# The dynamics of SMEs' capital structure and performance: Evidence from a panel VAR

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**Abstract**

We study the relationship between the capital structure and the performance of unlisted small and medium-sized firms in Germany. We employ a panel vector autoregressive model that allows to consider this relationship in a dynamic sense and accounts for potential endogeneity. While our results show that there is a strongly positive association between leverage and performance for medium-sized firms, we find no relation for small firms. This may be taken as evidence that small firms are unable to seize the performance-enhancing effects of higher leverage, thus refuting the tradeoff theory for this entrepreneurial size bracket.

**EFM Classification:** 140

**Keywords:** SMEs, Panel VAR, Dynamic panel data, Capital structure, Corporate finance

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# 1 Introduction

There is a large literature studying the relationship between firms' capital structures and their performances. Starting with the seminal work by Modigliani and Miller (1958), different capital structure theories have been developed that derive optimal leverage levels in accordance with specific firm characteristics, performance being prime among them.[1] The empirical evidence on the relation between leverage and performance is, however, inconclusive. Though the tradeoff theory posits a positive relation, as higher expected profits should increase the benefits and reduce the costs of higher leverage, several empirical studies find a negative association instead (Rajan and Zingales, 1995; Titman and Wessels, 1988). Recent research gives different reasons for this deviation from the (static) tradeoff theory. One argument states that frictions lead to deviations from the optimal capital structure and that high debt issuance costs keep firms from continuously adjusting their capital structure towards the optimum (Goldstein et al., 2001; Strebulaev, 2007; Morellec al., 2012). Another argument centers on the fact that empirical work typically relates leverage with past performance whereas the tradeoff theory actually refers to future performance (Xu, 2012).

Most of the empirical work on the relation between capital structure and performance employs data on large firms with access to public capital markets (Cassar and Holmes, 2003). Small and medium-sized enterprises (SMEs), in contrast, are rarely analyzed in this context. This is surprising, as SMEs are consistently characterized as the "backbone of the American and the European economies" according to the Office of the United States Trade Representative.[2] SMEs account for two-thirds of all newly created jobs in the US, while more than 70% of the working population in Germany have been employed by SMEs in 2016 (KfW, 2017). The small literature that does exist also typically examines leverage as a driver for performance rather than seeing the latter as an argument for a specific capital structure (Abor, 2007; Ahmad et al., 2012; Le and Phan, 2017). In particular when testing the tradeoff theory, there is a bi-directional causality, however, as the expected performance should lead to a particular leverage choice which, in turn, will yield a specific performance and firm value eventually. Studying both perspectives of the relation between leverage and performance thus appears reasonable, though it poses serious empirical challenges due to the potential

[1] See Harris and Raviv (1991) for a comprehensive overview of capital structure theories.

[2] See `https://ustr.gov/issue-areas/small-business`

endogeneity arising from the bi-directionality.[3]

This is where our work tries to contribute. We study the association between leverage and performance in a large panel dataset of German SMEs and take the bi-directionality of the relation explicitly into account. We model the dynamics of this relationship in a multivariate setting with a panel vector autoregression (PVAR) approach.[4] As this model treats all variables as endogenous it permits us to deal with potential endogeneity problems that may stem from autocorrelation, simultaneity or unobserved heterogeneity in the data. Our results not only shed light on the dynamics of SME finance but also add to the ongoing debate on the causality of the relationship between leverage and performance for this entrepreneurial size bracket. In this respect, our model comes close to two earlier papers that consider the bi-directional relation between capital structure and performance with simultaneous equation systems (Berger and Bonaccorsi di Patti, 2006; Margaritis and Psillaki, 2010), though for large firms rather than SMEs. Simultaneous equation systems need to impose exclusion restrictions on their exogenous variables to render the system identifiable, however. Both studies rely on the ownership structure of the firms under consideration to derive the exclusion restrictions. The PVAR approach, in contrast, allows more flexibility in this regard as it considers all variables as endogenous and not only the limited set of variables that link the equations within the system. Our analysis therefore does not require to place specific restrictions on the variables that we examine.

Within our PVAR model, we are particularly interested in the effect of a change in leverage on performance. Our results show that the impact of such a capital structure shock on performance is not homogenous across SMEs. Rather, we observe no effect at all for small companies. There is, however, a significantly positive effect for medium-sized firms. To some extent, this result is similar to Berger and Bonaccorsi di Patti (2006) who find that a 1% increase in debt leads to a 6% increase in performance in a sample of 7,320 private and public US banks. Their dataset does not, however, relate this association to the size distribution of firms. Further evidence for a positive relation between leverage and performance comes from Margaritis and Psillaki (2007,

[3]Compared to other, more agency-focused capital structure theories, the tradeoff theory nevertheless appears to be particularly applicable to small and medium-sized firms that are very often owner-managed and tightly held in the hand of one family so that agency conflicts rarely arise.

[4]One study that also applies the PVAR method in a corporate finance context is Love and Zicchino (2006).

2010)[5] and Gill et al. (2011), for New Zealand, French and US firms in different industries, respectively. Furthermore, there are a number of studies that analyze the relationship for emerging market companies.[6] Interestingly, these studies consistently find a negative relationship between debt and firm performance. They argue that tax savings from higher debt are notoriously difficult to achieve in emerging market economies whereas the costs of financial distress are equally likely to rise as in developed economies, therefore rendering leverage less beneficial.

The remainder of the paper proceeds as follows: section 2 describes the data and the panel VAR approach; section 3 presents the main results and robustness checks; section 4 concludes.

# 2 Data and methodology

## 2.1 Database

The data used in this study is obtained from the Bureau van Dijk *Dafne* panel database. We collect balance sheet and income statement information on 2,009 German SMEs over the ten-year period from 2006 to 2015, which results in about 24,000 observations. We select the companies based on the European Commission's definition of SMEs, so that their maximum number of employees does not exceed 250 and annual sales are not above 50m Euros. We impose no constraints on the ownership structure or the legal form. Moreover, we do not exclude firms that go bankrupt during our period of observation or enter the sample at a later date. However, we exclude financial institutions [7] in accordance with Fama and French (2002) because of specificities in their financing decisions and differences in their financial statements.

In order to estimate the dynamic relationship between firms' financing decisions and their performance, we compute different measures for leverage and performance. Moreover, we calculate a number of potential control variables, which might also be important for our further analysis. As the data show some faulty outliers,[8] which are likely to lead to biased estimates, we choose a conservative approach and winsorize the

[5]Margaritis and Psillaki (2010) show, however, that the positive relation reverses at high debt levels.

[6]See, amongst others, Abor (2005, 2007), Ahmad et al. (2012), El-Sayed Ebaid (2009), Majumdar and Chhibber (1999), Le and Phan (2017), Salim and Yadav (2012), Zeitun and Tian (2007).

[7]I.e. Standard Industry Classification (SIC) 6000–6700.

[8]For instance, some companies hold more debt than total assets, others have unrealistically high growth rates in sales, or show negative tax rates.

key variables at the 1st and 99th percentile.

Our choice of main variables follows the earlier literature (see, among others, Gleason et al., 2000; Abor, 2005 and 2007; King and Santor, 2008; Margaritis and Psillaki, 2010; Gill et al., 2011; Ahmad et al., 2012; Fosu, 2013; Le and Phan, 2017) and employ the return on equity ($ROE$) and the return on assets ($ROA$) as proxies for firm performance. They are calculated as net income divided by the book value of equity and total assets, respectively. Furthermore, we use the short-term ($SLEV$), long-term ($LLEV$), and total leverage ($TLEV$) as measures for the firms' capital structure. They are calculated as short-term, long-term, and total debt, respectively, divided by total capital. Due to data limitations we approximate short-term debt by subtracting other current liabilities from current liabilities to include interest-bearing current bank credits and trade credits. According to Bundesbank (2015), trade credits play an important role for German SMEs' financing decision and should therefore be included in short-term debt. The choice of control variables is based on Titman and Wessels (1988) and Brailsford et al. (2002). Table 1 reports these variables and further details on their computation.

Table 1: Overview of potential control variables.

| Variable | Measure |
|---|---|
| Growth in sales ($GRO$) | The natural logarithm of the percentage change in sales |
| Profitability ($PROF$) | The ratio of operating income to total assets |
| Efficiency ($EFF$) | The ratio of sales to total assets |
| Firm size ($SIZE$) | The natural logarithm of sales |
| Tax ($TAX$) | The ratio of total taxes paid to sales |
| Liquidity ($LIQ$) | The ratio of current to total assets |
| Tangibility ($TAN$) | The ratio of fixed assets to total assets |
| Intangibility ($INT$) | The ratio of intangible assets to total assets |

Table 2: Distributional properties of key variables and other characteristics.

| | *Panel 1*: Small firms | | | | | *Panel 2*: Medium-sized firms | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $N$ | Mean | SD | Min | Max | $N$ | Mean | SD | Min | Max |
| *Firm performance* | | | | | | | | | | |
| $ROE$ | $11,108$ | 0.110 | 0.222 | $-0.500$ | 0.946 | $11,698$ | 0.236 | 0.321 | $-0.500$ | 0.946 |
| $ROA$ | $12,045$ | 0.031 | 0.085 | $-0.260$ | 0.335 | $12,368$ | 0.056 | 0.081 | $-0.260$ | 0.335 |
| *Capital structure* | | | | | | | | | | |
| $SLEV$ | $11,170$ | 0.021 | 0.036 | 0 | 0.181 | $11,868$ | 0.025 | 0.036 | 0 | 0.181 |
| $LLEV$ | $11,917$ | 0.105 | 0.208 | 0 | 0.833 | $12,415$ | 0.180 | 0.179 | 0 | 0.833 |
| $TLEV$ | $11,170$ | 0.249 | 0.238 | 0 | 0.914 | $11,868$ | 0.310 | 0.255 | 0 | 0.914 |
| *Potential controls* | | | | | | | | | | |
| $GRO$ | $11,721$ | 0.687 | 0.120 | 0.339 | 1.185 | $11,856$ | 0.717 | 0.102 | 0.339 | 1.185 |
| $EFF$ | $12,045$ | 1.508 | 1.309 | 0.068 | 7.150 | $12,044$ | 2.234 | 1.374 | 0.068 | 7.150 |
| $PROF$ | $11,668$ | 0.023 | 0.198 | $-0.928$ | 0.403 | $11,553$ | 0.062 | 0.083 | $-0.928$ | 0.403 |
| $SIZE$ | $12,045$ | 2.175 | 0.709 | $-0.166$ | 2.892 | $12,044$ | 3.309 | 0.266 | 2.892 | 3.848 |
| $TAX$ | $8,484$ | 0.017 | 0.026 | $-0.017$ | 0.129 | $10,405$ | 0.017 | 0.021 | $-0.017$ | 0.129 |
| $LIQ$ | $11,537$ | 0.039 | 0.059 | 0.002 | 0.385 | $12,123$ | 0.031 | 0.050 | 0.002 | 0.385 |
| $TAN$ | $11,917$ | 0.438 | 0.303 | 0.002 | 0.962 | $12,434$ | 0.319 | 0.267 | 0.002 | 0.962 |
| $INT$ | $10,040$ | 0.175 | 0.775 | 0 | 6.412 | $10,039$ | 0.151 | 0.688 | 0 | 6.412 |
| *Other characteristics* | | | | | | | | | | |
| Employees | $11,707$ | 78.790 | 49.110 | 1 | 229 | $12,103$ | 95.190 | 55.410 | 5 | 250 |
| Sales (m EUR) | $12,045$ | 10.500 | 4.741 | 0.834 | 18.020 | $12,045$ | 28.350 | 7.804 | 0.834 | 46.920 |
| Total assets (m EUR) | $12,045$ | 13.850 | 17.840 | 0.552 | 144.400 | $12,534$ | 21.460 | 23.990 | 0.552 | 144.400 |

*Remark:* Statistics of *firm performance*, *capital structure*, and *potential controls* are from winsorized variables and do not contain outliers at the 1st and 99th percentile. The sample is split on the basis of the median $SIZE$.

The summary statistics of our key variables and of other firm characteristics are shown in Table 2. We split the sample in two groups – small firms on the one hand and medium-sized firms on the other – by using the median value of $SIZE$ as a threshold. As might have been expected from economic theory and previous evidence (see, e.g., Beck et al., 2005), small firms' performance is substantially lower on average than that of medium-sized firms. Moreover, small firms seem to use less short-term and long-term debt. Overall, they appear to have fewer growth opportunities and to be less profitable and efficient. While small and medium-sized firms have a similar tax structure, small firms tend to hold more liquidity and use a higher fraction of both tangible and intangible assets.

Figure 1: Average annual $TLEV$.

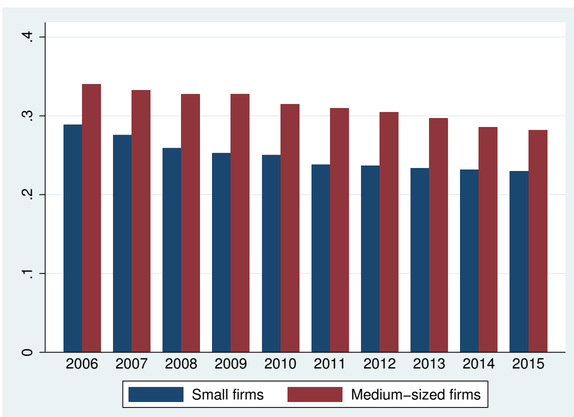
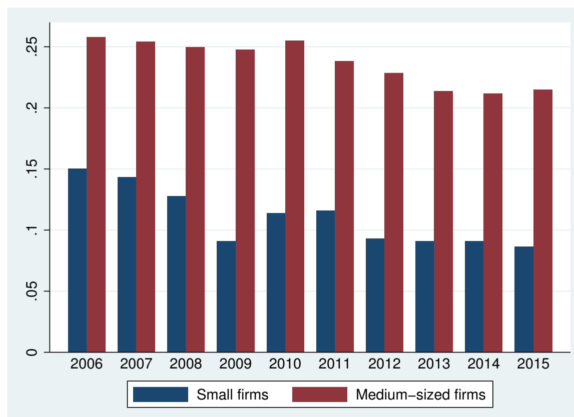



Figure 2: Average annual $ROE$.




Since our period of observation stretches over 10 years, the development of our key variables over time may be interesting. Figures 1 and 2 show the development of $TLEV$ and $ROE$ from 2006 to 2015, respectively. They reveal that our main conclusions from the summary statistics are consistent over the entire observation period: Although there is a downward trend in $TLEV$ for both company types, medium-sized firms have a higher leverage.[9] The same is true for $ROE$. Another interesting point to note is that small firms seem to have been hit harder by the recent global financial crisis in 2007/08 as their $ROE$s show a particularly strong dent in the years immediately following the crisis.

[9]This trend has been observable since the beginning of the 2000s. According to Jostarndt and Wagner (2006), it can be attributed to repeated initiatives by legislative and regulatory bodies to encourage equity financing.

## 2.2 Methodology

We employ a panel vector autoregressive (PVAR) model (see Holtz-Eakin et al., 1988) in order to assess the dynamic relationship between a firm's capital structure and its performance. The PVAR approach is particularly appealing in this context as it allows us to control for prevailing endogeneity problems in a meaningful way. That is, a potential autocorrelation is captured by the lagged terms and any unobserved heterogeneity or simulteneity issues are addressed by the individual-specific effects and the multivariate estimation method, respectively. Moreover, the approach enables us to draw inference with respect to the causality of the relation between the variables considered. This is achieved by combining the time series features of a multivariate VAR model, which is a commonly applied in macroeconomic research, with the advantages of panel data. We specify a homogeneous first-order PVAR model according to

$$\mathbf{w}_{i,t} = \eta_i + \Phi \mathbf{w}_{i,t-1} + \mathbf{e}_{i,t}, \quad \text{with } i = 1, ..., N \text{ and } t = 1, ..., T, \tag{1}$$

where $\mathbf{w}$ is a $(m \times 1)$ vector containing three varbiables: a measure of leverage, a measure of performance, and one control variable. It should be noted that we abstract from including more than three endogenous variables in the model as the number of coefficients increases exponentially and the same applies to strictly exogenous variables. We decide on which control variables to include with regard to the stability of the system; the process will be described below. Subscripts $i$ and $t$ denote the company and year, respectively, and the individual heterogeneity is captured by the company-specific fixed effect, which is indicated by the $(m \times 1)$ vector $\eta$; $\Phi$ denotes the coefficient matrix of dimension $(3 \times 3)$. Finally, $\mathbf{e}$ is a $(m \times 1)$ vector with $\mathbf{e} \overset{iid}{\sim} (0, \Sigma)$.

As an example, consider the case where $\mathbf{w}$ contains the variables $EFF$, $TLEV$, and $ROE$. This amounts to estimating the following system

$$\begin{aligned} ROE_{i,t} &= \eta_i + \phi_{11} EFF_{i,t-1} + \phi_{12} TLEV_{i,t-1} + \phi_{13} ROE_{i,t-1} + e_{ROE,i,t} \\ TLEV_{i,t} &= \eta_i + \phi_{21} EFF_{i,t-1} + \phi_{22} TLEV_{i,t-1} + \phi_{23} ROE_{i,t-1} + e_{TLEV,i,t} \\ EFF_{i,t} &= \eta_i + \phi_{31} EFF_{i,t-1} + \phi_{32} TLEV_{i,t-1} + \phi_{33} ROE_{i,t-1} + e_{EFF,i,t} \end{aligned} \tag{2}$$

simultaneously. Here, $\eta$ is identical for all three equations and only $e$ varies along with the individual company. The regression coefficients $\phi_{kl}$ denote the elements of the $k$-th row and $l$-th column of $\Phi$.

Blundell and Bond (1998) suggest to estimate a PVAR with a system generalized method of moments (GMM) estimator in order to minimize the estimation bias (see

Nickell, 1981) that is induced by the lagged endogenous variables. Another potential bias is caused by the correlation of the fixed effects and the lagged endogenous variables. There are two possible solutions in order to dispose of this correlation: taking first differences or forward mean-differencing. As the Monte-Carlo simulation by Hayakawa (2009) shows for most scenarios that the forward mean-differencing procedure performs better, we choose this approach. This transformation removes the forward-looking annual mean of the variables' future values while retaining the orthogonality condition.

To keep the number of variables sufficiently small, we need to determine which of the control variables to consider for our model. We use a rather technical procedure and estimate the model with every variable and check the system for its stability.[10] This leaves us with only three reasonable candidates for the control variables: $EFF$, $PROF$, and $TAX$.[11]

Our primary interest is in the effect of a change in leverage on performance. Based on the estimated model, we therefore compute ten-step orthogonalized impulse response functions (IRFs) with Monte-Carlo confidence bands at the 5% level. IRFs generally illustrate the reaction of a variable to an innovation (i.e. a one standard deviation change) in another variable, in the absence of any other shocks. In practice, however, this assumption is likely to be violated. The interdependent nature of the variables in the model suggests rather that once one variable is hit by a shock, the other variables will also react immediately. For example, if company $i$ issues new debt in period $t$, the firm's performance will also be affected in $t$ as the additional capital allows the company to pursue new projects and / or realize a tax advantage. We account for this interdependency by orthogonalizing the IRFs. Essentially, this implies that an assumption is imposed on the sequence of the variables. If the first variable in the system of equations is hit by a shock in $t$, it also affects all other variables in $t$. However, a shock to the second variable in $t$ will only affect the third variable in $t$. Is the third variable hit by a shock in $t$, the other variables will not be affected before $t + 1$. According to this logic, we order the variables in the following way: (1) the control variable, (2) the leverage measure, and (3) the performance measure.

[10] The stability condition requires that all roots of $det(\mathbf{I} - \Phi z)$ lie outside the unit circle.

[11] Although $LIQ$ is also a potential control, we discard it after an initial inspection as there are no reactions whatsoever.

# 3 Empirical results

## 3.1 Main PVAR results

We start by analyzing the model for the entire sample, i.e., without differentiating between small and medium-sized firms. We estimate Eq. (1) with $\mathbf{w}$ containing $(ROE, TLEV, EFF)$. Table 3 reports the results of the coefficient matrix $\Phi$ and Figure 3 shows the corresponding IRFs.

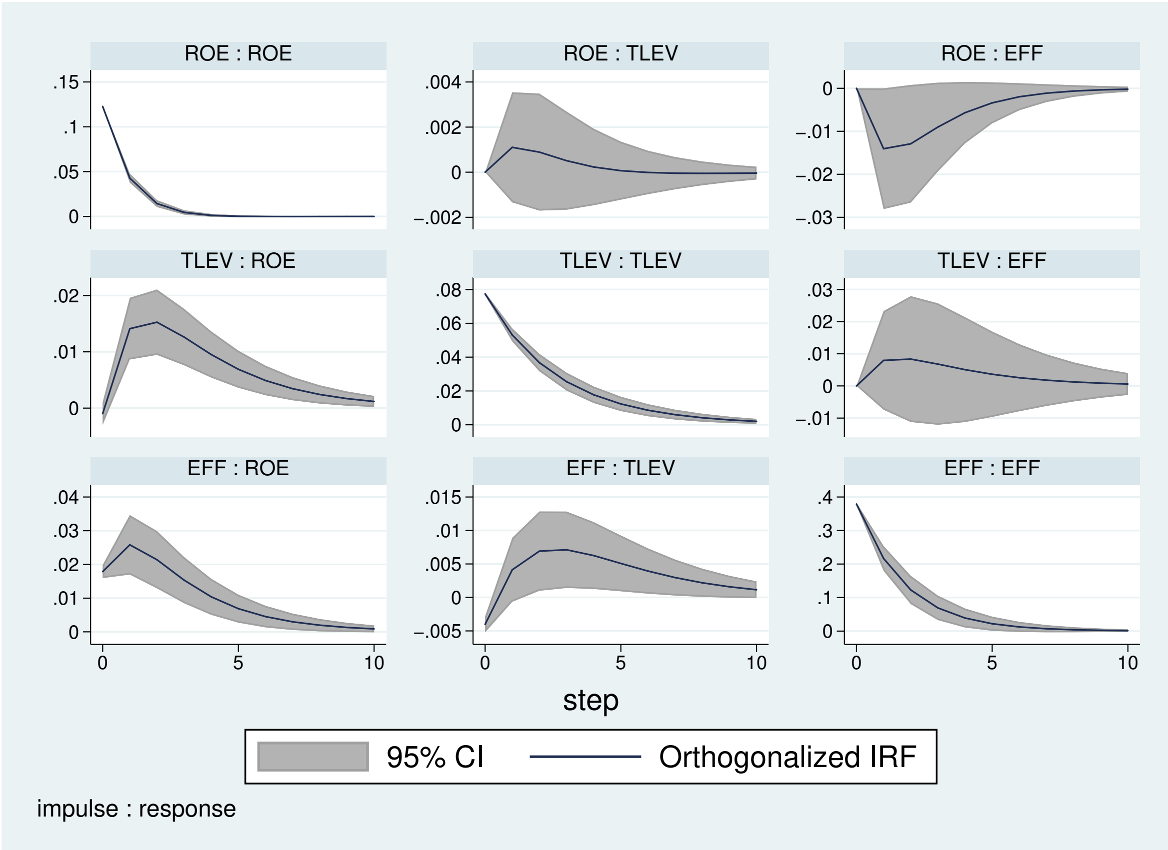
Table 3: Panel VAR results for the full sample.

| | $ROE_t$ | $TLEV_t$ | $EFF_t$ |
|---|---|---|---|
| $ROE_{t-1}$ | 0.348*** | 0.009 | −0.114** |
| | (0.000) | (0.380) | (0.046) |
| $TLEV_{t-1}$ | 0.186*** | 0.686*** | 0.102 |
| | (0.000) | (0.000) | (0.309) |
| $EFF_{t-1}$ | 0.053*** | 0.017*** | 0.578*** |
| | (0.000) | (0.006) | (0.000) |
| Observations | 15,688 | | |
| No. of panels | 2,376 | | |

*Remark:* Coefficients are from a first-order PVAR fixed effects model that is estimated with system GMM and employs forward mean-differencing of the variables. $p$-values derived from robust standard errors are in parentheses. They correspond to a Granger causality Wald test that indicates whether the endogenous variables are caused by the lagged ones. *** and ** indicate statistical significance at the 1% and 5% level, respectively.

Not surprisingly, the results show that all three variable are significant determinants of themselves in the future, i.e., there is positive autocorrelation both for leverage and profitability but also for the control factor, efficiency in this case. Furthermore, the control variable $EFF$ does not only affect itself but also $TLEV$ and $ROE$ so that higher efficiency today leads to both higher leverage and performance in the next period. This finding is rather intuitive as increasing efficiency allows a firm to handle more debt which helps to perform better. Leverage also has a positive effect on next period's performance

Figure 3: Orthogonalized impulse responses for the full sample.




*Remark:* The above IRFs are derived from the results displayed in Table 3; 95% confidence intervals (CIs) are Monte-Carlo simulated with 1000 repetitions.

but not so on future efficiency, whereas performance shows a negative impact on future efficiency but not on future leverage. The IRFs show a similar picture. Although the immediate reaction of $ROE$ to an innovation in $TLEV$ is close to zero, it causes a significant increase by approximately 1.5 percentage points in $t = 1$. According to this result, higher leverage appears to raise performance and, hence, firm value, thus supporting the major capital structure theories even for our sample of SMEs. This relatively straightforward picture changes considerably, however, when the sample is split into small and medium-sized firms.

Table 4 shows the results from two individual PVAR estimations for small and medium-sized firms, respectively. Figure 4 displays the corresponding orthogonalized IRFs. Panel 1 focuses on small firms only. As can be seen, all three variables are still significantly autocorrelated. However, the magnitude of the autocorrelation effect of $EFF$ decreases by more than 75% as compared to the effect in the full sample.

Table 4: Panel VAR results for small and medium-sized firms in isolation.

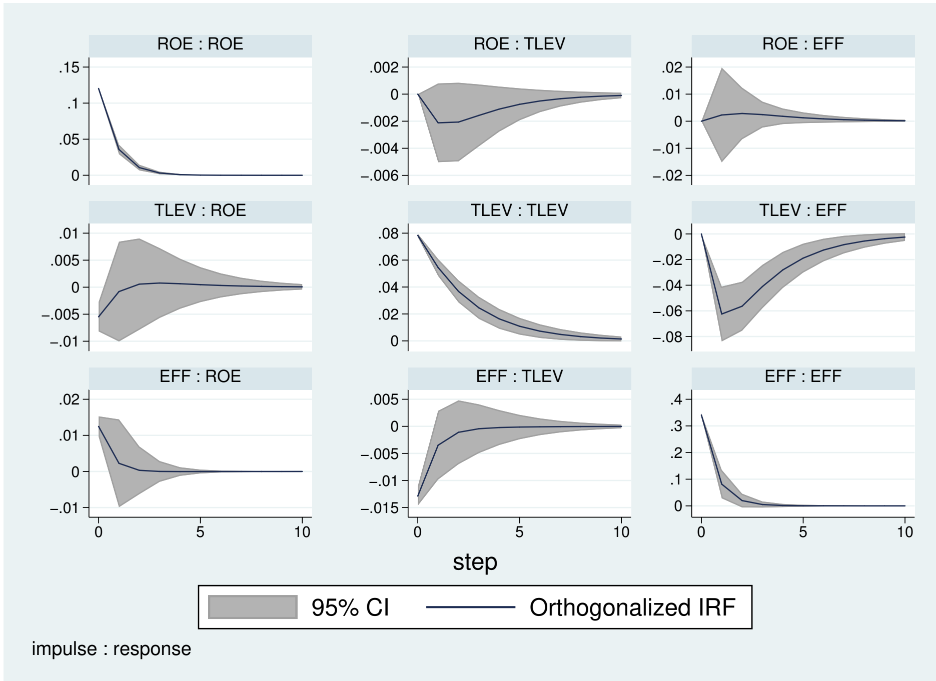
| | *Panel 1*: Small firms | | | *Panel 2*: Medium-sized firms | | |
|---|---|---|---|---|---|---|
| | $ROE_t$ | $TLEV_t$ | $EFF_t$ | $ROE_t$ | $TLEV_t$ | $EFF_t$ |
| $ROE_{t-1}$ | 0.298*** | −0.018 | 0.019 | 0.394*** | 0.039** | −0.309*** |
| | (0.000) | (0.175) | (0.797) | (0.000) | (0.016) | (0.002) |
| $TLEV_{t-1}$ | 0.010 | 0.694*** | −0.796*** | 0.313*** | 0.675*** | 0.789*** |
| | (0.861) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| $EFF_{t-1}$ | −0.004 | 0.017* | 0.208** | 0.089*** | 0.018** | 0.836*** |
| | (0.839) | (0.087) | (0.013) | (0.000) | (0.039) | (0.000) |
| Observations | 7,545 | | | 8,143 | | |
| No. of panels | 1,490 | | | 1,499 | | |

*Remark:* Coefficients are from a first-order PVAR fixed effects model that is estimated with system GMM and employs forward mean-differencing of the variables. The sample is split on the basis of the median of $SIZE$. $p$-values derived from robust standard errors are in parentheses. They correspond to a Granger causality Wald test that indicates whether the endogenous variables are caused by the lagged ones. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

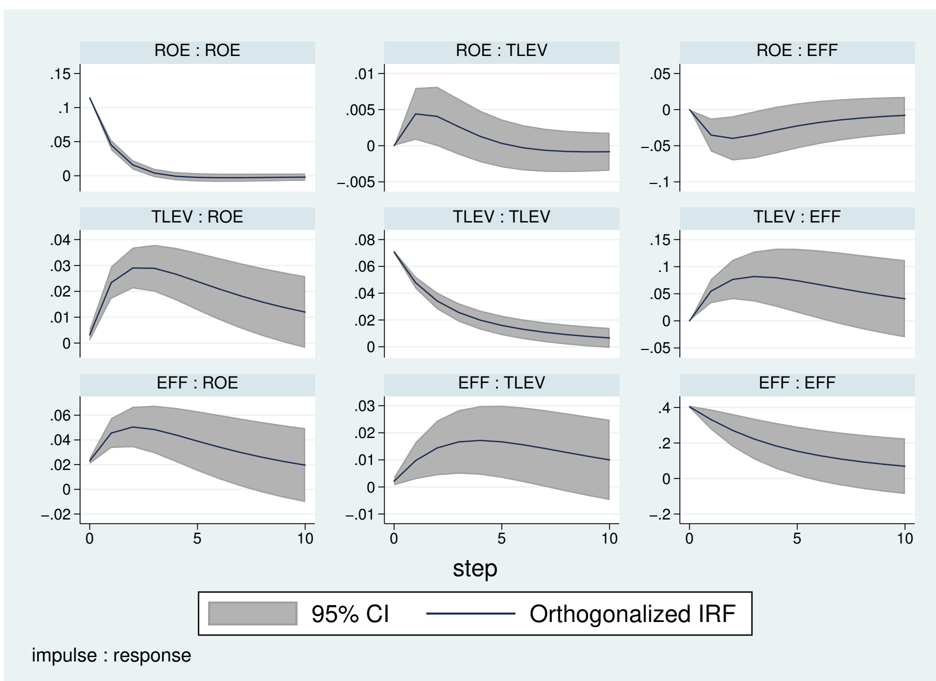
The efficiency of small firms hence appears to be less persistent. While efficiency still has a weakly significant positive effect on future leverage, the effect of leverage on future efficiency turns out to be negative. Additional debt hence appears to make small firms less efficient. Most remarkably, however, the influence of leverage on performance vanishes completely. The IRF even indicates that there might be a negative effect of leverage on profitability in the first period, which then quickly turns into a zero influence in the following periods. Small firms' performance hence does not appear to be in any way affected by changes in their capital structure. And vice versa, performance does not seem to cause specific capital structure choices for these firms.

Comparing these results to the case of medium-sized firms in Panel 2 of Table 4 shows that the significant effects from the total sample in Table 3 are driven by the medium-sized firms. The fact that all relationships show significant coefficients suggests that there are stronger interdependencies for the larger firms in our sample. With regard to the bi-directional association between leverage and performance, our estimates are not quite straightforward, as both leverage influences futuer performance positively and performance affects future leverage positively.

Figure 4: Orthogonalized impulse responses with size differentiation.




(1) IRFs for small firms.




(2) IRFs for medium-sized firms.

*Remark:* The above IRFs are derived from the results displayed in Table 4; 95% confidence intervals (CIs) are Monte-Carlo simulated with 1000 repetitions.

However, the difference in effect sizes (0.313 vs. 0.039) and the IRFs suggest that a shock to $TLEV$ increases $ROE$ in the first period after the shock by 2.5 percentage points, whereas there is only a minor (and barely significant) reaction of $TLEV$ if $ROE$ is hit by a shock.

Altogether, our results indicate that the capital structure choice can be an important driver of performance for medium-sized firms. A higher leverage raises performance for these firms quite strongly, while there is only weak evidence for the reversed effect. For small firms, in contrast, we do not find a significant association between leverage and profitability, irrespective of the direction of causality. This may be interpreted in two ways: either as a sign of a deep wedge between capital structure decisions and profitability, potentially caused by capital constraints, for small firms or as an indication of small firms' performance stability. In either case, capital structure decisions do not appear to be overly important for the small firms in our sample, but they are indeed very important for the medium-sized firms.

## 3.2 Robustness checks

In order to ensure that the above results are no statistical artefacts we conduct various robustness checks. That is, we estimate the model again with each control variable (either $EFF$, $PROF$, or $TAX$) included in one PVAR model. For the purpose of clear arrangement, we report only the sign and magnitude of the initial reaction of one performance measure (either $ROE$ or $ROA$) resulting from a shock on leverage (either $SLEV$, $LLEV$, or $TLEV$).[12] The following scheme is applied: We assess the impact of leverage on performance for each possible combination of the variables and assign different indicators with respect to the magnitude of the reaction. For example, if the maximum positive reaction is a 3 percentage point increase, we assign +++ for values greater than 0.02, ++ for values $\in (0.01, 0.02]$, and + for values $\in (0, 0.01]$. The opposite applies to negative values. If a response is not significantly different from zero, we simply assign a 0.

[12]The IRFs for the differentiated estimations can be found in the Appendix.

Table 5: Magnitude of the effect on firm performance resulting from a shock on capital structure.

| | All firm sizes | | | Small firms | | | Medium-sized firms | | |
|---|---|---|---|---|---|---|---|---|---|
| | $EFF$ | $PROF$ | $TAX$ | $EFF$ | $PROF$ | $TAX$ | $EFF$ | $PROF$ | $TAX$ |
| *Panel 1*: $ROE$ | | | | | | | | | |
| $TLEV$ | $+++$ | $+$ | $+$ | 0 | 0 | 0 | $+++$ | $+++$ | $+++$ |
| $SLEV$ | $++$ | $++$ | $++$ | 0 | 0 | 0 | $+$ | $+++$ | $+++$ |
| $LLEV$ | $+$ | $+$ | $+$ | 0 | 0 | 0 | $++$ | $+$ | $+$ |
| *Panel 2*: $ROA$ | | | | | | | | | |
| $TLEV$ | $-$ | $--$ | $---$ | $---$ | $--$ | $---$ | $+$ | $+$ | $+$ |
| $SLEV$ | $--$ | $-$ | $-$ | $---$ | $--$ | $--$ | $+$ | $+$ | $+$ |
| $LLEV$ | $-$ | $--$ | $---$ | $--$ | $--$ | $--$ | $+$ | $+$ | $+$ |

*Remark:* The above scheme classifies the magnitude and the direction that a shock on a leverage measure – i.e. either $TLEV$, $SLEV$, or $LLEV$ – has on firm performance, i.e. $ROE$ or $ROA$. If the reaction is not statistically significant, we assign a 0.

Table 5 summarizes all findings, where Panel 1 (Panel 2) reports the results using *ROE* (*ROA*) as performance measure. Although there is a consistently positive reaction of *ROE* when using the entire sample, this reaction disappears entirely if only small firms are cosidered. For medium-sized firms the reaction increases in almost all cases.[13] When the *ROA* is used instead of the *ROE*, the reaction of small firms even becomes negative. However, this is most likely explained by the changing capital structure and its effect on the balance sheet. For example, if a firm adds debt but keeps its equity constant the firm's assets have to increase proportionally to the increment of debt. Now, as the *ROE* does not appear to change, there is no increase in the operative performace. Hence, the *ROA* has to go down. The effect is yet positive for medium-sized firms but considerably smaller relative to the *ROE*, which might have been expected as it can be explained by the same argument.

This evidence suggests that the choice of capital structure has no causal effect on small firms' value, approximated by financial performance. The implication of our finding is that the validity of capital structure theories for small firms appears to be very limited. This does not hold for medium-sized firms, in contrast, as they show a statistically and economically significant reaction. The effect of size on the relation between capital structure and performance that our results present is particularly surprising since both small and medium-sized firms in our sample are not publicly listed. I.e., they both do not have access to capital markets but refer to either banks or their owners (very often: the founding family) for new capital injections.

# 4 Conclusion

This study provides empirical evidence on the question whether the choice of capital structure has an effect on the value of small and medium-sized firms. In a broader sense, we question the applicability of capital structure theories in the context of SMEs. We achieve this by applying the PVAR method, which allows us to circumvent endogeneity issues and to draw inference on the dynamics and causality of capital structure and performance (and, by extension, firm value).

To some extent our findings speak in favor of the tradeoff theory as there appears to be a positive causal effect going from leverage to profitability for medium-sized firms, which implies that for medium-sized firms the benefits of additional debt outweigh po-

[13] Except for the *SLEV* case.

tential distress costs. This is in line with the findings of Danis et al. (2014). However, small firms do not seem to be affected by innovations in leverage at all. Hence, our evidence may tie in with earlier arguments (see, e.g., Chittenden et al.,1996) on the lacking access to capital that small firms appear to have. Alternatively, it may simply speak to the robustness of small firms' profitability. As we find no effect of capital structure on performance, we argue in any case that traditional capital structure theories need to be applied with caution in the context of small unlisted firms. As Ardalan (2017) argues, theories expressed through mathematical models are driven by a set of often strong assumptions. Of course, the outcome and thus the implications of these models stand and fall with these assumptions. As small and medium-sized firms account for a majority of job providers, for example in the US and Germany, improving the current understanding of SME finance and its consequences appears particularly valuable.

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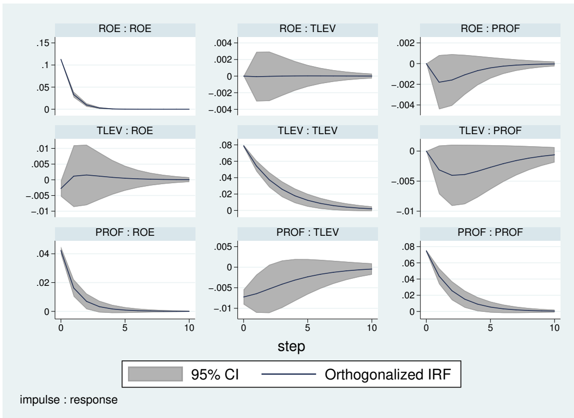
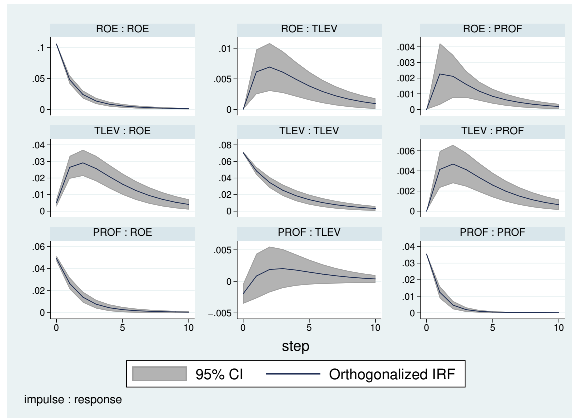
# Appendix

Appendix A: Orthogonalized impulse responses with $ROE$ and $TLEV$.




(1) Small firms; control: $PROF$.

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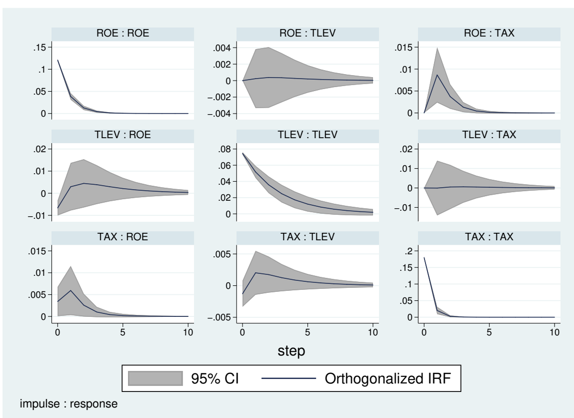
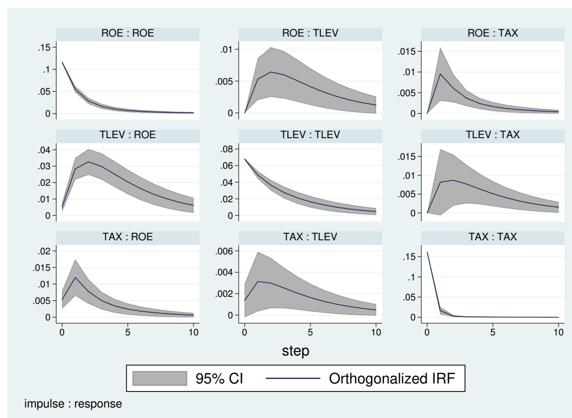


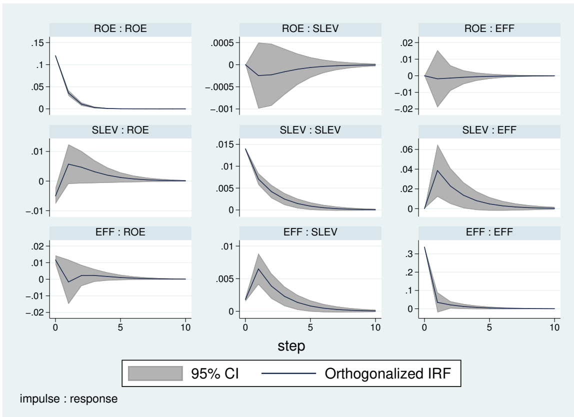

(3) Small firms; control: $TAX$.




(4) Medium-sized firms; control: $TAX$.

*Remark:* The 95% level confidence intervals (CIs) are Monte-Carlo simulated with 1000 repetitions.

Appendix B: Orthogonalized impulse responses with with $ROE$ and $SLEV$.

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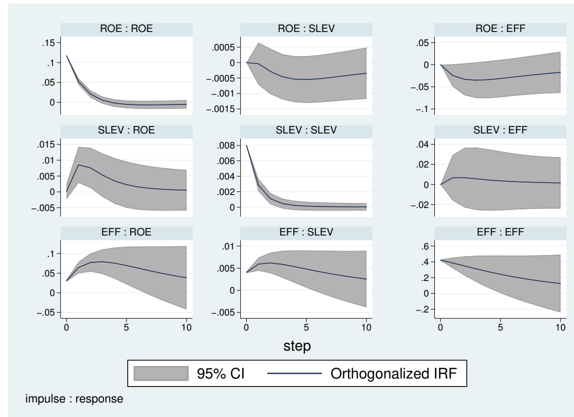


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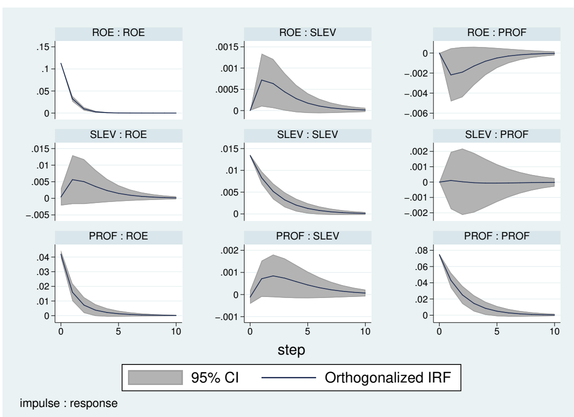


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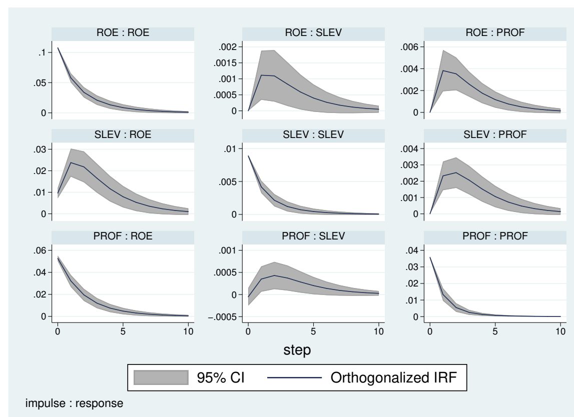


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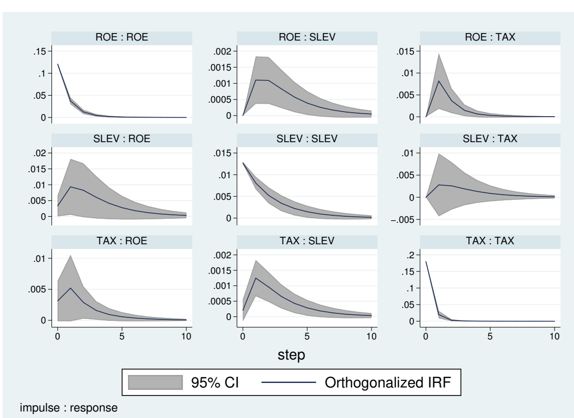


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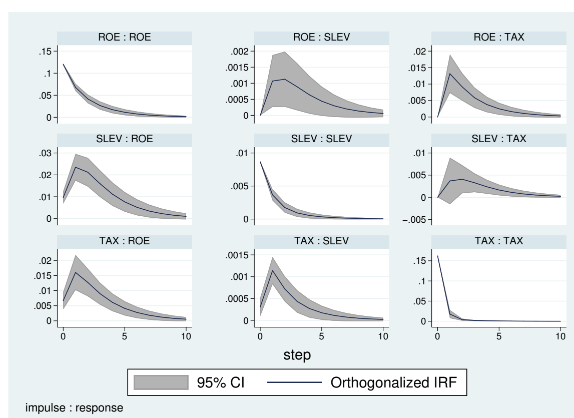
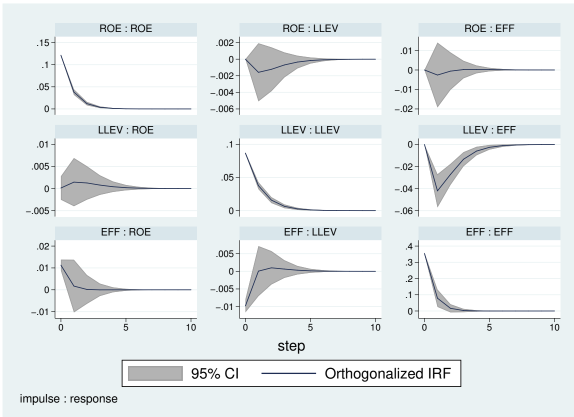



(6) Medium-sized firms; control: $TAX$.

*Remark:* The 95% level confidence intervals (CIs) are Monte-Carlo simulated with 1000 repetitions.

Appendix C: Orthogonalized impulse responses with with $ROE$ and $LLEV$.

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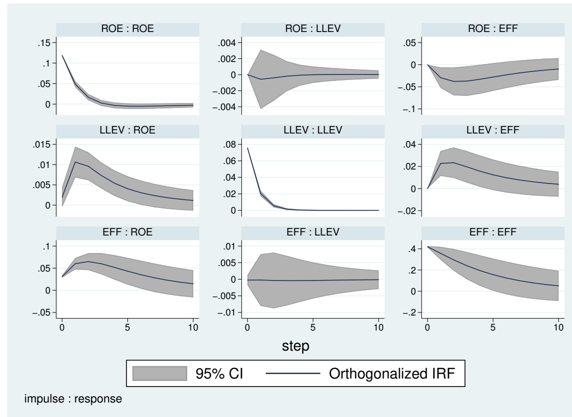


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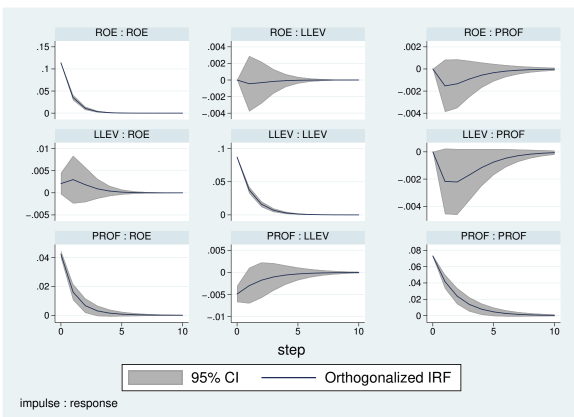


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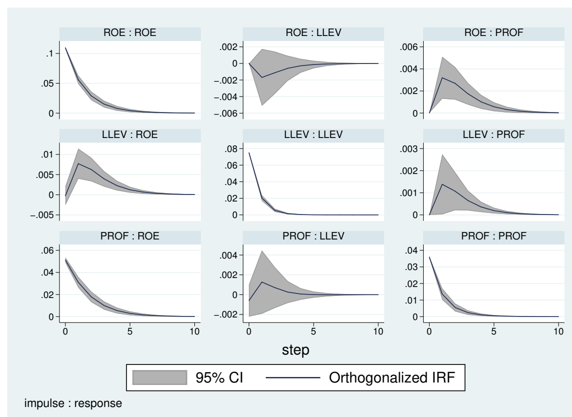


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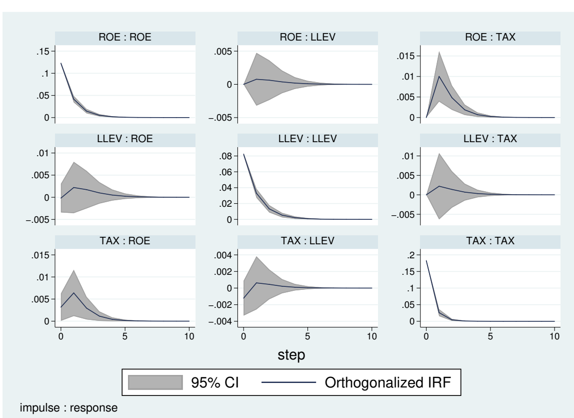


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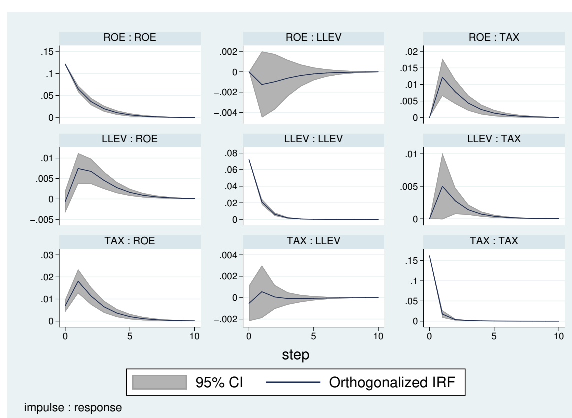
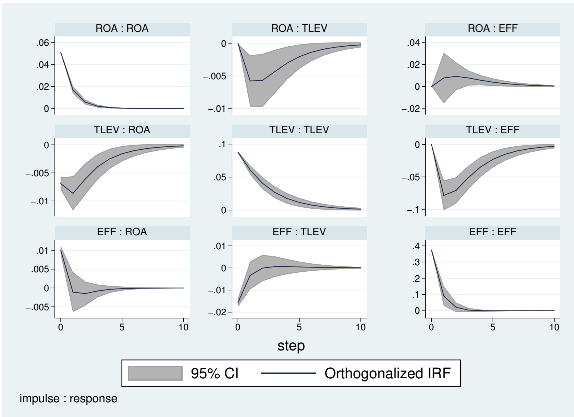



(6) Medium-sized firms; control: $TAX$.

*Remark:* The 95% level confidence intervals (CIs) are Monte-Carlo simulated with 1000 repetitions.

Appendix D: Orthogonalized impulse responses with $ROA$ and $TLEV$.

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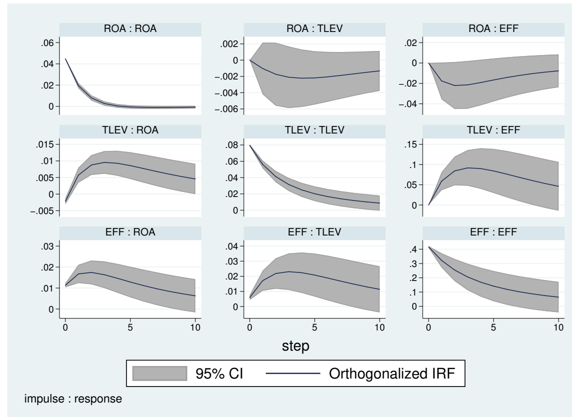


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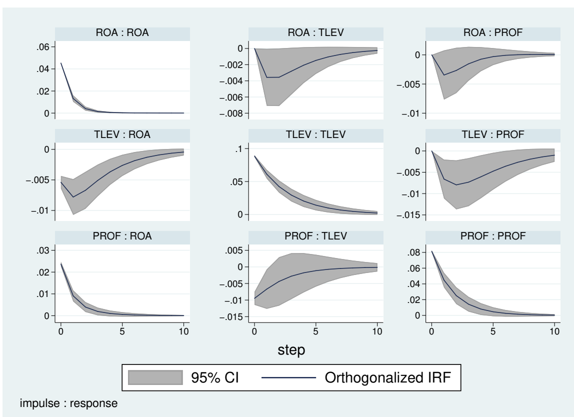


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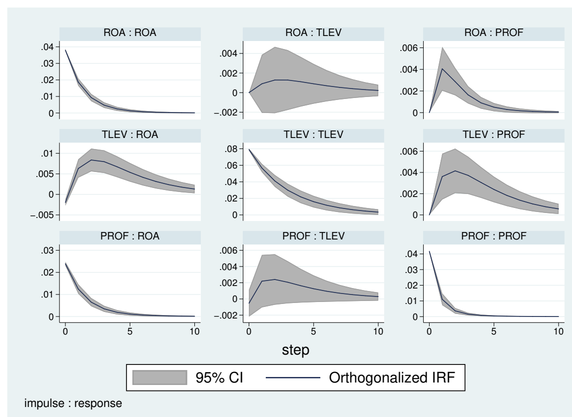


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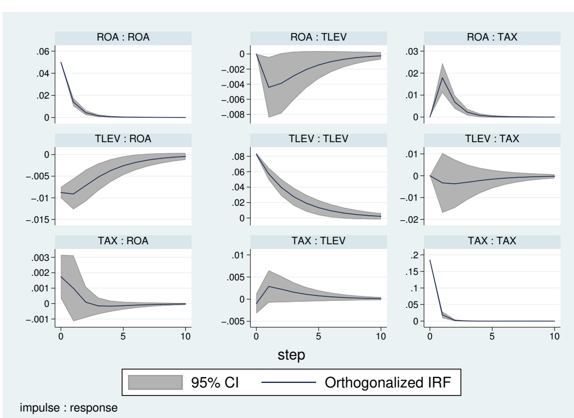
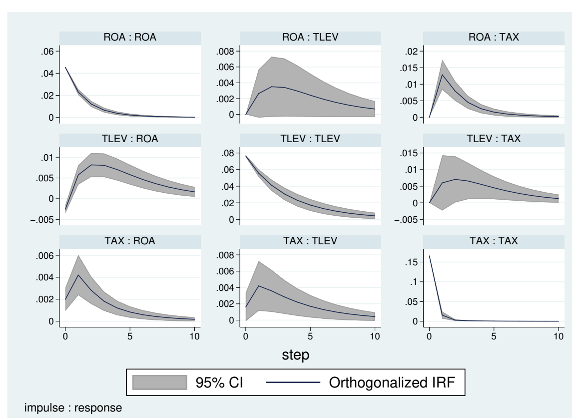


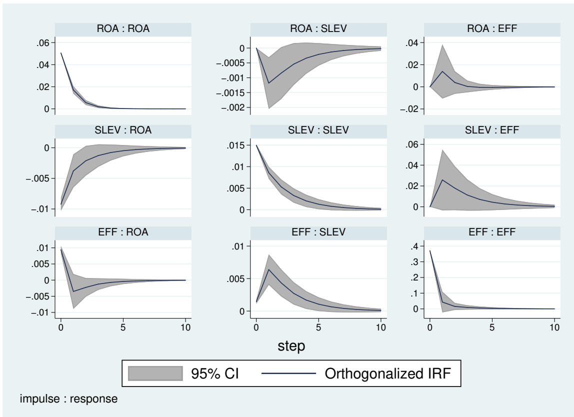

(5) Small firms; control: $TAX$.




(6) Medium-sized firms; control: $TAX$.

*Remark:* The 95% level confidence intervals (CIs) are Monte-Carlo simulated with 1000 repetitions.

Appendix E: Orthogonalized impulse responses with $ROA$ and $SLEV$.

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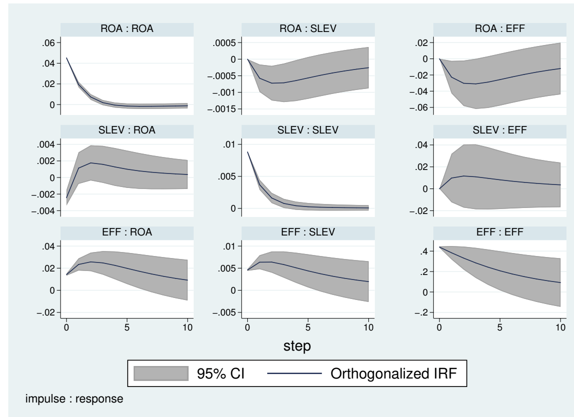


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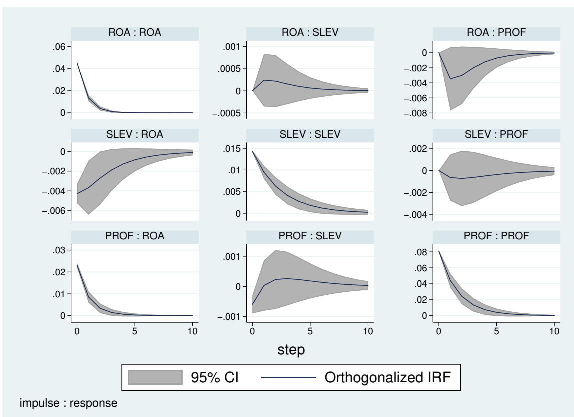


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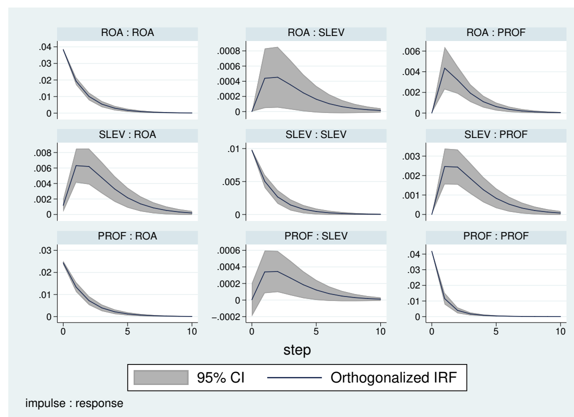


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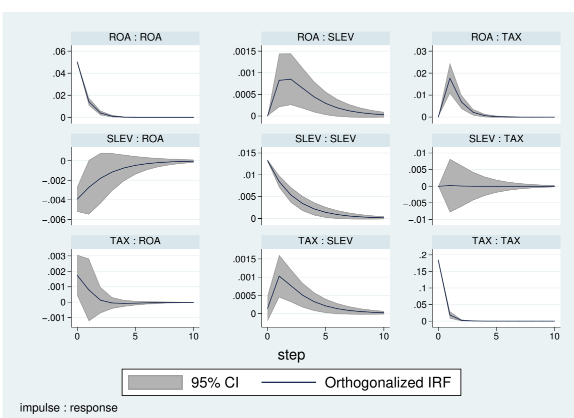


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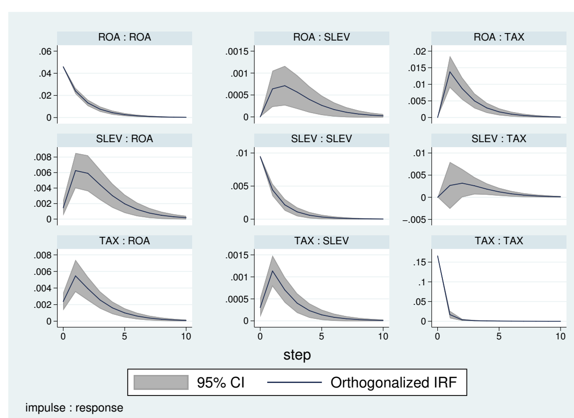
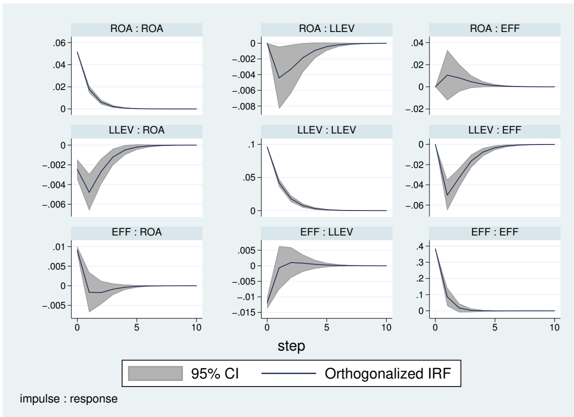



(6) Medium-sized firms; control: $TAX$.

*Remark:* The 95% level confidence intervals (CIs) are Monte-Carlo simulated with 1000 repetitions.

Appendix F: Orthogonalized impulse responses with $ROA$ and $LLEV$.

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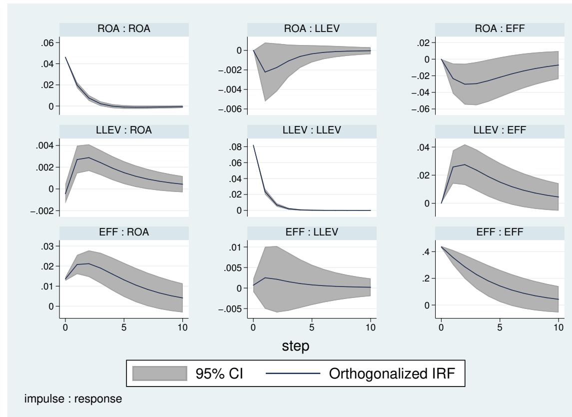


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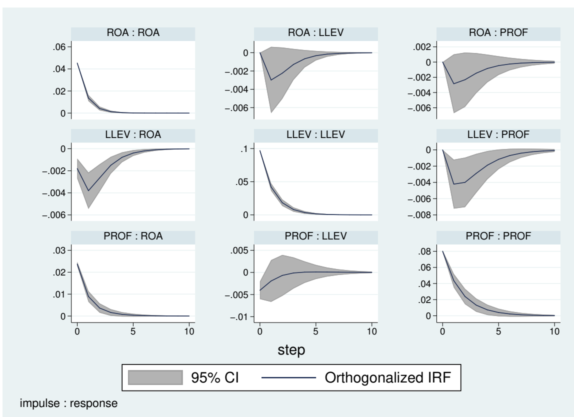


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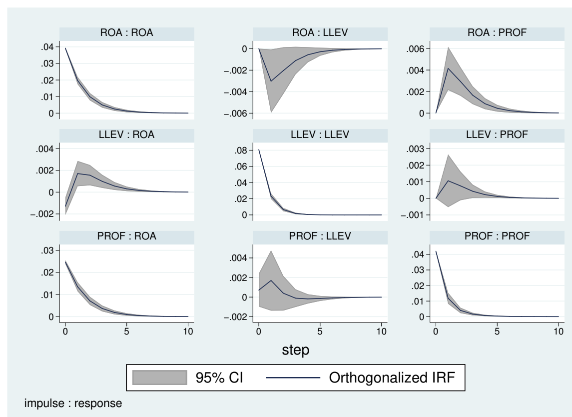


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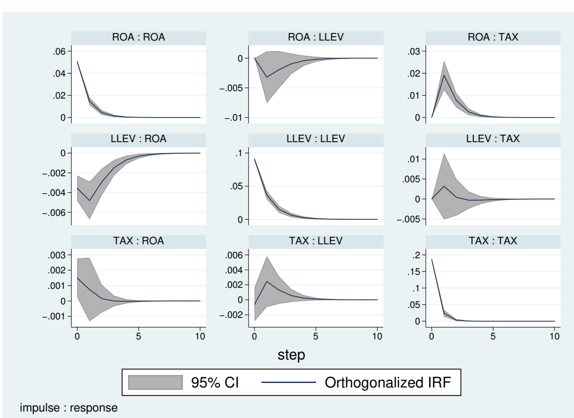


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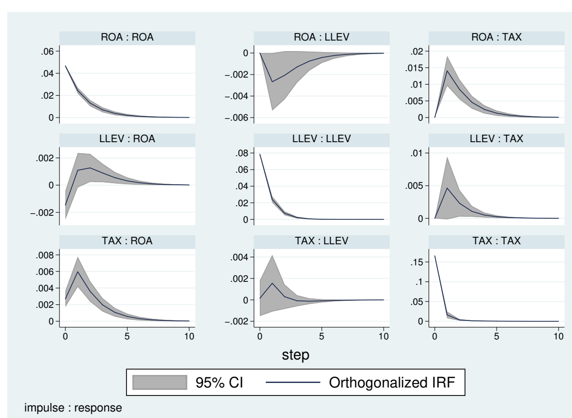


(6) Medium-sized firms; control: $TAX$.

*Remark:* The 95% level confidence intervals (CIs) are Monte-Carlo simulated with 1000 repetitions.