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Analysis of the debt burden in Russian economy sectors ☆

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Abstract

This paper provides an analysis of the debt burden of Russian companies and raises the issue of debt-level heterogeneity across economic sectors. To identify the causes of this heterogeneity, it estimates a regression model that includes both fundamental explanatory variables of companies and industry fixed effects. The results of the analysis demonstrate that standard variables, such as profitability, company size, asset turnover, and fixed-asset turnover ratio have a strong statistical significance. However, these do not fully explain the variation in the debt levels of companies in different sectors. According to model estimation, there are other industry specific factors that produce an imbalance between fundamental factors and companies' debt levels. An understanding of the formation process and structure of debt burden in individual industries is extremely important for the financial stability of companies and for an effective monetary policy.

JEL classification: C23, D24, E44, G32.
Keywords: debt burden, capital structure, sector analysis, microdata of Russian companies, emerging markets.

1. Introduction

The development and implementation of an effective monetary policy calls for a profound understanding of lending processes and the debt burden at the company level. High debt increases risks to financial stability and can act as a constraint

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on the sustainable development of companies and economic sectors. A large debt burden objectively constrains lending on both supply and demand sides.

The debt burden is also important for the entire financial system. Credit accumulation creates additional risks to the resilience of the banking system and limits the effectiveness of monetary and fiscal policies (Schäuble, 2015). Thus, high levels of debt undermine the ability of the central bank to have an impact on the economy.

Additionally, the influence of the debt burden on firms' investment activity should be noted. A number of studies have proven the negative relationship between the level of debt and investment, that is, the so-called "debt overhang" (Sholomitskaya, 2016). The effect observed has a varying impact according to the phase of the economic cycle. In crisis and post-crisis periods, the correlation between these factors becomes stronger. This effect must be taken into account in monetary policy making, because the central bank has a direct influence on real debt through inflation and interest rates. Therefore, an analysis of the factors that influence the debt burden remains a critical issue for a study of the financial system.

Aggregate data on the debt liabilities of firms show that the median company's debt level varies strongly according to type of economic activity (Donets and Ponomarenko, 2015). It is important to understand if the heterogeneity observed is a reflection of reality, or if it shows that sectors vary widely with respect to debt accumulation because credit supply and demand shocks have a strong impact on economic activity. The debt overhang in some sectors or lack of debt in others can have a significant impact on economic growth.

This study presents the results of an analysis of fundamental and industry specific factors and their influence on company debt levels. Using a regression analysis method based on the data of Russian companies, we determined that fundamental factors are significant in explaining the variation of the debt burden; however, they do not account for all of the debt heterogeneity. The results showed the existence of certain industry fixed factors that determine different values of the debt burden in individual sectors.

The rest of the paper is organized as follows: in Section 2 we provide a literature review on theoretical approaches to the identification of factors determining capital structure and debt level. Section 3 outlines brief data descriptions and the research hypothesis. Section 4 presents the main results and their economic interpretation. The paper concludes with Section 5. The Appendix contains additional details of the model estimation.

2. Literature review

Debt burden is directly related to the concept of capital structure. The capital structure of a company is the ratio between its equity and borrowed funds. A large number of research papers have been dedicated to determining an optimal capital structure that maximizes the company's value, and in particular, to determining the optimal capital structure and factors affecting decisions regarding this structure.

The majority of theories are based on the Modigliani-Miller theorem on the independence of a company's value from its capital structure; that is, for companies, debt and equity finance are interchangeable. This theorem only works in perfect capital markets without transaction or agency costs. Under weakened

assumptions, the theorem does not hold, which leads to other theories explaining how capital structure is formed in imperfect financial markets.

We begin with two fundamental theories in which the assumptions of a perfect capital market are weakened. One of the theories, the trade-off theory (Kraus and Litzenerger 1973; Myers, 1984), assumes that companies decide on an optimal debt size based on a compromise between the benefits of a tax shield and the losses due to the risk of insolvency. The simple static model examines a company that only exists for one period (i.e., at the end of the period the company will have no remaining funds). The following conclusions are derived from this model: rising costs of financial volatility and insolvency, the growth of the non-debt tax shield, and the reduction of taxes on equity decrease the optimal debt level. Since the static model encompasses a single period, this model does not take into account retained earnings as an important source of internal financing. In the dynamic model, as the company exists for more than one period, it may deviate from the optimal capital structure, use retained earnings for financing, and take market imperfections (transaction costs) into account (Kane et al., 1984; Fischer et al., 1989).

The second basic theory, the pecking order theory (Myers, 1984), sets the procedure for the preferred formation of financial resources in increasing order by the cost of the type of financing. According to companies, it is most rational to initially use internal sources, followed by external debt and, lastly, resort to external funding through equity financing. That sequence arises as a result of information asymmetry in the financial market, which leads to the adverse selection problem and increasing transaction costs.

There are a number of empirical studies that analyze the explanatory power of these theories: a series of fundamental variables (described below) are included in the model. Depending on the sample studied, the tested hypothesis and set of explanatory factors, authors reach various conclusions that range from partial compatibility with the theories to their complete contradiction. The study (Frank and Goyal, 2007) closely examined these theories, carried out a review of key studies on the subject, and presented the results of the empirical verifications. In particular, the authors discovered that in the long run, the aggregate level of debt was stationary, which did not quite correspond to the trade-off and pecking order theories. Fundamental factors like profitability, company size, asset structure, etc., proved significant in accordance with the theories. In a different study (Titman and Wessels, 1988), a significance of several fundamental factors (tax shield, income volatility, asset value, etc.) was not found. However, the authors showed a dependency on company size and the uniqueness of production. Using company manager surveys, Bancel and Mittoo (2004) found that determinants, such as tax advantages and bankruptcy costs, are not the determinants of an optimal capital structure, contradicting the trade-off theory.

There are indeed other trends in capital structure formation and factors that determine differences in the structure and levels of debt among companies. Bancel and Mittoo (2004) showed that factors that guided managers in decisions on capital structure are the same in Europe and the United States. However, the significance of these factors depends on the institutional characteristics of the country. A different study (Rajan and Zingales, 1995), based on the G7 countries, showed that financial leverage and capital structure are approximately equal among countries, while the variation observed in the data is attributable merely to a difference

in the financial reporting methodology. As for factors that account for the debt level, their correlation is similar among the countries studied.

Various factors influence the determination of companies' capital structures: macroeconomic, institutional, and company-specific factors. In addition, a number of studies have investigated the between-industry difference of capital structure and debt burden. Bowen et al. (1982) advance a hypothesis of a statistically significant difference in the average level of debt among industries, confirmed by parametric and non-parametric tests. At the same time, a different study (MacKay and Phillips, 2005) showed that industry fixed effects account for only 13% of capital structure variation. Within-industry factors (industry position, interaction with competitors, company status as entrant, incumbent, or exiting firm, and company concentration in the industry) have a statistically significant impact and account for a large share of the within-industry capital structure variation.

Various levels of debt can be caused by technological and manufacturing differences, along with differing levels of export potential and degrees of state support. During an economic crisis, the interest in studying industry risk factors increases, as sectors react differently to various macroeconomic shocks and ongoing national economic developments, due to individual characteristics. It is extremely important to take these factors into account when pursuing monetary policy.

Here, we consider the debt level as the ratio of the sum of long-term and short-term liabilities to total assets across industries of the Russian economy. According to macro data for 2010–2015, it can be seen that this indicator's average varies substantially (Fig. 1). The mining and quarrying industry in the period under review has the lowest average indicator; for construction, the debt burden is twice as high. The heterogeneity of the debt burden among sectors owing to

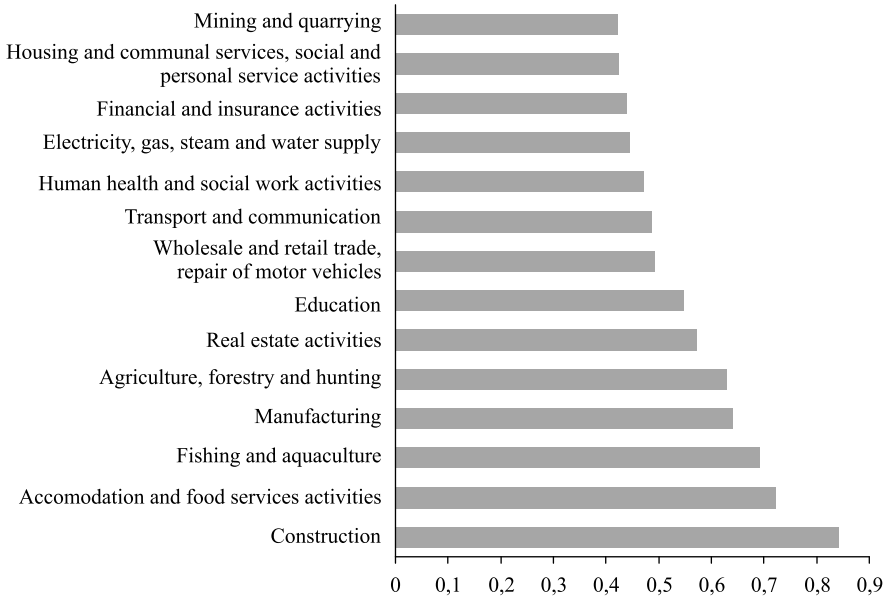

Fig. 1. Average debt burden (the ratio of the sum of long-term and short-term liabilities to total assets) for 2010–2015 by the type of economic activity.

Sources: Rosstat (P-3 Form Data "Information on Companies' Financial Standing"); authors' calculations.

their particular operations is confirmed by the above-mentioned studies (MacKay and Phillips, 2005).

At the macro level, the heterogeneity in between-industry debt levels is apparent. This study will test the hypothesis of statistical differences of debt levels across industries on microdata from Russian companies.

3. Methodology

3.1. Variable construction

A fairly broad list of different factors can have an impact on firms' debt levels. A large number of studies have been dedicated to the analysis of capital structure in relation to companies, sectors, and countries; different determinants are used according to objective. A list of variables used in early international research will be provided and the basis for their inclusion in the model discussed.

Profitability. Theories on capital structure advance various proposals about the nature of the relationship between a business's debt and its profitability. The trade-off theory (Kraus and Litzenberger, 1973; Frank and Goyal, 2007) predicted a positive correlation between companies' profitability and debt burden: more profitable companies have a lower probability of bankruptcy; consequently, their costs of additional debt attraction are lower. Since then, the dynamic trade-off theory has shown that the correlation between debt and profitability is more complex and can be negative (Jensen, 1986; Strebulaev, 2007).

Let us recall that, according to the pecking order theory (Myers, 1984; Titman and Wessels, 1988), all companies first use accumulated earnings to finance their activity and resort to external borrowing only when necessary. Thus, the pecking order theory predicts a negative correlation between debt level and profitability. The larger the company, the stronger the correlation (Rajan and Zingales, 1995).

Company size. Capital structure theories interpret the impact of this factor on debt in different ways (Frank and Goyal, 2007). Large companies are more diversified, and therefore their probability of bankruptcy should be lower than that of small companies. Thus, according to the trade-off theory, there is a positive correlation between company size and debt level. However, the liquidation process for large companies can be far more complex and expensive under existing legislation. Consequently, in this case, the relationship can become negative.

According to the pecking order theory, the relationship between company size and level of debt will be ambiguous. Owing to reputation (a smaller adverse selection problem, lower agency costs), large companies can use less expensive equity financing; consequently, they require less debt attraction. However, many assets can also exacerbate the adverse selection problem.

The results of an empirical test of capital theory by Titman and Wessels (1988) also showed that the effect of size on debt level differs according to the time structure of liabilities: small companies are more prone to use short-term borrowing than large companies.

To evaluate company size, the studies use indicators, such as asset value relative to sector average asset value, revenue logarithm, etc.

Growth opportunities. On the one hand, company growth means an investment flow and a rise in the welfare of the business owners, which makes it directly possi-

ble to lower the debt level and use internal funds (Rajan and Zingales, 1995; Titman and Wessels, 1988). On the other hand, growing companies with increasing investments, assuming fixed profitability, are obliged to somehow accumulate the necessary funds. According to the pecking order theory, they will do this primarily by borrowing, not by increasing equity (Frank and Goyal, 2007). As a proxy for company growth opportunities, the studies use market-to-book ratio. As our sample is not limited to joint-stock companies, the evaluation of this factor is not possible.

The share of fixed assets in total assets. Fixed assets are simple with respect to asset valuation, in contrast to intangible assets (for example, patents and company goodwill), thereby enabling lenders to calculate risks more easily and lowering the probability of adverse selection (Frank and Goyal, 2009; Erol, 2004). In addition, a large volume of fixed assets may serve as additional collateral for companies, likewise reducing agency costs and making the borrower less risky (Rajan, Zingales, 1995). Thus, a positive correlation is predicted between these indicators and debt levels. According to the pecking order theory (Harris and Raviv, 1991), low information asymmetry due to large fixed assets makes equity financing less costly. Consequently, the relationship can be negative.

For bank-based economies, the relationship between these variables can vary. Berger and Udell (1994) demonstrated that if companies have close relationships with lenders, the importance of physical collateral diminishes. Consequently, in these cases the strength of the relationship between the share of fixed assets and the debt burden will decrease.

Asset turnover. This coefficient shows the ratio of the value of a firm's revenues generated relative to its assets. This indicator characterizes the business technologically and is subject to sector-specific organization of production. In sectors with longer production cycles, asset turnover is lower (Fairfield and Yohn, 2001); consequently, the relationship between asset turnover and debt burden is expected to be negative.

Fixed asset turnover ratio. This indicator describes the amount of fixed assets necessary for output amounting to a single currency unit. Technologically, this coefficient is more significant for companies that primarily use long-lived equipment. Thus, mining and chemical industries are capital-intensive sectors, whereas textiles and communication industries are among the economic sectors with low capital intensity (Hasan et al., 2013). The effect of the fixed asset turnover ratio on a firm's debt level is expected to be positive.

Uniqueness. This indicator is widely used in the international literature, for instance, in capital structure studies in the United States (Frank and Goyal, 2007; Titman and Wessels, 1988; Mateev and Ivanov, 2011; De Jong and Van Dijk, 2007). This factor shows how specific and unique the goods produced in a sector are, how specialized the knowledge of workers in a sector is, and how difficult it is for consumers to find a replacement for products manufactured by the companies in a given sector. For example, unique sectors include chemical and automotive industries, whereas mining and construction are among the non-unique sectors. This indicator is usually represented by the ratio of R&D expenses to company revenue, the level of voluntary resignations, the volume of trade expenses, etc. However, as it was not possible to collect such representative statistics on Russian companies, this indicator was not included in the model.

Theoretically (Titman and Wessels, 1988), a company's uniqueness in a sector should have a negative impact on its debt level. In sectors of this kind, workers

possess greater specialized knowledge and skills that are difficult to apply or transfer to other types of activity. Equipment and capital goods in these sectors are also highly specialized and have low liquidity. As a result, the risks and, most importantly, the bankruptcy costs of businesses in unique sectors are noticeably higher. Consequently, debt attraction costs are higher as well.

Level of competition in industry. One study (MacKay and Phillips, 2005) showed that the debt burden is higher for companies functioning in concentrated sectors (Herfindahl-Hirschman index level higher than 1800) than for companies in more competitive sectors.

Company status. MacKay and Phillips (2005) showed a connection between debt level and the status of the company in the sector (entry, incumbent, or exiting firm). This effect is not linear: for entry firms and exiting firms, the debt level, all things being equal, will be higher than for companies already established in the sector.

Cash flow volatility. This indicator's effect on debt level is ambiguous. MacKay and Phillips (2005) indicated that the higher a company's cash flow volatility, the more borrowed funds it uses. However, high volatility of cash flows and, consequently, company income increases credit risks, which accounts for the indicator's negative correlation.

Expected inflation. A positive correlation between debt burden and expected level of inflation is explained as follows: tax deductions will be higher when expected inflation is higher (Taggart, 1985). Consequently, according to the trade-off theory, benefits from debt financing in this case will increase.

Non-debt tax shield. Tax deductions due to amortization and investment tax credits (non-debt tax shields) and debt tax shields can be equally important factors in the identification of an optimal capital structure (De Angelo and Masulis, 1980; Bowen et al., 1982). In other words, a company can forego debt financing if a non-debt tax shield provides more benefit to the company.

Market conditions. A proxy for market conditions can be found in the average annual return of the Moscow Interbank Currency Exchange (MICEX) market index and a spread of long-term and short-term returns of federal loan bonds. High values of these indicators signal significant company growth opportunities. In addition, the high return of the market index indicates additional possibilities in attracting private equity investment. Thus, both of the indicators used presumably have a negative correlation with businesses' debt levels.

Macroeconomic conditions. As regards this indicator, there are also conflicting positions. According to some studies (Gertler and Gilchrist, 1993), debt burden and economic growth have a positive correlation. Other theories, including the pecking order theory, postulate that economic expansion brings about a decline in borrowing (Frank and Goyal, 2009). In either case, the factor of the country's economic development can have an impact on company debt levels.

A list of factors included in the resulting model will be provided in paragraph 3.

3.2. Data description

The study used data from the unconsolidated accounting records (RAS) of Russian companies engaged in every type of activity except public administration, military security, and financial services. The financial sector was ex-

cluded due to particularities of company activity and accounting structure. The primary data source was the BIR-Analitik analysis and information system (https://bir.1prime.ru/). The study used annual data for the period 2010–2015. Only companies with data on all variables necessary for the analysis were included in the sample. In addition, the sample excluded companies with:

- reports that noticeably contained errors: negative assets and revenue, discrepancy in currency amounts on the balance sheet (total assets and total liabilities)
- negative long-term and short-term liabilities
- zero fixed assets
- value of fixed assets greater than total assets
- outliers (first and last 1% of distribution) (Fosberg, 2012).

As a result, the balanced sample consisted of 82,727 companies that conducted economic activity throughout the period under analysis. The sample's structure by type of economic activity is provided below (Table 1).

To evaluate the representativeness of the sample, let us compare the total assets and liabilities of the analyzed microdata with the macrodata according to similar indicators (Fig. 2). The total assets of companies in the sample in the period under analysis represent about 70% of the economy's total assets[1], the long-term liabilities represent 74–80% of the total long-term liabilities and the short-term liabilities in the sample comprise 49–70% of short-term liabilities, according to macrodata. On this basis, we can assume that the analyzed data are sufficiently representative for further analysis.

The heterogeneity in debt levels that we noted in macrodata (see Fig. 1) can also be observed in the data of the companies in the sample. Aggregate microdata on average debt burden (total, long-term, short-term) are presented in Fig. 3 for the sectors listed in Table 1. Sectors are ranked in ascending order by the average size of liabilities to assets ratio. In comparing the results of the overall debt level with macrodata received according to the P-3 form, a number of significant differences can be noted. These arise from the fact that P-3 does not monitor companies with staff size under 15. However, such companies are included in our sample, and in several types of activity the share of small companies is fairly

Table 1
Structure of the sample under analysis by the type of economic activity.

Industry	Codes*	Total (%)
Agriculture, hunting, forestry, fishing, and fish farming	01–05	14.5
Mining	10–14	1.6
Manufacturing	15–37	21.4
Electricity, gas, and water supply	40–41	3.4
Construction	45	8.6
Vehicle trade, maintenance, and repair	50	4.1
Wholesale trade	51	8.4
Retail trade	52	14.2
Transport, communications	60–64	7.4
Services	55, 71–74, 80, 85, 90–93	16.4

* Codes by Russian Classification of Economic Activities (OKVED).
Source: Authors' calculations.

[1] P-3 Form Data "Information on companies' financial standing".

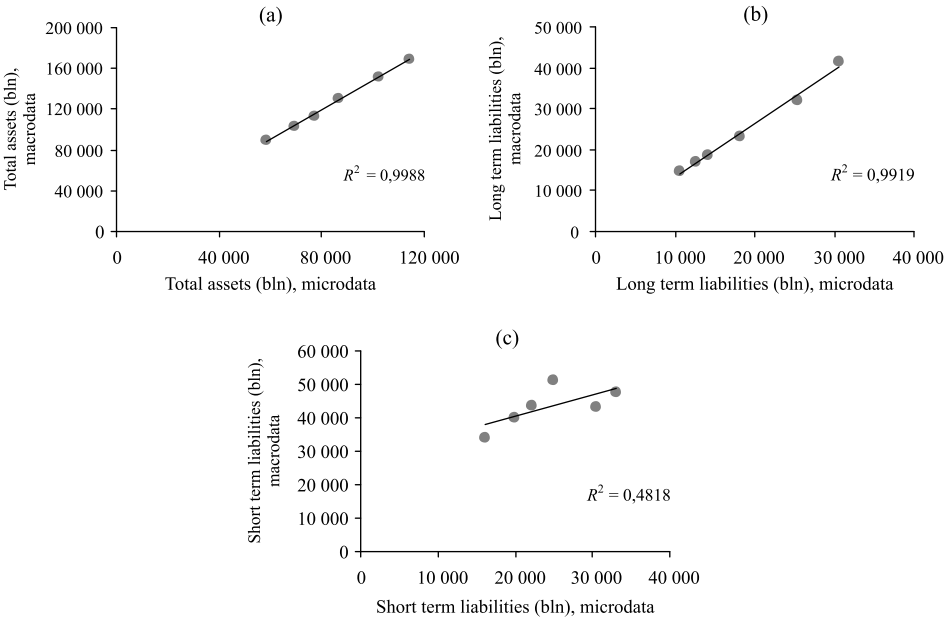

Fig. 2. Relation between micro- and macrodata, 2010–2015.

Sources: Rosstat; authors' calculations.

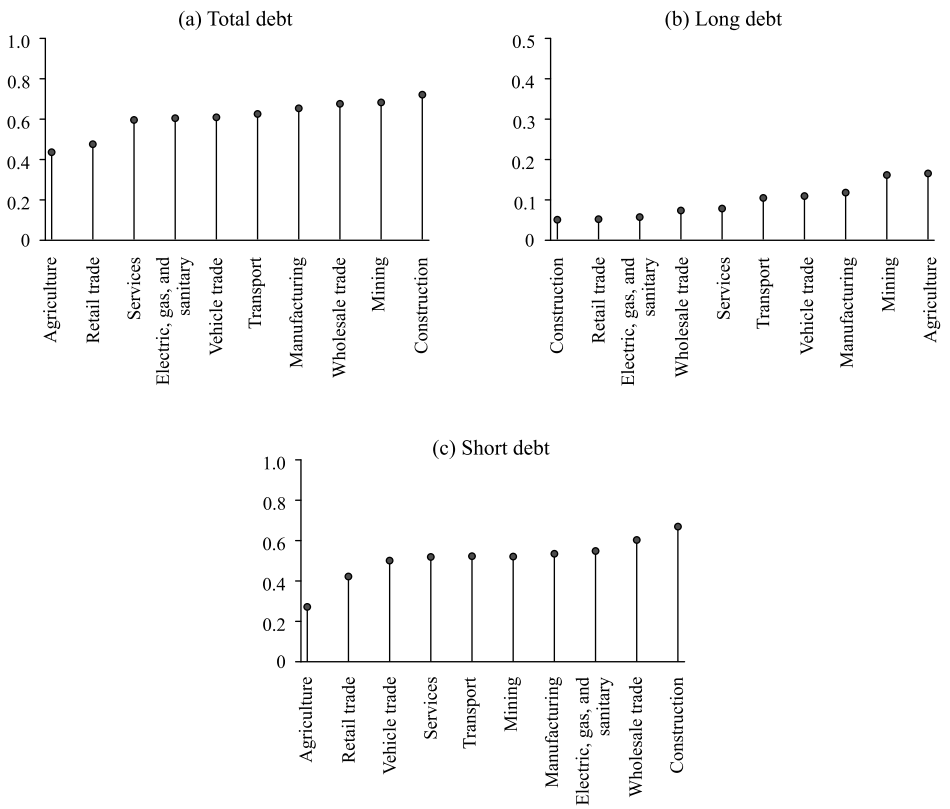

Fig. 3. Average debt burden by industry according to microdata, 2010–2015.

Sources: Rosstat; authors' calculations.

high (for example, in agriculture). The applied filters also excluded a number of companies, leading to certain disparities in the sector debt structure between our data and the Rosstat data according to the P-3 form.

It can be assumed that the observed heterogeneity of debt levels is determined by fundamental factors. The industry heterogeneity in terms of fundamental factors will contribute to their different levels of debt. High profitability is inherent to companies in the mining sector, as well as wholesale and retail trade, whereas agriculture, construction, transportation, and energy, gas, and water supply are characterized by low levels of profitability relative to other types of economic activity. Asset structure, specifically the share of fixed assets, also varies among sectors. A high degree of working capital is necessary for the operations in retail and wholesale trade, and construction and services. Similarly, clusters of sectors can emerge according to other fundamental factors. In this regard, we have formed a hypothesis that fundamental factors must have a significant impact on company debt level. However, the influence of these factors (indication of the effect) may depend on company policy: decisions on capital structure are taken in accordance with the trade-off theory (the existence of an optimal level), or in keeping with the pecking order theory (information asymmetry and agency costs).

At the same time, we assume that there are industry-specific factors that will determine higher or lower debt levels relative to others. For example, the high long-term debt level of agricultural companies may be related to government interest rate subsidization programs for companies in this sector. In turn, the high level of current liabilities in construction is linked to the specificity of its production process: a significant lag exists between purchasing materials and payment for construction services. Consequently, aside from checking the significance of fundamental factors, it is important to include industry-specific fixed effects in the hypothesis.

3.3. Model specification

We have formulated two hypotheses in accordance with the assumptions above:

Hypothesis 1: the variation of debt levels among companies in the Russian economy is not only attributable to fundamental factors, but also to industry-specific effects.

Hypothesis 2: there is an inter-temporal variation of sector fixed effects.

In order to test these hypotheses, a model was drawn up that included fundamental factors and sector fixed effects. The model employed the following indicators as fundamental variables:

- company size
- profitability
- asset turnover
- fixed asset turnover ratio
- the share of fixed assets to total assets

The significance and economic interpretation of these factors' effects is not unambiguous, as described in Section 2. To address endogeneity in the model, we introduced lagged explanatory variables (Frank and Goyal, 2009).

To directly evaluate industry effects and the differences between them, dummy variables for the types of activity listed in Table 1 have been added to the model. The first specification of the model to test the first hypothesis includes the aver-

age fixed effects of every industry for the period under review. The second specification to test the second hypothesis takes into account the effect of differences in sector debt burdens changing from year to year. In order to control macroeconomic factors in the model, time dummy variables are included.

The first specification is:

$$Y_{it} = \delta_t + \sum_k \beta_k X_{kit-1} + \sum_m \beta_m d_{mi} + \varepsilon_{it}. \quad (1)$$

The second specification is:

$$Y_{it} = \delta_t + \sum_k \beta_k X_{kit-1} + \sum_m \beta_m d_{mi} + \sum_m \beta_{mt} d_{mit} + \varepsilon_{it}, \quad (2)$$

where Y_{it}— debt burden; X_k— set of explanatory variables; d_m— dummy variables for each sector; δ_t—time effects, and i, t and m are indices of firms, time and sectors, respectively.

Estimation was done using an ordinary least squares (OLS) method with random effects. The model was also estimated by the generalized method of moments (GMM) to verify robustness. Fundamental and sector specific factors and coefficient significance are related to the core results.

The question of which indicator to examine as the debt burden is fairly controversial. In various studies, authors have determined debt burden indicators in different ways, depending on their research purposes. In order to analyze the agency problem, the ratio of debt size to company market value is used (Jensen and Meckling, 1976); in evaluating the conflict of interests between shareholders and lenders, interest coverage ratio is used (Aghion and Bolton, 1992).

In our model, we consider the ratio of the total liabilities to total assets at book value, and long-term and short-term liabilities as explanatory variables. The use of the size of liabilities to total assets ratio as an indicator may somewhat overestimate the size of the debt burden, as liabilities (both long-term and short-term) include not only loans, but also other obligations not entirely related to debt, for example, accounts payable, which is used for conducting operations rather than financing (Rajan and Zingales, 1995).

A separate examination of long-term and short-term liabilities as dependent variables stems from the fact that fundamental factors will most likely affect capital choice differently according to the time structure. Furthermore, an analysis of the macrodata of Russian companies' liabilities showed that, for several types of activity, accounts payable occupies a dominant share of short-term liabilities (Fig. 4).

Consequently, estimation of the model for long-term liabilities will give us an assessment of company debt burdens with respect to credits and loans. However, foregoing an analysis of short-term liabilities is also inadvisable. In a number of sectors, a large amount of accounts payable may have a strong influence on a company's financial situation and, consequently, on its operational activities, which is critical for understanding and pursuing monetary policy. In this case, the interpretation of model coefficients must be adjusted, given that short-term liabilities may largely be accounts payable rather than credits and loans.

The use of book value may be justified by the following factors identified by MacKay and Phillips (2005). First, Graham and Harvey's (2001) survey results showed that managers rely largely on book value when making decisions on optimal capital structure. Second, the ratio of the debt to assets at market value as

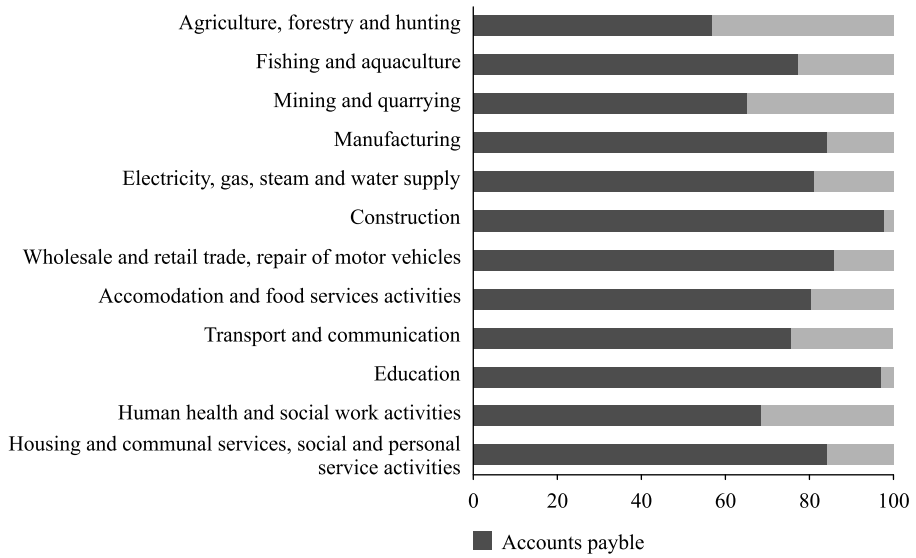

Fig. 4. Structure of short-term liabilities in 2015 (%).

Sources: Rosstat (P-3 Form Data "Information on Companies' Financial Standing"); authors' calculations.

a dependent variable can lead to its correlation with explanatory variables included in the model. In addition, market indicators are fairly volatile in the short term, which negatively affects the use of variables as factors to identify company financial policy. The fundamental difference lies in the fact that book value is backward-looking whereas the market value of the debt is forward-looking. Therefore, the choice between these two valuation methods depends on the methodology used and the purposes of the study. Several researchers demonstrate a significant difference between the results of using book and those of using market valuation.

In order to verify the robustness of our findings it would be useful to estimate the model using market valuation. However, this is not possible for the entire dataset because our sample does not only include joint-stock companies.

The chosen fundamental explanatory variables (Table 2) showed a strong correlation with debt level in empirical studies on the debt burden in other economies. Other variables tested in the empirical literature were not used in our study due to the absence of the respective data.

4. Empirical results

4.1. Descriptive statistics and analysis of model results

Table 3 presents descriptive statistics for the dependent and explanatory variables in our sample.

According to the data presented, it can be inferred that short-term debt burdens are nearly twice as volatile as long-term debt burdens. In this regard, we assume that the variation of the short-term debt burden will determine the significance of the coefficients in the model for total debt. In other words, we will observe similar results in the estimation of the models for total and for short-term debt.

Table 2
List of variables.

Variable	Description	Name in model
Debt burden	Total liabilities/Assets	debt_assets
Short-term debt burden	Short-term liabilities/Assets	shortdebt_assets
Long-term debt burden	Long-term liabilities/Assets	longdebt_assets
Company size	Assets/Average assets in sector	assets_av
Profitability	Profit before tax/Assets	profitability
Asset turnover	Revenue/Assets	revenue_assets
Fixed asset turnover ratio	Fixed assets/Revenue	tang_revenue
Share of fixed assets to total assets	Fixed assets/Assets	fa_share
Agriculture		d1
Construction		d2
Production and distribution of electricity, gas, and water		d3
Manufacturing		d4
Mining		d5
Retail trade		d6
Services		d7
Transport		d8
Vehicle trade		d9
Wholesale trade		d10

Table 3
Descriptive statistics of variables (N = 496 362).

Variable	Mean	Median	Standard deviation	Minimum	Maximum
Total debt burden	0.59	0.54	0.49	0.00	13.98
Long-term debt burden	0.09	0.01	0.23	0.00	7.20
Short-term debt burden	0.49	0.41	0.45	0.00	13.98
Company size	1.00	0.08	13.92	$5.65e^{-06}$	1722.70
Profitability	0.09	0.06	0.29	–12.19	14.10
Asset turnover	2.43	1.55	3.02	$9.46e^{-06}$	78.06
Fixed asset turnover	0.88	0.12	7.31	$1.22e^{-07}$	634.94
Share of fixed assets	0.29	0.22	0.26	$7.89e^{-09}$	1.00

It also must be noted that all variables have a right-skewed distribution, as the medians are lower than the arithmetic mean. Consequently, over 50% of the sample has below-average parameter values.

The average level of long-term debt for the companies under scrutiny is lower than their average level of short-term debt. Rajan and Zingales (1995) provide balance sheets analysis for G7 countries. According to their results, the ratio of short-term liabilities to total assets for these countries is larger than the ratio of long-term liabilities, except for the liability structures of Germany and Canada. The descriptive statistics of our sample agree with the results of that study.

Studies on developing countries show a much lower level of long-term debt (Demirguc-Kunt and Maksimovic, 1999; Booth et al., 2001; Mazur, 2007). The reason for this phenomenon may be the high costs of long-term borrowing and underdevelopment of the corporate bonds market.

If one looks at the liability structure of the selected Russian companies, it can be seen that the variation of liabilities in the analyzed period was insignificant (Table 4). Many Russian companies do not use long-term loans and credits at all.

Table 4
Liability structure of Russian companies for the period 2010–2015 (%).

Year	Total liabilities/ Assets	Long-term liabilities/ Assets	Short-term liabilities/ Assets
2010	58.8	8.9	49.8
2011	58.6	9.3	49.2
2012	57.8	9.5	48.2
2013	57.8	9.8	48.0
2014	58.8	9.8	48.9
2015	59.8	9.6	50.2

We estimated our regression model (equations 1 and 2) using the sample of companies with debt levels no greater than 2. To verify the robustness of the estimation results the models were also tested for the entire sample. In analyzing the model with fixed effects, the service industry was treated as a benchmark.

The presence of zeros for the dependent variable in the sample may pose a problem for the estimation of coefficients. The literature examines two cases of a zero "tail": (a) a true zero when a company decides not to take on debt liabilities, and (b) unobserved variable values, that is, the absence of data on a variable. In cases of self-selection and non-random samples, Tobit models, and Heckman models, including the regression equation and participation equation, etc., are used. In our sample, it is impossible to say whether zeros reflect the absence of debt (as the company's choice) or lack of data. Besides, in order to use the Heckman model, additional factors included in the participation equation model are necessary. Our sample limits the inclusion of additional variables. The use of the Tobit model in verifying robustness yielded results similar to the main findings. Consequently, it can be concluded that the "heavy tail" at zero did not substantially shift the results.

Appendix A presents the results of the estimation of the regression equations. All the coefficients of fundamental factors were significant at the 1% level, except for the fixed asset turnover ratio for explanations of short-term debt variation. The results for fundamental variables agree with the conclusions of Frank and Goyal (2009), Erol (2004), Hanousek and Shamshur (2011), and Titman and Wessels (1988).

Profitability demonstrated a sustainable negative effect on the debt level for all specifications. In our model, profitable companies are more likely to use internal resources to finance their activities than borrow. This result indicates the significance of the agency problem, the existence of information asymmetry in the market and the underdevelopment of the bond market for real sector companies. This conclusion is consistent with studies on the liability structure in emerging markets (Booth et al., 2001).

Asset turnover has a positive impact on total and short-term debt, but negatively affects long-term debt. The negative coefficient means that companies with longer production cycles have a higher long-term debt to asset ratio.

The fixed asset turnover ratio positively influences company debt levels. This means that businesses using long-lived equipment have higher debt burdens.

The effect of company size proved ambiguous. A positive correlation can be observed in two estimations: for total debt and for long-term debt. The impact on short-term debt is negative. The larger the company is, the less it will use short-term liabilities and the larger are its long-term liabilities.

The share of fixed assets negatively correlates with the total level and short-term level of debt and positively affects long-term debt. Companies with a high share of fixed assets will attract more long-term debt capital, whereas companies with a lower share of fixed assets will use short-term loans. This result is consistent with the standard argument that non-liquid and long-term assets are financed by long-term loans. A negative relationship between total (short-term) debt levels is due to the fact that the coefficient for the substitution of short-term with long-term funds is less than 1.

To test the hypotheses stated above, Figs. 5 and 6 present the results of the analysis of the coefficients with dummy variables (both average and time-varying). Fig. 5 depicts industry fixed effects in relation to the average value of debt. Sectors in the figure are ranked according to the size of the average debt burden. Despite the significance of the fundamental factors, there are differences in the debt burden between sectors. The resulting coefficients with dummy variables are significant at the 1% level, except for mining and vehicle trade in the model for short-term debt burdens. Differences in the average debt level in individual sectors cannot be entirely attributed to the fundamental factors in our model because the dynamics of the average debt level and coefficients vary.

Fig. 6 presents the results of the same model (1) with dummy variables ranked according to the size of fixed affects. To reiterate, all effects are calculated with the service industry as a benchmark. We have interpreted industry fixed effects in the model depicted in Fig. 5 as the difference among debt levels per industry stable over time. Confidence intervals at the 1% level of significance are depicted as vertical lines. Fig. 6 shows that there are sectors with a systematic difference in debt not explained by the selected regressors. For certain types of activity, industry effects will overestimate the debt burden to a statistically significant level (construction, wholesale trade, industrial production[2], transport, and vehicle trade — for the total debt; mining, agriculture, vehicle trade and wholesale trade, transport and manufacturing — for long-term debt; and construction, wholesale trade and industrial production — for long-term debt). For other sectors, fixed effects data will underestimate the debt burden com-

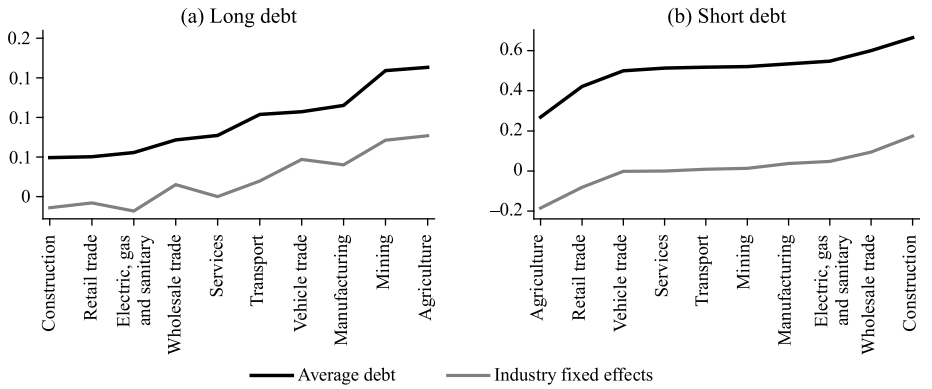

Fig. 5. Average debt level and industry fixed effects.

Source: Authors' calculations.

[2] Manufacturing, Mining, Electric, Gas and Sanitary

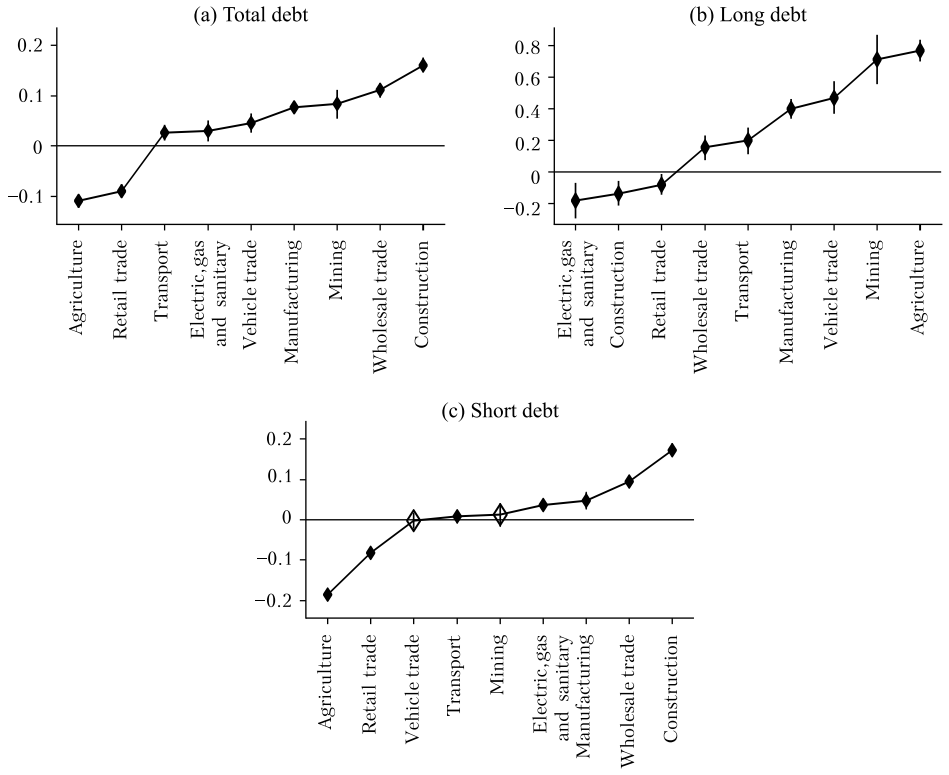

Fig. 6. Industry fixed effects.

Note: Coefficients statistically insignificant at the 10% level are represented on the figure by hollow diamonds.
Source: Authors' calculations.

pared to services: agriculture and retail trade in the total and short-term debt model, construction, retail trade and provision of electricity, gas, and water in the long-term debt model. As the coefficients obtained are statistically significant, we can conclude that the companies' industry profile is important in explaining variations in the debt burden.

It can also be noted that the behavior of industry-fixed effects for short-term and long-term debt varies greatly. As the coefficients for total and short-term debt are similar, it can be concluded that the largest contribution to the significance of coefficients for the total debt model is made specifically by short-term borrowing variation, as stated above.

The following are the results of the estimation of model (2) with dummy variables for each industry and each year. The benchmark industry for this model is the service sector in 2011 (as models with lags were tested, 2010 will not be present in the sample).

Fig. 7 shows coefficient dynamics with dummy variables separately for each industry. These coefficients show only inter-temporal differences of debt levels for sectors. The vertical lines are confidence intervals at the 1% level.

The diagram shows that the coefficients presented proved insignificant or extremely small for the majority of sectors, which indicates that although a statistically significant difference in debt levels among sectors exists, this difference has not changed during the period under review.

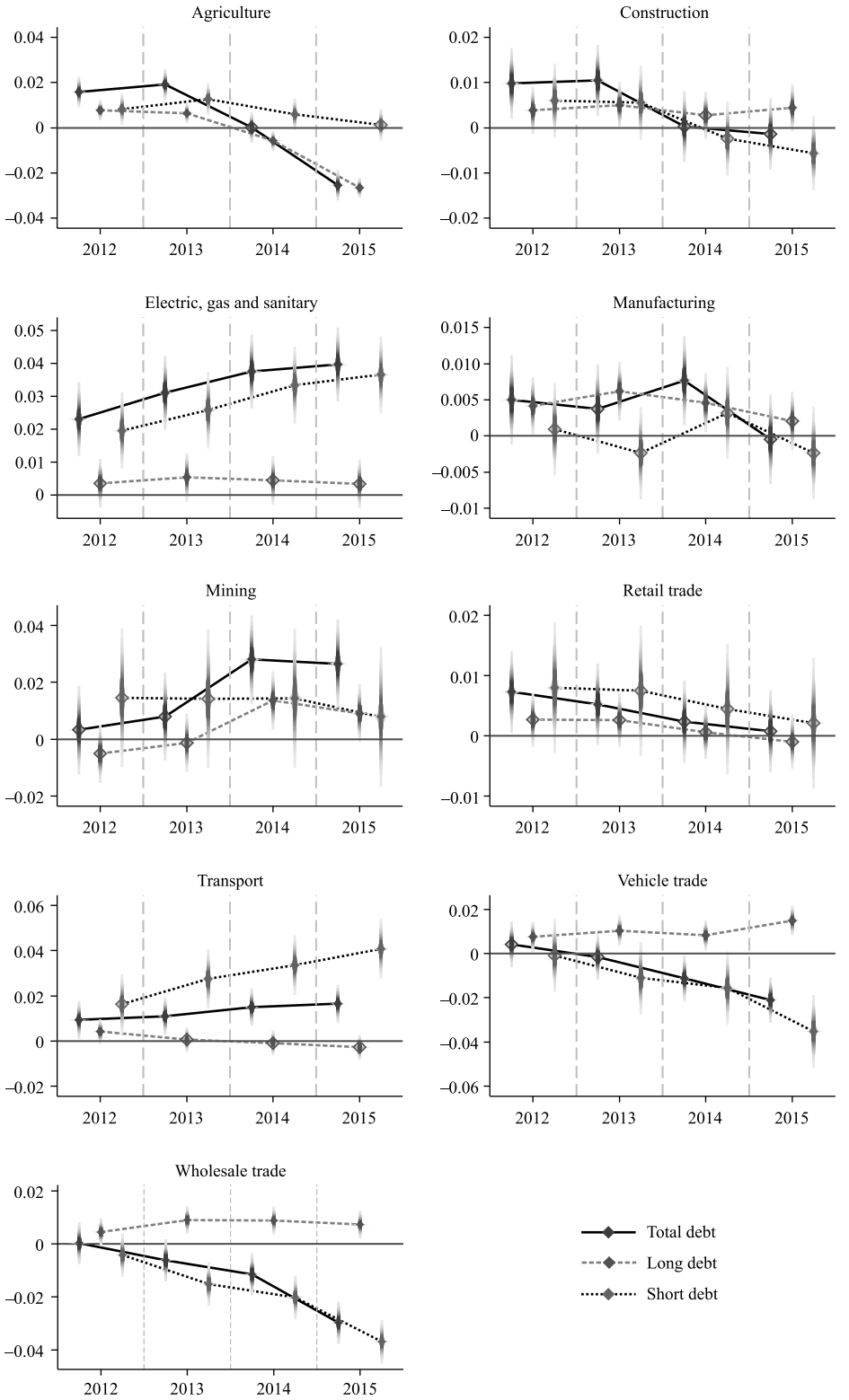

Fig. 7. Industry fixed effects for each year.

Note: Coefficients statistically insignificant at the 10% level are represented on the figure by hollow diamonds.
Source: Authors' calculations.

For all three dependent variables, the industry characteristics of manufacturing and retail trade had an almost identical impact for the period 2011–2015 (insignificance of virtually all fixed effects). For companies in the transport sector and providers of electricity, gas, and water, the differences in long-term debt from the benchmark were also constant throughout the period under review. For the remaining sectors, with the exception of certain years, the effects proved significant; however, the resulting coefficients were quantitatively fairly low, within a range of ±2 pp, notwithstanding their statistical significance.

There is no clear evidence of the existence of any macroeconomic shocks leading to a significant increase or decrease in debt levels. However, it should be noted here that our time interval is fairly short. If the time interval is expanded, conclusions regarding the dynamics of fixed effects may require updating.

Fig. 8 depicts total fixed effects for each industry over time, that is, differences due to sector and differences due to changes of these effects over time. Here, the results for model (2) are depicted with the explanatory variable, total debt burden and long-term and short-term debt burden, respectively. The vertical lines are confidence intervals at the 5% level of significance.

As already shown in Fig. 7, industry fixed effects change slightly from year to year whereas in certain cases, temporal changes are completely statistically insignificant. Consequently, the cumulative effect will not vary significantly over time. This can be seen in Fig. 8: all four lines behave in much the same way, with a few exceptions. All the sector effects depicted are statistically significant, apart from those for the mining and transport sectors in the short-term and long-term debt model.

Fig. 8 shows that, over time, sector specificity had a varying impact on the total level of debt for agriculture, mining, wholesale trade, and vehicle trade. For long-term debt in agriculture and mining, the differences also varied for the period 2012–2015. The dynamics of differences in short-term debt between industries were virtually identical every year, with the exception of wholesale trade companies.

Industry differences for the long-term debt and short-term debt model vary noticeably. Other things being equal, the long-term debt level in agriculture is higher than that in other sectors, whereas for short-term debt levels the effect is the reverse. Companies in the construction sector have a significantly lower long-term debt burden, whereas the short-term debt burden is much higher than in other sectors. As a result, the effect on total debt level is positive. There is no impact of sectoral characteristics on the short-term debt level in mining and transport, whereas the long-term debt for these sectors was higher than the benchmark, resulting in higher total debt.

Overall, we can say that sectors possess specific characteristics, which result in a higher debt burden for certain sectors and lower debt for others. These differences cannot be attributed to fundamental factors.

We have shown that there are sector effects that remain virtually unchanged over time. Now, let us see if these fixed effects among sectors vary. In other words, if the long-term debt level for companies in the construction and retail trade sectors is higher than that in other sectors, does this mean that the debt burden will vary between construction and retail trade?

For this purpose, the Wald test was conducted to check whether coefficients obtained from model (2) differ significantly. The results of the analysis are pre-

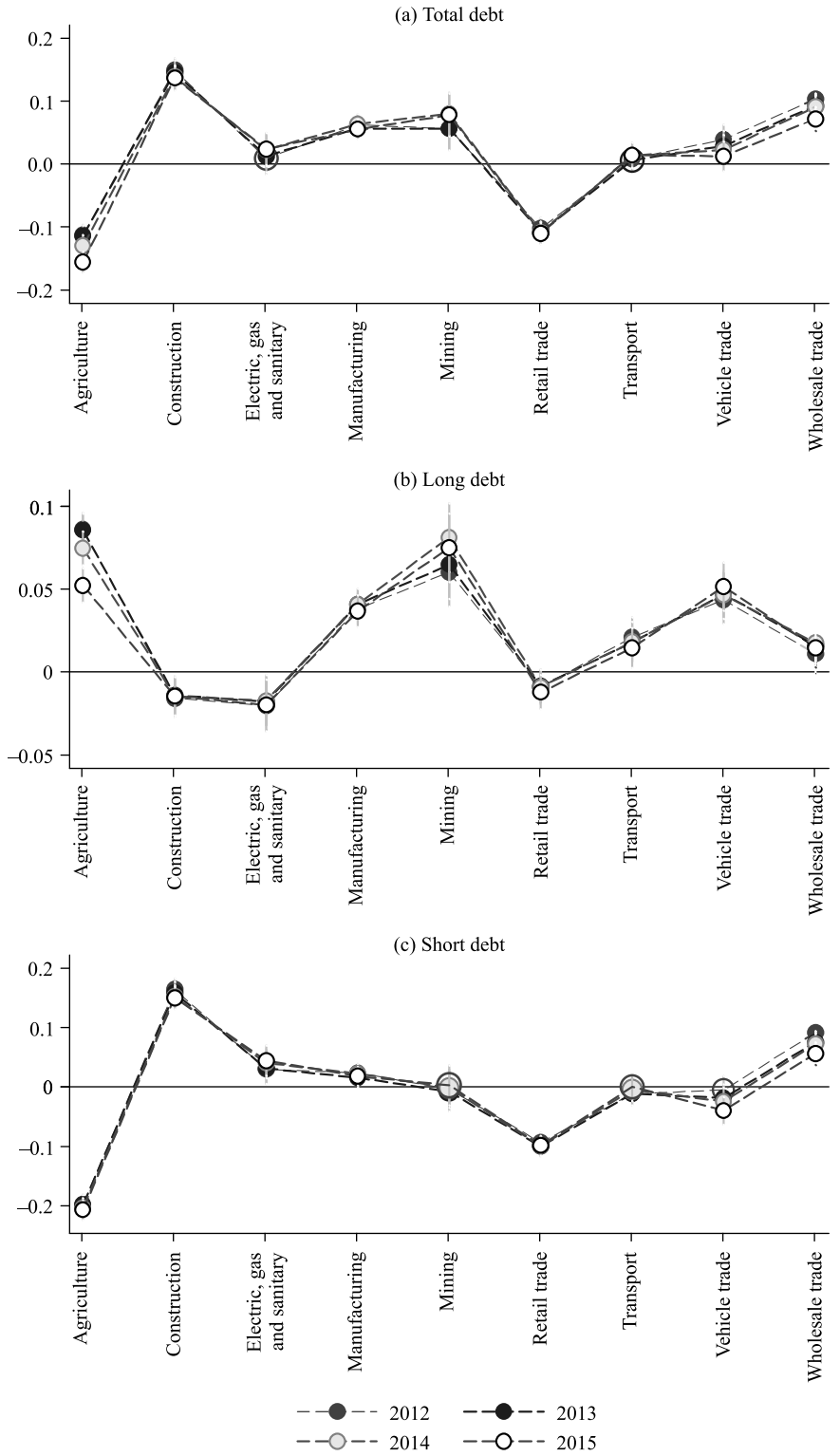

Fig. 8. Industry fixed effects for the period 2012–2015, by type of activity.

Note: Coefficients statistically insignificant at the 10% level are represented on the figure by puncture hollow circles.
Source: Authors' calculations.

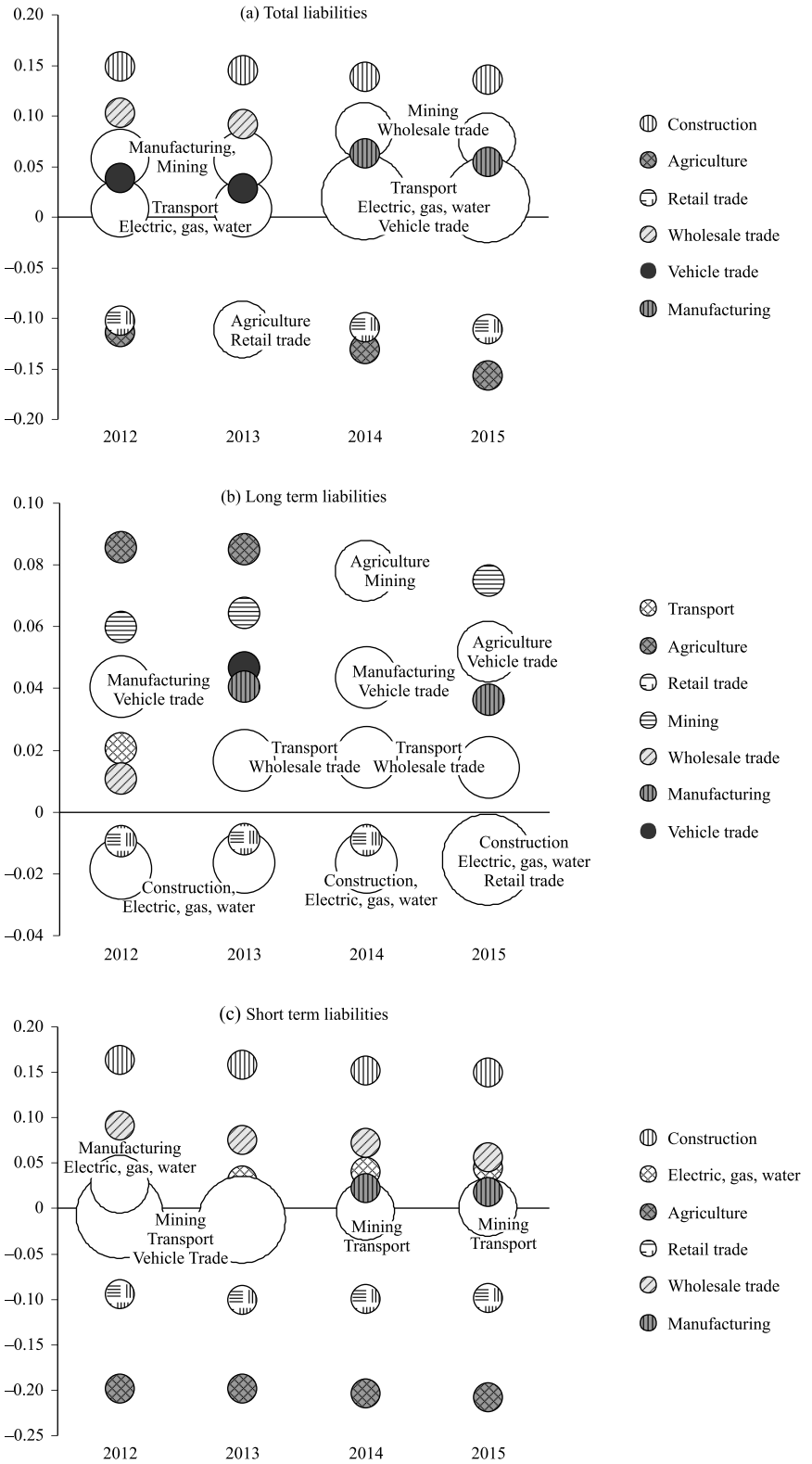

Fig. 9. Industry fixed effects grouped by significance of the differences between them.

Source: Authors' calculations.

sented in Fig. 9 and in Appendix B. The diagram depicts sectors grouped according to the coefficients' statistical significance. For example, in the explanation of the variation of long-term liabilities, the sectoral particularities of companies in agriculture and mining do not differ.

From this estimation, we can infer that sectoral specificities account for the variation in debt burden; however, these fixed effects are not always discernable among industries.

A test of the robustness of results was conducted. Models were estimated based on the entire sample, that is, the restriction that debt burden is lower than 2 was removed. Appendix C provides estimations of coefficients with control factors for the entire sample. As can be seen, the coefficients' significance did not change (apart from that for fixed asset turnover in the short-term debt model); the signs remained unchanged and the value of coefficient changed insignificantly. Consequently, the results are sustained.

4.2. Economic interpretation of results

Our results confirm *Hypothesis 1* that the variation of debt levels among companies in the Russian economy is not only attributable to fundamental factors such as firm size, profitability, asset structure, but also to industry-specific fixed effects. Industry fixed effects are strongly significant in explaining debt level formation in construction, wholesale, and retail trade, agriculture and mining companies. For other industries these fixed effects are significant but almost zero. In other words, there are sectors in which the relation between fundamental factors and the debt level is similar to the benchmark (service sector).

In models for total and short-term liabilities, companies in the construction sector are characterized by the largest debt level. At the same time, short-term debt in the sector is almost entirely (98%) composed of accounts payable (see Fig. 4). In terms of the variation of long-term liabilities, the industry effect has a reverse impact: construction, along with retail trade, shows low debt levels. A high level of accounts payable for construction companies is attributable to the specifics of their activity: the majority of work is carried out on the principle of project finance, where repayment of liabilities is financed by the handover of a finished project to the client. A cross-country comparison of the sectoral debt level showed that a relatively high debt level in construction is a normal situation for the European economies analyzed (Table 5).

For trade companies, a high level of current liabilities can be explained by their role as intermediaries in a supply chain. Many wholesale trade companies purchase goods from producers by deferred payment, which is essentially accounts payable. Retail chains, in turn, likewise acquire goods for sale from wholesalers through ongoing debt, which creates accounts receivable in wholesale trade companies. All else being equal, an optimal and effective supply network and stock management can ensure coverage of short-term liabilities of wholesale companies on account of retail trade companies' repayments. Due to high profitability retail trade companies discharge current liabilities by final customers' payments. The high debt level there is not an exception for Russian companies. Trade contracts with delay of payment are common in Russia and Europe. European trade companies are also members of the medium and high debt level groups (see Table 5).

Table 5
Debt level[a] by type of activity in Europe[b] and Russia, 2010–2014.

Debt burden	High	Medium	Low
Russia[c] (Rosstat)	Construction Hotels, restaurants Agriculture, hunting, fishing	Manufacturing Education Trade Transport, communications	Healthcare Production and distribution of electricity, gas and water Mining
Russia[d] (BIR-Analitik)	Wholesale trade Mining Construction	Transport Manufacturing Vehicle Trade Production and distribution of electricity, gas and water	Agriculture, hunting, fishing Retail trade Other services
Austria	Construction Hotels, restaurants Transport, communication	Education Trade Production and distribution of electricity, gas and water Mining	Healthcare Agriculture, hunting, fishing Manufacturing
Czech Republic	Construction Hotels, restaurants Trade	Manufacturing Education Transport, communications Healthcare	Agriculture, hunting, fishing Production and distribution of electricity, gas and water Mining
Germany	Construction Hotels, restaurants Mining	Manufacturing Trade Transport, communications Production and distribution of electricity, gas and water	Agriculture, hunting, fishing Education Healthcare
Spain	Construction Trade Healthcare	Hotels, restaurants Manufacturing Transportation, communications Production and distribution of electricity, gas and water	Agriculture, hunting, fishing Education Mining
France	Construction Education Production and distribution of electricity, gas, and water	Hotels, restaurants Trade Transport, communication Healthcare	Agriculture, hunting, fishing Manufacturing Mining
Poland	Construction Trade Healthcare	Hotels, restaurants Manufacturing Education Transport, communications	Agriculture, hunting, fishing Production and distribution of electricity, gas and water Mining
Portugal	Construction Hotels, restaurants Production and distribution of electricity, gas, and water	Manufacturing Education Trade Transport, communications	Agriculture, hunting, fishing Healthcare Mining
Slovakia	Construction Hotels, restaurants Trade	Agriculture, hunting, fishing Manufacturing Education Production and distribution of electricity, gas and water	Transport, communications Healthcare Mining

[a] Debt burden — relation of total liabilities to total assets.
[b] BACH database — non-financial firms, excl. micro-entities (average number of employees < 10).
[c] Rosstat P-3 Form Data "Information on Companies' Financial Standing" — non-financial firms, excl. micro-entities (average number of employees < 15).
[d] BIR-Analitik data — non-financial firms, incl. micro-entities.
Sources: BACH database (Banque de France); Rosstat; authors' calculations.

The sectors discussed above (construction and trade) are somehow oriented to domestic demand, which falls precipitously in times of crisis. Excessive debt burden in these sectors can only exacerbate a negative situation during a recession. According to Bank of Russia (2017), as of March 1st, 2017, the largest share of non-performing loans (NPL) was concentrated in the construction and trade sectors (27.5% and 16.7%, respectively). Even if accounts payable occupies a primary role in the liabilities structure for construction, poor quality of credit portfolio can significantly undermine the financial stability of companies in the sector. Deterioration in consumer activity led to a negative situation in trade, lowering profitability and the effectiveness of settlements with partners. From the banks' point of view this situation does not pose a serious problem due to debt restructuring and the reserve formation. However, high debt levels and decreased ability to meet current liabilities can seriously hinder post-crisis recovery.

In the mining sector industry, fixed effects raise companies' debt burden in the total debt and long-term debt models. Here, one should pay attention to the significant difference in the relative debt level of mining companies based on the aggregated Rosstat data and the relative debt level of analyzed BIR-Analytic sample (see Table 5). According to Rosstat data, the mining sector is a sector with a relative low debt level, whereas our data show the relative high level of debt in this sector. This difference can be explained by the absence of micro-entities in the Rosstat sample. Such companies are mostly aimed at the domestic market and characterized by a lower business diversification than large export-oriented companies. This has a direct impact on the needs of firms of the mining sector in debt funds. Without micro-entities, the debt level in the Russian mining sector is low, which is consistent with the results in foreign countries.

The liability (both long-term and short-term) of agricultural companies differs greatly from the benchmark: there is a significantly high level of long-term debt and low level of short-term liabilities. This characteristic of the companies in this sector cannot be entirely attributed to the fundamental factors. It can be assumed that a certain distortion in the liability structure is made by the existing government programs of support for agricultural lending in the form of subsidizing interest rates. The main recipients of subsidies for investment and short-term loans are large enterprises. At the same time, there are some problems (lack of liquid assets for loan collateral, difficulties in collecting and processing the necessary documents, etc.) which restrain the credit of small agricultural enterprises, among which short-term loans for operating activities are urgently needed. Thus, we can assume that the low level of current liabilities is linked to the difficulty of the sector's small companies in accessing short-term money, whereas the comparatively high level of long-term liabilities can be attributed to government agriculture programs, particularly subsidization of interest rates.

From 2005 to 2013 the amount of long-term debt of agricultural companies in Russia increased by 14.8 times. This was attributed to the state program of subsidizing investment loans. As a consequence, the total amount of accounts payable of agricultural enterprises in 2013 exceeded the product value (Shagaida et al., 2015). This reflects the extremely high debt burden of agriculture in Russia. Agriculture in Europe is a sector with a low debt level (see Table 5). Therefore, we can suggest that the debt level for the agricultural sector in Russia (calculated according to Rosstat data, excluding micro-entities) is abnormally high compared

to that in other countries. However, with a high debt burden in the agriculture sector, the share of overdue loans remains low, which is explained by the Government decisions to defer loan repayment and extend the period of subsidies. These measures are critically important for the financial stability of this sector.

It is also necessary to pay attention to the following result: one can observe the mirror structure of long-term vs. short-term liabilities in individual sectors. That is, sectors characterized by a relatively high level of short-term debt will most likely have a relatively low level of long-term liabilities, and vice versa. This can be seen in agriculture, supply of electricity, gas, and water, and partly in wholesale trade. This suggests that companies determine the maturity structure of their debt instruments according to their business needs but try to maintain a total debt at a certain chosen level. However, the analysis for determining the optimal or normal level of debt is beyond the scope of this study.

Hypothesis 2, regarding the existence of inter-temporal variation of sector fixed effects was rejected for most of the industries (except agriculture and mining), which means that industry fixed effects do not change significantly over time. It is noteworthy that the ruble depreciation (2012–2015) did not have a significant effect on the capital structure of companies in the sample. We do not see an increase in companies' indebtedness through increased foreign currency borrowing. Such a result can be explained by a number of factors. First, this might be a proportional increase in assets and liabilities, which did not cause a rise in the debt burden ratio. Asset growth could be attributable to revaluation of financial investments in foreign currency or reevaluation of accounts receivable (for example, export companies carry out settlements with their partners in foreign currency).

The two sectors with an observed, statistically significant growth of liabilities (particularly long-term) for the analyzed period are the mining industry and the agricultural sector (see Fig. 9). In our opinion, the increase of fixed effects in mining could be due to the coal companies because world prices for coal declined significantly. In agriculture with a high debt burden we can see the decrease of the long-term level relative to that in other industries. This can be explained by a significant reduction in the amount of issued investment loans due to the increase in the cost of credit resources.

To recapitulate, our results suggest that differences in debt levels are not entirely attributable to differences in the companies' fundamental explanatory variables, such as profitability, company size, asset turnover, etc. This can be hypothetically explained by two reasons. First, in our model of the debt level we did not include some potentially significant fundamental and other factors that could account for the difference in debt levels between types of economic activity, such as the share of accounts payable in current liabilities, the size of subsidies on loans, the size of tax shields, uniqueness of goods, and other variables used in international studies. Second, the significance of the fixed effects can indicate an imbalance in the nature of the link between the fundamental variables and the debt burden. In our sample, it is not possible to choose one reason or another. Possibly, longer time series will allow us to eliminate these differences in the future.

Persistent differences in the debt level between most industries in part confirmed the fact that the model does not include some other factors (as well as industry-specific characteristics), which lead to a higher debt level for some industries and a lower debt level for others. At the same time, the presence of sig-

nificant inter-temporal variation of sector fixed effects for agriculture and mining can indicate an imbalance in the nature of the link between the fundamental variables and the debt level in these sectors, which should adjust over time.

4. Conclusion

This study analyzed the sectoral level of debt in the Russian economy and the factors determining this level. A sample built on microdata of company accounting records revealed a number of factors characterizing the particularities of Russian companies' liability structures.

The analysis of the aggregate microdata in relation to sectors reflects differences in their relative debt levels. Some industries are characterized by rather high levels, whereas others have a low share of borrowed funds. In addition, we found that the ratio of long-term borrowing to current liabilities is quite low for Russian companies. A significant difference between bank and market-based financing is typical for developing countries, which is exacerbated by the presence of state-owned enterprises and regulation of the financial system. Price regulation of securities markets and government lending programs for certain industries have a significant impact on company decisions regarding debt level, and on debt structure.

To determine the nature of the differences, we set up an econometric model that includes the following explanatory variables: profitability, company size, asset turnover, fixed asset turnover, and share of fixed assets. All the variables demonstrate a robust correlation with the size of total, long-term and short-term liabilities. The results are consistent with the findings in other studies dedicated to capital structure analysis. In other words, stylized facts on capital structure and its determinants hold true for both developed countries, which were the subject of empirical tests in most of the literature sources, and for Russia with its developing financial markets.

However, further analysis showed that the fundamental explanatory variables were unable to account for all the variation in debt levels among companies engaged in various types of economic activity, as reflected by the significance of the fixed effects for each sector included in the model.

According to the models' results, special attention must be paid to non-tradeable (domestic-oriented) sectors: construction and trade (particularly wholesale). Companies in these industries are characterized by relatively high levels of short-term liabilities, which, in times of economic downturns and contractionary aggregate demand shocks, can increase the risks to the financial stability of firms and impede the recovery of economic growth. Companies in the mining sector have a relatively high long-term debt level. In the short-term, this sector will have the least opportunity to use external debt financing for supporting investment activities. The abnormally high level of long-term liabilities in agriculture can be attributed to the government program of subsidizing interest rates on loans.

The significance of the industry fixed effects can be explained by either the omission of some fundamental determinants in our model or an imbalance between the fundamental factors and the observed debt level, which should settle over time. In the latter case, a monetary or macroprudential policy response might be appropriate. The length of our time series may not be sufficient to clearly distinguish between these two reasons. The absence of the inter-temporal variation

of fixed effects would suggest the presence of some unobserved fundamental factors. However, cross-country comparison points to a relatively high debt level of some sectors of the Russian economy — in particular, mining and agriculture.

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Appendix A

Table A1
Results of model estimation for total debt burden.

	Dependent variable: total liabilities	
	(1)	(2)
ASSETS_AV$_{t-1}$	0.0002***	0.0002***
	(0.0001)	(0.0001)
PROFITABILITY$_{t-1}$	–0.1410***	–0.1402***
	(0.0013)	(0.0013)
REVENUE_ASSETS$_{t-1}$	0.0036***	0.0036***
	(0.0002)	(0.0002)
TANG_REVENUE$_{t-1}$	0.0003***	0.0003***
	(0.0001)	(0.0001)
FA_SHARE$_{t-1}$	–0.0573***	–0.0575***
	(0.0022)	(0.0022)
_cons	0.5561***	0.5587***
	(0.0028)	(0.0030)
Fixed effects		
firm	yes	yes
year	yes	yes
industry	yes	
industry × year		yes
Number of observations	400 090	400 090
Number of firms	80 018	80 018
sigma_u	0.290	0.290
sigma_e	0.144	0.144

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A2
Results of model estimation for long-term debt burden.

	Dependent variable: long-term liabilities	
	(1)	(2)
$ASSETS\_AV_{t-1}$	0.0005***	0.0005***
	(0.0000)	(0.0000)
$PROFITABILITY_{t-1}$	–0.0202***	–0.0198***
	(0.0008)	(0.0009)
$REVENUE\_ASSETS_{t-1}$	–0.0031***	–0.0030***
	(0.0001)	(0.0001)
$TANG\_REVENUE_{t-1}$	0.0004***	0.0004***
	(0.0000)	(0.0000)
FA_SHARE_{t-1}	0.0419***	0.0417***
	(0.0014)	(0.0014)
_cons	0.0607***	0.0620***
	(0.0015)	(0.0017)
Fixed effects		
firm	yes	yes
year	yes	yes
industry	yes	yes
industry × year		yes
Number of observations	400 090	400 090
Number of firms	80 018	80 018
sigma_u	0.155	0.156
sigma_e	0.095	0.096

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A3
Results of model estimation for short-term debt burden.

	Dependent variable: short-term liabilities	
	(1)	(2)
$ASSETS\_AV_{t-1}$	–0.0003***	–0.0003*
	(0.0001)	(0.0001)
$PROFITABILITY_{t-1}$	–0.1256***	–0.1255***
	(0.0014)	(0.0014)
$REVENUE\_ASSETS_{t-1}$	0.0068***	0.0067***
	(0.0001)	(0.0002)
$TANG\_REVENUE_{t-1}$	–0.00004	0.0000
	(0.0001)	(0.0001)
FA_SHARE_{t-1}	–0.1051***	–0.1052***
	(0.0022)	(0.0022)
_cons	0.4973***	0.4986***
	(0.0026)	(0.0028)
Fixed effects		
firm	yes	yes
year	yes	yes
industry	yes	yes
industry × year		yes
Number of observations	400 090	400 090
Number of firms	80 018	80 018
sigma_u	0.263	0.263
sigma_e	0.149	0.149

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Appendix B

Table B1
Test of the significance of fixed effects in the model for total debt burden.

Industries	Dependent variable: total liabilities	
	Average fixed effect	Wald test *p*-value
2012		
Agriculture	–0.11	–
Construction	0.15	–
Manufacturing; mining	0.06	0.53
Retail trade	–0.10	–
Transport; electric, gas, and sanitary	0.01	0.97
Vehicle trade	0.04	–
Wholesale trade	0.10	–
2013		
Agriculture; retail trade	–0.11	0.22
Construction	0.15	–
Manufacturing; mining	0.06	1.00
Transport; electric, gas, and sanitary	0.01	0.38
Vehicle trade	0.03	–
Wholesale trade	0.09	–
2014		
Agriculture	–0.13	–
Construction	0.14	–
Manufacturing	0.06	–
Mining; wholesale trade	0.09	0.27
Retail trade	–0.11	–
Transport; vehicle trade; electric, gas, and sanitary	0.02	0.31
2015		
Agriculture	–0.16	–
Construction	0.14	–
Manufacturing	0.06	–
Mining; wholesale trade	0.08	0.56
Retail trade	–0.11	–
Transport; vehicle trade; electric, gas, and sanitary	0.02	0.20

Note: The statistical significance of the difference between coefficients was verified using the Wald test. The average fixed effect is the sum of the industry fixed effect and the sum of the industry fixed effect each year.

Table B2
Test of the significance of fixed effects in the model for long-term debt burden.

Industries	Dependent variable: long-term liabilities	
	Average fixed effect	Wald test *p*-value
2012		
Agriculture	0.09	–
Construction; electric, gas, and sanitary	–0.02	0.27
Manufacturing; vehicle trade	0.04	0.12
Mining	0.06	–
Retail trade	–0.01	–
Transport	0.02	–
Wholesale trade	0.01	–

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Table B2 *(continued)*

Industries	Dependent variable: long-term liabilities	
	Average fixed effect	Wald test *p*-value
2013		
Agriculture	0.09	–
Construction; electric, gas, and sanitary	–0.02	0.34
Retail trade	–0.01	–
Manufacturing	0.04	–
Mining	0.06	–
Transport; wholesale trade	0.02	0.58
Vehicle trade	0.05	–
2014		
Agriculture; mining	0.08	0.23
Construction; electric, gas, and sanitary	–0.02	0.52
Retail trade	–0.01	–
Manufacturing; vehicle trade	0.04	0.10
Transport; wholesale trade	0.02	0.86
2015		
Agriculture; vehicle trade	0.05	0.85
Construction; retail trade; electric, gas, and sanitary	–0.02	0.13
Manufacturing	0.04	–
Mining	0.08	–
Transport; wholesale trade	0.01	0.96

Note: The statistical significance of the difference between coefficients was verified using the Wald test. The average fixed effect is the sum of the industry fixed effect and the sum of the industry fixed effect each year.

Table B3
Test of the significance of fixed effects in the model for short-term debt burden.

Industries	Dependent variable: short-term liabilities	
	Average fixed effect	Wald test *p*-value
2012		
Agriculture	–0.20	–
Construction	0.16	–
Manufacturing; electric, gas, and sanitary	0.03	0.34
Mining, transport; vehicle trade	–0.01	0.50
Retail trade	–0.09	–
Wholesale trade	0.09	–
2013		
Agriculture	–0.20	–
Construction	0.16	–
Electric, gas, and sanitary	0.03	–
Manufacturing	0.02	–
Mining, transport, vehicle trade	–0.01	0.43
Retail trade	–0.10	–
Wholesale trade	0.08	–
2014		
Agriculture	–0.20	–
Construction	0.15	–
Electric, gas, and sanitary	0.04	–

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Table B3 *(continued)*

Industries	Dependent variable: short-term liabilities	
	Average fixed effect	Wald test *p*-value
Manufacturing	0.02	–
Mining; transport	0.00	0.74
Retail trade	–0.10	–
Vehicle trade	–0.02	–
Wholesale trade	0.07	–
2015		
Agriculture	–0.21	–
Construction	0.15	–
Electric, gas, and sanitary	0.04	–
Manufacturing	0.02	–
Mining; transport	0.00	0.77
Retail trade	–0.10	–
Vehicle trade	–0.04	–
Wholesale trade	0.06	–

Note: The statistical significance of the difference between coefficients was verified using the Wald test. The average fixed effect is the sum of the industry fixed effect and the sum of the industry fixed effect each year.

Appendix C

Table C1
Test of robustness of model results: total sample (total debt).

	Dependent variable: total liabilities	
	(1)	(2)
$ASSETS\_AV_{t-1}$	0.0001	0.0001
	(0.0001)	(0.0001)
$PROFITABILITY_{t-1}$	–0.2398***	–0.2393***
	(0.0018)	(0.0018)
$REVENUE\_ASSETS_{t-1}$	0.0084***	0.0083***
	(0.0003)	(0.0003)
$TANG\_REVENUE_{t-1}$	0.0007***	0.0007***
	(0.0001)	(0.0001)
FA_SHARE_{t-1}	–0.0776***	–0.0778***
	(0.0034)	(0.0034)
_cons	0.6180***	0.6234***
	(0.0038)	(0.0041)
Fixed effects		
firm	yes	yes
year	yes	yes
industry	yes	yes
industry × year		yes
Number of observations	413 635	413 635
Number of firms	82 727	82 727
sigma_u	0.387	0.387
sigma_e	0.239	0.238

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C2
Test of the robustness of model results: total sample (long-term debt).

	Dependent variable: long-term liabilities	
	(1)	(2)
$ASSETS\_AV_{t-1}$	0.0005***	0.0005***
	(0.0000)	(0.0000)
$PROFITABILITY_{t-1}$	–0.0365***	–0.0362***
	(0.0009)	(0.0009)
$REVENUE\_ASSETS_{t-1}$	–0.0029***	–0.0029***
	(0.0001)	(0.0001)
$TANG\_REVENUE_{t-1}$	0.0005***	0.0005***
	(0.0000)	(0.0000)
FA_SHARE_{t-1}	0.0460***	0.0458***
	(0.0017)	(0.0017)
_cons	0.0741***	0.0753***
	(0.0019)	(0.0020)
Fixed effects		
firm	yes	yes
year	yes	yes
industry	yes	yes
industry × year		yes
Number of observations	413 635	413 635
Number of firms	82 727	82 727
sigma_u	0.190	0.190
sigma_e	0.121	0.121

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C3
Test of the robustness of model results: total sample (short-term debt).

	Dependent variable: short-term liabilities	
	(1)	(2)
$ASSETS\_AV_{t-1}$	–0.0004***	–0.0004***
	(0.0001)	(0.0001)
$PROFITABILITY_{t-1}$	–0.2091***	–0.2089***
	(0.0018)	(0.0018)
$REVENUE\_ASSETS_{t-1}$	0.0118***	0.0117***
	(0.0002)	(0.0002)
$TANG\_REVENUE_{t-1}$	0.0003***	0.0003*
	(0.0001)	(0.0001)
FA_SHARE_{t-1}	–0.1315***	–0.1316***
	(0.0032)	(0.0032)
_cons	0.5454***	0.5495***
	(0.0034)	(0.0038)
Fixed effects		
firm	yes	yes
year	yes	yes
industry	yes	yes
industry × year		yes
Number of observations	413 635	413 635
Number of firms	82 727	82 727
sigma_u	0.346	0.346
sigma_e	0.233	0.233

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.