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GDP Growth, Private Debt and Monetary Policy

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GDP Growth, Private Debt and Monetary Policy

Abstract

Economic research has considered Private Debt a determinant of GDP growth for years. By keeping this perspective, the objective of this work is to understand how much of the GDP response to a monetary shock is due to the variation of private debt. This is the marginal contribution of private debt, which we relate to an increase of the aggregate demand. We study the USA, the UK and Germany in the period 1980q1-2015q4. Our approach is based on the comparison of one baseline structural VAR with one counterfactual for each country. The analysis is developed using the two main constituents of private debt: households and corporations debt.

JEL-Codes: O110, O160, O510, O520, E440.

Keywords: private debt, GDP, monetary policy, structural VAR.

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1 Introduction

The relationship between private debt and GDP has been object of intense research for years. There are many contributions which describe, attempt to explain and question such a relationship that is undoubtedly important for the understanding of how the economy evolves, but also for economic policy. Interestingly, such a relationship is studied by, at least, two different branches of literature. The first is the one focused on the long-run effects of financial development on economic growth (Levine 2005). The second, which instead refers to the short run, is the one about the transmission mechanism of monetary policy (Bernanke & Gertler 1995).

GDP essentially grows with the aggregate demand in the short-run. The two aggregate-demand components more directly affected by market interest rates are private consumption and private investments. These respond to an interest rate variation because of several possible channels. In any case, the more they depend on indebtedness, the more responsive they are to an interest rate variation (Eggertsson & Krugman 2012, Foley-Fisher et al. 2016). At a first sight, this could seem more significant for investment, but also consumption of durable goods has relied more and more on indebtedness (Benmelech et al. 2016, Mian & Sufi 2010). The amount of private debt in the economy mainly depends on the interest rate on such a debt. When the transmission channel of monetary policy works properly, market rates evolve with the policy rate set by the Central Bank (ECB 2011). Generally speaking, a monetary expansion through a rate cut is known to have a positive effect on the GDP (among the others, Christiano et al. 1999). A positive effect which depends also on the expansion of the above-mentioned aggregate-demand components made possible by lighter borrowing costs.

The objective of this work is to quantify how much of the GDP response to a monetary shock depends on the variation of private indebtedness. We aim to assess what is known as *credit channel* (Bernanke & Gertler 1995), a propagation mechanism which we base on the variation of the aggregate demand. With this purpose we study the USA, the UK and Germany in the period 1980q1-2015q4. We estimate a baseline VAR and compare it with a counterfactual in order to asses the marginal contribution of private debt to the GDP variation following a monetary policy shock. The contribution of our research

consists in results about an important part of the transmission channel of monetary policy achieved through a technique, to our knowledge, not elsewhere applied in this branch of literature. Our results point towards a significant effect of households debt, while corporations debt does not seem to play a significant role.

The paper is organized as follows. In section 2 we discuss the theoretical aspects at the basis of our research which explain the link between GDP growth, private debt and monetary policy in the short-run. In section 3 we explain the analytical approach taken. In section 4 we provide information about the VAR estimation and report about the data used. In section 5 we discuss the impulse-response functions based on the baseline VAR and we compare same of those with the ones from the counterfactual VAR in section 6. Section 7 concludes.

2 Theoretical considerations

The literature about finance and growth has developed a lot since King & Levine's (1993) seminal contribution. In this branch of literature, private debt is the variable commonly used to measure the financial depth of the economy (Levine 2005), consequently the results about finance and growth can be read as the results about private debt and growth. This literature abounds with contributions explaining how a well-developed financial system supports the economy (Ang 2008).[1] On the whole, those contributions study the relationship between private debt and GDP in the long-run. Indeed, they refer to channels such as *mobilizing and pooling savings, facilitating risk management and diversification, facilitating transactions, higher factor productivity, etc* (Ang 2008) which are all relevant in the long-run. Coherently, in applied works, it is usually the effect of year $t-1$ debt on GDP growth in the period $t+n/t$ which is studied (Levine 2005).

Differently, the very point of our analysis consists in understating how much a monetary intervention, which results successful in supporting the GDP, works through a private debt increase. The idea is that the Central Bank's rate cut allows private debt to increase, since private debt is at the basis of same consumption typologies and short-term investments, these increase and therefore sustain GDP growth.

[1] Undoubtedly, the more thorny issue with this relationship is that of causality (Puente-Ajovín & Sanso-Navarro 2015). Even though the issue is far from solved, majority consensus favors causality from private debt to GDP (Arcand et al. 2015).

As sketched, the channel by which debt allows growth is different in our setting compared to the long-run literature: we link that effect to the aggregate demand, which increases thanks to softer conditions to get indebted (Mian & Sufi 2012). From this perspective, the effect of monetary policy on GDP growth via private debt is part of the transmission channel of monetary policy. As explained in Bernanke & Gertler (1995), we do not consider such a debt (credit) channel a different one by which monetary policy affects the real economy. Private debt in this context works more as a *financial accelerator* in the sense that monetary interventions trigger "endogenous developments in credit markets which amplify and propagate shocks to the macroeconomy" (Bernanke et al. 1999). In fact, the variation of private debt allows an increase/reduction of certain components of the aggregate demand.

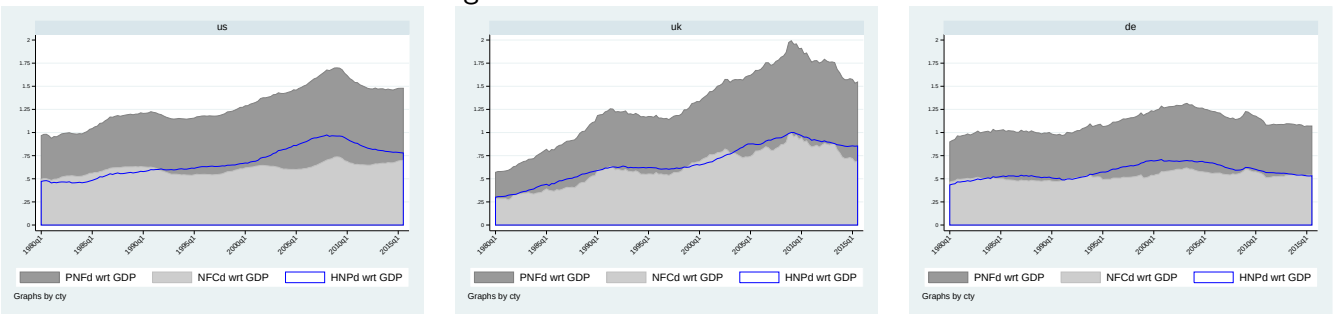
Our data show significant GDP variation as well as significant private debt variation from quarter to quarter with respect to the yearly average. The question is whether changes in private debt caused by a monetary shock add something significant to the GDP variation caused by the same monetary shock. In normal times, monetary policy affects private debt directly. Contractual frictions (to wit, fixed rate contracts) might limit the response of households debt to an interest rate variation, but this emerges anyway because of their desire to consume more (Di Maggio et al. 2014).[2] As for corporations, Bernanke & Gertler (1995) explain in details how interest rate variations, even hikes, lead firms to borrow more in their discussion of the credit channel of monetary policy.[3]

The way private debt affects GDP in the short-run is easy to envisage. As mentioned in the introduction, GDP essentially grows with the aggregate demand. The two aggregate-demand components which are more directly affected by market rates via debt in the short-run are private consumption and private investments. Private consumption responds to an interest rate variation mainly to the extent it depends on debt (Eggertsson & Krugman 2012). Conversely, households debt arises mainly for consumption purposes where the by-far larger portion is made of mortgages (Debelle 2004). But also consumption of some other items, particularly durable goods, has been based more and more on debt (consumer credit) and it is therefore responsive to lending conditions (Ramcharan et al. 2016). Among

[2]Wealthy borrowers might reduce their debt because of their will to deleverage, but the net effect is positive because of low-income borrowers. Interestingly, some authors notice that in the case of adjustable-rate debt, an increase of the interest rate does cause an overall decrease of debt but it may also cause a partial increase of debt when borrowers are forced to get more indebted to pay the interest-bill.

[3]Accordingly, following a monetary tightening which impacts on market rates, large corporations might increase short-term debt in an attempt to counterbalance the decline in their cash-flow caused by that monetary tightening (Gertler & Gilchrist 1993, 1994).

Figure 1: Private Debt wrt GDP



the others, Benmelech et al. (2016) discuss how tighter lending conditions during the financial crisis have caused a drop of car sales and suggest that interventions aimed at easing those conditions in the short term might have helped to contain the real effects of the crisis, Mian & Sufi (2010) show that US counties with higher household leverage prior to the 2008-2009 recession reduced durable consumption by significantly more after the fall of 2008. As for private investments, Foley-Fisher et al. (2016) study how firms respond to policy actions aimed to reduce borrowing costs and conclude that those might be effective in relieving financial constraints and stimulating economic activity in the aftermath of a crisis for some firms.

The varying cost of debt affects differently distinct groups of private agents (Sufi 2015). In fact, as previously mentioned, their response to a monetary shock might not be in the same direction. Moreover, an increase in households debt should act more quickly on GDP than an increase in corporations debt (Cafiso 2016). We take into account such possible differences between households and firms by considering their debt separately. Hence, we base the analysis on the two main constituents of private debt. The first is *Households and Non-Profit Debt* (NHPd), which is the amount of bank credit to households and non-profit organizations in the economy. The second is *Non-Financial Corporations Debt* (NFCd), which is the amount of bank credit to non-financial firms. These are plotted in GDP terms in Figure 1.

In the next section, we describe the procedure used to evaluate the debt/credit channel just discussed. We use the expression *marginal contribution of private debt* when we refer to its intensity and significance.

3 Outline of the Analysis

The analysis is based on the estimation of two structural VARs for each country, we favour a country-by-country analysis in order to unveil significant differences. The first VAR yields the baseline estimation, the second VAR serves as a counterfactual functional to assess the role of private debt on GDP after a monetary policy shock. We start with the baseline VAR and then explain the difference of the counterfactual with respect to the baseline.

We include 5 variables in the VAR: GDP (g), inflation (π), households debt (hnp), corporations debt (nfc), monetary rate (m). To the four variables necessary to our analysis, we add inflation because it is the target variable of monetary policy; for examples of a similar specification, see Christiano et al. (1999), Robstad (2014), Angeloni et al. (2015) or Bauer & Granziera (2016). In table 1 we report how the variables are included in the VAR.[4]

Table 1: Variables in the VAR

GDP	g	1st difference of log values
inflation	π	percentage rate
HNPd	hnp	1st difference of log values
NFCd	nfc	1st difference of log values
MMR	m	percentage rate

Notes: HNPd stands for Households and non-Profit debt, NFCd stands for Non-Financial Corporations debt, MMR stands for Money Market Rate.

Baseline Vector Auto-Regression. Any VAR is estimated in its reduced form, the structural form is identified from the reduced-form estimation output through restrictions. The structural-form can be expressed as:

$$M \cdot Y_t = B_0 + B_1 \cdot Y_{t-1} + ... + B_p \cdot Y_{t-p} + u_t \tag{1}$$

or more compactly as:

$$M \cdot Y_t = \Gamma \cdot X + u_t$$

where $\Gamma \equiv \begin{bmatrix} B_0 & B_1 & ... & B_p \end{bmatrix}$, $X' \equiv \begin{bmatrix} 1 & Y_{t-1} & ... & Y_{t-p} \end{bmatrix}$ and M is the matrix of the con-

[4] GDP, HNPd and NFCd are included in first difference because the variables are not stationary, $I(1)$ variables.

temporaneous coefficients.

The reduced form of this structural model is the VAR:

$$Y_t = A_0 + A_1 \cdot Y_{t-1} + ... + A_p \cdot Y_{t-p} + \epsilon_t \tag{2}$$

or more compactly

$$Y_t = \Pi' X + \epsilon_t \tag{3}$$

where

$$\Pi' = M^{-1}\Gamma \text{ and } \epsilon_t = M^{-1}u_t. \tag{4}$$

The variance-covariance matrix of the reduced-form errors is $\Omega = E\left(\epsilon_t \epsilon_t^{'}\right)$, that of the structural-form errors is $D = E\left(u_t u_t^{'}\right)$.

The equations in 4 show the relationship between reduced-form and structural-form parameters. Restrictions on the M and D matrices are required in order to recover the structural parameters. Across the different types of restrictions, we opt for short-run restrictions (Lutkepohl 2005). As said, the matrix M governs the contemporaneous feedback across all the variables, given $Y_t \equiv[y_t \ \pi_t \ hnp_t \ nfc_t \ m_t]$ we restrict that feedback as follows:

$$u_t = M \cdot \epsilon_t$$

$$\begin{bmatrix} u_y \\ u_\pi \\ u_{hnp} \\ u_{nfc} \\ u_m \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ \beta_{21} & 1 & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & 1 & 0 & \beta_{35} \\ \beta_{41} & \beta_{42} & 0 & 1 & \beta_{45} \\ \beta_{51} & \beta_{52} & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} \epsilon_y \\ \epsilon_\pi \\ \epsilon_{hnp} \\ \epsilon_{nfc} \\ \epsilon_m \end{bmatrix}. \tag{5}$$

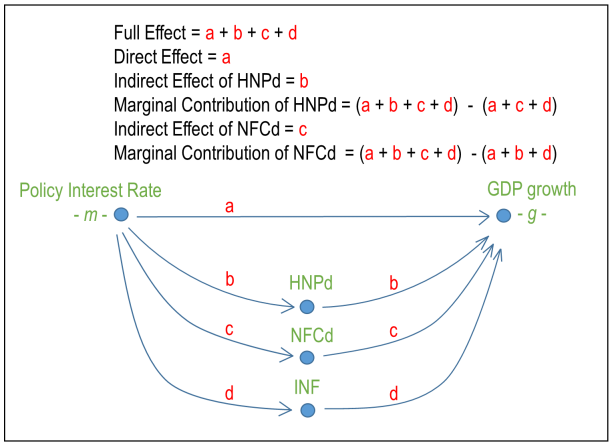
In terms of shocks, GDP (y_t) responds only with 1-lag to a shock in any other variable; this is in line

with many contributions in this branch of literature (Christiano et al. 1999). GDP reacts with delay to the debt evolution because it may take some time to a debt increase to materialize into a consumption increase (Robstad 2014). Inflation (π_t) responds contemporaneously only to a GDP shock and with 1-lag to a shock in the other variables. HNPd (hnp_t) responds contemporaneously to a GDP shock, to an inflation shock and to a monetary shock, as well as NFCd (nfc_t). Since the time period is a quarter, we assume that private debt has therefore the time to adjust to an interest rate variation within such a period. The monetary authority is not primarily concerned with the evolution of private debt, the monetary variable (m_t) therefore responds contemporaneously to GDP and inflation, but with 1-lag to private debt. Such a setting of structural relationships is not unusual in the literature (Angeloni et al. 2015), particularly with respect to the fact that monetary policy responds contemporaneously only to the variables object of evaluation by the Central Bank, inflation in particular.

Counterfactual Vector Auto-Regression. The counterfactual VAR serves to assess the marginal contribution of one variable (let us say Z) on the variable object of analysis (let us say Y) after a shock in any of the other variables included in the VAR (let us say X). Hence, in our case to assess the marginal contribution of HNPd and NFCd (Z) on GDP (Y) after a monetary shock (X). This is achieved by comparing the Impulse-Response Function (IRF) based on the baseline VAR with the IRF based on the counterfactual VAR. This approach has been applied, among the others, by Ludvigson et al. (2002), Giuliodori (2005), Elbourne (2008). The counterfactual VAR is as the baseline VAR except for a relevant difference: the contemporaneous coefficients (M matrix in eq. 1) and the lagged coefficients ($B_1 ... B_p$ matrices in eq. 1) of the variable whose marginal contribution we are interested in are set equal to zero. By so doing, the IRF based on the counterfactual does not include the indirect effect of the variable we are interested in (HNPd and NFCd). Hence, the comparison of the IRF based on the baseline VAR with the IRF based on the counterfactual VAR provides information on the marginal contribution of the variable of interest.[5] See Figure 2 for a representation.

[5] In our application of this approach the contemporaneous feedback of HNPd and NFCd with the GDP is set equal to zero already in the baseline VAR (β_{13} β_{14} in 5). The difference with the counterfactual therefore consists in having set equal to zero the HNPd and NFCd coefficients for any lag in the GDP equation of the reduced-form VAR. Indeed, we approximate $\beta_{ij,t-p} = 0$ in eq. 1 with $a_{ij,t-p} = 0$ in eq. 2.

Figure 2: A monetary shock on GDP



4 VAR Estimation

Data

We use private debt data made available by the Bank of International Settlements. These are quarterly data for private non-financial debt, to wit, the amount of bank lending granted to the private non-financial sector of the economy.[6] Such a debt is studied through its two main blocks: 1- Households & Non-Profit debt (HNPd), 2- Non-Financial Corporations debt (NFCd).[7]

Real GDP quarterly data for the same group of countries are extracted from the OECD database as well as the inflation rate, which is obtained as the log-difference of the consumer price index. The 3-month Money-Market Rate (MMR) is extracted from Thomson Reuters.

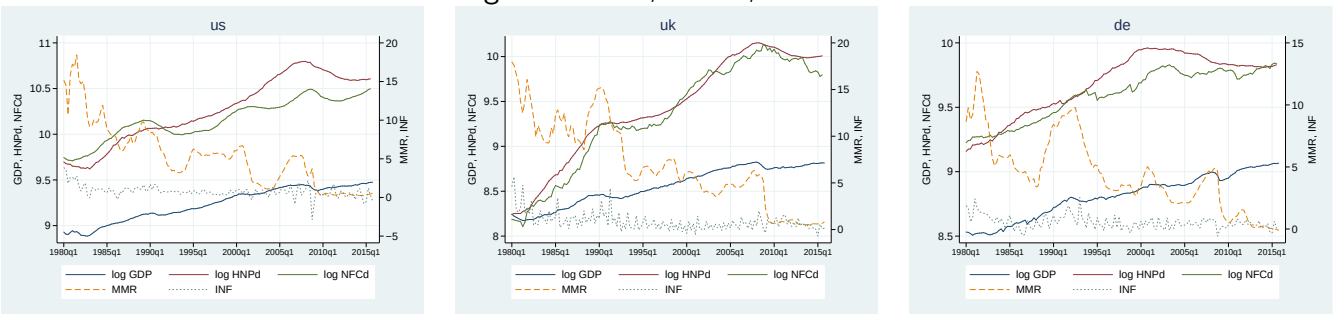
Many analyses normalize debt figures using GDP and then consider the effect of normalized debt on GDP (Arcand et al. 2015). We believe that this procedure might induce co-movement in the two series and condition somehow the results. We believe a normalization with respect to population to be more sound, we therefore use the variables in per-capita terms.[8] From here on in the following Tables and Figures, the variable GDP is real GDP per-capita, HNPd is the households part of private debt in

[6] *Long series on total credit to the private non-financial sector* (www.bis.org/statistics). "All series capture the outstanding amount of credit at the end of the reference quarter. Credit is provided by domestic banks, all other sectors of the economy and non-residents. In terms of financial instruments, credit covers the core debt, defined as *loans, debt securities and currency & deposits.*"

[7] We extract private debt at market value in national currency. All debt figures are originally in nominal terms, but we deflate them using the country-specific Consumers Price index (from OECD). We opt for national currency data since we develop a country-by-country analysis and consequently there is no need to have all the values in the same currency. At the same time, this avoids using data that might be somehow altered by the exchange rate conversion.

[8] Annual population data are extracted from the OECD database. To match the quarterly debt and GDP data, annual population figures are interpolated (cubic-spline) to quarterly values.

Figure 3: GDP, HNPd, NFCd



Notes: All variables are in real, per-capita terms. Logarithm transformation applied.

real per-capita terms, NFCd is the corporations part of private debt in real per-capita terms.

We report charts for the variables under analysis in Figure 3. The charts show that private debt has grown along GDP in the three countries considered in the last decades. In all countries both debt variables are higher than GDP per-capita. As expected, the MMR dynamics is remarkably similar across countries.

VAR estimation

We estimate a VAR for each of the three countries considered: USA, UK and Germany. As known, it is crucial to specify correctly the VAR by including the appropriate number of lags in order to avoid auto-correlated residuals (ϵ_t). Standard methodologies suggest to start with the maximum reasonable number and to run Exclusion Tests of the highest lag-order included or, alternatively, to compare alternative lag-orders through information criteria (Lutkepohl 2005). We opt for the first approach since the information criteria suggest a number of lags which exhibit auto-correlation. We start with an economically reasonable lag length, which is 6 (one year and a half dependence), and stop when the Wald test rejects the exclusion hypothesis and no auto-correlation emerges. The results of this procedure for each of the three countries considered are reported in Table 2.

The purpose of VAR estimations is not the checking of the single coefficients, but hypothesis testing on those coefficients and impulse-response analysis (Stock & Watson 2001). In the next section we focus on the structural IRFs of the baseline VAR.

Table 2: VAR Lag Selection

	USA		UK		Germany	
	p-value (χ^2)	procedure	p-value (χ^2)	procedure	p-value (χ^2)	procedure
Exclusion test of 6th lag	0.000	stop	0.000	stop	0.585	test further
Exclusion test of 5th lag					0.002	stop
Exclusion test of 4th lag						
AC test at 6th lag	0.912		0.415		0.009	
AC test at 5th lag					0.824	
AC test at 4th lag						
Final Selected:	6		6		5	

Notes: · AC is the auto-correlation test: H0 "no auto-correlation" · The Exclusion test is the Wald test: H0 "lag non-statistically different from zero".

5 Baseline-VAR IRFs

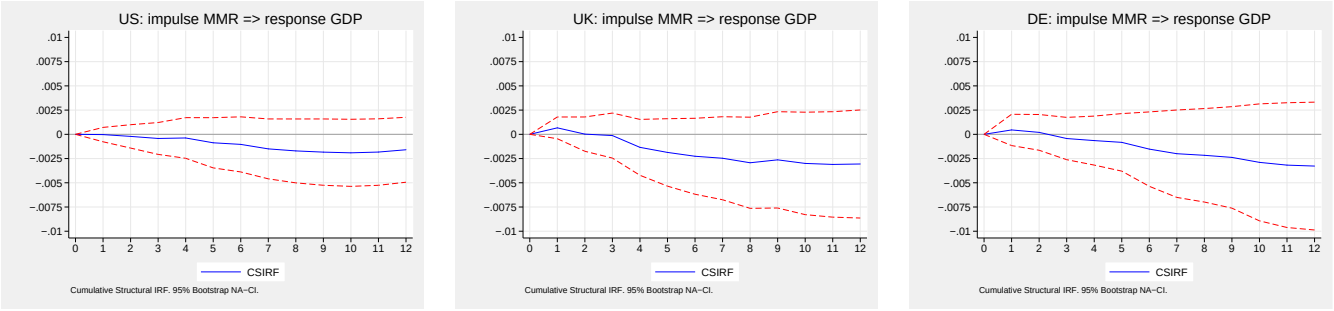
As explained in the introduction our interest lies in the relationship between a monetary shock, the evolution of private debt and GDP. Accordingly, we discuss the response of GDP and private debt to a monetary shock in this section. Our monetary policy indicator is the 3-month money market rate (MMR, m), we assume that a shock in its evolution reflects a variation of the policy stance as customary in this branch of literature. We plot cumulative structural IRFs since the response variables are all in terms of growth rates (log-difference). Confidence intervals are reported for each IRF.[9]

GDP response to a Monetary Shock. The effect of a monetary shock on the GDP, visualized through IRFs, is reported in Table 3. This is the *full effect* as sketched in Figure 2, it therefore comprises both the direct effect of m on g and the indirect effect of m on g via HNPd, NFCd and INF. This is what impulse-response analysis normally yields. On the whole, the effect is similar across the three countries considered and it materializes after 1-lag because of the structural identification imposed. We observe an initial GDP increase for the UK and Germany, but it quickly decays reflecting a recession as expected; this is not an uncommon dynamics (among the others, see Faust et al. 2004).

Private Debt response to a Monetary Shock. The response of households debt to a monetary shock is shown in Table 4 (first row of graphs). Such a response meets what conventional wisdom suggests: an increase of the interest rate causes a decrease of loans to households and non-profit

[9]These are normal-distribution-based confidence intervals in which the standard error of the IRFs is approximated with the standard deviation of their Bootstrap distribution.

Table 3: Response of GDP to a Monetary shock (baseline)



institutions. The response is more intense in the UK than in the US, while it is milder in Germany. These results are directly comparable with Angeloni et al. (2015).

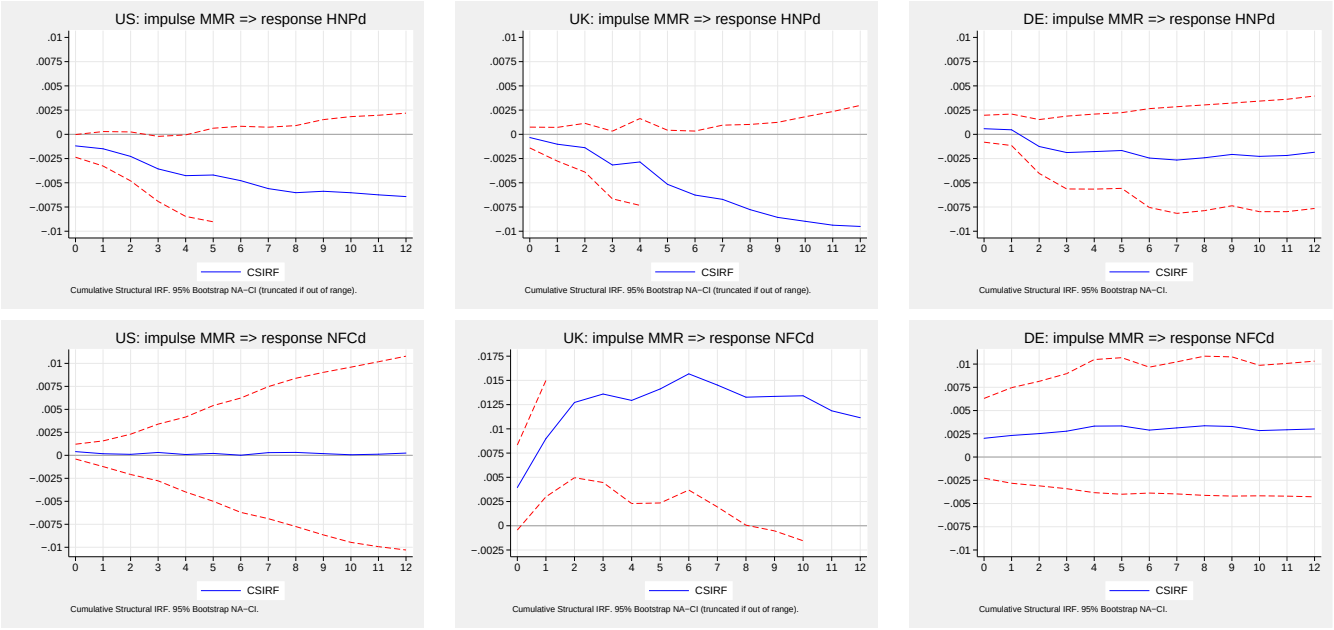
The response of corporations debt to a monetary shock is in the second row of Table 4. Differently from HNPd, such a response is not intuitive. The UK exhibits a marked increase of NFCd, Germany's NFCd increases too, NFCd does not decrease in the US. A NFCd increase in case of a positive monetary shock has been reported already by other contributions. Gertler & Gilchrist (1993) and, more recently, Den Haan et al. (2007) spot it in US data. Giannone et al. (2012) report the same result for the Euro Area as a whole. Busch et al. (2010) refer to this issue with regard to Germany. With reference to the supply-side, Den Haan et al. (2007) suggest that an increase in interest rates induces banks to re-balance their loans portfolio in favor of more profitable and less risky short-term corporate loans. Referring to the demand side, faced by a monetary tightening which puts pressure on the cost of lending, corporations may be encouraged to draw-down their credit lines with banks at a previously lower bargained cost. Gertler & Gilchrist (1993) argue that the demand of loans may increase during an economic downturn because of firms' need to counterbalance the squeeze in their cash flows.[10]

In conclusion, HNPd and NFCd seem to vary in an opposite direction following a monetary shock.

For the sake of completeness we report also the GDP response to a private debt shock in Appendix A. On the whole, GDP seems to respond much more to HNPd, while its response to NFCd is very limited; for a deeper discussion of a similar result, see Cafiso (2016).

[10]We have checked the robustness of this result by computing the same IRFs under two different scenarios. First, based on an estimation over the 1980q1-2008q4 period in order to rule out the financial crisis and the period thereafter. Second, using an alternative identification structure based on the Wald Causal Chain (Cholesky decomposition). On the whole, the results look very much the same.

Table 4: Response of Private Debt to a Monetary shock (baseline)



Note: mind the difference in the Y-axis scale for the UK graph.

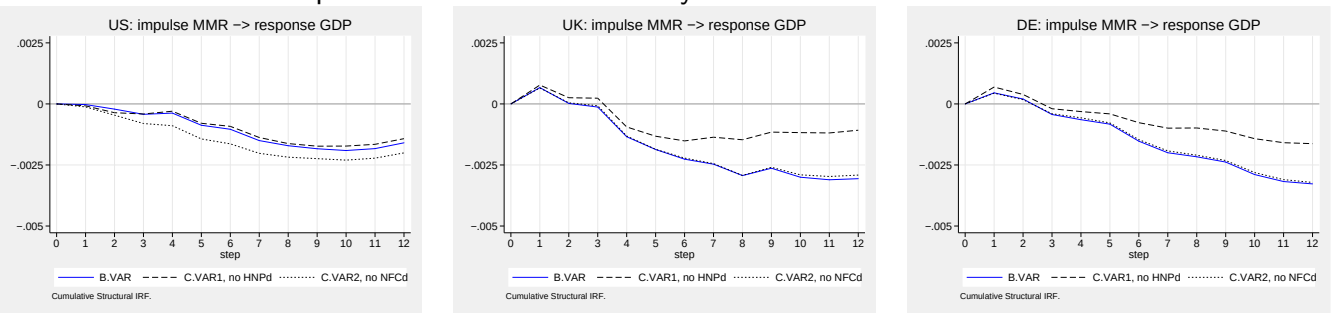
6 Baseline VAR vs. Counterfactual: IRFs comparison

In this section we compare the IRFs from the baseline VAR with the IRFs from the counterfactual VAR. The objective is to assess the marginal contribution of private debt to the GDP response to a monetary shock. The procedure is the one described in section 3 and sketched in Figure 2. This is done both for households and for corporations debt in the three graphs of Table 5. A simple prediction could be that the GDP response in the baseline VAR is larger than the GDP response in the counterfactual VAR when: (i) both the full effect of the monetary shock on the GDP (Table 3) and on private debt (Table 4) are of the same sign, (ii) the full effect of private debt on GDP is not inverse and sufficiently large. Nonetheless, we cannot foresee how the variables really interact in the system, so this simple prediction is not to be used to evaluate the output of the analysis.

The GDP response to a monetary shock is negative in the **US** (first graph in Table 5). When HNPd is excluded, the GDP response to a monetary shock is slightly smaller (dashed line). Differently, the GDP response to a monetary shock is slightly larger when NFCd is ruled out (dotted line). However, the difference across the IRFs is too small to be considered informative. Accordingly, we judge the marginal contribution of private debt not significant in this case.

As for the **UK**, the cumulative GDP response to a monetary shock becomes negative after two

Table 5: Response of GDP to a Monetary shock: Baseline vs Counterfactual



periods (second graph in Table 5). When the indirect effect of HNPd is ruled out, the GDP response is more than halved (dashed line); this is in line with the effect of a monetary shock on HNPd in the UK (Table 4). Differently, when NFCd is ruled out, the response seems the same (dotted line). This is unexpected since NFCd exhibited a marked response to a monetary shock in the UK (Table 4) and suggests that its marginal contribution is not significant.

As for **Germany**, the GDP response to a monetary shock becomes negative after two periods (third graph in Table 5). When HNPd is excluded, the cumulative GDP response is halved (dashed line); this is in line with the HNPd response to a monetary shock (Table 4). Differently, when NFCd is ruled out, the response seems the same (dotted line). This suggests a non-significant marginal contribution of NFCd for Germany as well.

On the whole, all the three countries considered exhibit a smaller GDP response when HNPd is excluded; but the difference does not seem significant for the US. Accordingly, a positive marginal contribution of households debt emerges. Differently, the marginal contribution of NFCd does not seem to be significant in any country.

6.1 Robustness checks

We have tested the results emerging from Table 5 through a robustness check in which the estimation is based on a shorter sample going from 1980q1 to 2008q4. This shorter sample excludes the financial crisis and the period thereafter which exhibits interest rates constantly at the zero-lower-bound. Moreover, after 2008 the standard relationship between private debt and GDP might have altered for reasons related to the economic recession. The IRFs for this robustness check are in Table 7 in Appendix B.

This check confirms the robustness of the results found for the UK and Germany with regard to

the deep role of households debt. The marginal contribution of NFCd gains weight in the UK in this exercise.

6.2 Discussion of the results

The IRFs in Table 5 are the final output of our analysis. The most direct conclusion that we can draw is that households debt has a role in the transmission mechanism of monetary policy, at least in the UK and Germany. On the contrary, corporations debt does not seem to play a significant role in any of the countries under analysis.

A different weight of households debt with respect to corporations debt was expected given the divergent output of their impulse-response analysis in Table 4: households debt is seen to decrease in response to a monetary shock, while corporations debt never decreases but exhibits a marked increase in Germany and particularly in the UK. Moreover, the output in Appendix A shows that GDP responds much more to a shock in households debt than to a shock in corporations debt.

In the effort to find an explanation for the non-significant result of the US, we notice that the corporations debt's response to a monetary shock does not seem significant in the US (Table 4), while it does in the UK and Germany. Moreover, the response of GDP to a monetary shock (Table 3) is more similar between the UK and Germany (to wit, a positive variation in the first quarter followed by negative ones) than between any of these two countries and the US.

7 Conclusions

In this research work we have studied the marginal contribution of private debt in the transmission of a monetary shock to the real economy. More in details, our objective was to quantify how much of the GDP response to a monetary shock is due to the variation of private debt caused by the same shock. We have based such potential marginal effect on the aggregate demand, to wit, on how expansions/contractions of private debt determine variations of aggregate-demand components; consumption in particular. This piece of research is at the crossroads of two branches of literature: the one on the relationship between debt and growth, and the one studying the transmission mechanism of monetary policy.

The results of our analysis over the 1980q1-2015q4 period suggest that *households and non-profit*

debt plays a role, at least in the UK and Germany. Differently, *non-financial corporations debt* does not seem to play a significant role in any of the three countries considered. Furthermore, our analysis confirms a previous counter-intuitive result in this branch of literature which consists in an increase of corporations debt in response to a monetary tightening. While households debt decreases as expected after a positive monetary shock. GDP responds as expected to a private debt shock too (Appendix A), to wit, it increases. This confirms the basic result in the finance and growth literature.

As for the difference between households and corporations debt in terms of marginal contribution, we believe it to depend upon the different response to a monetary shock of each of these two as well as upon their different impact on GDP. But the explanation of the across-country differences remains more dubious, this point will be object of further research.

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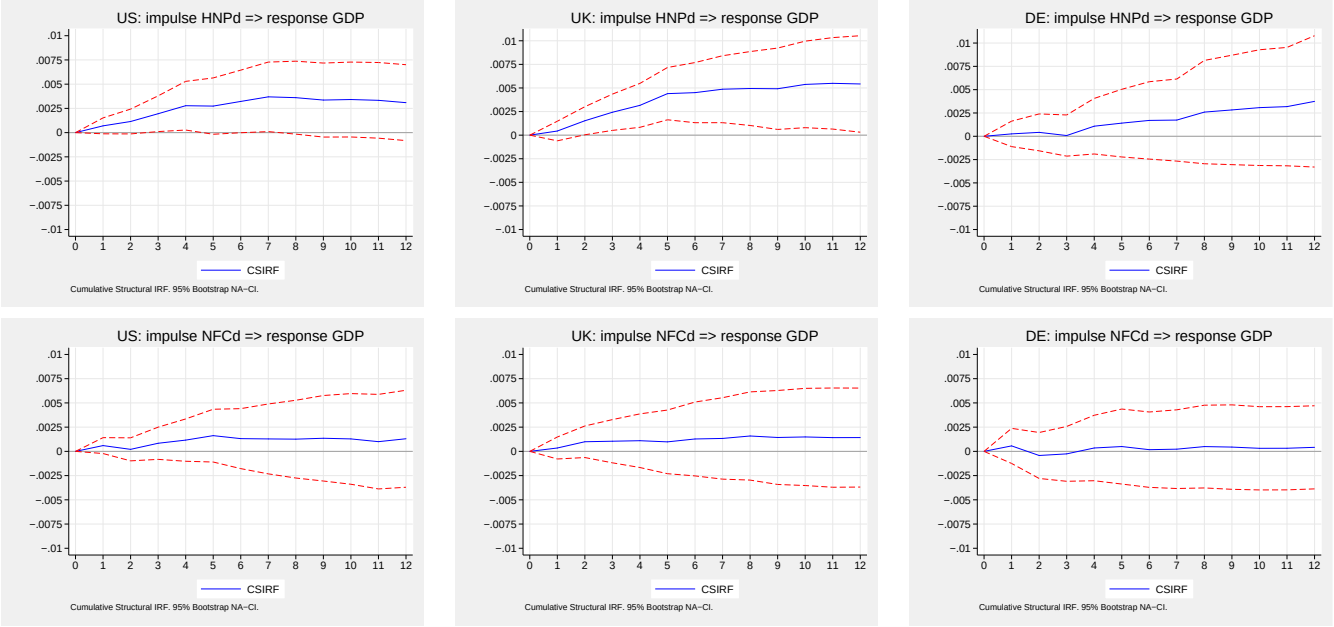
Appendix A. GDP response to a debt shock

We report here the response of GDP to a private debt shock (Table 6). When the shock occurs in HNPd (first row of graphs), the cumulative GDP response is positive for all the three countries considered. When the shock occurs in NFCd (second row of graphs) the cumulative effect is again positive for all the three countries; but Germany's effect does not seem much different from zero. On the whole, HNPd impacts GDP more deeply.

Table 6: Response of GDP to a Private Debt shock (Baseline)



Appendix B. Robustness Checks

Table 7: Full vs Marginal Effects, 1980q1-2008q4 period