprudential policy and vice versa (i.e., $\beta > 0$). The opposite insignificant relationship is found for EMs, with a one percent rise in in the interaction term leading to a -0.060 decrease in private debt. Nevertheless, note that the coefficient signs for the controls in EMs are now consistent with theory predictions.

The above-presented evidence does not follow many of the results from previous empirical literature and may indicate that OLS estimates are biased and suffer from endogeneity (see section 6.2 for more detailed discussion). This necessitates the adoption of a cautious interpretation of these and forthcoming evidence. Moreover, it requires a careful assessment of the OLS estimator appropriateness, which will be carried out in the next sub-section.

Table 6: Preliminary Results – Ordinary least squares (OLS) estimates

<table>
<thead>
<tr>
<th>Dependent Variable: Private Debt</th>
<th>(1) Advanced</th>
<th>(2) Emerging</th>
<th>(3) Advanced</th>
<th>(4) Emerging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Debt</td>
<td>1.015***</td>
<td>1.010***</td>
<td>1.013***</td>
<td>1.011***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.009)</td>
<td>(0.007)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>MPI * Fiscal Policy</td>
<td></td>
<td></td>
<td>0.266**</td>
<td>-0.060</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.108)</td>
<td>(0.067)</td>
</tr>
<tr>
<td>MPI</td>
<td>0.074</td>
<td>-0.169</td>
<td>0.193</td>
<td>-0.124</td>
</tr>
<tr>
<td></td>
<td>(0.284)</td>
<td>(0.209)</td>
<td>(0.286)</td>
<td>(0.215)</td>
</tr>
<tr>
<td>Fiscal Policy</td>
<td>0.088</td>
<td>-0.143</td>
<td>-0.184</td>
<td>-0.060</td>
</tr>
<tr>
<td></td>
<td>(0.113)</td>
<td>(0.095)</td>
<td>(0.157)</td>
<td>(0.132)</td>
</tr>
<tr>
<td>Crisis</td>
<td>1.241</td>
<td>0.529</td>
<td>1.255</td>
<td>0.564</td>
</tr>
<tr>
<td></td>
<td>(0.990)</td>
<td>(1.131)</td>
<td>(0.983)</td>
<td>(1.132)</td>
</tr>
<tr>
<td>Monetary Policy</td>
<td>0.146</td>
<td>0.008</td>
<td>0.174</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>(0.161)</td>
<td>(0.066)</td>
<td>(0.161)</td>
<td>(0.066)</td>
</tr>
<tr>
<td>Countries</td>
<td>30</td>
<td>19</td>
<td>30</td>
<td>19</td>
</tr>
<tr>
<td>Observations</td>
<td>390</td>
<td>246</td>
<td>390</td>
<td>246</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.985</td>
<td>0.984</td>
<td>0.985</td>
<td>0.984</td>
</tr>
</tbody>
</table>

Notes: All the variables are lagged one period. Estimates in Column (3) and (4) includes the interaction term between the MPI index and Fiscal Policy. Country fixed effects are excluded. Robust standard errors clustered by country are in parentheses.

*** Significant at the 1
** Significant at the 5
* Significant at the 10
6.2 Identification Restrictions

The obtained results in Table 6 raise two important caveats. First, as previously discussed the lagged dependent variable that appear on the right-hand-side (RHS) of equation (35) is likely to be correlated with the error term $\varepsilon$, and hence the OLS estimator render biased and inconsistent estimates (Cameron and Trivedi, 2009). Second, it is conceivable that macroprudential policies could be implemented after the peaking of the private debt cycle (Fendoglu, 2017).

In this regard, causality may well run from the interaction term to private debt. By not addressing this issue, one assumes that causality flows from private debt. This could yield attenuation bias, since private debt is expected to lessen with the enactment of macroprudential policies. Following Baltagi (2013) several steps are taken to mitigate these issues (see Appendix B for details).

The difference GMM estimator offers a viable option, by using the lagged values of the RHS variables as instruments for their change. Although this estimator remove any potential bias from country fixed effects and allows control for endogeneity and measurement error, the previous alluded time persistence in private debt is a notable shortcoming. Therefore, applying the first difference eliminates most of the variation within the data, and suggest that the lagged levels of the exogenous variables are weak instruments for the variables in differences, resulting in biased and imprecise estimates (Cameron and Trivedi, 2009).

Blundell and Blond (1998) demonstrate that the system GMM estimator leads to more consistent and efficient parameter estimates, while its asymptotic finite sample properties are superior to the difference GMM estimator. The drawbacks with asymptotic efficiency improvements from additional orthogonality conditions is that the number of GMM instruments tend to rise exponentially with the number of time periods in the sample. This exponential rise in instruments could possibility lead to finite sample bias from overfitting the endogenous variables, which in turn increases the likelihood of results becoming false positive and suspiciously high pass rates of specification tests (Baltagi, 2013). However, given the properties of the retrieved data (small $T$ and large $N$) the system

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13 The relationship between private debt and the interaction term may also be driven by foreign banks fuelling substantial debt, which may ratify policy action.
GMM estimator is valid, conditional on the assumption that $\Delta \epsilon_{i,t}$ are serially uncorrelated and the GMM instruments (i.e. the lagged differences) exogeneity to the error term in the level equation. To test for serial correlation in $\Delta \epsilon_{i,t}$ an Arellano-Bond test is employed, which has a null hypothesis of no autocorrelation.$^{14}$ The validity of the instruments can be tested using the Hansen (1982) J-test, failure to reject the null hypothesis indicates that the instruments are valid (Roodman, 2009).$^{15}$ For all specification tests a 5% threshold is set for the p-values. As a rule of thumb the number of instruments should also not exceed the number of groups (i.e. countries). Following Roodman (2009b) results from the collapsed instrument matrix is presented in the subsequent section.

To summarizes, the proposed system GMM estimator offers several advantages to OLS estimators, which is believed to yield more consistent estimates. The first concern of endogeneity is simply removed by applying first difference of equation (35). The second concern is addressed by including lagged level variables to avoid contemporaneous feedback between private debt and the exogenous variables.

6.3 Baseline Results

Table 7 demonstrates the main empirical findings from using the system GMM estimator. Boiled down the coefficient sign for the interaction term in AEs and EMs indicate two opposing effects and concur with theoretical predictions (i.e. positive and negative), with a smaller outcome found in the latter. Nevertheless, it is critical to underline the limitations of the presented evidence. Specifically this

$^{14}$The null hypothesis of the first-order autocorrelation test is $H_0: \text{cov} \{\Delta \epsilon_{i,t}, \Delta \epsilon_{i,t-1}\} = 0$. Note, that we usually expect to reject the $H_0$, as $\text{cov} \{\Delta \epsilon_{i,t}, \Delta \epsilon_{i,t-1}\} = \sigma^2_{\epsilon_{i,t}} \neq 0$. However, if residuals are uncorrelated, it is still expected that first difference are correlated, making the AR(2) much more important for the overall validity of the model. For the second-order autocorrelation test $H_0: \text{cov} \{\Delta \epsilon_{i,t-1}, \Delta \epsilon_{i,t-2}\} = 0$ is that residuals are serially uncorrelated. Failure to reject the null hypothesis, such that $\text{cov} \{\epsilon_{i,t}, \epsilon_{i,t-1}\} = 0$ implies that all $\epsilon_{i,t}$ is first-order serially correlated. All $Y_{i,t-s}$ for $s \geq 2$ are valid instruments for $\Delta Y_{i,t}$ in equation (37), and all $Y_{i,t-s}$ for all $s \geq 1$ are valid instruments for $Y_{i,t-1}$ in equation (35).

$^{15}$Asymptotically distributed as $\chi^2$, the Hansen statistics test the null hypothesis of overidentifying instruments validity. The Hansen statistic’s is preferred to the Sargan test as it is not robust to heteroscedasticity.
relates to the insignificance of the interaction term in both country sub-groups. This imply that the observed relationship with private debt could have been due to chance, and thus the evidence of the combined effect from the policies is not conclusive.

The MPI illustrate some notable differences to findings encountered using the OLS estimator. Baseline estimates find that the use of macroprudential policies is negative and significant in AEs. The effect is also larger than for EMs, a one percent rise in macroprudential policies is associated with a -0.17 decrease in private debt. This economic effect is somewhat surprising, particularly since the descriptive evidence (see section 4.2) suggested that EMs rely more heavily on macroprudential policies. Analogous to Columns (3) and (4) in Table 6, the fiscal policy indicator coefficient signs are in line with the predicted theory, but remain insignificant.

In terms of the controls variables, some interesting results are established. The occurrence of a banking crisis has a more profound positive and significant effect on AEs (1.47) than in EMs (1.13), which is unexpected bearing in mind the latter’s more fragile financial systems. Klein (2016) argue that this can be explained by some countries undergoing a sharp shift from leveraging to deleveraging during the recent GFC, while others are still experiencing an increase in private sector borrowing relative to income. Hence, one shortcoming of the empirical framework may be that the crisis index and private debt developments is not perfectly synchronized. The monetary policy indicator is positive and significant in both AEs (0.47) and EMs (0.05) but akin to OLS estimates considerable more important in explaining rises in private debt in the former. Finally, the lagged private debt coefficient is now greater in AEs (1.10 to 1.08), consistent with private debt developments in these countries being less exposed to the financial market volatility experienced in EMs.

Also noteworthy is that the specification tests in rows 8, 9 and 10 in both columns support the assumptions made in the previous subsection. As expected the null hypothesis of the Arellano-Bond AR(1) test for autocorrelation of the residuals is rejected, since first differencing generate autocorrelation of order 1. The Arellano-Bond test for AR(2) fails to reject the null hypothesis, ratifying the assumption of uncorrelated errors in the levels equation and that the specification is correct. In addition, the Hanson J test for
overidentified restrictions fails to be rejected, indicating the validity of the GMM instruments. The collapsed matrix has also ensured that the rendered estimates follow the advised rule of thumb for instruments. All in all, this infers that the system GMM estimator represents an improvement over the OLS specification.

### Table 7: Baseline Results – System generalized method of moments (System GMM) estimates

<table>
<thead>
<tr>
<th>Dependent Variable: Private Debt</th>
<th>(1) Advanced</th>
<th>(2) Emerging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Debt</td>
<td>1.095***</td>
<td>1.078***</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.045)</td>
</tr>
<tr>
<td>MPI * Fiscal Policy</td>
<td>0.206</td>
<td>-0.106</td>
</tr>
<tr>
<td></td>
<td>(0.205)</td>
<td>(0.113)</td>
</tr>
<tr>
<td>MPI</td>
<td>-1.708**</td>
<td>-0.371</td>
</tr>
<tr>
<td></td>
<td>(0.854)</td>
<td>(0.577)</td>
</tr>
<tr>
<td>Fiscal Policy</td>
<td>0.270</td>
<td>-0.078</td>
</tr>
<tr>
<td></td>
<td>(0.386)</td>
<td>(0.320)</td>
</tr>
<tr>
<td>Crisis</td>
<td>1.469**</td>
<td>1.129*</td>
</tr>
<tr>
<td></td>
<td>(0.617)</td>
<td>(0.602)</td>
</tr>
<tr>
<td>Monetary Policy</td>
<td>0.472**</td>
<td>0.050*</td>
</tr>
<tr>
<td></td>
<td>(0.213)</td>
<td>(0.029)</td>
</tr>
<tr>
<td>Instruments</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.009</td>
<td>0.065</td>
</tr>
<tr>
<td>AR(2)</td>
<td>0.121</td>
<td>0.206</td>
</tr>
<tr>
<td>Hansen J test (p-value)</td>
<td>0.470</td>
<td>0.979</td>
</tr>
<tr>
<td>Countries</td>
<td>30</td>
<td>19</td>
</tr>
<tr>
<td>Observations</td>
<td>390</td>
<td>246</td>
</tr>
</tbody>
</table>

*Notes: All the variables are lagged one period and includes the interaction term between the MPI index and Fiscal Policy. Country fixed effects are included. The standard errors, presented in the parentheses are clustered by country, are robust and corrected according to Windmeijer (2005).*

### 6.4 Robustness

Several robustness checks are carried to test the validity of the empirical findings, including using alternative samples and specifications (see Appendix C for tables).\(^\text{16}\) First, the assumption of instruments in the MPI carrying the same weight is checked for robustness. Next, the baseline specification is further altered by

\(^{16}\) Note also that the crisis index was excluded but lead to no alterations from the previous findings.
including additional control variables to assess whether there are other factors that could influence private debt.

6.4.1 Alternative samples

The baseline specification and particularly the MPI is based on the previous stated assumption (see 4.1.2) of instruments carrying the same weight. Recall also that the chosen set-up of using an aggregate measure refrains from capturing the intensity of individual instruments. This is despite the prospect that some instruments has a more profound impact on private debt than others. Hence, it is worthwhile to slice the MPI into individual measures to explore the sensitivity of the empirical findings. The first exercise involves the inclusion of all the individual measures in the baseline specification to assess whether any of these should be ascribed a different weight to 1.\textsuperscript{17} Table 8 presents the first set of robustness checks. The results are unchanged from only including the aggregate measure. The two exceptions is the LTV and DTI measures. The significant results for LTV caps in EMs is particularly surprising given that the descriptive evidence demonstrated larger use in AEs. The TAX instrument is the only other measure that enters significantly, but note that the instrument total (i.e. violates the advised rule of thumb) and the Hansen J test raise some concern of the overall validity of these results, with a very unusual high pass rate. Hence, following Akinci and Olmstead-Rumsey (2015), the robustness of the results in the previous section are further tested by using a Wald exclusion test (F-test for joint significance). The aim is to observe if any individual measure ought to be included in the baseline regression equation\textsuperscript{18}. In Table 9 the exclusion test null hypothesis of equal weight across these measures cannot be rejected, which validates the use of an aggregate index.

6.4.2 Alternative model specification

Another concern with the obtained system GMM results is that the interaction term may still proxy for some unobserved heterogeneity. The interaction term could simply be too crude to adequately capture asymmetries between AEs and EMs. To assess the merits of this

\textsuperscript{17} The interaction term is excluded in this case, as the aim is only to test the robustness of the macroprudential measure.

\textsuperscript{18} In this table the aggregate measure is excluded.
statement, the baseline specification is augmented by adding two additional controls. These controls include an exchange rate classification index constructed by Ilzetzki et al. (2017) and a de jure measure of financial openness from Chinn and Ito (2006). Higher values for each measure correspond to greater exchange rate flexibility respectively openness. In all instances, Table 10 illustrates that the key interaction term is robust to the inclusion of the two country characteristics. The interaction between the MPI and prevailing exchange rate is positive for both sets of country groups. Put differently, flexible exchange rate regimes and thus more open economies have an overall tendency to intensify private debt growth. Indeed, the fact that the financial openness measure enters positively seem to support the theory of greater openness raising private debt. The only surprising aspect of the findings, is that the coefficient on the exchange rate regime is lesser in EMs, since these countries are in general more vulnerable to volatile capital inflows.
7 Discussion

Overall, the empirical analysis do not support the hypothesis of macroprudential and fiscal policies reinforcing each other in deleveraging private debt. Although these findings are insignificant, the estimated coefficients measuring the combined impact of macroprudential and fiscal policy on private debt vary in sign and magnitude across the two country sub-groups, from positive 21 percent to negative 11 percent. This implies that the effect is mixed and necessitate more diligent assessments, with a narrower scope.

As aforementioned, the findings could also reflect two opposing effects of policy interaction. Macroprudential authorities in countries with larger fiscal space and greater scope to use countercyclical fiscal policies may be reluctant to lessen the tightening of policies during downturns. This reluctance could emerge from expansionary fiscal policies reinforcing the efficiency of macroprudential policies and consequently private debt deleveraging. Whilst in countries with smaller fiscal space, a transition towards more prudential fiscal policies could reinforce macroprudential policies and efforts to deleverage private debt. Yet from a historical standpoint the tightening of macroprudential and fiscal policies in booms have often been disliked by market participants and become politically unpopular. Moreover, since governments are more concerned with realizing employment objectives they could ignore these needs for tightening (Villaverde et al. 2013). The suggestion is that this provides severe obstacles to policymakers implementation of prudential policies, causing bias in their actions and sub-optimal outcomes for financial stability.

In case of governments prioritizing employment targets during booms, the build-up of public debt could have two opposed effects on the efficiency of macroprudential policies and thus private debt deleveraging. There are instances of implemented macroprudential policies causing declines in private leverage, bank recapitalization and reducing interest rate spreads. However, larger public debt may also lessen the impact of macroprudential polices by inducing governments to substitute public debt for private debt to achieve the employment target (Martin and Phillipon, 2017). The existing variation between countries prevalent policy regime, financial systems
and overall economic landscape can therefore go a long way towards explaining the absence of a comprehensive effect in this thesis.

Additionally, this thesis uses CAPB data, which according to the related empirical literature is the primary proxy for fiscal policy and closest emulates the theoretical framework. Although this measure benefits, it hardly corresponds to direct changes in fiscal policies. In actuality, the use of different fiscal policies may have a more non-linear effect on macroprudential policies and hence private debt developments, thereby hindering the ability to capture the real effect. This provides difficulties in drawing any firm conclusions of whether fiscal policies reinforce or reduce the effectiveness of macroprudential policies in private debt deleveraging. Future studies ought to directly model fiscal policies, to better interpret the effects. One such alternative measures, which was beyond the scope of this thesis is the European System of Central Banks (ESCB) dataset (see e.g. Agnello and Cimadomo, 2012; Attinasi and Klemm, 2014). The measure directly corresponds to legislative and budgetary fiscal policy changes and may better reflect the use of fiscal policies.

The sequential smoothing of the private debt, fiscal policy and monetary policy indicators are also likely to downward bias the obtained estimates. There is obviously an element of limitation in linearly interpolating the missing data. In particularly, as it raises the possibility of under or overestimating the variability in these measures. The short-time period of the retrieved data also reduces the accuracy of interpolation, since there is less variation in the data. While this issue was partly mitigated by setting an arbitrarily threshold for the number of years that could be interpolated, it cannot be claimed that the problem has been fully remedied and therefore it remains a limitation.

It is worth assessing these findings within the context of the non-exhaustive related literature. The findings for EMs build on the literature, which advocate that the optimal policy combination of macroprudential and fiscal policy to ensure financial stability, is for both to be countercyclical in the business cycle. Put differently, an increase in government spending crowds out private capital investments during a downturn, thereby reducing the demand for commercial loans and leading to a fall in private debt (Carvalho et al. 2017).
The findings also builds on Martin and Phillipon (2017) empirical investigation of how Eurozone countries would have fared with a different set of policies. It is important to stress that in this study, the ideal implementation of policies (i.e. macroprudential policies with prudential fiscal policies), specifically relate to the AEs in the Eurozone (e.g. Greece, Spain and Portugal) that suffered the most during the sovereign debt crisis. Yet, the indication is that these countries did not suffer by virtue of merely being AEs, but rather their respective governments inability to uphold a countercyclical fiscal policy stance. This possibly clarifies why other Eurozone countries (e.g. Austria, Finland) did not experience similar rises in private debt and the resulting decline in financial stability.

The presented clarification in tandem with the previously stated empirical literature on fiscal policy could possibly signify the positive coefficient for AEs in the empirical findings. There may, however, be an alternative explanation of the results, specifically related to the literature that find that government spending multipliers is positively related to private indebtedness. Section 4 stylized facts suggested that AEs on average have higher private debt than EMs. Bernardini and Peersman (2015) find that in high private debt states government spending multipliers are significantly greater than one, and occasionally reaches values above three. This results from the crowding in effect on private consumption and investment. Moreover, in high private debt states an expansionary fiscal policy shock results in a larger decline in public and private debt. Hence, the high private debt levels for AEs in Southern European countries may have amplified the distortionary effect of austerity measures (i.e. large-scale fiscal consolidations) on private consumption and GDP during the sovereign debt crisis and increased solvency problems (Klein, 2016). Contrary, austerity measures implemented in countries with low debt states, such as EMs have no distortionary effect on private consumption and GDP.

From the above discussion three arguments can be made. First, expansionary fiscal policies crowding in effect is greater in periods of private debt overhang, while the opposite hold in times of low private debt. Second, the indication is that AEs optimally combine the tightening of macroprudential polices with expansionary fiscal policies. While EMs benefit from policy coordination such that fiscal policy countercyclically react to countercyclical macroprudential policies. Finally, the short-run trade-off between economic growth
and financial stability is likely to be narrowed if these policy coordination arrangements hold.

In summary, the potential implications of this thesis are interesting, but it is essential to reiterate that the results presented here, inability to establish conclusive evidence of macroprudential and fiscal policy interaction effect on private debt outcomes. However, within the context of the related literature, the findings align with theoretical predictions and indicate that further research ought to consider the role of the interaction of these two policies in establishing optimal deleveraging of private debt.
8 Conclusion

Existing literature mainly assess the effectiveness of macroprudential policies in preserving financial stability by exploiting variations in household credit or its interaction with monetary policy. More broadly, the literature on the role of fiscal policy in crisis prevention is very limited. Since the GFC in 2009, policymakers have used macroprudential policies more extensively. While most of the related literature recognizes the importance of these policies in upholding financial stability, there is less of an understanding of how they interact with existing fiscal policies. Furthermore, there are very few examples of literature that explore the outcome of financial stability from implementing macroprudential and fiscal policies simultaneously, which does not use calibration techniques to generate the direction and intensity of policy responses. This thesis reduce Batini et al. (2015) model to one dynamic equation such that the optimal interaction between macroprudential and fiscal policy for financial stability, i.e. private debt can be empirically analysed using a DPD model.

The contribution to the literature is twofold. First, by assessing the optimal behaviour of macroprudential and fiscal policy to enhance the efficiency of private debt deleveraging, for a more extensive and diverse country sample, including AEs and EMs. Second, the original theoretical model is extended, by accounting for a banking sector and a macroprudential authority. Thereafter, the model is reduced to one dynamic equation. Empirical analysis is carried out by reproducing the MPI from Cerutti et al. (2017) and assessing its interaction with the CAPB variable, as well as the recognized controls from the related literature. Thus, the analysis builds on a DPD approach and examines the combined effect of 12 macroprudential instruments, and the CAPB in 49 countries over the period 2000-2013.

Our findings illustrate contrasting signs between the estimated coefficients for the two country sub-groups and great difference in magnitude from positive 21 to negative 11 percent. Whilst the suggestive inferences are interesting, they provide no conclusive evidence of the interaction between macroprudential and fiscal policies in deleveraging private debt. However, the findings imply the existence of two opposing effects. On the one hand the efficiency of imposed macroprudential policies in deleveraging private debt may be
reduced following more prudential fiscal policies. This applies to countries that are more likely to run countercyclical fiscal policy and have a larger fiscal space during downturns, which concur with the characteristics of AEs. On the other hand, the capability of macroprudential policies to reduce private debt could also be reinforced by more prudential fiscal policies, in countries that are more liable to use procyclical fiscal policy and experience less fiscal space, as is often the case with EMs.

In spite of the presented empirical evidence insignificance, interesting inferences can be drawn within the context of existing research. First, in countries with smaller fiscal space, the efficiency of private debt deleveraging is mainly driven by the extent to which both macroprudential and fiscal policies are countercyclical. Second, government spending multipliers are significantly greater in countries that face periods of private debt overhang.

The findings have important policy implications. They seemingly align with the theoretical predictions from the model, which highlights the importance of initial public debt levels and fiscal policy stances for private debt deleveraging. Furthermore, high private debt levels may amplify the effect of expansionary fiscal policies and reinforce macroprudential policies in deleveraging private debt and hence promote financial stability.

In this vein, this thesis provides several directions for future research. First, future research could include more direct and alternative measures of fiscal policy. This would require explicit country-level data that oversee enactments on a variety of fiscal policy indicators. Agnello and Cimadomo (2012) and Attinasi and Klemm (2014) provide a foundation for such work. Second, future research may examine the optimal use of macroprudential and fiscal policies in developing countries. It would particularly be interesting to examine whether countries that consistently use procyclical fiscal policies have similar policy outcomes. Including developing countries would therefore enable researchers a more clear depiction of the interaction between macroprudential and fiscal policies, and thus private debt. However, this provides a tall order, as country-level private debt for developing countries is essentially unattainable. Finally, while political economic bias is acknowledged as an vital feature to policymakers choices, it is not accounted for in the theoretical or empirical framework. In principle this violates the identifying
restriction made in the theoretical model, that governments ultimate goal is to maximize the welfare of the economy. The implicit assumption akin to Martin and Phillipon (2017) is that political economic bias and private debt booms are not directly related to one another. This does not only stress the need for future researchers to consider political economic bias, but the importance of fostering a greater understanding of how government actions may influence financial markets.
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Appendix

A First-Order Conditions Model

Patient Households

Intertemporal maximization yields the following first-order conditions with respect to $c_t,  \iota_t,  b_t,  b_t^G$ and $h_t$

\[ \mu_t = \frac{1}{z_t} \tag{A.1} \]

\[ w_t = (\iota_t)^{\gamma - 1} Z_t \tag{A.2} \]

\[ \frac{1}{z_t} = \beta E_t \left[ \frac{1 + \iota_t^G}{\iota_{t+1} Z_{t+1}} \right] \tag{A.3} \]

\[ \frac{1}{z_t} = \beta E_t \left[ \frac{1 + \iota_t^G}{\iota_{t+1} Z_{t+1}} \right] \tag{A.4} \]

\[ \frac{q_t}{z_t} = \frac{\xi}{h_t} + \beta E_t \left[ \frac{q_{t+1}}{z_{t+1}} \right] \tag{A.5} \]

Impatient Households

Intertemporal maximization yields the following first-order conditions with respect to $c_t,  \iota_t,  b_t^I$ and $h_t^I$:

\[ \mu_t = \frac{1}{z_t^I} \tag{A.6} \]

\[ w_t^I = (\iota_t^I)^{\gamma - 1} Z_t^I \tag{A.7} \]

\[ \frac{1}{z_t^I} = B^I E_t \left[ \frac{1 + \iota_t^I}{\iota_{t+1} Z_{t+1}^I} \right] \tag{A.8} \]

\[ \frac{q_t}{z_t^I} = \frac{\xi}{h_t^I} + E_t \left[ \frac{B^I q_{t+1}^I}{z_{t+1}^I} \right] + \lambda_t^I m^I q_{t+1}^I \pi_{t+1} \tag{A.9} \]
Entrepreneurs

Intertemporal maximization yields the following first-order conditions with respect to $c_t$, $\Delta^E$, $b^E_t$, and $h^E_t$

$$\mu_t = \frac{1}{\pi^E_t}$$ (A.10)

$$w^E_t(1-\phi) = \phi^E_t$$ (A.11)

$$\frac{1}{\pi^E_t} = \pi^E_t \left[ \frac{1+r_t}{\pi^E_{t+1}} \right]$$ (A.12)

$$q_t = E_t \left[ \frac{\phi^E_t}{\pi^E_{t+1}} \left( \frac{\Delta^E_t}{\pi^E_{t+1}} + q_{t+1} \right) + \lambda_t m^E x_{t+1} \pi_{t+1} q_{t+1} \right]$$ (A.13)

Banks

Intertemporal maximization yields the following first-order conditions with respect to dividends

$$\beta^B E_t \left[ \left( \frac{\Delta^A_{t+1}}{\pi^A_t} \right) \left( \frac{\Delta^b_{t+1}}{\pi^b_t} \right) \left( \frac{\Delta^d_{t+1}}{\pi^d_t} \right) \right]$$ (A.14)

$$(1+u_t)P^I_t = \beta^B E_t \left[ \left( \frac{\Delta^a_{t+1}}{\pi^a_t} \right) \left( \frac{\Delta^b_{t+1}}{\pi^b_t} \right) \left( \frac{\Delta^d_{t+1}}{\pi^d_t} \right) \right]$$ (A.15)

$$(1+u^E_t)P^E_t = \beta^B E_t \left[ \left( \frac{\Delta^a_{t+1}}{\pi^a_t} \right) \left( \frac{\Delta^b_{t+1}}{\pi^b_t} \right) \left( \frac{\Delta^d_{t+1}}{\pi^d_t} \right) \right]$$ (A.16)
B Identification Strategy

The first concern of endogeneity is assessed by momentarily assuming that the interaction term is exogenous. Panel fixed effects are unlikely to eliminate the inconsistency created by including the lagged dependent variable on the RHS and the error term $\varepsilon$ correlation with future values of the regressors. This can be expressed by:

$$E[(Y_{i,t-1} - \bar{Y}_{i,t-1})(\varepsilon_{i,t-1} - \bar{\varepsilon}_{i,t-1})] \neq 0$$

where $\bar{Y}_{i,t-1}$ and $\bar{\varepsilon}_{i,t}$ represents the within the group means values of the respective terms.

The *difference generalized method* of moments (GMM) was developed by Arellano and Bond (1991) to address this type of country heterogeneity. The difference GMM method can be illustrated by simply applying the first difference to equation (35):

$$\Delta Y_{i,t} = \alpha \Delta Y_{i,t-1} + \beta \Delta \left( MPI_{i,t-1} * \bar{F}_{p,i,t-1} \right) + \gamma \Delta MPI_{i,t-1} + \delta \Delta F_{p,i,t-1} + \theta \Delta X_{i,t} + \Delta \varepsilon_{i,t} \quad (B.1)$$

where $\Delta$ is the operator of the first difference. $\Delta Y_{i,t-1}$ is endogenous since,

$$E(\Delta Y_{i,t-1} \Delta \varepsilon_{i,t}) = E[(Y_{i,t-1} - \bar{Y}_{i,t-1})(\varepsilon_{i,t-1} - \bar{\varepsilon}_{i,t-1})] = -E(Y_{i,t-1} \varepsilon_{i,t-1}) \neq 0 \quad (B.2)$$

The following three assumptions are made:

(i) The error terms $\varepsilon_{i,t}$ are serially uncorrelated, i.e. $cov(\varepsilon_{i,t}, \varepsilon_{i,t-s}) = 0$ if $s \neq 0$

(ii) $E(Y_{i,t-1} \varepsilon_{i,t}) = 0$ for $t \geq 2$

(iii) $E(\eta_i \varepsilon_{i,t}) = 0$

Using the above assumptions, the moment conditions can be derived for the difference GMM method:

$$E[Y_{i,t-s} \Delta \varepsilon_{i,t}] = 0, \text{ when } t = 3, ..., T \text{ and } s \geq 2 \quad (B.3)$$

Hence, all $Y_{i,t-s}$ for $s \geq 2$ are valid instruments for $\Delta Y_{i,t-1}$ in equation (B.1).
To address the second concern of endogeneity with regards to the interaction term $\text{MPI}_{i,t-1} \times Fp_{i,t-1}$ and the $\text{MPI}_{i,t-1}$ variable, a similar method to the one used for omitted variable bias is applied.

Endogeneity is suspected, such that causality flows from private debt to the $\text{MPI}_{i,t} \times Fp_{i,t-1}$ term and the $\text{MPI}_{i,t-1}$ variable.

It is assumed that $E(\text{MPI}_{i,t} \times Fp_{i,t} \Delta \epsilon_{i,s}) \neq 0$ for $s \leq t$, $E(\text{MPI}_{i,t} \Delta \epsilon_{i,s}) \neq 0$ for $s \leq t$

Under this assumption, the moment conditions can now be derived as:

$$E[\text{MPI}_{i,t-s} \times Fp_{i,t-s} \Delta \epsilon_{i,t}] = 0, \text{ when } t=3,...,T \text{ and } s \geq 2 \quad \text{(B.4)}$$

$$E[\text{MPI}_{i,t-s} \Delta \epsilon_{i,t}] = 0, \text{ when } t=3,...,T \text{ and } s \geq 2 \quad \text{(B.5)}$$

Therefore, all $\text{MPI}_{i,t-s} \times Fp_{i,t-s}$ and $\text{MPI}_{i,t-s}$ for $s \geq 2$ are valid instruments for both $\Delta Y_{i,t}$ and $\Delta Y_{i,t-1}$.

This makes it possible for the difference GMM to use the two moment conditions derived in equation (B.3), (B.4) and (B.5) to estimate equation (B.2).

As the dependent variable is highly time persistent, the standard first difference GMM suffers from the problem of weak instrumental variables (Cameron and Trivedi, 2009). Blundell and Bond (1998) solve this issue by using the derived moment conditions in equation (B.3), (B.4) and (B.5) as instruments for the level equation, using the above assumptions. This leads to the system GMM estimator and the following specification of equation (35):

$$E[\Delta Y_{i,t-1} (\eta_{i} + \epsilon_{i,t})] = 0, \text{ for } t= 2,3,..., T \quad \text{(B.6)}$$

$$E[\Delta \text{MPI}_{i,t-1} \Delta Fp_{i,t-1} (\eta_{i} + \epsilon_{i,t})] = 0, \text{ for } t= 2,3,..., T \quad \text{(B.7)}$$

$$E[\Delta \text{MPI}_{i,t-1} (\eta_{i} + \epsilon_{i,t})] = 0, \text{ for } t= 2,3,..., T \quad \text{(B.8)}$$
# Robustness Checks

Table 8: Robustness Checks - System generalized method of moments (System GMM)

<table>
<thead>
<tr>
<th>Dependent Variable: Private Debt</th>
<th>(1) Advanced</th>
<th>(2) Emerging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Debt</td>
<td>1.022***</td>
<td>0.964***</td>
</tr>
<tr>
<td></td>
<td>(0.049)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>MPI</td>
<td>-1.949</td>
<td>4.336*</td>
</tr>
<tr>
<td></td>
<td>(3.209)</td>
<td>(2.454)</td>
</tr>
<tr>
<td>LTV,CAPS</td>
<td>2.737</td>
<td>-7.824**</td>
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<tr>
<td></td>
<td>(5.880)</td>
<td>(3.888)</td>
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<tr>
<td>DTI</td>
<td>4.007</td>
<td>-6.274*</td>
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<tr>
<td></td>
<td>(4.196)</td>
<td>(3.800)</td>
</tr>
<tr>
<td>DP</td>
<td>57.129</td>
<td>-0.909</td>
</tr>
<tr>
<td></td>
<td>(44.213)</td>
<td>(2.515)</td>
</tr>
<tr>
<td>CTC</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>LEV</td>
<td>7.522</td>
<td>0.971</td>
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<tr>
<td></td>
<td>(16.197)</td>
<td>(15.662)</td>
</tr>
<tr>
<td>SIFI</td>
<td>4.171</td>
<td>-1.171</td>
</tr>
<tr>
<td></td>
<td>(18.100)</td>
<td>(7.164)</td>
</tr>
<tr>
<td>INTER</td>
<td>1.636</td>
<td>-4.219</td>
</tr>
<tr>
<td></td>
<td>(6.818)</td>
<td>(3.954)</td>
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<tr>
<td>CONC</td>
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<td>-10.229</td>
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<td>(7.703)</td>
<td>(6.900)</td>
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<td>(10.978)</td>
<td>(4.447)</td>
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<td>(0.000)</td>
<td>(3.865)</td>
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<tr>
<td>CG</td>
<td>0.000</td>
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<td></td>
<td>(0.000)</td>
<td>(29.452)</td>
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<tr>
<td>TAX</td>
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<td>(4.020)</td>
<td>(6.673)</td>
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<tr>
<td>Fiscal Policy</td>
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<td>-0.253</td>
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<td>(0.157)</td>
<td>(0.229)</td>
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<tr>
<td>Monetary Policy</td>
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<td>(0.315)</td>
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<td>Crisis</td>
<td>1.270**</td>
<td>1.328**</td>
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<td>(0.577)</td>
<td>(0.664)</td>
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Notes: All the variables are lagged one period. The interaction term and country fixed effects are excluded. The standard errors, presented in the parentheses are clustered by country, are robust and corrected according to Windmeijer (2005).

*** Significant at the 1%
** Significant at the 5%
* Significant at the 10%
Table 9: Robustness Checks – Wald Test

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\[ \text{chi2}(8) = 6.04 \quad 9.16 \]

\[ \text{Prob} > \text{chi2} = 0.6422 \quad 0.0573 \]
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<tr>
<td>Private Debt</td>
<td>1.111***</td>
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<tr>
<td></td>
<td>(0.034)</td>
<td>(0.042)</td>
<td>(0.027)</td>
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<td>0.388</td>
<td>-0.155*</td>
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<tr>
<td>MPI * Fiscal Policy</td>
<td>(0.191)</td>
<td>(0.094)</td>
<td>(0.221)</td>
<td>(0.103)</td>
<td>-5.101</td>
<td>0.601</td>
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<td>-0.177</td>
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<tr>
<td>MPI</td>
<td>(4.017)</td>
<td>(2.074)</td>
<td>(9.797)</td>
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<td>0.253</td>
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<td>Fiscal Policy</td>
<td>(0.347)</td>
<td>(0.302)</td>
<td>(0.368)</td>
<td>(0.309)</td>
<td>0.388</td>
<td>-0.155*</td>
<td>0.305</td>
<td>-0.189</td>
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<td>Crisis</td>
<td>1.626***</td>
<td>1.916***</td>
<td>1.865**</td>
<td>1.840**</td>
<td>(0.674)</td>
<td>(0.628)</td>
<td>(0.764)</td>
<td>(0.620)</td>
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<td>(0.347)</td>
<td>(0.037)</td>
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<tr>
<td>AR(1)</td>
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<td>AR(2)</td>
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Notes: All the variables are lagged one period and includes the interaction term between the MPI index and Fiscal Policy. The Exchange Rate Regime and Openness index is included. Country fixed effects are included. The standard errors, presented in the parentheses are clustered by country, are robust and corrected according to Windmeijer (2005).

*** Significant at the 1
** Significant at the 5
* Significant at the 10