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## Corporate Debt Overhang in Croatia: Micro Assessment and Macro Implications

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Ana Martinis, Igor Ljubaj

Zagreb, June 2017





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## Abstract

High corporate sector leverage has often been highlighted as one of the major impediments to economic recovery. We conduct a debt sustainability analysis for Croatian corporates based on firm-level data. The analysis shows that around one third of the corporate debt in Croatia is unsustainable, thus pointing to sizeable deleveraging needs. By relating the estimated firm-level debt overhang indicator with investment activity, we find that over-indebted firms have reduced their investment to a greater extent than those without debt overhang. This especially holds among exporters and domestically owned private companies, whose higher sensitivity to unsustainable debt probably explains why they are less debt burdened. Our paper contributes to the existing literature by showing that, in the case of Croatia, the estimated firm-level debt sustainability thresholds, unlike the aggregate thresholds, capture the asymmetrically negative effect of debt overhang on investment. The estimated size and impact of the debt overhang in Croatia warrant policy engagement that would include more efficient bankruptcy procedures, swifter balance sheet clean-up supported by specific tax treatments, enhanced restructuring of unsustainably indebted state-owned companies as well as a comprehensive policy strategy for improving business climate and competitiveness.

**Keywords:**

corporate debt, investment, debt overhang, deleveraging, crisis, Croatia

**JEL:**

D22, E22, F34, G31

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# 1 Introduction

The issue of (over)indebtedness came into the focus of economic research during the global financial crisis. Deleveraging needs are frequently cited as the key limitation to a stronger economic recovery. In this respect, Croatia is not very different from many other EU countries. During the expansion phase, which was characterised by low risk perception and abundant capital inflows, Croatian firms accumulated high debt from both domestic and foreign sources. As a result, non-consolidated corporate debt has increased to around 100% of GDP, thus putting the Croatian corporate sector among the most indebted in Central and Eastern Europe. Nonetheless, since the beginning of the financial crisis corporate deleveraging has been sluggish and uneven. This raises questions whether and to what extent the existing corporate debt in Croatia is unsustainable, how much deleveraging can be expected in the medium term, and what the macroeconomic implications of debt overhang are.

The high debt of non-financial corporations and the accompanying deleveraging needs may have various negative implications for economic activity. They create pressures on firms' profitability and overleveraged companies have no financial space to engage in potentially prosperous investment opportunities. Moreover, excessive corporate indebtedness may hinder the reallocation of economic resources from firms with low productivity to more productive firms. Finally, unsustainable debt poses risks for financial stability as it leads to deterioration in loan performance as well as to increased vulnerability of firms to interest rate shocks.

The aim of this paper is two-fold. First, we perform various estimations of the size of the debt overhang in the corporate sector and analyse its distribution and its sensitivity to selected economic shocks. Second, we assess the impact of corporate (over)indebtedness on investment activity using the dynamic panel data model of the investment equation in which we include our previously estimated firm-level debt overhang indicator. Our findings point to the need for proper policy actions to deal with the problem of the debt overhang.

The paper is structured as follows. The introduction is followed by a literature review. The third section provides an estimation of the debt overhang for the corporate sector in Croatia and its subgroups divided by industry, firm size, ownership and export orientation. The fourth section presents the econometric panel estimation of the investment equation with particular emphasis on asymmetric effects of debt overhang on investment activity. The paper concludes with policy implications and a discussion on actions capable of tackling the issue of the corporate debt overhang.

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## 2 The concept of corporate debt sustainability and literature review

The starting point in theory of corporate finance is Modigliani and Miller (1958) and their capital structure irrelevance proposition. They argue that the value of a firm and its investment decisions do not depend on indebtedness; i.e. it is irrelevant if the firm uses internal (capital and retained earnings) or external financing (loans and securities). However, subsequent theories have challenged the funding structure irrelevance theorem. This strand of literature emphasises that the structure and price of financing sources affect corporate operations and investment due to market frictions. In particular, the trade-off and the pecking order theories of corporate leverage (Myers, 1984) suggest that firms decide on the structure of financing sources by comparing the marginal benefits and costs of various financing sources. More precisely, the trade-off theory argues that a firm sets a target debt-to-asset ratio that is determined by the tax benefits of debt on the one hand and potential bankruptcy costs on the other.

The pecking order theory argues that a firm generally prefers internal to external financing, and debt to equity in case of external financing. Murray and Goyal (2005), in their overview of theoretical concepts of corporate debt, refer to numerous empirical studies that confirm the general hypotheses of these two theories. Contrary to the Modigliani-Miller approach, these concepts suggest that the quantity and price of corporate debt have significant implications on a firm's operations. In the long run, they influence investment decisions, which has far-reaching consequences for overall economic developments. This theoretical background has motivated the analysis of corporate debt in Croatia in this paper.

Following the trade-off and pecking order theories, the issue of debt (un)sustainability has increasingly been in the focus of economic research. This issue becomes even more relevant in the aftermath of recessions when unsustainable debt and rollover risks can pose a great burden on economic recovery. Lo and Rogoff (2015) find a negative influence of debt overhang of all sectors (including the corporate) on recovery after the recent global financial crisis. Likewise, in a comprehensive overview of the debt overhang issue, Buttiglione et al. (2014) point out that many countries are caught in a vicious circle between unsustainable debt and deleveraging, as debt overhang implies slower growth, which makes deleveraging more difficult, feeding back into continued slow growth. Another prominent paper is Eggertson and Krugman (2011), who theoretically formalise the fact that excessively leveraged economic agents must reduce their debt, which adversely affects aggregate demand.

As for empirical quantifications of the threshold value above which corporate debt becomes detrimental for the economy, the literature is not as rich as in the case of public debt. One paper that stands out is Cecchetti et al. (2011). Based on data for 18 OECD countries in the period from 1980 to 2010, they estimate that the threshold value above which corporate debt becomes a burden to economic growth is 90% of GDP, as higher nominal debt in the case of shocks increases real sector volatility and financial vulnerability, which together reduce growth. Furthermore, Cecchetti et al. (2011) point out that high private debt in combination with high public debt makes the economy even more vulnerable to shocks. Similarly, Arcand et al. (2012) estimate that debt financing starts having a negative effect on output growth when credit to the private sector reaches 100% of GDP. The fact that Croatian corporate debt and private debt more generally already exceed these thresholds warrants an in-depth assessment of the corporate indebtedness in Croatia. We build our assessment on these macro-level findings, but take a more disaggregated approach by estimating corporate debt thresholds on the firm level.

The issue of corporate (over)indebtedness is often incorporated in studies analysing its implications on specific macroeconomic developments. Goretti and Souto (2013) find a negative correlation between debt burden and investment on a sample of euro area periphery countries in the period from 2000 to 2011. By using a narrative approach and observing deleveraging experiences in post-crises periods, they stress the need for orderly deleveraging of the corporate sector, while at the same time pointing to the risks and macrofinancial costs of deleveraging. Coricelli et al. (2010) assess the impact of debt overhang on productivity growth

in Central and Eastern Europe and detect a threshold debt level at 40% of total equity above which additional borrowing leads to a decrease in productivity growth. Likewise, Kalemlı-Ozcan et al. (2015) show that debt overhang and rollover risk have weakened the investment activity in Europe. Their results suggest that these two factors caused half of the drop in investment activity during the crisis. Moreover, they find that European firms with higher debt overhang invested less even before the crisis and that the negative correlation intensified during the crisis. This is especially valid for firms with a higher share of short-term debt, which is usually associated with a higher rollover risk at times of financial market shocks.

Regarding the studies for specific countries, Lawless et al. (2014) find the negative impact of debt overhang on SMEs' performance in Ireland, in particular on their investment, employment and financial stress indicators. Damijan (2014) obtains similar findings for Slovenian enterprises: excessive leverage and lower debt service capacity hinder growth of corporate productivity, exports, employment and investment. In addition, he finds that the negative impact of excessive indebtedness is greater for micro and small enterprises. In his more recent study for six Central and Eastern European countries (including Croatia), Damijan (2016) again finds a negative impact of overleveraged firms on corporate performance, employment, investment and exports. Finally, Kuchler (2015) finds that high corporate leverage in Denmark contributed to a reduction in investment, in particular for small and medium-sized enterprises.

To sum up, the problem of unsustainable indebtedness of the corporate sector and its micro and macroeconomic implications is a widely represented topic covered in numerous empirical and theoretical papers, which, together with the current developments in Croatia (high and corporate debt), offer a good starting point and motivation for conducting the analysis of debt overhang of Croatian enterprises and of its impact on investment activity.

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## 3 Corporate debt overhang in Croatia

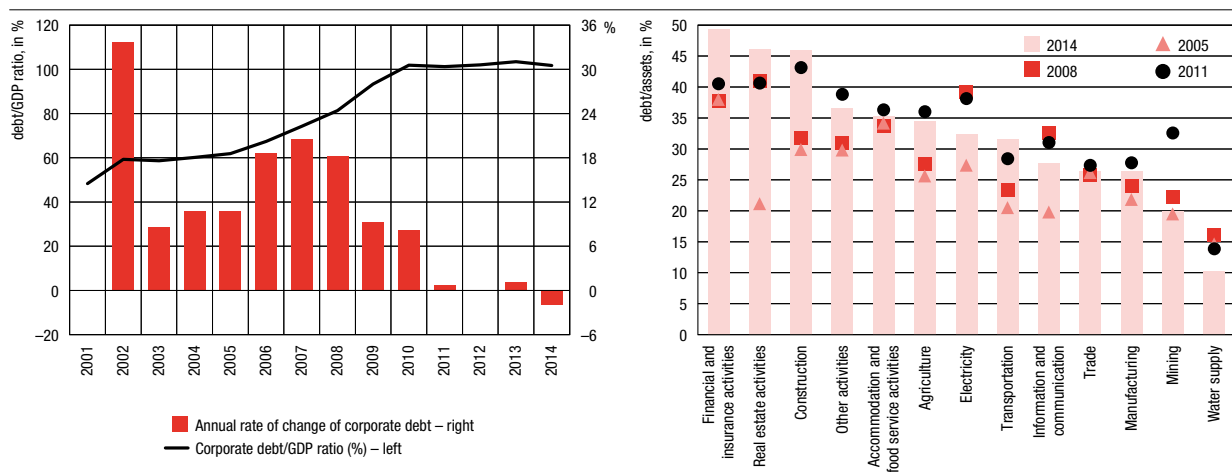
### 3.1 Evolution of corporate debt in Croatia

Corporate sector debt in Croatia grew strongly in the years preceding the global financial crisis, supported by low risk perception, large capital inflows and the boom in the construction and real estate sectors. In the period from 2001 to 2008, the total corporate sector debt increased threefold, growing by 17% annually (Figure 1, left panel). The central bank introduced measures that have successfully slowed down domestic credit activity, but firms turned to direct foreign borrowing, thus contributing to continued growth of the total corporate debt until the beginning of the crisis. After 2009, recession and higher risk aversion of both creditors and debtors led to a marked slowdown of corporate borrowing. However, up to end-2014 there was still no evidence of significant deleveraging.

Accumulation and subsequent stabilisation of the corporate debt occurred together with its reallocation within the sector. As a result, the distribution of debt across industries significantly differed in the adjustment phase compared to the pre-crisis expansionary phase (Figure 1, right panel). Debt growth in the period 2005-2014 was the strongest in the real estate sector, construction, and transportation activities, for which the debt-to-assets ratios increased by more than 50% on average. Conversely, since the beginning of the crisis indebtedness decreased in only four industries, primarily those where indebtedness was initially not very high (water supply, mining, ICT and electricity supply).

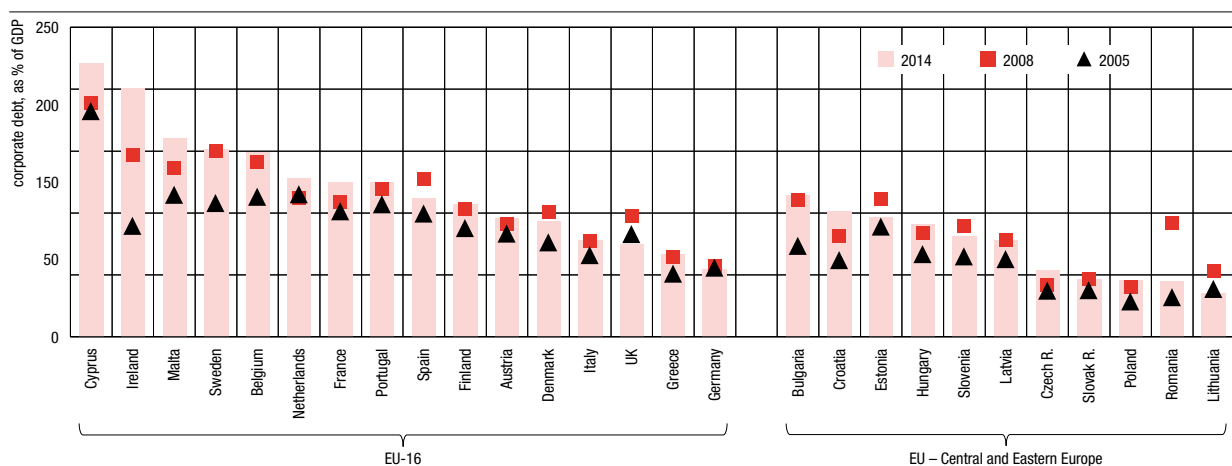
Unlike almost all Central and Eastern European countries, the Croatian corporate sector has not deleveraged since the beginning of the crisis. In fact, the share of corporate debt in GDP until the end of 2014 actually increased to over 100% of GDP, thus making the Croatian corporate sector among the most indebted in Central and Eastern Europe (Figure 2).

Figure 1 Corporate debt in Croatia – dynamics and distribution



Note: Corporate debt on the left panel is the sum of loans and debt securities from non-consolidated financial accounts. Corporate debt on the right panel refers to a sample of firms used in debt sustainability assessment in Chapter 3.2).  
Sources: CNB (left panel) and Amadeus (right panel).

Figure 2 Debt of the non-financial corporations in EU countries

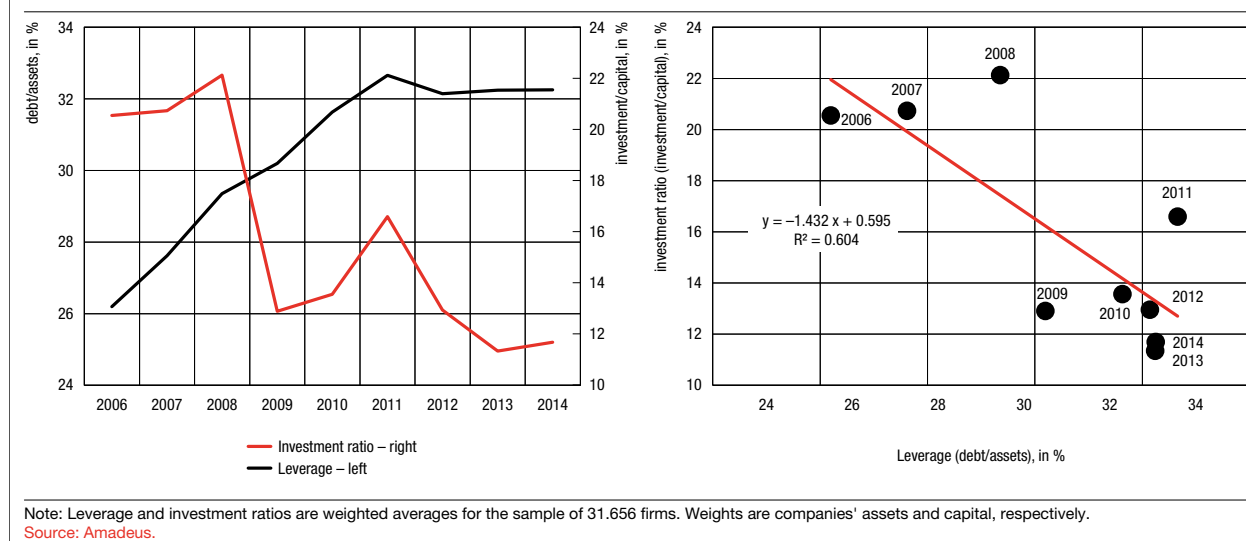


Note: Corporate debt is the sum of loans and debt securities from non-consolidated financial accounts. Luxembourg (in which corporate debt stood at 346% of GDP in 2014) is not shown in the chart.  
Source: Eurostat.

Nonetheless, the leverage level itself does not necessarily imply that the corporate sector is excessively indebted or unable to service its debt. In fact, the majority of the “old” EU members have been facing significantly higher corporate leverage levels for years. The firms’ capacity to finance debt should therefore be assessed by taking into account their profitability and the cost of debt. The average profitability of Croatian enterprises, measured by the ratio of EBIT to total assets, recorded a strong decline in the wake of the crisis, after which it remained at approximately 2% (Annex I). This is almost one third below the pre-crisis profitability levels. At the same time, the gradual decline in global and domestic interest rates resulted in a decrease in the interest payment burden. This has contributed to a gradual improvement of the interest coverage ratio, which, after a sharp decline in 2008-2010, gradually increased until the end of the observed period and, by 2014, slightly exceeded the pre-crisis level.

These indicators suggest not only a relatively strong negative correlation between aggregate investment and leverage ratios (Figure 3) but also that the high debt of Croatian firms has become a serious burden on their performance. The European Commission (EC, 2016) and International Monetary Fund (IMF, 2015) also recognized this issue, pointing to corporate indebtedness as one of the main impediments to the recovery of

Figure 3 Leverage and investment dynamics



investment and of economic growth in Croatia. In order to investigate the extent of this issue, the following section presents a quantitative assessment of corporate debt sustainability in Croatia.

### 3.2 Methodology of debt sustainability assessment and data description

There is no uniform approach to the assessment of corporate debt sustainability. The most frequently used methods are comparative, based on indebtedness and debt-servicing burden indicators that are compared to arbitrarily selected thresholds. The most common indebtedness indicators include the share of corporate debt in GDP, total assets or equity (an overview of the methods and indicators is presented in Bruggeman, 2013). However, while these indicators point to the relative indebtedness compared to peer firms, they do not reveal whether a firm is able to service debt from regular operations.

More comprehensive methods that take into account the debt-servicing capacity of firms include: (i) Stationarity Approach (Cuerpo et al., 2014), (ii) Contingent Claims Analysis (Gapen et al., 2004) and (iii) the method based on the concept of net free cash flow (IMF, 2013). The first method (i) is based on the notion that a debt is sustainable if it moves in line with total discounted assets, meaning that the “debt-to-discounted assets” ratio should be stationary. The advantage of this approach is that it does not require debt thresholds to be specified. Its disadvantage is that the assessment of the imbalance between sustainable and actual debt levels depends on the selection of a reference year for sustainable debt, such a selection being made arbitrarily. The second method (ii) is based on the assessment of probability of corporate default using data on market value of listed companies. However, the limited number of listed companies in economies with less developed capital markets, such as the Croatian, narrows the scope for such research.

The third method (iii) estimates what share of debt a firm will be able to finance from its regular operations in the medium term. The method is based on the concept of net free cash flow (NFCF), which shows whether a firm is able to finance its liabilities to creditors and owners from current operations. This disaggregated approach accounts for heterogeneity among firms and detects the most vulnerable firms, which would not be possible from aggregate data. Another advantage of this method is its dynamic forward-looking perspective, which allows the assessment of debt sustainability over the medium term and its sensitivity to various macroeconomic scenarios (e.g. the interest rate shock and the economic downturn shock). This approach appears the most appropriate for the debt sustainability analysis of Croatian enterprises. A detailed description of this method, along with its modifications, follows below.

Net free cash flow is defined as operating cash flow (before interest) minus interest expenses, capital expenditures and dividends. It is calculated as follows:

$$NFCF = \frac{\text{Net free cash flow}}{\text{Assets}} = \frac{\text{Operating cash flow before interest}}{\text{Assets}} - \frac{\text{Interest expense}}{\text{Debt}} \times \frac{\text{Debt}}{\text{Assets}} - \frac{\text{Capital expenditures}}{\text{Assets}} - \frac{\text{Dividends}}{\text{Assets}} \quad (1)$$

A positive value of NFCF indicates that corporate debt is sustainable, i.e. that a firm can finance debt from its current operations. In contrast, if NFCF is negative, it means that the firm is unable to generate sufficient cash flow to finance its existing debt level (while maintaining a certain level of capital investment and dividend payments), so the company has debt overhang.

Corporate debt sustainability is assessed based on the projection of NFCF in the medium term (up until 2017). For this purpose, we use various assumptions and combinations of the forecasted and the historical inputs to the equation (1), the following input options being employed in the analysis:

1. The operating cash flow is forecast based on the regression between firm-level operating cash flow and real GDP growth for the period from 2005 to 2014<sup>1, 2</sup>. We estimate two regressions between the cash-flow and GDP: (a) a panel-data regression yielding sector- and firm-level intercepts and sector-level elasticities, applying sectoral dummies for 82 sectors (following 2-digit NACE classification); and (b) individual regressions for each firm, yielding firm-level intercepts and elasticities. Additionally, as the third (c) option, we use historical averages of operating cash flows for the period 2006-2014 for each firm.
2. Interest expenses are forecast based on the assumption that both domestic and foreign interest rates remain low until 2017 (around the levels recorded in 2015) and that the structure and maturity of the corporate remains unchanged<sup>3</sup>.
3. Debt-to-assets ratio is kept at the last recorded level because the focus of the analysis is to assess the sustainability of the current leverage levels given projected trends in profitability and interest rates (in line with IMF, 2013).
4. For the capital expenditure ratio, we also use several alternatives: (a) the last recorded level (following the assumption that investment reached a trough in 2014, which is justified in view of the prolonged six-year recession in Croatia); (b) the minimum capital expenditure/assets ratio in the period 2006-2014; and (c) no capital and dividend expenditures (i.e. extreme case scenario).

The combinations of these inputs yield a range of the debt sustainability estimations rather than one single estimation, thus providing a range of NFCF projections, with the aim of ensuring a robust debt sustainability assessment.

Next, the corporate debt sustainability analysis focuses on those firms that have high debt, i.e. debt exceeding 30% of total assets (IMF, 2013)<sup>4</sup>. The rationale behind this assumption is that highly indebted firms are expected to be more exposed to default risk. The chosen threshold level appears suitable for Croatia, as the Croatian corporate debt-to-assets ratio of 30% corresponds to the corporate debt-to-GDP ratio of about 90%, which, according to Cecchetti et al. (2011), is the threshold value for the aggregate corporate debt overhang.

Firms with debt-to-assets ratios above 30% and a negative projected net free cash flow ( $NFCF_{2017} < 0$ ) are considered to have unsustainable debt, or a debt overhang. For such firms, the sustainable debt level is derived as the debt level at which  $NFCF_{2017}$  equals zero (i.e. becomes non-negative). The positive difference between the existing debt level and the sustainable debt level is the debt overhang. It represents deleveraging needs in the medium term.

1 Operating cash flow is regressed over the change in real GDP in years  $t$  and  $t-1$ , and a constant, using OLS method on a firm-level panel.

2 The forecast of the operating cash flow is based on the estimated coefficients and the CNB's July 2016 official projection of real GDP growth rates (1.6% in 2015, 2.6% in 2016 and 2.6% in 2017).

3 According to CNB data for end-2015, enterprises have 41% of domestic debt (predominantly loans) and 59% of foreign debt (36% accounted for by loans of non-affiliated creditors, 18% by debt to affiliated companies and 5% are debt securities).

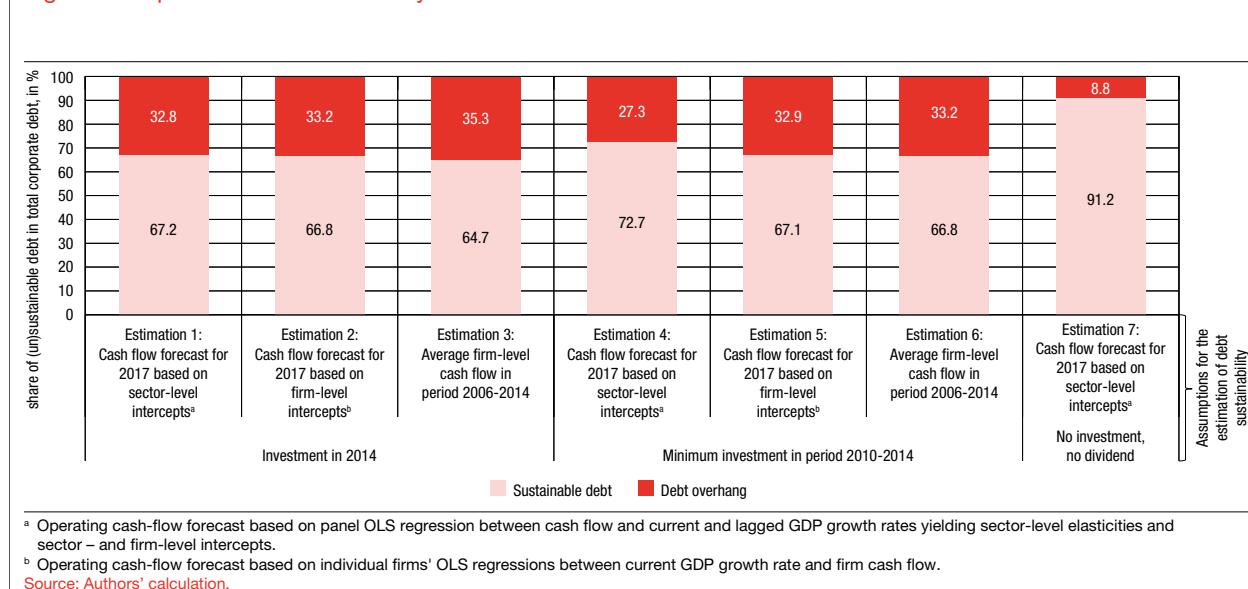
4 Following IMF (2013), the corporate debt-to-assets threshold of 30% is chosen based on the crisis debt levels in the core EU countries and the pre-crisis debt levels in EU peripheral countries.

As regards data sources, the analysis is based on annual data sets obtained from the Amadeus database compiled by *Bureau van Dijk*. Data on interest expenses and exports are obtained from the annual financial reports databases compiled by the Croatian Financial Agency (FINA). We excluded firms that are part of the government sector according to ESA 2010 classification. We also treated the sample for outliers in line with Lopez-Garcia and di Mauro (2015). In particular, we excluded firms with variable values outside the range between the 2nd and the 99th percentiles or outside the range “median  $\pm$  10\*interquartile range”. In addition, we excluded firms with fewer than two employees and firms with negative assets or assets equalling zero. The definitions of all variables used in the debt sustainability analysis can be found in Annex II. The resulting sample comprises 31,656 firms, representing about 62% of total corporate sector assets and 59% of total corporate sector debt in 2014 (Annex I). In the sample, 6,726 firms have high debt (debt-to-assets ratio above 30%), which is 21% of the total number of the enterprises in the sample, but they hold as much as 50% of total assets of the sample.

### 3.3 Estimation of debt overhang and sensitivity analysis of deleveraging needs

The results of the debt sustainability analysis show that approximately one third of the corporate debt is unsustainable (Figure 4)<sup>5</sup>. The estimated unsustainable debt ranges between 27.3% (Estimation 4) and 35.3% of total debt (Estimation 3), with the mean and the median of 32.4% and 33.1% of total debt, respectively<sup>6</sup>. The estimations using the 2014 investment ratios do not differ substantially from those using the minimum investment ratios during the recession period, thus supporting the assumption that the year 2014 indeed may have been a trough for investment activity in many highly indebted firms.

Figure 4 Corporate debt sustainability – estimation results



These results suggest that the debt overhang issue in the Croatian economy is sizeable, implying that individual firm-driven cuts in operating costs, investments and dividends may not be sufficient to bring debt back to sustainable levels. In fact, even under the extreme assumption that firms completely cut capital expenditures and dividend payments in order to reduce indebtedness, about 9% of the total debt would remain

<sup>5</sup> These results are in line with the assessment by the European Commission (EC, 2015) that found, on the basis of a comparison of firms by their debt-to-earnings and debt-to-capital ratios, that more than one third of the corporate debt may be considered at high risk of defaulting.

<sup>6</sup> Mean and median are computed excluding the Estimation 7 in Figure 4 (the extreme-case assumption of no dividends and no capital expenditures).

unsustainable (Figure 4, Estimation 7).

The distribution of debt overhang reveals that unsustainable debt is concentrated in a small number of firms. About two thousand firms (Table 1, column 3) out of close to 32 thousand firms in the sample have debt overhang or negative projected NCF<sub>2017</sub>, and they account for 5-7% of the total number of firms in the sample (Table 1, column 4) and 16-26% of the total assets of the sample (Table 1, column 5). Moreover, the top 10 firms with the highest debt overhang in absolute terms hold more than one third of the total debt overhang, and the top 100 enterprises with the highest debt overhang hold as much as three quarters of the entire debt overhang of the sample.

**Table 1 Corporate debt overhang distribution**

	Inputs for the debt sustainability estimation		No of firms with debt overhang	Share of overindebted firms in total number of firms	Share of overindebted firms' assets in total assets	Share of top 10 firms with largest debt overhang in total debt overhang	Share of top 100 firms with largest debt overhang in total debt overhang
	Operating cash flow before interest	Investment ratio (capital expenditure/assets)					
	1	2					
1	Forecast based on sector-level estimation <sup>a</sup>	2014 investment ratio	2,036	6.4%	25.8%	44.6%	77.8%
2	Forecast based on firm-level estimation <sup>b</sup>	2014 investment ratio	2,173	6.9%	21.9%	38.0%	73.6%
3	Firm-level average in period 2006-2014	2014 investment ratio	2,346	7.4%	24.2%	35.2%	71.7%
4	Forecast based on sector-level estimation <sup>a</sup>	Lowest investment ratio in period 2010-2014	1,549	4.9%	16.3%	47.0%	81.7%
5	Forecast based on firm-level estimation <sup>b</sup>	Lowest investment ratio in period 2010-2014	1,760	5.6%	22.2%	43.5%	79.0%
6	Firm-level average in period 2006-2014	Lowest investment ratio in period 2010-2014	1,826	5.8%	22.6%	39.4%	77.1%
7	Forecast based on sector-level estimation <sup>a</sup>	No investment, no dividend	923	2.9%	5.1%	31.1%	81.5%
	Mean (excl. estimation 7)		1,948	6.2%	22.2%	41.3%	76.8%
	Median (excl. estimation 7)		1,931	6.1%	22.4%	41.5%	77.5%

<sup>a</sup> Operating cash-flow forecast based on panel OLS regression between cash flow and current and lagged GDP growth rates yielding sector-level elasticities and sector- and firm-level intercepts.

<sup>b</sup> Operating cash-flow forecast based on individual firms' OLS regressions between current GDP growth rate and firm cash flow.

Source: Authors' calculation.

The debt sustainability analysis by activities shows that the most severe deleveraging pressures are present in the construction sector (Figure 5)<sup>7</sup>. Despite several years of deleveraging, this sector still has a very high debt level (over 45% of assets) and its profitability has been limited by a continued decline in real estate prices, which is then reflected in the high share of non-performing loans in total loans of domestic banks (33% at end-2014)<sup>8</sup>. High deleveraging needs also burden the real estate sector and other activities (dominated by firms that provide services to the construction sector)<sup>9</sup>. On the other hand, the financial services sector is to the largest extent able to service high debt thanks to somewhat higher profitability<sup>10</sup>. In absolute terms, the highest debt overhang is found in manufacturing (which is expected given that manufacturing is the largest sector measured by its share in total corporate assets), followed by construction and electricity supply.

7 In view of the relatively minor differences among the results of the estimations, the following analysis of the distribution of debt sustainability by firm characteristics is presented based on Estimation 2 (i.e. the estimation using the 2014 investment ratio and the cash-flow forecast based on firm-level regressions). Estimation 2 is the closest to the median of the six debt overhang estimations (Estimation 7 is not taken into account). The equivalent distribution analyses for other estimations are not presented here for simplification purposes, but are available upon request from the authors.

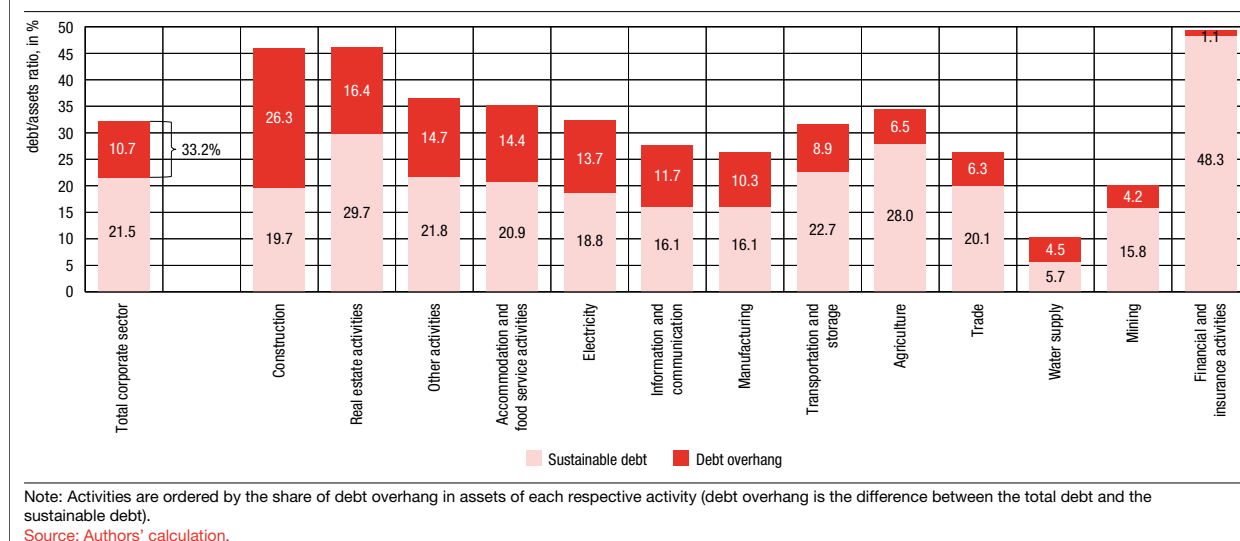
8 Loans of domestic banks to the construction sector declined in the period 2011-2014 by approximately 15%.

9 Other activities, according to the NCA 2007 classification, include the following: professional, scientific and technical activities, administrative and auxiliary service activities, public administration, defence and compulsory social security, education, human health and social work activities, arts, entertainment and recreation and other service activities.

10 Financial services activity includes firms that operate as holding companies for the affiliated non-financial corporations, i.e. playing the role of their financial service provider.

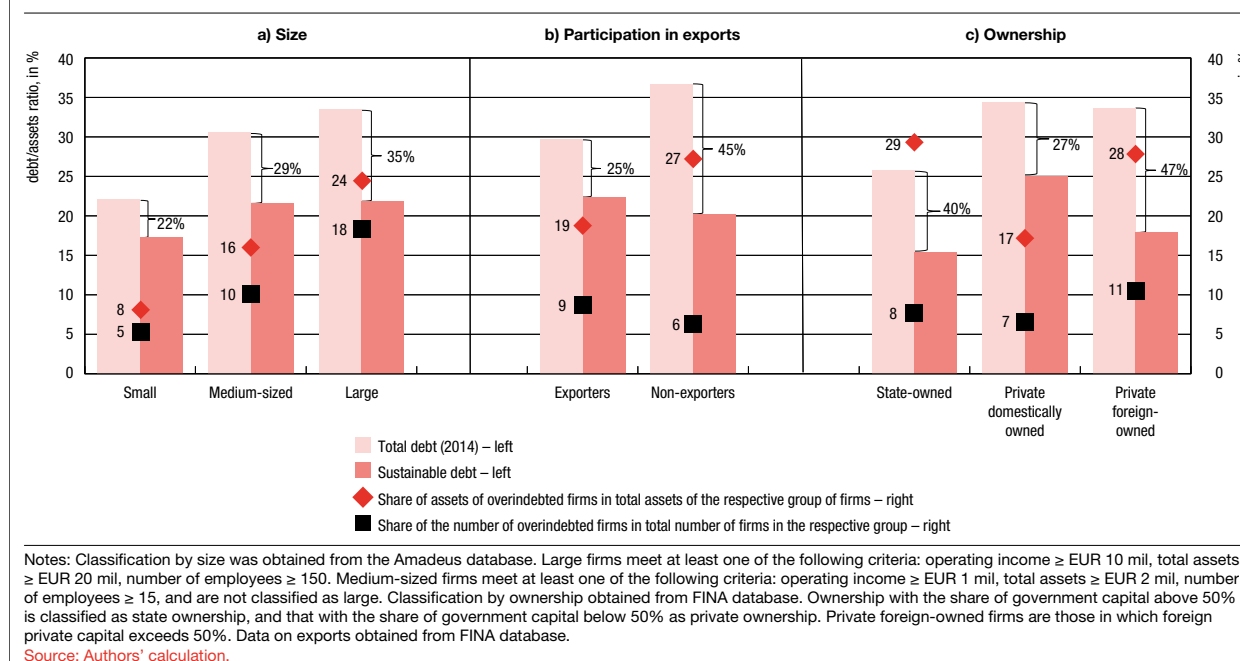


Figure 5 Corporate debt sustainability by activities



As regards firm size (Figure 6, panel a), small enterprises are considerably less indebted and have markedly lower deleveraging needs than the rest of the corporates. The weighted average debt-to-assets ratio of small enterprises ranges around 22%, while in large enterprises debt exceeds 33% of their assets. These results indicate that smaller enterprises, despite their growth potential and rather low indebtedness, probably have limited access to finance, partly because a large part of creditors' lending potential is already allocated to large firms, but also because of lack of collateral<sup>11</sup>. This is also in line with the findings from Damijan (2014 and 2016) and Kuchler (2015) who find that firm performance among SMEs is more sensitive to debt overhang than the performance of firms of other sizes.

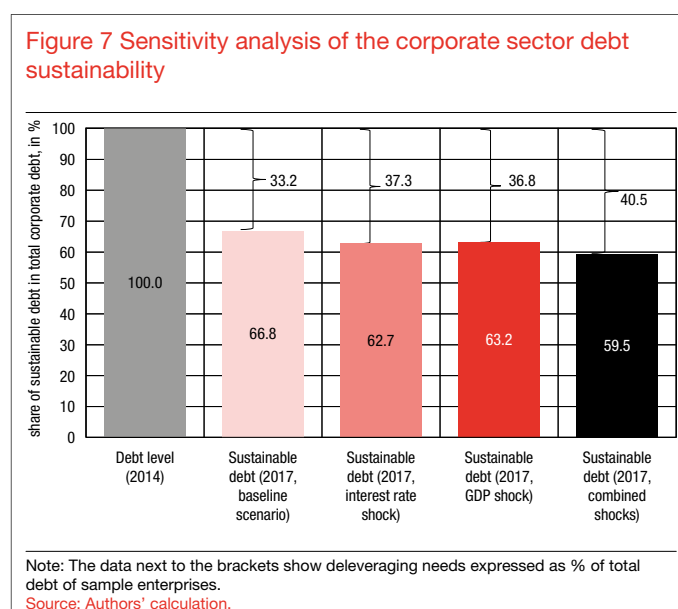
Figure 6 Corporate debt sustainability by firm size, ownership and export participation



11 For more information on access to finance of SMEs in Croatia, see Box 6, CNB Bulletin No. 220.

Second, we find that exporters have a noticeably lower debt level than non-exporters and that they have significantly lower deleveraging needs (Figure 6, panel b). Conversely, almost half of the non-exporters' debt is assessed as unsustainable. However, the non-exporters' large debt overhang is held by a small number of relatively larger firms (6% of all non-exporters holding 27% of total non-exporters' assets). Better debt sustainability for exporters may be related to the fact that exporters are on average more profitable than non-exporters, so they can finance debt more easily.

As regards the type of ownership (Figure 6, panel c), the debt sustainability analysis has shown that state-owned firms, although less indebted than private ones, are substantially more burdened by unsustainable debt. In fact, more than half of the state-owned firms' debt is estimated as unsustainable, and is again highly concentrated in a small number of large companies. Furthermore, foreign-owned private firms are significantly more burdened with debt overhang than domestically owned private firms, although their overall indebtedness levels are very similar. Namely, nearly one-half of the debt of foreign-owned firms has been assessed as unsustainable, compared to the only 27% of domestic private firms. This probably relates to the fact that foreign-owned firms largely use financing from their parent companies that is predominantly related to the owners' business strategies rather than on the subsidiaries' current profitability.



Finally, a sensitivity analysis of the debt overhang is conducted applying downside scenarios that include interest rate and GDP shocks (Figure 7). More precisely, the following scenarios were analysed: (a) the shock of interest rate increase by one percentage point annually in 2016 and 2017, (b) the shock of GDP decline by one standard deviation relative to the baseline scenario and (c) the combination of both shocks<sup>12</sup>. The sensitivity analysis shows that the interest rate shock would increase the share of debt overhang in total debt by 4.1 percentage point, i.e. from 33.2% to 37.3%. A relatively moderate effect on debt overhang partially reflects the fact that interest rates in 2015 dropped compared to 2014 (which is the reference year for this analysis), and this drop partially neutralises the effect of the expected rise in interest rates in the subsequent years (2016-2017). In addition, one should bear in mind that around 45% of foreign debt has a fixed interest rate and the interest rate shock does not affect this portion of the debt. The negative GDP shock would have a similar effect on corporate debt sustainability. In the GDP downturn scenario, 36.8% of total corporate debt would become unsustainable by 2017 (relative to 33.2% in the baseline). Finally, if both shocks materialised, more than 40% of total corporate debt would become unsustainable, and the share of deleveraging needs in total corporate assets would increase from 10.7% to around 13%.

12 One standard deviation of the annual rate of change in real GDP in the period 2005-2014 equals 3.9 percentage points.

## 4 Econometric assessment of the impact of corporate debt overhang on investment

In this chapter we test the impact of corporate indebtedness on firms' investment activity in the crisis period in Croatia. Particular attention is given to the asymmetry of this impact depending on whether a firm has unsustainable debt or not. For this purpose, we use firm-level data to estimate the basic investment equation, which includes common investment determinants such as sales growth and company size, and we further extend it by including corporate indebtedness as the explanatory variable.

The baseline dynamic model of the investment equation is:

$$INV_{i,t} = \alpha_i + \beta INV_{i,t-1} + \gamma \Delta S_{i,t-1} + \delta \log(A)_{i,t-1} + \sigma D_{i,t-1} + \varepsilon_{it} \quad (2)$$

where the dependent variable  $INV$  is the investment-to-capital stock ratio,  $\Delta S$  is the change in the logarithm of the sales income and illustrates the firm's growth potential (Barbosa et al., 2007),  $\log(A)$  is the value of the firm's total assets and stands as a proxy for the firm's size (expressed in logarithms to reduce variations), and  $D$  is the firm's debt-to-assets ratio<sup>13</sup>. Subscripts  $i$  and  $t$  refer to firm  $i$  and year  $t$ . The first lag of the dependent variable is included in the model to account for the autocorrelation in the investment activity, as well as to incorporate possible adjustment costs of the capital stock, as stated by Barbosa et al. (2007). All regressors are included with one lag ( $t-1$ ) as they aim to represent the conditions prevailing at the beginning of investment period  $t$ . Descriptive statistics of the variables are provided in Annex III.

The panel consists of annual data for 21,339 firms for the period from 2009 to 2014 (the time coverage of the sample is from 2007 to 2014, however, due to lagged variables two initial periods are lost). The panel is unbalanced since there are missing data for some enterprises in some years. Nonetheless, the number of observations exceeds 95 thousand.

The dynamic model was estimated using the GMM method in line with Arellano and Bond (1991) in order to take account of the problem of endogeneity of the lagged dependent variable. The Arellano-Bond estimator is particularly suitable for the assessment of dynamic models with fixed effects where the number of periods ( $t$ ) is small, and the number of units ( $N$ ) is large. The instruments that replace the endogenous explanatory variable ( $INV_{t-1}$ ) are the second and the third lags of the dependent variable ( $INV_{t-2}$  and  $INV_{t-3}$ ). The instruments pass the Hansen test of over-identifying restrictions, thus confirming the validity of the instrument choice. In addition, we include year dummies to control for macroeconomic conditions common to all firms.

Estimation results of the equation (2) are presented in Table 2, column 1. All estimated coefficients (except the coefficient related to the lagged dependent variable) are significant and have economically justified signs. The estimated coefficient associated with sales growth is significant and with a positive sign, supporting the assumption that the firm's investment decisions are positively affected by the demand for its products (Barbosa et al., 2007). By contrast, firm size displays a negative impact on investment, which supports the assumption that larger firms are investing less because they overinvested in their growth cycle. In other words, investment weakens with the "maturity in the life cycle", while at the same time young propulsive firms must invest more in order to grow.

Finally, the results for the effect of indebtedness on investment show a statistically significant negative effect of a firm's leverage on investment during the crisis. This finding supports the assumption that the corporate borrowing boom in Croatia prior to the crisis was indeed harmful for investment activity in the aftermath of the crisis. Furthermore, as the coefficient associated with indebtedness is significantly different from zero, we can reject the Modigliani-Miller hypothesis of the irrelevance of capital structure or corporate finance.

<sup>13</sup> Investment in year  $t$  is calculated as the difference between the value of fixed tangible assets in year  $t$  and in year  $t-1$  plus the amount of depreciation in year  $t$ .

**Table 2 Results of the baseline corporate investment model**

Dependent variable: Investment/Capital ratio (INV)  
 Instruments: Lags 2 and 3 of the dependent variable  
 Period of estimation: 2009-2014

Explanatory variables	Interpretation of the interaction terms	Linear model	
		1	2
INV <sub>t-1</sub>		-0.001	-0.001
S <sub>t-1</sub>		0.177**	0.170**
log(A <sub>t-1</sub> )		-1.668***	-1.634***
D <sub>t-1</sub>		-1.906***	
D <sub>t-1</sub> * 1 {D <sub>t-1</sub> > τ <sub>t-1</sub> }	Firms with debt overhang		-2.369***
D <sub>t-1</sub> * 1 {D <sub>t-1</sub> ≤ τ <sub>t-1</sub> }	Firms without debt overhang		-1.077***
J-statistics		16.016	17.091
Hansen test (p-value)		0.141	0.105
AR 1 (p-value)		0.074	0.075
AR 2 (p-value)		0.492	0.513
Number of firms		21,339	21,339
Number of observations		95,670	95,670

Notes: Variable τ<sub>it</sub> denotes firm-specific and time-variant debt threshold above which debt is considered unsustainable. \*\*\*, \*\*, \* indicate significance at 1, 5, and 10 percent level. In none of the models is there evidence of second-order autocorrelation in residuals (based on Arellano-Bond test). Instruments are second and third lag of the dependent variable. All regressions pass the Hansen test of overidentifying restrictions, indicating the validity of the instrument choice. The models include fixed effects for enterprises and dummy variables for time periods (coefficients for time dummies are not presented).

Source: Authors' calculation.

Finally, the magnitude of the negative debt effect on investment is much larger than in the comparable study by Rodriguez-Palenzuela et al. (2016), who estimated the effect of debt on investment at -0.49 for SMEs in selected Western European countries during the crisis.<sup>14</sup> This again implies that the corporate debt burden in Croatia has severe macroeconomic implications, even compared to Western European countries with higher debt levels.

We further extend the model to test asymmetry in the impact of corporate debt on investment activity. This approach is motivated by the assumption that enterprises with unsustainably high debt invest less than other enterprises, in line with the trade-off and pecking order theories of financing structure. For this purpose, we introduce two interaction terms that enable differentiation of the debt effect on investment between firms with debt overhang and firms with no debt overhang. A similar approach to assessing asymmetric effects of indebtedness on investment was used in a series of empirical studies (e.g. Rodriguez-Palenzuela et al., 2016, Goretta and Souto, 2013, and Jaeger, 2003).

The baseline investment equation is extended as follows:

$$INV_{i,t} = \alpha_i + \beta INV_{i,t-1} + \gamma \Delta S_{i,t-1} + \delta \log(A)_{i,t-1} + \bar{\sigma} D_{i,t-1} \times 1\{D_{i,t-1} > \tau_{i,t-1}\} + \underline{\sigma} D_{i,t-1} \times 1\{D_{i,t-1} \leq \tau_{i,t-1}\} + \epsilon_{it} \quad (3)$$

where the interaction term  $1\{D_{i,t-1} > \tau_{i,t-1}\}$  represents the “debt overhang indicator” and takes the value 1 if a firm has debt overhang (e.g. if its leverage ( $D_{it}$ ) exceeds the threshold value  $\tau_{it}$ ), and zero otherwise. By contrast, the second interaction term, the “no debt overhang indicator” ( $1\{D_{i,t-1} \leq \tau_{i,t-1}\}$ ), takes the value 1 when the firm does not have debt overhang and zero otherwise. By including the two offsetting interaction terms, we divide the sample into two subgroups to estimate whether the debt effect on investment significantly differs between firms with debt overhang and firms with sustainable debt. In other words, we test whether there is a statistically significant difference between the coefficients  $\bar{\sigma}$  and  $\underline{\sigma}$  and whether the latter is less negative than the former.

<sup>14</sup> Other studies covering the same topic use different indebtedness indicators (i.e. debt-to-equity instead of debt-to-assets) so their estimated coefficients are not comparable.

The key difference between our approach and the aforementioned papers is that the threshold value for identifying the overleveraged firms ( $\tau_{it}$ ) is computed individually for each firm and each year. Specifically, we compute the firm-specific time-variant threshold value of the debt-to-assets ratio  $\tau_{it}$  in line with the equation (1) and the methodology described in Chapter 3.2. Other studies use either aggregate or arbitrarily chosen thresholds that are equal for all firms and constant during the whole period under consideration (alternative thresholds are assessed in detail in section 4.2.).

The results of the panel estimation of the equation (3) are presented in Table 2, column 2. The estimated coefficients suggest that the corporate investment indeed reacts asymmetrically to indebtedness, i.e. investment activity contracts more strongly when a firm has debt overhang. Specifically, the statistically significant negative coefficient associated with indebtedness is more than twice as high for firms with debt overhang as for the others: the value of the coefficient related to the debt of unsustainably indebted firms is estimated at  $-2.37$ , compared to  $-1.08$  for firms without debt overhang. In addition, the Wald test rejects the hypothesis that the two coefficients associated with the debt variable are statistically identical (results of the Wald test are shown in Annex IV). The interpretation of these results is that for two firms with similar characteristics except for leverage, one with debt overhang and the other without, the expected adverse response of investment to a debt increase would be about twice as strong for the firm with debt overhang. In view of the high share of corporate debt overhang in Croatia (estimated to around one third of total debt), this result implies that deleveraging pressures indeed had a particularly strong adverse effect on investment activity in Croatia during the crisis.

Our findings of statistically significant asymmetric impact of debt on investment activity are in line with empirical findings for other countries. Jaeger (2003) has shown a significantly stronger negative effect of indebtedness on investment for the USA and Germany if indebtedness exceeds threshold values (the coefficients for the impact of debt on investment for the USA have been estimated at  $-1.9$  for highly indebted firms vs  $-0.5$  for other firms and for Germany at  $-0.7$  vs  $-0.3$ ). Rodriguez-Palenzuela et al. (2016) have also shown for the five largest euro area economies that the negative effect of debt on investment is greater if indebtedness exceeds the threshold value. In addition, a recent study of the Danish corporate sector done by Kuchler (2015) suggests that highly leveraged firms (i.e. those with leverage ratios above 80%) have reduced their investment rate by 3.9 percentage points more than the firms with low leverage. Finally, Goretti and Souto (2013) have even obtained different signs of the impact of debt on investment (e.g. positive sign for lower debt levels and negative for higher levels), thus also confirming the existence of asymmetry of the debt-to investment relation.

## 4.1 Breakdown by firm ownership and exports

To check whether the sensitivity of investment decisions to indebtedness depends on other firm-specific characteristics, we perform a set of robustness checks. In particular, we extend the model represented by equation (3) by including additional interaction terms with which we break down the sample to subgroups according to firms' participation in exports (e.g. exporters vs non-exporters) and type of ownership (e.g. foreign vs domestic ownership and private vs public ownership). The extended investment models are specified as follows:

$$INV_{it} = \alpha_i + \beta INV_{i,t-1} + \gamma \Delta S_{i,t-1} + \delta \log(A)_{i,t-1} + \overline{\sigma_{\Psi}} D_{i,t-1} \times 1\{D_{i,t-1} > \tau_{i,t-1}\} \times \Psi_{i,t-1} + \overline{\sigma_{1-\Psi}} D_{i,t-1} \times 1\{D_{i,t-1} > \tau_{i,t-1}\} \times (1 - \Psi_{i,t-1}) + \underline{\sigma_{\Psi}} D_{i,t-1} \times 1\{D_{i,t-1} \leq \tau_{i,t-1}\} \times \Psi_{i,t-1} + \underline{\sigma_{1-\Psi}} D_{i,t-1} \times 1\{D_{i,t-1} \leq \tau_{i,t-1}\} \times (1 - \Psi_{i,t-1}) + \varepsilon_{it} \quad (4)$$

where the term  $\Psi$  interacts with debt variable and takes the value 1 if a firm is exporter/foreign-owned/state-owned in the three extended models, respectively. Conversely, the interaction term  $(1-\Psi)$  takes the value 1 when a firm is non-exporter/domestically-owned/private-owned, respectively.

Overall, the main results from the baseline estimations robustly hold after accounting for selected firm characteristics (Table 3). The estimated values of the coefficients for sales income and firm size remain stable and statistically significant in all extended models. Moreover, a stronger negative effect of debt on investment (i.e. the asymmetry) is empirically found for five out of six subgroups of firms (except for foreign-owned firms).

Estimations of the extended models reveal additional interesting findings. First, the asymmetry in the effect of debt on investment particularly holds for exporters, domestically owned firms and privately-owned firms. Specifically, the exporters with debt overhang seem to contract investment far more strongly following a debt increase than the exporters without debt overhang: the negative estimated coefficient for overleveraged exporters is more than twice as large as for other exporters,  $-2.4$  compared to  $-1.0$ , as shown in Table 3, column 3). Conversely, for non-exporters, having unsustainable leverage does not seem to make a difference in their investment behaviour (e.g. the coefficients for non-exporters with and without debt overhang are almost equal:  $-1.4$  vs.  $-1.3$ ). This finding is in line with the assumption that exporters are exposed to stronger competition than non-exporters, so in a situation of growing debt, exporters would not be in a position to finance their rising debt obligations through price increases, but would be forced to cut investment. This may also be one of the underlying reasons behind our finding that exporters are less burdened by debt and have lower deleveraging needs (Figure 4, panel b), as debt overhang is more likely to hurt their performance outlook than is the case for non-exporters.

**Table 3 Results of the extended corporate investment models**

Dependent variable: Investment/Capital ratio (INV)  
Instruments: Lags 2 and 3 of the dependent variable  
Period of estimation: 2009-2014

Explanatory variables	Interpretation of the interaction terms	Linear model	Model testing for asymmetric effects	Extended models accounting for firm-specific characteristics		
				Exporters vs. Non-exporters	Foreign-owned vs. Domestically-owned firms	State-owned vs. Private-owned firms
		1	2	3	4	5
$INV_{i,t-1}$		-0.001	-0.001	-0.001	-0.001	-0.001
$S_{i,t-1}$		0.177**	0.170**	0.170**	0.169**	0.170**
$\log(A_{i,t-1})$		-1.668***	-1.634***	-1.635***	-1.631***	-1.634***
$D_{i,t-1}$		-1.906***				
$D_{i,t-1} * 1 \{D_{i,t-1} > \tau_{i,t-1}\}$	Firms with debt overhang		-2.369***			
$D_{i,t-1} * 1 \{D_{i,t-1} \leq \tau_{i,t-1}\}$	Firms without debt overhang		-1.077***			
$D_{i,t-1} * 1 \{D_{i,t-1} > \tau_{i,t-1}\} * (1-\Psi_{i,t-1})$	Non-exporters with debt overhang			-1.439***		
$D_{i,t-1} * 1 \{D_{i,t-1} > \tau_{i,t-1}\} * \Psi_{i,t-1}$	Exporters with debt overhang			-2.423***		
$D_{i,t-1} * 1 \{D_{i,t-1} \leq \tau_{i,t-1}\} * (1-\Psi_{i,t-1})$	Non-exporters without debt overhang			-1.293***		
$D_{i,t-1} * 1 \{D_{i,t-1} \leq \tau_{i,t-1}\} * \Psi_{i,t-1}$	Exporters without debt overhang			-1.034***		
$D_{i,t-1} * 1 \{D_{i,t-1} > \tau_{i,t-1}\} * (1-\Psi_{i,t-1})$	Domestic firms with debt overhang				-2.513***	
$D_{i,t-1} * 1 \{D_{i,t-1} > \tau_{i,t-1}\} * \Psi_{i,t-1}$	Foreign firms with debt overhang				0.321	
$D_{i,t-1} * 1 \{D_{i,t-1} \leq \tau_{i,t-1}\} * (1-\Psi_{i,t-1})$	Domestic firms without debt overhang				-1.181***	
$D_{i,t-1} * 1 \{D_{i,t-1} \leq \tau_{i,t-1}\} * \Psi_{i,t-1}$	Foreign firms without debt overhang				0.801	
$D_{i,t-1} * 1 \{D_{i,t-1} > \tau_{i,t-1}\} * (1-\Psi_{i,t-1})$	Private firms with debt overhang					-2.370***
$D_{i,t-1} * 1 \{D_{i,t-1} > \tau_{i,t-1}\} * \Psi_{i,t-1}$	Public firms with debt overhang					-2.397*
$D_{i,t-1} * 1 \{D_{i,t-1} \leq \tau_{i,t-1}\} * (1-\Psi_{i,t-1})$	Private firms without debt overhang					-1.072***
$D_{i,t-1} * 1 \{D_{i,t-1} \leq \tau_{i,t-1}\} * \Psi_{i,t-1}$	Public firms without debt overhang					-1.535
J-statistics		16.016	17.091	17.131	17.086	17.080
Hansen test (p-value)		0.141	0.105	0.104	0.105	0.106
AR 1 (p-value)		0.074	0.075	0.075	0.075	0.075
AR 2 (p-value)		0.492	0.513	0.514	0.514	0.513
Number of firms		21,339	21,339	21,339	21,339	21,339
Number of observations		95,670	95,670	95,670	95,670	95,670

Notes: Variable  $\tau_{i,t}$  denotes firm-specific and time-variant debt threshold above which debt is considered unsustainable. Variable  $\Psi_{i,t}$  takes the value 1 when firm  $i$  in year  $t$  is exporter, foreign-owned and state-owned firm in the estimations presented in columns 3, 4, and 5, respectively. \*\*\*, \*\*, \* indicate significance at 1, 5, and 10 percent level. In none of the models is there evidence of second-order autocorrelation in residuals (based on Arellano-Bond test). Instruments are second and third lag of the dependent variable. All regressions pass the Hansen test of overidentifying restrictions, indicating the validity of the instrument choice. The models include fixed effects for enterprises and dummy variables for time periods (coefficients for time dummies not presented).

Source: Authors' calculation.

Turning to ownership, domestic firms' investment expectedly reacts negatively to a debt increase, especially if they have unsustainable debt. Conversely, for foreign-owned firms we do not find a statistically significant effect of debt on investment, and this holds for firms both with and without debt overhang (Table 3, column 4). This result probably reflects the fact that foreign-owned firms have access to direct financing from their parent company, and the intra-company financing does not primarily depend on the subsidiary's financial performance, but rather on general investment policies and business strategies determined by the owner. This also partly explains why foreign-owned firms accumulated larger debt overhangs than domestically owned firms (Figure 4, panel c).

Finally, for private firms we obtain a statistically significant negative impact of debt on investment, which is, as expected, much stronger for firms with debt overhang than for those without it (Table 3, column 5). However, interestingly, for public firms without debt overhang we do not find a statistically significant effect of debt on investment. This can be explained by the assumption that investment decisions in state-owned firms are not solely driven by economic criteria, but are often also subject to political objectives and cycles.

## 4.2 Alternative debt overhang thresholds

Finally, in order to assess whether the aggregate debt thresholds detect the over-indebted firms as well as the firm-level debt thresholds, we perform a set of alternative estimations of the investment equation in which we apply various debt thresholds commonly used in comparative literature ( $\tau$ ). The aim is to test whether the asymmetrically adverse impact of debt overhang on investment would also be empirically revealed if the over-indebted firms were identified using alternative approaches rather than firm-level estimation used in this paper. Thus, we re-estimate the equation (3) applying aggregate thresholds following Goretti and Suoto (2013), Jaeger (2003) and Rodriguez-Palenzuela et al. (2014), in particular the 25th percentile, the median and the mean

**Table 4 Alternative thresholds for unsustainable indebtedness**

Dependent variable: Investment/Capital ratio (INV)  
Instruments: Lags 2 and 3 of the dependent variable  
Period of estimation: 2009-2014

Explanatory variables	Linear model	Models testing for asymmetric effects using various thresholds $\tau$				
		$\tau_{i,t}$ = Debt overhang threshold based on NCF for firm $i$ in year $t$	Debt-to-assets ratio			$\tau_{i,t}$ = Debt-to-EBITDA > 4 for firm $i$ in year $t$
			$\tau$ = 25th percentile	$\tau$ = Median	$\tau$ = Mean	
	1	2	3	4	5	6
INV <sub><i>t-1</i></sub>	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
S <sub><i>t-1</i></sub>	0.177**	0.170**	0.177**	0.177**	0.177**	0.175**
log(A <sub><i>t-1</i></sub> )	-1.668***	-1.634***	-1.673***	-1.669***	-1.671***	-1.661***
D <sub><i>t-1</i></sub>	-1.906***					
D <sub><i>t-1</i></sub> * 1 {D <sub><i>t-1</i></sub> > $\tau_{i,t-1}$ }		-2.369***	-1.829***	-1.897***	-1.916***	-2.012***
D <sub><i>t-1</i></sub> * 1 {D <sub><i>t-1</i></sub> ≤ $\tau_{i,t-1}$ }		-1.077***	1.146	-1.667***	-1.410***	-1.765***
J-statistics	16.016	17.091	16.014	16.017	16.013	16.084
Hansen test (p-value)	0.141	0.105	0.141	0.141	0.141	0.138
AR 1 (p-value)	0.074	0.075	0.074	0.074	0.074	0.074
AR 2 (p-value)	0.492	0.513	0.491	0.492	0.492	0.492
Wald test C5=C6 (p-value)		0.000	0.052	0.543	0.144	0.376
Number of firms	21,339	21,339	21,339	21,339	21,339	21,339
Number of observations	95,670	95,670	95,670	95,670	95,670	95,670

Notes: Variable  $\tau$  denotes debt threshold above which debt is considered unsustainable. Thresholds in the model in column 2 are estimated following the methodology described in Section 3.2. \*\*\*, \*\*, \* indicate significance at 1, 5, and 10 percent level. In none of the models is there evidence of second-order autocorrelation in residuals (based on Arellano-Bond test). Instruments are second and third lag of the dependent variable. All regressions pass the Hansen test of overidentifying restrictions, indicating the validity of the instrument choice. The models include fixed effects for enterprises and dummy variables for time periods (coefficients for time dummies not presented). The null hypothesis of the Wald test is that the two coefficients representing the impact of debt on investment for firms with and without debt overhang are equal.

Source: Authors' calculation.

of the total distribution of debt-to-assets ratio of our sample in period 2009-2014 (standing at 9.2 percent, 23.0 percent and 32.9 percent, respectively). Finally, we also apply the firm-specific threshold defined as debt-to-EBITDA ratio equalling 4, following the approach by Damijan (2014). Results of the alternative estimations are presented in Table 4, columns 3 to 6, respectively.

Unlike the results based on our firm-specific thresholds (Table 4, column 2), the coefficients for the debt effect on investment in all four alternative estimations do not differ significantly between firms with debt overhang and firms without debt overhang (Table 4, columns 3 to 6). In all four alternative regressions, all but one coefficients related to the debt variable are statistically significant and expectedly negative. However, the pairs of coefficients with the debt variable for the firms with and without debt overhang do not significantly differ between themselves (as confirmed also by the Wald test). The largest difference between the coefficients occurs when the debt-to-assets threshold is the 25th percentile ( $-1.8$  vs.  $-1.1$ ), but the latter coefficient is not statistically significant. Overall, the results based on alternative thresholds do not provide empirical evidence of the existence of asymmetric effects, thus supporting the appropriateness of the choice of the firm-level debt overhang indicator as a threshold in capturing the adverse impact of debt overhang on investment activity.

To sum up, the results of the econometric model based on panel data confirmed that the issue of high indebtedness of non-financial corporations in Croatia hinders investment growth, with negative effect being stronger if the enterprise has debt overhang, i.e. if the corporate debt is unsustainable. Given the above-described scale of the debt overhang problem in Croatia and the insufficient speed of corporate deleveraging in the recent years, the results indicate that this unsustainable indebtedness could have negative macroeconomic implications for the dynamics of recovery of the Croatian economy.

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## 5 Conclusion and policy implications

Corporate sector debt in Croatia is high. We estimate that its unsustainable part ranges between 27.3% and 35.3% of the outstanding debt. In the event of combined shocks of a GDP decline and an interest rate hike, deleveraging needs may exceed 40% of the current debt. Although the debt overhang is not evenly distributed across the corporate sector, but rather concentrated in large and non-exporting enterprises, the estimated extent of over-indebtedness can nonetheless have an unfavourable impact on macroeconomic recovery. This is confirmed by the results of the estimated dynamic econometric model on firm-level panel data, where we found that high indebtedness of non-financial corporations hinders investment activity in Croatia. Moreover, the results imply that the over-indebted firms, identified by firm-level debt sustainability estimation, reduce their investment activity far more strongly than the firms without debt overhang. This asymmetrically adverse impact of debt on investment is not empirically captured when applying alternative measures for debt overhang, thus suggesting that the firm-level based methodology presented in this paper may be more appropriate in identifying the unsustainably indebted firms.

The extent of the corporate debt overhang in Croatia and its impact on investment, along with the slow progress in unwinding the overhang, underscore the need for a proactive and coordinated policy action to facilitate the deleveraging process. Accordingly, changes to the regulatory and institutional framework should go in two directions – on the one hand, to stimulate debt restructuring for firms with growth potential, including such measures as write-offs of non-performing loans, and on the other hand to simplify the liquidation process for those businesses that are unsustainable in the long run even with debt restructuring. The latter particularly refers to more efficient implementation of bankruptcy procedures, particularly having in mind that the Act on Financial Operations and Pre-Bankruptcy Settlement that came into force in 2012 did not succeed in speeding up these processes. Looking forward, desirable policy efforts require a balanced approach between achieving the greatest possible debt reduction and ensuring at the same time a fair liquidation process that would respect owners' rights and minimize moral hazard and potential fiscal costs. This also calls for more efficient



institutional support – legislative and judicial.

As for potentially viable businesses, policy efforts should be oriented towards easing and simplifying the process of writing off debt. In fact, the European Commission, in its country-specific recommendations for Croatia, also highlighted the need to facilitate the resolution of non-performing loans, in particular by improving their tax treatment. In this context, the recently introduced tax deduction for banks' income generated by non-performing debt write-offs, which will come into force during 2017, is a welcome step in this direction. Moreover, special tax treatments of debt forgiveness at the corporate level to underpin the debt restructuring process for corporates are also possible (World Bank, 2016).

In addition, the financial supervisory authorities also play a key role in encouraging banks to carry out loan restructuring. More specifically, the policy efforts to increase provisioning of bad loans incentivize banks to eliminate bad loans from their balance sheets once they become fully covered by provisions. Starting from 2013, the Croatian National Bank has required banks to raise provisions for non-performing receivables that they did not actively try to collect or for which they did not mark-to-market collateral. This led to significant improvement in the provisioning coverage and set the stage for loan sales that gained momentum in 2015 and 2016. In addition to debt write-offs, financial restructuring can also entail injections of capital, debt-to-equity swaps, restructuring of debt through reduction in interest rates, longer maturities, asset sales, or equity issues (Shin, 2017).

Whereas the ongoing efforts discussed so far predominantly focus on private sector debt, the issue of overleveraged state-owned companies requires a different approach because their debt is not considered non-performing due to state guarantees. Therefore, policy action for state-owned companies should focus on the restructuring of their debt obligations (by rescheduling debt repayments to lower future instalments or refinancing at a lower interest rate), and business models in general.

Finally, the recovery of potentially viable yet unsustainably indebted firms requires not only financial restructuring, but also operational and investment restructuring. Corporate restructuring, while sometimes challenging in the short term, has typically been associated with more rapid economic growth afterward (Shin, 2017). On the company level, this includes revision of business strategies, changes in the production structure and internal business reorganization. On the economy level more broadly, this highlights the need for removal of administrative bottlenecks and excessive regulatory burden, and providing a better investment and business climate in which enterprises could operate more easily, which might in turn improve firms' debt servicing capacity. While the recent reduction of the labour tax wedge (implemented as of the beginning of 2017) is a measure in that direction, improvement of the business climate is a more comprehensive process that requires active engagement by all policy actors in Croatia. The results obtained in this paper, implying a particularly strong adverse impact of unsustainable debt on the investment activity of Croatian firms, suggest that Croatia could achieve considerable investment and output gains from a swift and orderly resolution of the corporate debt overhang issue.

## Annexes

### ANNEX I Indicators of indebtedness and debt service capacity

Sample firms	2006	2007	2008	2009	2010	2011	2012	2013	2014
Assets (in million HRK)	405,220	467,707	525,775	545,795	555,784	587,174	602,832	619,436	649,047
Share in total assets of the whole corporate sector (in %)	49.5	50.5	53.1	52.0	53.4	56.0	58.5	59.8	62.3
Debt (in million HRK)	106,164	129,192	154,328	164,814	175,806	191,755	193,763	199,719	209,335
Share in total debt of the whole corporate sector (in %)	41.8	41.8	51.5	49.4	51.0	53.9	55.3	56.3	59.0
Indebtedness (Debt/Assets, in %)	26.2	27.6	29.4	30.2	31.6	32.7	32.1	32.2	32.3
Profitability (EBIT/Assets, in %)	4.5	4.7	4.2	3.0	2.9	3.4	2.5	2.9	3.4
Debt burden (Interest expenses/Debt, in %)	4.4	4.8	5.0	4.8	4.8	4.8	5.3	5.0	4.7

Source: Amadeus.

Total corporate sector	2006	2007	2008	2009	2010	2011	2012	2013	2014
Indebtedness (Debt/Assets, in %)	31.0	33.3	30.3	31.8	33.1	33.9	34.0	34.2	34.0
Profitability (EBIT/Assets, in %)	2.6	2.8	2.8	1.6	1.6	2.3	1.8	1.5	2.1
Debt burden (Interest expense/Debt, in %)	–	–	4.9	4.5	4.5	4.4	4.4	4.1	3.9
Interest coverage ratio (EBITDA/Interest expenses)	–	–	4.3	3.7	3.5	4.0	3.7	4.0	4.5

Source: FINA.

### ANNEX II Data description

Variable:	Description:	Source:
Operating Cash Flow before Interest	EBIT – Taxation + (Depreciation & Amortization)	Authors' calculation based on Amadeus data
Assets	Total assets	Amadeus
Debt	Loans + Long term debt	Authors' calculation based on Amadeus data
Interest expense	Interest expense	FINA
Capital expenditures	$\Delta(\text{Tangible fixed assets}) + (\text{Depreciation} \& \text{Amortization})$	Authors' calculation based on Amadeus data
Dividends	$\Delta(\text{Retained earnings}) + \text{Current earnings} - \Delta(\text{Income reserves}) - \Delta(\text{Revaluation reserves})$	Authors' calculation based on FINA data
GDP	Annual rate of change of real gross domestic product	Bureau of Statistics
Sales	Income from sales	Amadeus
Capital	Shareholder funds	Amadeus
Investment/Capital	Capital expenditures/Shareholder funds	Authors' calculation based on Amadeus data

## ANNEX III Summary statistics for the variables included in equations (3) and (4)

Year (t)	Number of firms (i)	Number of firms with debt overhang	Total assets (A)			Investment/Capital (INV)		Sales growth ( $\Delta \log(S)$ )		Debt	Debt/Assets (D)	
			Sum	Mean	Median	Mean	Median	Mean	Median	Sum	Mean	Median
			in 000 HRK	in 000 HRK	in 000 HRK	%	%			in 000 HRK	%	%
2006	20,039	2,981	405,219,908	20,217	1,466	93.5	14.3	19.5	11.1	106,164,479	23.0	14.4
2007	20,996	3,328	467,706,978	22,268	1,570	97.9	13.7	18.3	10.4	129,191,973	23.5	15.2
2008	22,667	2,765	525,774,757	23,194	1,607	113.6	16.5	15.9	9.2	154,327,714	16.5	5.2
2009	24,936	2,150	545,794,510	21,885	1,493	63.5	6.5	-7.7	-10.9	164,813,611	15.5	3.3
2010	25,884	2,406	555,783,757	21,467	1,397	171.3	6.4	0.1	-4.7	175,806,239	18.1	2.8
2011	26,659	3,019	587,173,890	22,025	1,456	116.0	8.3	12.7	4.9	191,754,711	21.7	3.0
2012	29,697	3,095	602,831,921	20,295	1,314	96.0	6.6	3.5	-0.7	193,763,058	19.3	2.3
2013	31,654	2,976	619,436,323	19,568	1,291	73.6	6.3	11.8	4.3	199,718,955	16.6	1.5
2014	31,656	2,471	649,046,813	20,503	1,360	40.7	3.6	-2.0	0.4	209,334,942	16.4	1.7

## ANNEX IV Results of the Wald test for equality of coefficients in equation (3)

$$\text{Equation (3): } INV_{it} = \alpha_i + \beta INV_{it-1} + \gamma \Delta S_{it-1} + \delta \log(A)_{it-1} + \bar{\sigma} D_{it-1} \times 1\{D_{it-1} > \tau_{it-1}\} + \underline{\sigma} D_{it-1} \times 1\{D_{it-1} \leq \tau_{it-1}\} + \varepsilon_{it}$$

Null Hypothesis:  $\bar{\sigma} = \underline{\sigma}$

Test Statistic	Value	df	Probability
t-statistic	-5.109	95659	0.000
F-statistic	26.104	(1. 95659)	0.000
Chi-square	26.104	1	0.000

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