Non-Linear Debt Dynamics

Abstract

We investigate the capital structure and the dynamic behavior of firms' debt ratios in a large sample of companies from 52 countries. Our results support a complex view of capital structure decisions, where firm, macroeconomic, and institutional factors interact in determining both the optimal leverage and the adjustment process towards it. These interactions contribute for almost two thirds of the explained heterogeneity of the target leverage and around one third of the speed of adjustment. Overall, our results suggest that market timing and pecking order arguments prevail in the short-run, while dynamic trade-off with costly readjustment matters mainly in the long-run.

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JEL Classification: C23, E44, G32, G38

1. Introduction

Following Modigliani and Miller's (1958) 'irrelevance' proposition, a large body of literature has investigated firms' financial structure, both theoretically and empirically. Several factors – such as taxes, asymmetric information, financial distress, and transaction costs – are known to affect financing choices, making the irrelevance proposition fail. Two classical theories are typically invoked to explain capital structure decisions: the trade-off theory (Kraus and Litzenberger (1973)) and the pecking order theory (Myers and Majluf (1984)). The empirical literature has assessed the relative merits of both theories, and a number of papers (see e.g. Leary and Roberts (2005), and Byoun (2008)) suggest that in fact they may jointly contribute explaining firms' capital structure[1].

Strebulaev (2007) argues that firms may accept temporary deviations from target leverage, avoiding to converge to the optimal debt ratio if the perceived benefits are smaller than the costs. As a consequence, debt ratios should fluctuate as a function of the financing surplus (or deficit) until the distance from optimal leverage is such that rebalancing generates net benefits. Therefore, the estimation of the speed of adjustment towards target leverage is an indirect test of the validity of the trade-off theory: if an optimal leverage exists, firms should eventually converge to it sufficiently quickly in order to avoid the costs of sub-optimal financial policies. In this perspective, a stream of literature (see Frank and Goyal (2007) for a comprehensive survey) focuses on the investigation of the dynamics of leverage ratios, mainly using the so-called partial adjustment model, first proposed by Jalilvand and Harris (1984), in order to estimate the average speed at which firms adjust towards their optimal debt ratio. A limit of the classic linear partial adjustment model is that it estimates a common speed of adjustment for all firms, irrespective of their characteristics or market conditions; an assumption that is likely to be too restrictive to properly describe firms' behavior. As a consequence, more recent research (see, in particular, Byoun (2008), Cook and Tang (2010), Öztekin and Flannery (2012), Dang et al. (2014), Daskalakis et al. (2017), and Çolak et al. (2018)) focuses on more sophisticated models of partial adjustment in which firms may have different speeds of adjustment as a function of firm-level or macroeconomic factors.

Our paper adds to this literature by estimating firm-specific speeds of adjustment, focusing in particular on how the *interaction* between firm-level, macroeconomic, and institutional characteristics affects the dynamic adjustment of leverage towards its optimal level. This is an issue that has so far received little attention, although it can be quite important as it highlights the possibility of indirect effects in addition to the direct ones typically reported in the pertinent literature. It is well known that institutional factors (such as the protection of property rights, the efficiency of bankruptcy procedures, the ease to move capital across investments, or the transparency of financial markets) and macroeconomic conditions (such as inflation and economic growth rates) have a large impact on firms' choices and are likely to affect the *level* of optimal leverage both directly and indirectly through their impact on the effects of firm level variables. We show that they are also likely to affect the *dynamics* of debt ratios, both directly and by influencing the relationship between firm characteristics and capital structure adjustments, a fact that has so far received little attention in the pertinent literature[2].

Our analysis is based on a large sample of 350,073 firm-year observations, covering 52 countries over a period of twenty-one years from 1996 to 2016. We rely on a non-linear partial adjustment model, where the heterogeneity in the speed of adjustment depends crucially on firm characteristics, macroeconomic conditions, national institutions, and on their interactions. We find that firm-level variables contribute close to 19% of the explained variation in observed debt ratios, macroeconomic factors account for just above 16%, and national institutions for an additional 5%. These findings are robust to the use of two different estimators – namely, the Blundell and Bond (1998) system-GMM and the Fama and MacBeth (1973) estimators. Overall, this implies that the direct effect of firm-level characteristics accounts for as much as the total direct effect of macroeconomic conditions and national institutions. More importantly, we show that the interactions between firm and macroeconomic variables account for an additional 28% of the explained variation in leverage, while those between firm and institutional factors contribute for around 32%. This implies that almost 60% of the explained variation in leverage is due to the interactions between macroeconomic or institutional indicators and firm-level variables. Furthermore, we find that also firm-specific speeds of adjustments depend crucially on the interactions between firm-level, macroeconomic and institutional characteristics, which in turn produce significant non-linearities in the rebalancing process. Around 17% of the explained variation in the adjustment process depends on the distance from target leverage alone, and an additional 29% on the interaction between the distance from the target and a dummy variable indicating that the firm was over-levered at the end of the previous year. The remaining 54% of the explained variation is instead due to the interactions between the distance from the target leverage and firm, macroeconomic and institutional factors, which shows once more their fundamental role.

Our results indicate that different firms behave differently within the same macroeconomic or institutional environment, as suggested by the direct effect of firm characteristics not only on the target leverage but also on the speed of adjustment. At the same time, different macroeconomic or institutional scenarios affect all firms' behavior. Indeed, not only firms adjust their leverage differently depending on macroeconomic or institutional conditions, but also set a different target leverage depending on the specific environment in which they operate. Finally, our results highlight that different firms react differently to changes in macroeconomic or institutional conditions, precisely due to the interactions between aggregate factors and individual firm characteristics.

Overall, we show how a proper investigation of the causes of heterogeneity in the speed of leverage readjustment cannot rely solely on the direct impact of firm, macroeconomic, or institutional factors. In fact, the indirect effects described by the interaction between different groups of variables play a fundamental role in producing continuously changing speeds of adjustment, suggesting that the dynamics of leverage is even more complex than highlighted in the literature. Our results support a complex view of dynamic financing choices. Firms holding sufficient internal funds to finance their investments do not appear to systematically adjust their debt to equity ratio in order to rebalance their capital structure, and avoid accessing external capital markets altogether. Furthermore, even when external funds are needed, in the short run firms do not necessarily converge to their target leverage. In fact, during bad market conditions, over-levered firms with low credit risk avoid issuing equity, postponing the adjustment until better market conditions are met (or the level of credit risk becomes too high). Conversely, over-levered firms with high credit risk appear to issue equity regardless of market conditions, possibly as a consequence of having exhausted their debt capacity. These conditional behaviors appear to be stronger in countries with more 'market-friendly' institutions, a sign that improvements in the institutional setting allow firms to adopt more flexible financial strategies.

The paper is organized as follows. Section 2 reviews the pertinent literature and provides the theoretical background for our empirical analysis. Section 3 illustrates the methodology we adopt in the analysis, while Section 4 describes our dataset. In Section 5 we estimate the optimal level of leverage and present a linear model of partial adjustment, while in Section 6 we introduce a full non-linear partial adjustment model. Section 7 estimates (linear) models of debt readjustments for sub-groups of firms based on the same factors that determine the non-linearities examined in Section 6, to provide an easier interpretation of our main findings. Section 8 draws implications of our results for the capital structure debate and Section 9 concludes.

2. Related Literature and Theoretical Background

The way in which firms take their capital structure decisions is a long-standing issue in the financial literature. Since Modigliani and Miller's (1958) seminal contribution, a large literature has shown that market imperfections and frictions result in a violation of the irrelevance proposition, due to different tax treatments between equity and debt (Modigliani and Miller, 1963), bankruptcy costs (Stiglitz, 1972), or asymmetric information (among others, Jensen and Meckling (1976)), which may induce firms to have specific preferences over different sources of capital. Two theories have emerged out of this debate: the trade-off theory (Kraus and Litzenberger, 1973), according to which firms balance costs and benefits of debt and equity in order to achieve an optimal capital structure that maximizes firm value, and the pecking order theory (Myers and Majluf, 1984), under which – due to asymmetric information – firms do not target an optimal capital structure, but take financing decisions characterized by hierarchical preferences over different financial instruments.

While the earlier empirical works on capital structure (see, e.g. Rajan and Zingales (1995)) focused on cross-sections of observed debt ratios as a means of testing the validity of either of the two theories, the more recent literature has taken a more complex view arguing that, due to market frictions, firms may postpone the convergence to their target debt level until the benefits are larger than the rebalancing costs, thus allowing for temporary deviations from the optimal level of leverage. As a consequence, the attention has shifted to the usage of partial adjustment models (entailing gradual convergence towards the target) to determine the speed of adjustment, with the idea that firms effectively pursue an optimal capital structure if their estimated speed of convergence towards the target level of leverage is sufficiently high. Estimates of the speed of adjustment are quite heterogeneous. For instance, Fama and French (2002) estimate a speed of adjustment for US firms in the 7%-18% range per year – depending on the type of firm (dividend or non dividend payer) and on the measure of debt (book, or market value) – concluding that firms adjust "at a snail's pace". Flannery and Rangan (2006) find, instead, a yearly speed of adjustment of more than 30%. Lemmon et al. (2008) determine a yearly speed of adjustment between 22% and 25%, showing also that firms' capital structures are relatively stable even over long periods of time. Indeed, firms with high or low leverage tend to remain as such even after several years. Finally, Huang and Ritter (2009) estimate a speed of adjustment for market leverage around 23%, which suggests that firms move towards optimal debt ratios at 'moderate' speed only.

A drawback of the linear partial adjustment models used in the papers mentioned above is that they estimate a common speed of adjustment for all firms, irrespective of their characteristics or market conditions; an assumption that is likely to be too restrictive to properly describe firms' behavior. To overcome the problem, a number of recent contributions have focused on more sophisticated models of partial adjustment, in which firms may have different speeds of adjustment as a function of firm-level, macroeconomic, and institutional factors. In particular, Byoun (2008) shows how the speed of adjustment differs depending on whether firms are under or over-levered, or have a financial surplus or deficit. Cook and Tang (2010) investigate the effect of macroeconomic conditions on the adjustment process, finding that the speed of adjustment is greater in good rather than in bad macroeconomic states. Faulkender et al. (2012) expand the results of Byoun (2008) by using a continuous measure of financial surplus or deficit, rather than a simple dummy variable to divide firms in two sub-samples. Using various cash flow definitions as a measure of financial surplus, they demonstrate that firms with large (positive or negative) operating cash flow make more 'aggressive' changes in their leverage ratios. Öztekin and Flannery (2012) analyze the role of national institutions, showing that they have a significant impact on the average speed of adjustment observed in different countries. Dang et al. (2014) provide evidence on the importance of both firm characteristics and macroeconomic conditions, also showing the impact of the global financial crisis on the relationship between firm-level factors and the speed of adjustment. Similarly, Daskalakis et al. (2017) show how the average speed of adjustment changes depending on macroeconomic conditions, and Çolak et al. (2018) report how higher political or economic uncertainty significantly reduces the speed of adjustment.

We contribute to this literature by highlighting that the *interactions* of firm characteristics, institutional variables and macroeconomic conditions have important implications – adding significantly to the direct effects of such variables – for target debt ratios and their speeds of adjustment towards the optimal values[3]. The speed of adjustment towards the optimal level of leverage depends mainly on two key elements: the inefficiency costs connected with deviating from the optimal leverage, and the costs to be incurred for rebalancing a firm's capital structure. Firms must, therefore, continuously assess the costs and benefits of adjusting their leverage based on the trade-off between the cost of deviating from the target and the cost of actively converging towards it. There are fundamental reasons to argue that the interaction among firm characteristics, institutional factors and macroeconomic conditions affect these costs and alter firms' behavior in significant ways. Indeed, institutional and macroeconomic factors may mitigate or exacerbate the impact of firm characteristics on the optimal debt ratio and on its speed of adjustment. Agency issues within firms are key in explaining why this is the case. The outcome of the contractual relationship to raise external funds may be affected by the opportunistic behavior of managers and/or dominant shareholders, forcing external investors to monitor firms' decisions in order to protect their rights. The strength of national institutions may affect both the cost and effectiveness of external monitoring (Judge et al., 2008), as well as the degree of contract enforcement (Demirgüç-Kunt and Maksimovic, 1999). Aguilera et al. (2008) suggest that firm and country-level factors interact in shaping the effects of agency costs on capital structure decisions, for example because of differences in the degree of property rights protection[4]. Indeed, by dividing firms into different sub-samples based on various institutional factors, Gungoraydinoglu and Öztekin (2011) show how the impact of firm-level variables on leverage differs across institutional environments, consistently with the idea that weaker institutions exacerbate agency costs. The interplay between institutions and capital structure decisions goes, however, beyond the role of agency costs. Claessens and Laeven (2003) argue that a country with a poorly developed financial system, or weak property rights, suffers two negative effects: firms see a reduction in their access to external capital and allocate their resources sub-optimally, which ultimately affects their ability to pursue long term growth. This suggests that firms in countries with higher financial and investment freedom and a better legal environment (i.e. stronger protection of property rights, and lower corruption) display higher flexibility in their financing behavior. Also the quality of the legal environment seems to play an important role in leverage choices. Fan et al. (2012) find that firms tend to be more levered in more corrupt countries or in countries where the protection of investors' rights is weaker[5]. Graham et al. (2015) document how government debt may crowd out corporate debt, hence affecting firms' ability to issue new debt. Their findings therefore suggest that the level of government spending affects capital structure decisions. Hodder and Senbet (1990) argue that also the presence of integrated capital markets has a relevant impact on firms' capital structure choices. For example, in the absence of restrictions to trade or capital movements, multinational firms may structure their operations and financing decisions in a way to arbitrage tax differentials, which suggests that both trade and investment freedom may affect capital structure. Furthermore, given that firm size and leverage are positively correlated (e.g. Öztekin (2015)), to the extent that better institutions (like a higher protection of property rights or lower corruption) reduce asymmetric information and bankruptcy costs, they should be expected to significantly interact with firm size in determining firms' capital structure decisions. The direction of this interaction will depend on whether institutions are substitutes or complements to firm size in reducing asymmetric information. Similarly, it is well known that firms with a higher proportion of tangible assets over total assets have higher debt ratios (due to the possibility of using those assets as collateral for their debt). Focusing on the role of land as debt collateral, Hall (2012) shows that the positive relation between tangible assets and leverage is stronger in countries with less restrictions on the use of collateral, such as limits to the transferability of land property. Moreover, Degryse et al. (2020) show that in countries with laws and institutions that ensure better creditor protection the recovery rate for collateral is significantly higher, thus increasing firms' debt capacity. Finally, more profitable firms benefit from a tax shield, favoring the usage of leverage to reduce tax liabilities (see e.g. Graham (1996)). This effect is likely to be stronger in countries with an higher tax burden, suggesting that institutional measures connected with the level of taxation in a country exert a significant indirect effect on the relationship between a firm's profitability and its capital structure.

Besides their effects on capital structure decisions, and hence on the level of leverage, it is worth noting that the interplay of firm level characteristics and institutional factors may as well have an impact on the adjustment towards the optimal debt-equity ratio for different types of firms[6]. For instance, it has been shown that the degree of financial development reduces the cost of raising external capital (Rajan and Zingales, 1998), as well as the cost of capital for financially constrained firms (Love, 2003). Moreover, the efficiency of the legal system, a higher degree of protection of property rights, and lower corruption are also shown to reduce the cost of raising capital for financially constrained firms. Overall, this seems to suggest that the asymmetry in the adjustment process between firms with a financial surplus compared to those with a financial deficit is exacerbated in countries with low quality institutions.

As noted above, also macroeconomic conditions interact with firm characteristics (and institutional factors) in shaping capital structure decisions, by reducing or amplifying the costs connected with alternative financing strategies. In this respect, Korajczyk et al. (1992) show how firms may reduce the negative effects of asymmetric information on the cost of raising external equity by properly choosing the timing of their equity issues. Indeed, Bayless and Chaplinsky (1996) report that equity issues are more costly in cold than in hot markets. Korajczyk and Levy (2003) find that target leverage is pro-cyclical for financially constrained firms and counter-cyclical for the unconstrained ones, and that macroeconomic conditions significantly affect the choice of issuing equity for unconstrained firms but not for constrained ones. Erel et al. (2012) document how macroeconomic conditions affect firms' ability to raise capital, arguing that also supply-side effects are relevant in determining firms' financing decisions, while Becker and Ivashina (2014) study firms' substitution between loans and bonds over the business cycle, finding evidence of a strong shift from loans to bonds during recessions due to a contraction in bank-credit supply[7].

Finally, as already argued when focusing on the role of institutional factors, the interaction between firm level characteristics and macroeconomic or financial conditions – besides affecting capital structure choices – may induce heterogeneous adjustments towards the target leverage for different types of firms. We already recalled Byoun's (2008) contribution, showing that the speed of adjustment differs between over- and under-levered firms, and between firms having a financing deficit or surplus. This suggests that firms do not always actively rebalance their capital structure. Indeed, firms with a financing surplus may be more reluctant to raise external capital simply to readjust their leverage. Conversely, firms facing a financing deficit may combine the need to raise new capital to support their investment plans with the opportunity to also readjust their leverage. However, especially for over-levered firms that need new equity to lower debt ratios, the timing of the issue is important in determining the cost of raising equity capital, and this may induce them to temporarily deviate even further from the optimal leverage. Hence, the interplay between financial market conditions and financing surpluses/deficits at the firm level can be expected to indirectly affect the speed of adjustment towards the target leverage[8].

3. Methodology

In a methodological perspective, a variety of approaches have been proposed to jointly estimate the optimal level of leverage and the speed of adjustment towards it through partial adjustment models. Flannery and Hankins (2013) test the reliability of a number of estimators, including standard ordinary least squares (OLS), panel fixed effects (FE), Arellano and Bond (1991) Generalized Method of Moments (GMM), Blundell and Bond (1998) system-GMM, and Bruno (2005) least squares dummy variable corrected estimator (LSDVC), finding that the LSDVC estimator is to be preferred when endogeneity and second order serial correlations are not found in the data and the sample size is limited, while system-GMM and FE are to be used in the presence of endogeneity. However, when jointly estimating both the target leverage and the speed of adjustment towards it, the system-GMM estimator suffers from dependent variables clustering at zero and second order serial correlation, while the FE estimator can be used in the presence of both first and second order serial correlation, but it performs poorly in short panels and in the presence of highly persistent dependent variables.

Hovakimian and Li (2011) observe that using future data to estimate target debt ratios produces significantly higher estimates for the speed of adjustment of leverage due to a look-ahead bias. To properly deal with this issue one must design a 'two-step procedure' that first estimates year-by-year specific target leverage equations based on past information only and then exploits the obtained results to derive out-of-sample predictions for leverage in each year, using them as target proxies in the partial adjustment equation. We build on the latter approach and estimate the target leverage in the first step by means of panel fixed effects, using only past information for predicting each year's optimal leverage in order to avoid the distortions due to the look-ahead bias. The use of firm fixed effects allows to obtain sharper estimates of the target (Flannery and Rangan, 2006); moreover, introducing fixed effects into the target debt ratio model mitigates the measurement error problem in the second step, by reducing the impact of omitted determinants of optimal leverage that may vary across firms but are constant over time (Hovakimian and Li, 2011)[9].

As for the second step, we adopt the Blundell and Bond (1998) system-GMM estimator, which has the major advantage of accounting specifically for the dynamic nature of our model and for the presence of a number of endogenous regressors. It is known that the system-GMM estimator has the drawback of suffering from second-order serial correlation in the regression residuals (Dang et al., 2015), possibly also as a consequence of measurement errors in one of the regressors (Roberts and Whited, 2013). Notwithstanding, when testing for second-order serial correlation in the residuals by means of the Arellano and Bond (1991) test, we cannot reject the null hypothesis of no serial correlation[10]. To further limit the possibility of distortions in the estimation of the standard errors, we use the robust standard error correction method for finite sample proposed by Windmeijer (2005), which increases the likelihood that the error variance converges to its real value[11].

We confirm that our results are not due to the specific use of system-GMM by adopting the alternative approach proposed by Fama and French (2002) and recommended by Hovakimian and Li (2012). Such a procedure relies on the Fama and MacBeth (1973) estimator that exploits yearly cross-sectional data and then averages the estimated coefficients over time. An interesting feature of the Fama-MacBeth estimator is that the statistical significance of the coefficients is based on the time-series standard errors of the average coefficients, so that the year-by-year variation in the estimated speeds of adjustment that determines their standard errors already incorporates the estimation error stemming from the fact that target debt ratios are determined in the first-stage regression, which may cause a 'generated regressors' bias in the standard error estimates (Hovakimian and Li, 2012).

Yet another approach would be to rely on pooled ordinary least squares to estimate coefficients and then use bootstrap sampling to estimate standard errors, as proposed by Faulkender et al. (2012)[12]. Both the Faulkender et al. (2012) and Fama and French (2002) approaches, however, suffer from the fact that pooled ordinary least squares, due to the potential measurement errors in the target leverage, entail endogeneity in the second-step regression, which is shown by Roberts and Whited (2013) to produce downward-biased coefficients in an ordinary least squares regression. Hovakimian and Li (2012) argue that the Fama-MacBeth method should be preferred in this respect, as it proves able to mitigate this issue. Furthermore, while the estimates based on the Fama-MacBeth's approach are still likely to be downward biased (being based on repeated ordinary least squares regressions for estimating the required coefficients), in Section 6 of the paper we show that the system-GMM and the Fama-MacBeth approach produce very similar results, most likely due to the large size of our sample that allows to minimize the potential biases connected with the latter estimator. While both approaches turn out being able to properly account for a large part of the actual variability in debt ratios, the Fama-MacBeth estimator – being based on OLS regressions – has the advantage of producing a proper R^2 as a goodness-of-fit measure (which is instead not available for system GMM). We exploit this advantage in Section 6 to produce a dominance analysis for the various regressors included in the empirical model, allowing us to discuss the relative importance of the different groups of covariates we consider.

Finally, it is important to stress that the adoption of a two-stage approach has the advantage of permitting a clear distinction between over-levered and under-levered firms, by making it possible to compare estimated targets and actual debt ratios. We can then properly test whether the financing behavior of the two groups of firms differs, a test that wouldn't be possible if target leverage and the dynamic adjustment were jointly estimated as in one-step procedures.

Formally, in order to evaluate the yearly target leverage, in line with Hovakimian and Li (2011), we estimate the following fixed effect regression based on information from past periods only[13]; i.e.

$$\frac{D_{i,t}}{A_{i,t}} = \beta X_{i,t-1} + \gamma Z_{j,t} + \delta X_{i,t-1} Z_{j,t} + \alpha_i + u_{i,t}, \tag{1}$$

where i, j and t indicate firm, country and time, respectively; X is a vector of firm-level variables; Z is a vector of macroeconomic and institutional indicators; β, γ, and δ are vectors of parameters, and α indicates firms' fixed effects. It is immediate to see that the model in Equation (1) allows to explicitly control for both the direct and the indirect effects of macroeconomic and institutional factors in the estimation of the determinants of target leverage through their interaction with firm-level characteristics.

Having estimated the determinants of target debt ratios, in the second-step regression we analyze the dynamic adjustment towards the target and estimate the speed of adjustment by means of the equation

$$\frac{D_{i,t}}{A_{i,t}} - \frac{D_{i,t-1}}{A_{i,t-1}} = \alpha + \lambda\left(\left(\frac{D_{i,t}}{A_{i,t}}\right)^{*} - \frac{D_{i,t-1}}{A_{i,t-1}}\right) + \epsilon_{i,t}, \tag{2}$$

where $\left(\frac{D_{i,t}}{A_{i,t}}\right)^{*}$ denotes the target debt ratio. Note that the way in which Equation (2) is estimated may be biased because of the fractional nature of the debt ratio, which may induce mechanical mean reversion. To solve the problem, again following Hovakimian and Li (2011), we include the target leverage and the lagged debt ratio separately into the partial adjustment equation, i.e.:

$$\frac{D_{i,t}}{A_{i,t}} - \frac{D_{i,t-1}}{A_{i,t-1}} = \alpha + \lambda_1\left(\frac{D_{i,t}}{A_{i,t}}\right)^{*} + \lambda_2\frac{D_{i,t-1}}{A_{i,t-1}} + \epsilon_{i,t}. \tag{3}$$

This approach has the drawback of pooling all observations over the entire sample and producing a constant speed of adjustment regardless of firm characteristics, macroeconomic conditions and national institutions. Therefore, we relax the 'pooling' assumption implicit in the model above and augment the specification of Equation (3) to encompass various types of non-linearities in the adjustment process in order to obtain firm-specific heterogeneous speeds of adjustment. As a result, we construct the following augmented version of Equation (3):

$$\frac{D_{i,t}}{A_{i,t}} - \frac{D_{i,t-1}}{A_{i,t-1}} = \alpha + \alpha^1 D^a_{i,t} + \beta\frac{D_{i,t-1}}{A_{i,t-1}} + \beta^1 D^a_{i,t}\frac{D_{i,t-1}}{A_{i,t-1}} + \Gamma_{i,j,t}\overline{TD}_{i,t} + \Gamma^1_{i,j,t}D^a_{i,t}\overline{TD}_{i,t} + \epsilon_{i,j,t}, \tag{4}$$

where i refers to firms, j to countries, and t to time. $\overline{TD}_{i,t}$ is the target debt ratio for firm i at time t, $D^a_{i,t}$ is a dummy variable that takes value one if firm i debt at $t-1$ is above the target at time t and zero if it is below (the coefficients corresponding to the terms involving such a dummy variable are indicated with the superscript 1). $\Gamma_{ij,t}$ and $\Gamma^1_{ij,t}$ are vectors of firm, country and time specific coefficients, which allow us to estimate firm-specific and time varying individual speeds of adjustment, hence relaxing the pooling assumption of a constant speed for all firms in all macroeconomic and institutional scenarios. For instance, when considering direct effects and two-way interactions in a setup with two firm-level and two country-level covariates, $\Gamma_{ij,t}$ is defined as

$$\begin{aligned}\Gamma_{i,j,t} = {} & \gamma_0 + \gamma_1 x_{1i,t} + \gamma_2 x_{2i,t} + \gamma_3 z_{1j,t} + \gamma_4 z_{2j,t} + \gamma_5 x_{1i,t} * x_{2i,t} + \\ & + \gamma_6 x_{1i,t} * z_{1j,t} + \gamma_7 x_{1i,t} * z_{2j,t} + \gamma_8 x_{2i,t} * z_{1j,t} + \\ & + \gamma_9 x_{2i,t} * z_{2j,t} + \gamma_{10} z_{1j,t} * z_{2j,t},\end{aligned} \tag{5}$$

where γ_0 to γ_{10} indicate regression coefficients, $x_{1i,t}$ and $x_{2i,t}$ denote firm level variables at time t, $z_{1j,t}$ and $z_{2j,t}$ are country level variables at time t [14].

4. Dataset and descriptive statistics

Our dataset includes listed firms from 52 different countries for which accounting data are available in the Worldscope database over the period 1996-2016. The sample includes a total of 350,073 firm-year observations. As it is standard in the capital structure literature, financial companies and utilities are not considered because their financing behavior is strongly affected by capital requirements and regulation. We use Fama and French industry classification and the SIC codes provided by Worldscope to sort companies within industries, and the country of incorporation to assign companies to a specific country. Considering that our regression models include lagged variables, and we are interested in both within-firm time variation and between-firms cross-sectional variation, we require that firms have at least four consecutive years of available data in order to be included in the sample. The resulting panel is strongly unbalanced, as several firms enter and leave the market, merge, are taken over, default, or cease operations.

In line with the pertinent literature, we measure leverage as the ratio between total financial debt divided by the sum of total financial debt and market capitalization[15]. The set of individual firms' characteristics that we use as determinants of debt ratios includes the variables that are typically considered in the literature (Rajan and Zingales, 1995; Ozkan, 2001): profitability (*profitability*), growth opportunities (*growth*), firm size (*size*), asset tangibility (*tangible*), and inventories (*inventories*)[16]. As for profitability, we rely on earnings before interests and taxes divided by total assets. On the one hand, according to the pecking order theory, more profitable firms should rely mainly on internal funds, hence having less debt. On the other hand, more profitable firms should hold more debt to reduce the agency costs associated with high levels of free cash flow (as noted by Jensen (1986)) and to increase firm efficiency (Margaritis and Psillaki, 2007). Consistently with the related literature, we measure growth opportunities as the ratio between the sum of market capitalization and total financial debt divided by the sum between the book value of equity and total financial debt. We expect firms with higher growth opportunities to issue less debt in order to avoid the agency costs associated with high leverage, as in the case of risk-shifting and debt overhang (Jensen and Meckling, 1976; Dang, 2011; Nishihara et al., 2019). We define asset tangibility as the ratio of total tangible fixed assets over total assets. Tangible assets can act as an explicit or implicit collateral for debt, so we expect firms with higher levels of tangible assets to issue more debt. Firm size is measured as the log of total reported firm sales, converted in 2005 units of local currency using the price index for the country where the firm is incorporated and then converted into US dollars (at the 2005 fiscal year end market exchange rate) to make it comparable across countries. A consolidated result in the empirical literature on capital structure is the positive relationship between leverage and firm size: asymmetric information may be less of a concern for larger firms because they are better known by investors and are required (by law or market practices) to provide more information. Moreover, bigger firms may be able to face downturns better than smaller firms (due to their geographic or product diversification), hence facing a lower default probability and lower expected bankruptcy costs. This, in turn, allows them to cope with higher levels of leverage. Therefore, consistently with the literature, we expect to find a positive relationship between firm size and leverage. Finally, we measure inventories as the ratio between the accounting value of inventories and total assets. Inventories, like tangible fixed assets, can act as a form of debt collateral, hence expanding a firm's debt capacity. Accordingly, we expect a positive and significant relationship between inventories and debt ratios.

Macroeconomic and institutional data are obtained from various sources. We use the national Consumer Price Index and exchange rates between national currencies and the US dollar, both taken from Datastream, in order to adjust accounting values for the effect of inflation and currency differences, and make them comparable both across countries and over time. In order to measure international financial markets conditions, we introduce an indicator that we label Global Financial Condition Index (GFCI). Such indicator is computed as the first principal component on the following set of variables: the spread between Baa and Aaa rated corporate bonds (*Rating Spread*); the spread between Aaa rated corporate bonds and US government 3-month T-bills (*Corporate Spread*); the 50-day moving average over the 200-day moving average in the levels of the S&P500 index (*S&P500-ma*), the DJ Eurostoxx index (*Eurostoxx-ma*), the Nikkei 225 Index (*Nikkei-ma*), and the Gold Bullion price on the London Bullion Market (*Gold-ma)*; the 20-day volatility on the same four price indexes (*S&P500-var*, *Eurostoxx-var*, *Nikkei-var*, *Gold-var*). The first principal component explains 49.38% of the overall variance. All variables used for creating the Global Financial Condition Index are obtained from Datastream. We then compute a four-quarter moving average of the index (GFCIa) in order to have a smoother indicator and an average measure of the index over the entire financial year for each firm. Note that higher values of the index correspond to periods of financial turbulence, while lower values indicate periods of financial ease. The index is calculated from the first quarter of 1989 until the fourth quarter of 2018 – a longer period than the one considered in our estimates in order to reduce the drawbacks of the principal component analysis at the two ends of the estimation window.

To account for the role of the business cycle in each of the countries included in our sample, we rely on the IFO World Economic Survey, a commonly used leading indicator for economic activity published quarterly by the IFO Institute and taken from Datastream. An higher value of the IFO index signals higher confidence in the current and future prospects of a country's economy. We do not use business cycle indicators issued by national statistical agencies or central banks because they are not homogeneous and hence are hardly comparable, while indicators issued by international agencies such as the OECD are not available for all the countries included in the dataset. The IFO World Economic Survey is instead available for a large number of countries over the entire sample period and its calculation method is uniform across time and countries. Finally, we use annual rates of inflation and annual growth rates of real GDP from Datastream for each individual country.

We rely on the Index of Economic Freedom, published annually by *The Wall Street Journal* and *The Heritage Foundation*, as an indicator of the market-friendliness of each of the countries in our sample [17]. The index measures if and to what extent countries refrain from coercion or constraint of individual liberty along four dimensions: rule of law, limited government, regulatory efficiency, and market openness. All countries are ranked on a scale from 0 to 100 (where a score of 100 indicates the economic environment that is most conducive to economic freedom) for each of the following indicators: *business freedom*, *trade freedom*, *monetary freedom*, *government spending*, *fiscal freedom*, *property rights*, *investment freedom*, *financial freedom*, *freedom from corruption*, and *labor freedom*[18]. The scores for each indicator are then averaged equally in order to get the overall index. In our empirical analysis, we use both the overall index and its components (but for *Labor Freedom*, which is available only from 2007 onward), referring to them with a slight abuse of notation as institutional variables, based on the idea that they proxy the quality of 'institutions'. It is important to note that the index is constructed by looking primarily at policy variables which are under the government's control, rather than simply looking at outcome variables as other indicators do. As highlighted by Heckelman and Stroup (2000), outcome variables may be simultaneously affected by different policies, hence potentially providing misguided measures of the quality of the regulatory framework. Conversely, the Heritage Index, by focusing primarily on policies rather than on outcomes, provides for a cleaner indicator of the quality of institutions.

As we mainly focus on the role of macroeconomic and institutional variables on capital structure decisions, we use a conservative set of firm-level determinants. Despite this, our results are in line with the pertinent literature. It is important to note that we do not explicitly include taxes among our regressors, even if the usage of debt may be an effective way to reduce the tax burden, so that the level of taxation faced by a firm might well be a potential determinant of its capital structure decisions. We account for taxes only indirectly through an indicator of *freedom from taxation* at the country level. While this is just a rough proxy for tax structures, in a globalized economy firms may design their legal structures and global operations in order to reduce taxable income, by generating (whenever possible) their profits in countries characterized by lower tax rates. In the end, as shown by Huizinga et al. (2008), the tax rate in the residence country of a multinational firm has a small effect on leverage as a consequence of international debt and income shifting. Consistently with this finding, Frank and Goyal (2009), examining US firms, and Öztekin (2015), looking at an international sample of companies, show that taxes do not constitute a robust determinant of capital structure and that higher taxes do not appear to have a statistically significant effect on leverage.

Table 1 reports the mean, standard deviation, minimum and maximum of the relevant variables over the entire sample.

[Table 1 about here.]

5. Optimal leverage and debt dynamics: the linear partial adjustment model

This section investigates the determinants of optimal debt ratios and their dynamics over time by means of a linear partial adjustment model. As already discussed in Section 3, our analysis relies on a two-step procedure by which we first estimate the optimal leverage and then a partial adjustment equation to account for its dynamics. We estimate target leverage by means of a fixed effect regression of Equation (1). In order to isolate the direct effect of macroeconomic and institutional variables, we first run a regression without interaction terms between firm-level and country-level variables. Table 2 (*Part a*) reports our results.

[Table 2 about here.]

The coefficients of three of the macroeconomic factors – *inflation*, the *GFCIa* indicator, and the *IFO* index – are statistically significant, while that of *GDP* is not. Inflation is positively correlated with leverage, suggesting that firms tend to use more debt when inflation is higher[19]. Conversely, leverage appears to be counter-cyclical with respect to financial conditions and expectations about the real economy: debt ratios are higher when financial conditions, or expectations, are worse. The indicators of the 'quality' of national institutions (as proxied by the components of the *Index of Economic Freedom* described in Section 4) are all statistically significant. *Freedom from corruption*, *business freedom*, and *trade freedom* are negatively correlated with debt ratios, while *protection of property rights*, *freedom from taxation*, *freedom from government spending*, *monetary freedom*, *investment freedom*, and *financial freedom* are positively correlated with leverage. The positive relationship between freedom from taxation (or from government spending) and leverage is in stark contrast with the predictions of the trade-off theory. However, as shown by Graham et al. (2015), corporate and government debt may act as substitutes, so that in countries in which public debt is larger firms may not be able to issue as much debt as similar firms in countries with smaller public debts[20]. As for firm-level covariates, our results are consistent with those in the pertinent literature. The coefficients are all statistically significant. More precisely, we find a negative coefficient for profitability and growth opportunities, and a positive one for tangible assets, inventories and firm size.

Table 2 (*Part b*) summarizes our findings from the estimation of the full model in Equation (1). The interactions between firm- and country-level variables are strongly significant in most cases. In particular, the interactions of *tangible*, *inventories* and *size* with *Financial Freedom* have negative coefficients. The higher the degree of financial freedom, the lower the importance of collateral and firm size as determinants of leverage, which suggests that firms' potential profitability matters more than the collateral from assets in place. This indicates that financial freedom acts as a substitute to those specific firm characteristics in supporting firms' ability to increase leverage. On the contrary, an higher protection of property rights increases the positive effect of size and tangible assets on leverage, so that in this case national institutions reinforce the effects of firm characteristics.

Inflation has the expected positive coefficient, indicating that periods of higher inflation are associated with higher leverage. Firms in countries with higher *freedom from government spending* display higher leverage, and more so when *profitability* increases. Growth opportunities (*growth*) and *profitability* are negatively correlated with leverage. These results hold even under changing macroeconomic and institutional conditions: when the interaction is significant, the sign of the combined effect remains negative.

Table 2 (*Part c*) reports the results of a dominance analysis investigating the relative importance of the regressors included in the model[21]. In our baseline specification without interactions between firm-level and macroeconomic/institutional variables, we find that around 50% of the explained 'within' variation can be attributed to firm-level variables, and the other 50% to macroeconomic and economic freedom indicators (the latter being a proxy of the institutional environment in which a firm operates)[22]. More specifically, around

37% of the explained variation can be attributed to macroeconomic indicators, a sign of the impact of the business cycle on capital structure. When looking at firm level variables alone, *growth* and *profitability* turn out to be the two most important regressors, accounting respectively for around 29% and 23% of the share of variance explained by this set of variables, followed by firm size and asset tangibility (contributing for around 17% each), by the industry mean debt ratio (12%), and finally by inventories (2%). Instead, when we add the interactions between firm-level and macroeconomic or institutional variables in the regression, a dominance analysis for groups of regressors finds that 31.87% of the within variability of the fixed effect specification can be attributed to the interaction between institutional and firm-level variables, 28.02% to the interaction between macroeconomic and firm-level variables, 18.72% to firm-level variables, 16.05% to macroeconomic indicators, and 5.34% to institutional indicators. This finding illustrates how individual variables alone are not sufficient to explain differences in observed capital structures, and it highlights the fundamental role of interactions among different factors, which jointly account for around 60% of the explained variation.

Having estimated the determinants of target debt ratios, we turn to the dynamic adjustment of leverage towards the target by estimating Equation (3), using both system-GMM ad Fama-MacBeth, to measure the average speed of adjustment (SOA) towards the target. The estimated speed of adjustment is equal to 9.25% when relying on the system-GMM estimator and to 8.33% when using Fama-MacBeth, implying an half-life of deviations from the target (calculated as $ln(0.5)/ln(1-SOA)$) between 7.14 and 7.97 years depending on which estimator is used. These findings suggest that the adjustment process is on average quite slow.

6. The non-linear partial adjustment model

In this section, we remove the 'pooling' assumption implicit in the previous analysis and estimate a model with heterogeneous speeds of adjustment by means of Equation (4), which includes various types of non-linearities in the adjustment process. As for the potential (direct and indirect) sources of heterogeneity, we build on the literature discussed in Section 2. Byoun (2008) shows how the speed of adjustment may depend on whether a firm is over or under-levered, and on whether it faces a financial surplus or deficit. To this end, we introduce the dummy *above* (D^a in Equation (4)), which is equal to one if a firm had a debt ratio higher than its optimal level at the end of the previous year (over-levered firm), and zero if it was below the target (under-levered firm). We then consider the variable *surplus* – obtained as the operating cash flow of the period plus the cash holdings at the beginning of the year minus the capital expenditures in the year – that measures the financial surplus (if positive), or deficit (if negative), of a firm. In other words, it indicates whether a firm has sufficient internal funds to pay for its investment needs, or if it has to raise external capital. Furthermore, following de Jong et al. (2011), we consider credit risk as a potential determinant of debt dynamics, using it as a proxy for the amount of spare debt capacity, defined as the maximum level of debt that a firm can bear without falling below investment grade. Unfortunately, credit rating data are available only for a small part of our sample, which prompts us to rely on a credit scoring methodology to measure credit risk. In particular, we estimate Ohlson's O-score (*O-score*) for each firm in the sample[23]. Finally, we include the *GFCIa* indicator to allow for the effects of macroeconomic conditions and the *Heritage* index to analyze the impact of national institutions. As a result, the vector $\Gamma_{ij,t}$ from Equation (5) becomes

$$\begin{aligned}\Gamma_{ij,t} =& \gamma_0 + \gamma_1 Surplus_{i,t} + \gamma_2 O\text{-}score_{i,t} + \gamma_3 GFCIa_{j,t} + \gamma_4 Heritage_{j,t} + \gamma_5 Surplus_{i,t} * O\text{-}score_{i,t} + \\ &+ \gamma_6 Surplus_{i,t} * GFCIa_{j,t} + \gamma_7 Surplus_{i,t} * Heritage_{j,t} + \gamma_8 O\text{-}score_{i,t} * GFCIa_{j,t} + \\ &+ \gamma_9 O\text{-}score_{i,t} * Heritage_{j,t} + \gamma_{10} GFCIa_{j,t} * Heritage_{j,t}.\end{aligned} \tag{6}$$

We also use an even more complex model that allows for 3 and 4-way interactions among variables, implying that further terms are added to Equation (6). This allows for the interactions of the target debt ratio first with three and then with four covariates (e.g. *surplus*o-score*GFCIa*, ..., *surplus*Heritage*o-score*GFCIa*).

As our results in Table 3 indicate, the speed of adjustment (obtained by relying on the system-GMM estimator) is significantly affected by firm, macroeconomic, and institutional variables both directly and indirectly, through the interaction effects among these variables.

[Table 3 about here.]

Columns (1) and (2) of Table 3 report the coefficients of the model obtained by substituting Equation (6) into Equation (4), thus deriving the firm-specific parameters for the speed of adjustment as a function of individual variables and two-way interactions. All direct effects are statistically significant, indicating that the considered covariates affect the speed of adjustment. The interactions with the dummy $D^a_{i,t}$ (*above*) are also significant, showing that the direct effect of the four variables changes between under-levered and over-levered firms. As for two way-interactions, we find that they are all statistically significant. When including the dummy *above*, five out of the six interactions are statistically significant. Our results indicate that having a financial surplus severely reduces the speed of adjustment, suggesting that firms are more reluctant to access financial markets to raise capital simply to adjust their leverage. This effect is mitigated when firms have an higher credit risk, or when they are in countries with more market-friendly institutions. An increase in credit risk induces a faster speed of adjustment, although – quite surprisingly – less so for over-levered firms. In fact, the interaction of credit risk with financial surplus suggests that over-levered firms with high credit risk adjust faster in the presence of financial surplus, hinting that high risk firms with a financing deficit may engage in some form of gambling for survival by further increasing leverage rather than going through a (costly) equity increase. The interaction of credit risk with *GFCIa* suggests instead that firms are less likely to reduce leverage in bad market conditions, likely because of the larger costs of issuing equity during negative market periods, an effect that has been reported in the previous literature (Bayless and Chaplinsky, 1996). Conversely, with more market-friendly institutions firms are more likely to reduce leverage when credit risk increases.

Columns (3) and (4) report the relevant coefficients for the model that also considers 3-way and 4-way interactions among variables. We find that five of the ten additional coefficients are statistically significant, suggesting that the overall effects of firm, macroeconomic, and institutional factors are deeply interconnected, so that a model allowing only for a direct effect of any of these variables on the speed of adjustment would be too simplistic.

Table 4 reports the results obtained when relying on the Fama-MacBeth method, rather than on the Blundell-Bond System-GMM estimator.

[Table 4 about here.]

Our findings are consistent across the two estimation methods both in terms of the signs of the coefficients and of their statistical significance. Despite some differences in the magnitude of the individual coefficients, the correlation between the estimated speeds of adjustments from the two estimators is extremely high, with a degree of correlation of around 95% (as reported in Table 5).

[Table 5 about here.]

In order to confirm that both the system-GMM estimators and the Fama-MacBeth do a good job in capturing the variability in debt ratios, it is also useful to measure the correlation between the fitted values of the two regression models with the actual level of leverage of each firm in each year. We find that the correlation between our predicted values and the actual debt ratios is close to 90%, indicating that our regressions provide accurate estimates of the leverage dynamics[24]. The fact that the results we obtain using Blundell-Bond system-GMM and Fama-MacBeth are fully consistent is likely to be a consequence of the very large sample used in our estimations, which allows to mitigate the potential biases induced by the dynamic nature of the regression model when using the Fama-MacBeth estimator.

As noted in Section 3, an advantage of the Fama-MacBeth estimator is that – being based on a sequence of OLS regressions – it allows for a proper dominance analysis, providing further quantitative insights on the relative importance of firm-level, macroeconomic and institutional factors for capital structure dynamics. Table 6 reports the results of such an analysis, based on the standardized dominance statistics (SDS) associated to the Fama-MacBeth estimates.

[Table 6 about here.]

Focusing on the model that includes direct effects and two-way interactions (see Columns (1) and (2) in the table), we find that around 17% of the explained variance can be attributed to the target leverage, and an additional 29% to the interaction between the target and the dummy *above*. Thus, around 54% of the remaining explained variance is due to the one and two-way interactions. In particular, 29% of the explained variance is accounted for by two-way interactions between firm, macroeconomic and institutional factors, indicating that the indirect effects play an important role in explaining the adjustment process. This finding suggests that the adjustment process is ultimately determined by a complex function of firm, macroeconomic, and institutional variables. In Columns (3) and (4), we report the standardized dominance statistics for the model that also considers 3-way and 4-way interactions among variables. The target itself directly accounts for only 11% of the explained variance (see the SDS for the coefficient γ_0 in Column (3)), and its interaction with the dummy *above* for another 15% (see the SDS for the coefficient γ_0 in Column (4)). An additional 45% – given by the sum of the SDS for the coefficients γ_1-γ_4 in Columns (3) and (4) – is explained by the direct effect of firm, macroeconomic, or institutional characteristics. This implies that the indirect effects of the different characteristics, represented by the two, three, and four-way interactions contribute for around 30% of the explained variance, a clear sign of their importance in the adjustment process.

To further explain the implications of our findings, we compute the time-varying firm specific speed of adjustment and organize our sample in deciles obtained by ranking firms based on their estimated speeds. Given that our results suggest significant differences in the behavior of under-levered vs. over-levered firms, we do so by separating firms in the two corresponding sub-samples. We then analyze the mean of the speed of adjustment (as well as that of the four variables included in the estimation of the speed of adjustment) for the first and tenth deciles, and test whether they are statistically different. The results reported in Table 7 for the Blundell-Bond system-GMM and the Fama-MacBeth estimates show that the means of both the speed of adjustment and the four variables included in its estimation differ significantly between the first (i.e. the slowest group at adjusting) and the tenth (i.e. the fastest) deciles in the sub-samples of both the under-levered and over-levered firms.

[Table 7 about here.]

These results lead to interesting insights. Overall, we highlight the existence of significant and complex non-linearities in the dynamic adjustment process as a result of the interaction between the availability of internal funds, credit risk, and macroeconomic conditions, with national institutions further adding to the dynamics of leverage, both directly and indirectly. More specifically, a higher speed of adjustment is correlated to a lower availability of internal funds (*surplus*). In fact, firms in the decile corresponding to the highest speed of adjustment have on average a financial deficit both when below and when above the target. As expected, above target firms in the highest decile have a higher O-score, corresponding to a higher credit risk. The GFCIa indicator suggests that leverage is counter-cyclical for below target firms, while it is pro-cyclical for over-levered ones (although to a lesser extent).

7. Speeds of adjustment in different groups of firms

While the full non-linear model estimated in the previous section has the advantage of producing firm-specific speeds of adjustment, it has the main drawback of generating a large number of coefficients, making it difficult to draw general lessons on how the various factors affect the rebalancing process. In order to better highlight our main insights, in this section we estimate different speeds of adjustment for sub-groups of firms, based on their characteristics and on macroeconomic/institutional factors, and then compare the estimated speeds of the different groups in order to better understand the effects of each of the relevant factors on the debt rebalancing process.

7.1. The role of firm conditions

We first account for the fact that being above or below the target level of leverage may have an impact in determining firms' behavior, allowing the speed of adjustment to change depending on whether firms are under- or over-indebted; i.e.

$$\frac{D_{i,t}}{A_{i,t}} - \frac{D_{i,t-1}}{A_{i,t-1}} = \alpha_1 D^b_{i,t} + \alpha_2 D^a_{i,t} + \lambda_{1b}\overline{TD}_{i,t} D^b_{i,t} + \lambda_{1a}\overline{TD}_{i,t} D^a_{i,t} + \lambda_{2b}\frac{D_{i,t-1}}{A_{i,t-1}} D^b_{i,t} + \lambda_{2a}\frac{D_{i,t-1}}{A_{i,t-1}} D^a_{i,t} + \epsilon_{i,t}, \quad (7)$$

where $\overline{TD}_{i,t}$ is the target debt ratio of firm i at time t, $D^a_{i,t}$ is a dummy variable that takes value one if firm i debt at $t-1$ is above the target estimated for period t and zero if it is below, and $D^b_{i,t}$ is a dummy variable equal to one if firm i debt at $t-1$ is below the estimated target for time t and zero if it is above. *Part a* of Table 8 reports our results. We find that firms above the target tend to adjust at a speed of 27.78% when using the system-GMM estimator (24.62% when using the Fama-MacBeth method), while firms below the target show a speed of adjustment not significantly different from zero in both cases. This suggests that not only firms partially adjust to target leverage, and do so at a somewhat low speed, but they also behave asymmetrically depending on the sign of the deviation[25].

[Table 8 about here.]

In *Part b* of Table 8, we illustrate the results obtained by adding to the specification in Equation (7) a dummy variable that indicates whether a firm has a positive financial surplus and interacting it with all regressors, to examine whether under- and over-levered firms behave differently depending on their financial surplus[26]. We find that the adjustment speed changes significantly both between under- and over-levered firms, and between firms with financing deficits and surpluses. It turns out that firms with a financing deficit adjust at a speed of 22.26% with system-GMM (19.37% with Fama-MacBeth) when they are below target, which indicates that they tend to cover their financing deficits relying more on debt than on equity. Conversely, firms below target with a financial surplus display a negative speed of adjustment of -0.016%, indicating that they do not systematically converge towards the target, but rather mover further away, although the magnitude of this effect is not particularly significant from an economic standpoint. When firms are instead over-levered, the speed of adjustment appears to be significantly higher in the presence of a financial deficit than of a financial surplus (51.66% vs. 15.53% with system-GMM and 46.94% vs. 13.13% with Fama-MacBeth, respectively), showing that firms that need to raise funds from external sources rely more on equity than on debt, so that their leverage decreases. This behavior suggests that firms are not entirely active in adjusting their capital structure towards the target. When in need of external resources, they raise capital by choosing the source of funds that allows them to move towards the target faster (particularly if over-levered). Conversely, when internal funds exceed the amount needed to support investments, they tend to adjust towards the target leverage at a much slower speed, using the available funds to pay for capital expenditure and avoiding to raise new capital in order to actively re-balance their leverage ratio.

We further divide our sample in three sub-groups depending on firms' estimated credit risk, which leads to 12 sub-groups overall as a function of financial slack, the sign of the deviation of debt from the target level, and credit risk. As it is commonly assumed, we classify firms with a value of the Ohlson's o-score below 0.038 as *investment grade*, firms with a value above 0.5 as *junk*, and firms with a value between 0.038 and 0.5 as near-investment grade debt (i.e. *risky*). We report our additional results in *Part c* of Table 8. We still find that firms below target and with positive financial slack do not converge towards the target debt ratio, with the sole exception of the firms in the *junk* group, for which a positive – although very small – and statistically significant speed of adjustment is observed. Conversely, under-levered firms with negative financial slack tend to systematically adjust towards the target. Once more, this occurs at a faster speed for the riskiest firms. When over-levered, instead, firms with positive financial slack adjust towards the target at a much lower speed than firms with negative slack. Moreover, the latter adjust at a speed that is almost twice as large for 'junk' firms than for investment grade ones. This reinforces our previous finding that firms are not entirely active in rebalancing debt, but rather tend to do so only if they need to raise external funds, and more so if credit risk is high.

7.2. The role of macroeconomic conditions

We further enrich the analysis by investigating how the speed of adjustment of a firm's debt towards the target changes under different macroeconomic scenarios. Firms may have strong incentives to avoid issuing equity during financial crises because the conditions at which they could do so may be perceived as too penalizing for existing shareholders. If this is the case, we may expect over-levered firms to adjust faster when market conditions are more favorable and at a slower pace when market conditions are less favorable.

In order to assess the effects of macroeconomic conditions on the adjustment process, we divide our sample in three sub-groups using the financial conditions index GFCIa. In particular, we use the 33^{rd} and 66^{th} percentiles of the index as dividing thresholds. Note that our analysis here relies on the Fama-MacBeth estimator only. There are two main reasons for imposing this restriction. First, with system-GMM some sub-samples would become extremely small, as the estimator uses lags up to four years of the regressors as instruments, which implies that we could only consider firms with seven consecutive years of data (given that we need at least three years of lagged data to estimate each year's target debt ratio). Second, given the reliance of system-GMM on variables measured up to four years in the past, the estimator may end up capturing entirely different macroeconomic (and, possibly, also institutional) conditions. This is inconsistent with the goal of capturing the effect of a specific phase of the business cycle (or of other macroeconomic or institutional factors) on firms' debt readjustment decisions. *Part a* of Table 9 reports the results of our analysis.

[Table 9 about here.]

In hot markets, firms above the target and without financial slack tend to reduce leverage whatever their credit risk: the estimated speed of adjustment is 40.79% for the *investment grade* group, and 53.18% for the *junk* group. Conversely, in cold markets riskier firms reduce leverage at relatively high speed (56.01%), while low-risk firms do not appear to adjust their debt ratios (their speed of adjustment is not statistically significant). At the same time, firms above the target with financial surplus tend to reduce debt at slow speed regardless of market conditions and credit rating, suggesting that the reduction in leverage is achieved through internal funds. Somewhat surprisingly, firms below the target and with a financial deficit tend to increase leverage regardless of market conditions when their credit risk is already high, a behavior that looks like 'betting for resurrection'. When credit risk is low, instead, firms appear to increase leverage more during hot rather than cold markets, although in both cases the speed of adjustment is not statistically significant. Finally, firms below the target and with a financial surplus do not seem to adjust their leverage at all. Overall, these findings suggest that firms actively engage in capital structure rebalancing only when they need to raise external funds. Not surprisingly, when market conditions are not favorable, firms tend to delay deleveraging if at all possible, although over-levered risky firms may be forced to rebalance also under bad market conditions.

Part b of Table 9 shows the results obtained by splitting the sample for the three terciles of GDP growth rates[27]. Also under this decomposition, above-target low credit risk firms with a financial deficit do not seem to adjust debt in low-growth periods ('*Recession*' in the table), while they do show a positive speed of adjustment during high-growth periods ('*Expansion*' in the table). Conversely, high credit risk companies have a positive adjustment speed in all macroeconomic environments, with a minimum of 40% during recessions and a maximum of 56% in periods with growth rates in the intermediate tercile ('*Normal*' in the table). Similar results are obtained when splitting the sample based on the three terciles of the IFO index, both calculating terciles on the overall sample (*Part c* of Table 9) and country-by-country (*Part d* of Table 9), although with lower statistical significance in the latter case.

Our findings indicate the existence of common patterns on how the combination of financial surplus, credit risk, and macroeconomic conditions affects the speed at which firms adjust their capital structure towards the optimum. First, we find that firms are keener to adjust when they need accessing financial markets to raise external capital. Conversely, they are more reluctant to adjust when they have sufficient internal resources to fund investments. Second, differences in credit risk affect the dynamic behavior of firms in the rebalancing process, especially in the case of above-target firms during recessionary periods, or during periods with negative financial markets conditions. More specifically, while above-target low-risk firms seem to defer the adjustment and avoid issuing equity under unfavorable conditions (thus slowing the speed of the adjustment process), high credit risk firms adjust towards the target at a similar speed regardless of market conditions.

7.3. The role of institutional indicators

Finally, we extend our analysis by conditioning the debt adjustment towards the target also on the quality of institutions. We divide our sample in three sub-groups and look at the differences between the bottom, middle and top third of the distribution of the Heritage index, thus allowing the adjustment dynamics to change depending on the level of 'market friendliness' of national institutions. This further decomposition enables us to assess the effects of the interaction between macroeconomic conditions, institutional variables, and firm characteristics, allowing for the asymmetries in the adjustment process to be contemporaneously affected by all the three groups of factors. We summarize our results in Table 10.

[Table 10 about here.]

Looking at the estimated coefficients, it appears that in countries with more market-oriented institutions (i.e., those whose institutional "quality" is above the 66^{th} percentile) the effect of the business cycle on the adjustment dynamics is stronger than that reported for the overall sample. Focusing in particular on over-levered firms with financial deficits, those with low credit risk show different speeds of adjustment depending on the conditions prevailing in the financial market, while those with high credit risk tend to adjust towards the target leverage with the same speed regardless of macroeconomic conditions. We obtain similar results when looking at the intermediate group (Group 2 in the table), corresponding to firms located in countries whose institutional 'quality' lies between the 33^{rd} and the 66^{th} percentile. This type of asymmetric behavior is not found when looking instead at firms in countries displaying less market-friendly institutions, where also low credit risk firms are characterized by a constant speed of adjustment regardless of market conditions. These findings suggest that the interaction between macroeconomic conditions and the quality of institutions significantly affects the dynamics of leverage ratios. In particular, more market-friendly institutions appear to increase firms' financial flexibility, allowing them to better accommodate the effects of the business cycle on the costs and benefits of capital structure readjustments.

8. Implications for the capital structure debate

Our results contribute to the debate on the relative merits of different capital structure theories. The importance of the financial surplus for the dynamics of leverage indicates that pecking order arguments play a key role in financing decisions, with firms reducing leverage when internal funds exceed financial needs regardless of whether they are over- or under-levered. However, when external funds are needed, under-levered firms seem to cover their financing deficits by increasing leverage, while over-levered firms do so by issuing equity and hence reducing leverage (to a larger extent when credit risk is high). More generally, when accounting explicitly also for macroeconomic conditions, our results point to a complex view of capital structure decisions, with a co-existence of pecking order and trade-off arguments.

The short-run debt dynamics seems to be guided by pecking order and market timing considerations: external funds are raised only if internal resources are lacking, and debt is preferred until credit risk becomes too high. Moreover, this behavior appears to be stronger when financial conditions are not favorable to equity issues. Looking at a longer horizon (i.e. at time intervals spanning different phases of the business cycle), however, our results indicate that firms tend to converge to a target leverage, in line with the predictions of the trade-off theory with costly rebalancing. In particular, over-levered firms needing external funds tend to reduce leverage – moving towards the target regardless of their credit risk – when facing good macroeconomic conditions. Conversely, under bad macroeconomic conditions, high credit risk firms tend to reduce leverage, while firms with lower credit risk avoid the costs of rebalancing waiting for an expansionary phase of the business cycle. The fact that firms behave differently depending on their characteristics (e.g. being over-levered vs. under-levered, high risk vs. low risk) in different macroeconomic environments suggests that pure market timing arguments cannot be taken as entirely convincing alternatives to the trade-off view. Furthermore, by removing the pooling assumption from the partial adjustment model, our results indicate how pecking order and trade-off arguments jointly contribute at explaining firms' behavior. In particular, adverse selection costs seem to be a major driver for low credit risk firms, which display a behavior strongly affected by pecking order arguments. Conversely, when adverse selection becomes less of a concern and the connected costs become less severe, also these firms display a rebalancing behavior, indicating that trade-off arguments become more relevant. Additionally, leverage readjustments are more pronounced when firms are over-levered rather than under-levered, suggesting that financial flexibility (i.e. the presence of spare debt capacity to be used in case of unfavorable market conditions) is a primary concern for firms, which in turn indicates that pecking order arguments influence financing choices. Finally, better institutions contribute at granting firms more flexibility in their capital structure decisions, so that they can better handle the effects of the negative phase of the business cycle by temporarily moving away from the optimal debt target established by the trade-off theory – exploiting the pecking order until more favorable market conditions for rebalancing are met.

9. Concluding Remarks

The recent literature investigates the dynamics of capital structure decisions by means of partial adjustment models of leverage. These models build on the assumption that asymmetric information and market frictions make the adjustment towards the optimal debt-equity ratio costly, leading firms to only partially – if at all – reduce the distance from their targets. Our paper shows that the speed at which firms rebalance their capital structure is highly heterogeneous, being affected by firm, macroeconomic, and institutional conditions, all interacting with each other. This implies that simply estimating one speed of adjustment over a number of years and a large sample of companies is too simplistic. Even allowing for individual speeds of adjustment as a direct function of firm or macroeconomic factors does not provide a full description of the dynamic process. A more realistic approach needs to allow for changing speeds of adjustment as a function of the interactions between firm, macroeconomic, and institutional variables, which produce continuously changing marginal effects. We do so by relying on two different estimators – the Blundell-Bond system-GMM and the Fama-MacBeth estimators, finding that our results are fully consistent across them.

A dominance analysis reveals that around 80% of the explained variation in leverage can be attributed to macroeconomic and institutional variables; in particular, their interactions with firm-level characteristics account for about 60% of the explained variation. This supports the hypothesis that capital structure decisions are strongly affected by country-level indicators. Our results also document how firm-level, macroeconomic, and institutional factors directly and indirectly affect the rebalancing behavior of firms through complex interactions that represent around 30% of the explained variation in the speed of adjustment.

In addition, we show how the two competing theories of capital structure – trade-off and pecking order – may coexist. Firms are shown to take decisions that are consistent with the presence of a long-run target leverage ratio, but their short-run behavior is in good accordance with the predictions of the pecking order theory. The relative importance of adverse selection costs, their interactions with macroeconomic conditions, and the quality of national institutions help explaining this phenomenon. The presence of a financial surplus has a strong effect on debt dynamics: firms show a much higher speed of adjustment when they need to raise external funds in order to finance investments than when they can rely solely on internal resources. This means that firms are not always actively engaging in reducing the distance from their optimal debt-equity ratio. When they need accessing financial markets to raise new capital, firms take decisions in line with the trade-off view, while if they don't need external capital they do not seem concerned about accessing financial markets simply to rebalance their capital structure. When we allow for distinct adjustment speeds under different market conditions, we find that firms with low credit risk and above-target debt ratios do not align their debt with the target level under bad macroeconomic conditions, reinforcing the view that the convergence to optimal debt ratios is not seen as a priority by firms when taking financing decisions. Given that issuing equity is significantly costlier during bad market times, this result implies that firms may prefer deferring leverage adjustment until market conditions become more favorable. This behavior suggests that – for firms with spare debt capacity, proxied by low credit risk – the convergence towards the target is a long-run phenomenon, while short-run decisions are guided by pecking order arguments. Finally, we find that also the quality of institutions influences the dynamic behavior of firms, with the degree of market friendliness not only affecting target leverage but also the speed of adjustment towards it. Indeed, countries characterized by a more friendly market environment provide firms with higher financial flexibility, allowing them to better adapt to changing macroeconomic conditions.

Overall, our results show that a systematic analysis of capital structure decisions needs to allow for a non-linear dynamic adjustment of the debt-equity ratio, where the optimal level of leverage and the adjustment process have to be modeled as a non-linear function of both microeconomic and macroeconomic factors. By making the dynamic adjustment process strongly heterogeneous, we show how the relative level of leverage, financial surplus, and credit risk interact with each other – and with changing macroeconomic and institutional conditions – in affecting firms' intertemporal financing decisions, and we quantify their relative contributions.

Notes

[1]Denis (2012) provides a thorough review of the main challenges to the two traditional theories as stand-alone models of capital structure decisions.

[2]We add to the literature also by enriching the investigation of the role of institutional characteristics through a set of measures of the quality of national institutions with both a cross-section and a time dimension, which allows us to accurately control for within-country variations.

[3]Furthermore, by considering both the cross-sectional and time series dimensions of a set of indicators of the quality of national institutions, we also properly control for within-country variations, whereas a large part of the literature (see e.g. Öztekin and Flannery (2012)) – while carefully investigating the role of institutional variables – relies on a set of time-invariant institutional measures only.

[4]A typical conflict arises when managers, or large shareholders, have excessive control over a company. In such situations, either because monitoring costs are too high or the protection of property rights is too weak, managers may take advantage of their positions to pursue private benefits (Jensen, 1986) or to increase shareholders' value at the expense of creditors – either through asset substitution (Jensen and Meckling, 1976) or by the tunneling of corporate resources (Myers, 1977; Aslan and Kumar, 2012).

[5]Fan et al. (2012) note also that when firms operate in countries with higher taxes, they tilt their capital structures towards more debt. However, the tax effect on capital structure is not as strong and pervasive as that of other factors.

[6]By highlighting the direct and indirect role of institutional variables on the optimal debt-equity ratio and on its rebalancing process, our work is also related to the literature focusing on the effects of national institutions on firms' behavior. As we further explain in Section 4, we rely on the Index of Economic Freedom published annually by the Heritage Foundation to describe the quality of national institutions. This index has often been used by researchers in economics and finance to provide a quantitative measure of the quality of a nation's institutional framework (see, among others, Johnson et al. (1998), La Porta et al. (1999), Claessens and Laeven (2003), Mercieca et al. (2007), Hasan et al. (2009), Panchenko and Wu (2009), and Chortareas et al. (2013)).

[7]These empirical results are consistent with the theoretical analysis in Hackbarth et al. (2006), who show that firms adjust their capital structure more often in booms than in recessions, that debt capacity increases during hot markets compared to cold markets, and that debt becomes more costly during recessions, with higher credit spreads. Again in a theoretical perspective, Levy and Hennessy (2007) predict that firms with higher structural protection are more flexible in their capital structure decisions, and their leverage ratio is strongly counter-cyclical, with leverage increasing during recessions and decreasing during expansions. Conversely, firms with more severe agency problems due to lower protection of outside investors face much lower flexibility in their capital structure decisions, and their leverage ratio has a more uniform dynamics over the business cycle.

[8]Since raising capital (and equity in particular) is more expensive in cold markets, one should expect market conditions to mitigate the impact of the financing deficit on the propensity of over-levered firms to readjust their capital structure. Similarly, firms with high credit risk, a factor that should induce them to quickly rebalance their leverage (de Jong et al., 2011), may reduce their speed of adjustment to avoid raising new equity when the costs are higher.

[9]Note that the use of the Blundell-Bond system-GMM estimator in the first step would produce biased estimates in the presence of second order serial correlation, as it is the case with our data.

[10]The absence of serial correlation is due to the adoption of a two-step procedure. Indeed, when we jointly estimate both the target leverage and the speed of adjustment – using therefore a one-step procedure – we find second-order serial correlation in the residuals, as indicated by Dang et al. (2015).

[11]An alternative approach may be the application of bootstrap sampling, but Bond and Windmeijer (2002) report problems with the bootstrap procedures in the context of dynamic panel data models estimated with GMM procedures, showing that the weight matrix is a poor estimate of the true covariance matrix of the moment conditions.

[12]In this case, the issue of the biased estimates of the true standard errors due to cross-sectional correlation in residuals induced by the 'generated regressors' problem would be dealt via bootstrap sampling.

[13] Note that we have a panel with T=3 for the first year, as we use leverage ratios from the period 1996-1998 to estimate the target for the year 1999. We then simply add additional years as we move forward, so that the time dimension of the dataset increases each year, replicating the procedure proposed in Hovakimian and Li (2011).

[14] The full expression of $\Gamma^1_{i,j,t}$ is defined in a similar fashion. We hence avoid reporting its full specification.

[15] Since we are using book values of debt, we should define the leverage ratio at quasi-market values rather than at full market values. We use the traditional definition of market debt ratio in the remainder of the paper for simplicity. Note that total financial debt includes capitalized lease obligations.

[16] All the variables are winsorized at the first and ninety-ninth percentile in order to limit the effects of outliers.

[17] The Index of Economic Freedom offers a number of advantages over alternative indicators: it is available for a large number of countries and for a sufficiently long time frame, it is comparable both across countries and over time, and it is updated annually, hence providing both cross-sectional and time-series variation. Other indexes, like those proposed by the literature on law and economics (see e.g. La Porta et al. (1997, 1998, 1999, 2000), Djankov et al. (2008)), and used for example in Gungoraydinoglu and Öztekin (2011) or Öztekin and Flannery (2012), depict only cross-sectional variance, so that they cannot be used to analyze variations over time.

[18] *Business Freedom* is a quantitative measure of the ability to start, operate, and close a business that represents the overall burden of regulation as well as the efficiency of government in the regulatory process. *Trade Freedom* is a composite measure of the absence of tariff and non-tariff barriers that affect imports and exports of goods and services. *Monetary Freedom* is a combined measure of price stability and price control. *Government Spending* measures the level of government expenditures as a percentage of GDP. *Fiscal Freedom* is a measure of the overall tax burden imposed by the government. *Property Rights* is an assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the State. *Investment Freedom* is an indicator of the ability to move capital and resources into and out of specific activities internally and across the country's borders without restriction. *Financial Freedom* is a measure of banking efficiency and of the lack of government intervention in the financial sector. *Freedom from Corruption* is an index of the lack of corruption and bribery by public officials in the country. *Labor Freedom* is a quantitative measure of the regulatory environment in a country's labor market.

[19] Note that inflation reduces the real burden of debt and increases the value of leverage, as argued already by Modigliani (1982). Hence, a positive relationship between inflation and debt is to be expected.

[20] The coefficients of these two variables are quite small. Moreover, at least for multinational companies, the effective tax rate paid on consolidated income is different from the statutory rate of the country of origin, as shown by Huizinga et al. (2008).

[21] See Grömping (2007) for the technical details of dominance analysis. Note that the fit statistic (R^2-within) used in our dominance analysis does not consider the share of variance explained by firm fixed effects.

[22] Due to the large number of independent variables, the number of auxiliary regressions required for a complete variable-by-variable dominance analysis is computationally demanding, so we only report the results for jointly considered sets of variables.

[23] Ohlson (1980) selects nine independent variables for predicting bankruptcy with what is known as the O-score, given by the following estimated equation: $O-score = -1.32 - 0.407 ln(TA_t) + 6.03\frac{TL_t}{TA_t} - 1.43\frac{WC_t}{TA_t} + 0.0757\frac{CL_t}{CA_t} - 1.72X - 2.37\frac{NI_t}{TA_t} - 1.83\frac{FFO_t}{TL_t} + 0.285Y - 0.521\frac{NI_t - NI_{t-1}}{|NI_t| + |NI_{t-1}|}$, where TA is total assets, TL is total liabilities, WC is working capital, CL is current liabilities, CA is current assets, X is a dummy equal to 1 if TL >TA and 0 otherwise, NI is net income, FFO is funds from operations, Y is a dummy equal to 1 if the company had a net loss for the last two years and 0 otherwise. We use the O-score instead of the better known Z-score from Altman et al. (1977) because according to Begley et al. (1996) the O-score has higher predicting ability.

[24] The correlation coefficients are 87.31% and 87.29% when using the system-GMM estimator with two- and four-way interactions, respectively, and 85.92% and 86.68% when using the Fama-MacBeth method with two- and four-way interactions.

[25] This asymmetric behavior appears to be much stronger than estimated by Byoun (2008) for U.S. firms.

[26] The dummy takes value one if capital expenditures in the year are lower than the operating cash flow of the period plus cash holdings at the beginning of the year (surplus), and zero if they are bigger (deficit).

[27]The lower tercile includes periods with GDP growth rates below the 33rd percentile, which is equal to 1.46%. The second tercile includes periods with GDP growth rates between the 33rd and the 66th percentile, which corresponds to a GDP growth rate of 3.19%. The top tercile includes periods with GDP growth rates above the 66th percentile.

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Table 1: Summary statistics

The table provides summary statistics for the variables considered in the paper. St. dev., Min and Max denote the standard deviation, and the minimum and maximum values of each variable, respectively. With the exception of debt ratios, all other firm-level variables are winsorized at the 1^{st} and 99^{th} percentile to mitigate the effect of extreme outliers.

	Mean	**St. dev.**	**Min**	**Max**
Market debt ratio	0.289	0.271	0.000	1.000
Book debt ratio	0.320	0.270	0.000	1.000
Profitability	0.018	0.207	-1.143	0.375
Growth opportunities	1.288	1.341	0.180	8.932
Tangible	0.319	0.231	0.003	0.913
Inventories	0.127	0.128	0.000	0.606
Firm size	6.984	2.351	-0.474	12.28
GFCIa	0.611	1.927	-1.834	7.067
GDP growth rate	2.886	2.976	-17.70	15.24
Inflation rate	0.025	0.036	-0.063	0.707
IFO index	4.903	2.264	1.000	9.000
Heritage index	71.20	8.968	46.00	90.00
Property rights	76.29	16.55	15	95.00
Freedom from corruption	66.81	19.13	17.00	100.0
Fiscal freedom	67.55	12.27	29.80	93.80
Government spending	60.52	21.19	0.000	99.30
Business freedom	79.66	13.79	35.50	100.0
Monetary freedom	82.84	7.354	0.000	95.40
Trade freedom	78.67	10.18	13.20	95.00
Investment freedom	64.32	16.03	20.00	95.00
Financial freedom	63.03	18.97	30.00	90.00

Table 2: The estimation of optimal debt ratios

Part a reports the estimate on the full international sample of Equation (1), without interaction effects between firm- and country-level variables. The first row reports the intercept and the coefficients for firm-level variables, while the first column reports the coefficients for macroeconomic and institutional factors. *Part b* reports the estimate of the full model in Equation (1). The first row reports the intercept of the regression, and the coefficients for firm-level variables. The first column reports the coefficients for macroeconomic and institutional factors. Columns 2-7 and rows 2-14 report the coefficients for the interactions between firm and country-level variables. *Part c* reports the results of a dominance analysis for groups of variables for the two regression models. Leverage is measured using market debt ratios. *IFO* is the IFO World Economic Survey indicator. *GFCIa* is the moving average of quarterly values of the Global Financial Conditions Index. *GDP* is the annual growth rate in real GDP. *Inflation* is the annual growth rate of the national Consumer Price Index. *Heritage* is the Heritage Index of Economic Freedom, while *PR* is Property Freedom, *FfC* is Freedom from Corruption, *FFT* is Freedom from Taxation, *GS* is Freedom from Government Spending, *BF* is Business Freedom, *MF* is Monetary Freedom, *TF* is Trade Freedom, *IF* is Investment Freedom and *FF* is Financial Freedom. The estimates are obtained with panel firm fixed effects. Coefficient estimates significantly different from zero at the 1%, 5% and 10% level are marked with ***, **, and *, respectively. Standard errors are not reported to save on space.

	Intercept	**Profitability**	**Growth**	**Tangible**	**Size**	**Inventories**	**Industry**
Part a: model with no interaction effects							
	0.2108***	-0.1311***	-0.0190***	0.1594***	0.0255***	0.0845***	0.0363***
Inflation	0.9070***						
GDP	-0.0002						
Ifo	-0.0089***						
GFCIa	0.0084***						
PR	0.0023***						
FfC	-0.0018***						
FFT	0.0006***						
GS	0.0004***						
BF	-0.0007***						
MF	0.0003***						
TF	-0.0021***						
IF	0.0003***						
FF	0.0001***						
Part b: model with interaction effects							
	0.1600***	-0.2853***	-0.0549***	0.3530***	0.0032	-0.2798***	0.8096***
Inflation	0.8588***	-0.6225***	-0.0237**	-0.5693***	0.0213***	-0.0706	-1.2139***
Gdp	-0.0049***	-0.0011	0.0005***	-0.0028***	0.0006***	-0.0013	0.0043**
Ifo	0.0099***	0.0135***	0.0020***	-0.0115***	-0.0008***	-0.0081***	-0.0369***
GFCIa	0.0144***	0.0078***	-0.0002	0.0010	0.0011***	0.0101***	-0.0489***
PR	-0.0007**	-0.0004	0.0000	0.0024***	0.0002***	0.0008	0.0010*
FfC	-0.0022***	0.0032***	0.0004***	0.0002	0.0000	0.0032***	-0.0017***
FFT	0.0005	-0.0017***	-0.0001**	-0.0005*	-0.0001**	-0.0001	0.0031***
GS	0.0004	0.0012***	0.0001***	0.0018***	0.0000	0.0017***	-0.0036***
BF	0.0013***	-0.0004	-0.0001	-0.0026***	-0.0001*	-0.0019***	-0.0015***
MF	-0.0027***	-0.0014***	-0.0001	-0.0001	0.0003***	0.0045***	0.0014
TF	-0.0003	-0.0016***	0.0000	-0.0007**	0.0002***	0.0006	-0.0103***
IF	0.0010***	0.0019***	0.0000	0.0010***	-0.0001***	-0.0013***	-0.0026***
FF	0.0011***	0.0010***	0.0001***	-0.0027***	-0.0003***	-0.0022***	0.0065***

Part c: Dominance analysis	**No interactions**	**With interactions**
Firm-level variables	50.44%	18.72%
Macroeconomic indicators	37.51%	16.05%
National institutions	12.05%	5.34%
Interaction of firm and macroeconomic variables		28.02%
Interaction of firm and institutional variables		31.87%

Table 3: The effect of firm, macroeconomic and institutional variables on the speed of adjustment: Blundell-Bond system-GMM estimates

The Table reports the vectors of coefficients $\Gamma_{ij,t}$ and $\Gamma^1_{ij,t}$ for the estimated target debt ratio $\overline{TD}$ as defined in Equations (4) and (5). Columns (1) and (2) report the coefficients for models allowing only for individual variables and for two-way interactions affecting the speed of adjustment, while Columns (3) and (4) report the coefficients for models allowing also for 3-way and 4-way interactions. Columns (1) and (3) report the coefficients corresponding to the vector Γ in Equation (4) letting $D^a = 0$, while Columns (2) and (4) report the coefficients corresponding to the vector Γ^1, obtained by interacting each variable (or combination of variables) with the dummy D^a, which is equal to one when a firm is above its target leverage (i.e. letting $D^a = 1$). All estimates are obtained using the Blundell-Bond system-GMM estimator. Coefficient estimates significantly different from zero at the 1%, 5%, and 10% level are marked with ***, **, and *, respectively. Windmeijer (2005) robust standard errors are in parenthesis.

Coefficient:	(1) $\Gamma(D^a = 0)$	(2) $\Gamma^1(D^a = 1)$	(3) $\Gamma(D^a = 0)$	(4) $\Gamma^1(D^a = 1)$
$\overline{\mathbf{TD}}$	0,527***	-0,039**	0,482***	-0,046***
	(0,105)	(0,019)	(0,011)	(0,017)
$\overline{\mathbf{TD}}$*Surplus	-0,980***	-0,354***	-0,881***	-0,838***
	(0,060)	(0,119)	(0,047)	(0,092)
$\overline{\mathbf{TD}}$*O-score	0,132***	-0,089***	0,157***	-0,104***
	(0,024)	(0,009)	(0,004)	(0,007)
$\overline{\mathbf{TD}}$*GFCIa	0,082***	-0,024***	0,119***	-0,062***
	(0,015)	(0,006)	(0,004)	(0,007)
$\overline{\mathbf{TD}}$*Heritage	-0,005***	0,004***	-0,004***	0,004***
	(0,001)	(0,000)	(0,000)	(0,000)
$\overline{\mathbf{TD}}$*Surplus*O-score	0,007***	0,187***	0,228***	0,154***
	(0,002)	(0,032)	(0,011)	(0,029)
$\overline{\mathbf{TD}}$*Surplus*GFCIa	-0,063***	-0,002	-0,102***	-0,009
	(0,009)	(0,017)	(0,019)	(0,038)
$\overline{\mathbf{TD}}$*Surplus*Heritage	0,010***	0,004**	0,012***	-0,002
	(0,001)	(0,002)	(0,001)	(0,001)
$\overline{\mathbf{TD}}$*O-score*GFCIa	0,005***	-0,009***	0,020***	-0,017*
	(0,001)	(0,002)	(0,002)	(0,009)
$\overline{\mathbf{TD}}$*O-score*Heritage	-0,001***	0,002***	-0,002***	0,002***
	(0,000)	(0,000)	(0,000)	(0,000)
$\overline{\mathbf{TD}}$*GFCIa*Heritage	-0,001***	0,001***	-0,001***	0,001***
	(0,000)	(0,000)	(0,000)	(0,000)
$\overline{\mathbf{TD}}$*Surplus*O-score*GFCIa			-0,002	0,009
			(0,005)	(0,011)
$\overline{\mathbf{TD}}$*Surplus*O-score*Heritage			0,003***	0,000
			(0,000)	(0,000)
$\overline{\mathbf{TD}}$*Surplus*Heritage*GFCIa			0,000	0,000
			(0,000)	(0,001)
$\overline{\mathbf{TD}}$*O-score*GFCIa*Heritage			0,000***	0,000*
			(0,000)	(0,000)
$\overline{\mathbf{TD}}$*Surplus*O-score*GFCIa*Heritage			0,000	0,001***
			(0,000)	(0,000)

Table 4: The effect of firm, macroeconomic and institutional variables on the speed of adjustment: Fama-MacBeth estimates

The Table reports the vectors of coefficients $\Gamma_{ij,t}$ and $\Gamma^1_{ij,t}$ for the estimated target debt ratio $\overline{TD}$ as defined in Equations (4) and (5). Columns (1) and (2) report the coefficients for models allowing only for individual variables and for two-way interactions affecting the speed of adjustment, while Columns (3) and (4) report the coefficients for models allowing also for 3-way and 4-way interactions. Columns (1) and (3) report the coefficients corresponding to the vector Γ in Equation (4) letting $D^a = 0$, while Columns (2) and (4) report the coefficients corresponding to the vector Γ^1, obtained by interacting each variable (or combination of variables) with the dummy D^a, which is equal to one when a firm is above its target leverage (i.e. letting $D^a = 1$). All estimates are obtained by using the Fama-MacBeth procedure. Coefficient estimates significantly different from zero at the 1%, 5%, and 10% level are marked with ***, **, and *, respectively. Standard errors are in parenthesis.

Coefficient:	(1) $\Gamma(D^a = 0)$	(2) $\Gamma^1(D^a = 1)$	(3) $\Gamma(D^a = 0)$	(4) $\Gamma^1(D^a = 1)$
$\overline{\text{TD}}$	0.475***	-0.053***	0.481***	-0.028***
	(0.104)	(0.004)	(0.155)	(0.008)
$\overline{\text{TD}}$*Surplus	-0.745***	-0.586***	-0.715***	-0.481***
	(0.120)	(0.135)	(0.102)	(0.142)
$\overline{\text{TD}}$*O-score	0.076***	-0.052**	0.207***	-0.130***
	(0.019)	(0.023)	(0.061)	(0.016)
$\overline{\text{TD}}$*GFCIa	0.045***	-0.151***	0.128***	-0.334***
	(0.014)	(0.035)	(0.038)	(0.079)
$\overline{\text{TD}}$*Heritage	-0.002***	0.002**	-0.002***	0.003***
	(0.001)	(0.001)	(0.0006)	(0.001)
$\overline{\text{TD}}$*Surplus*O-score	0.021**	0.178***	0.167**	0.179***
	(0.009)	(0.012)	(0.057)	(0.056)
$\overline{\text{TD}}$*Surplus*GFCIa	-0.031***	0.090	-0.082***	2.019
	(0.006)	(0.155)	(0.025)	-1.615
$\overline{\text{TD}}$*Surplus*Heritage	0.007***	0.004***	0.020***	-0.049*
	(0.001)	(0.002)	(0.004)	(0.02)
$\overline{\text{TD}}$*O-score*GFCIa	0.001***	-0.022*	0.014***	-0.028*
	(0.001)	(0.013)	(0.004)	(0.013)
$\overline{\text{TD}}$*O-score*Heritage	-0.001***	0.001***	-0.001***	0.002***
	(0.000)	(0.000)	0	0
$\overline{\text{TD}}$*GFCIa*Heritage	-0.001***	0.002***	-0.001***	0.004***
	(0.001)	(0.001)	(0.003)	(0.001)
$\overline{\text{TD}}$*Surplus*O-score*GFCIa			0.263	1.056
			(0.152)	(0.744)
$\overline{\text{TD}}$*Surplus*O-score*Heritage			0.002***	-0.001
			(0.0006)	(0.009)
$\overline{\text{TD}}$*Surplus*Heritage*GFCIa			-0.006	0.029
			(0.002)	(0.022)
$\overline{\text{TD}}$*O-score*GFCIa*Heritage			0.001***	0.003
			(0.0006)	(0.003)
$\overline{\text{TD}}$*Surplus*O-score*GFCIa*Heritage			-0.003	0.014***
			(0.002)	(0.004)

Table 5: Correlation matrix for speed of adjustment estimates

The Table reports the correlation matrix for the firm-specific estimated speeds of leverage adjustment. *FMB* indicates that the speed of adjustment is estimated using the Fama-MacBeth method, while *sGMM* indicates that it is estimated using the Blundell-Bond system-GMM estimator. We indicate with *2-way* the models allowing only for individual variables and for two-way interactions affecting the speed of adjustment, while *4-way* refers to models allowing also for 3-way and 4-way interactions.

	FMB 2-way	**FMB 4-way**	**sGMM 2-way**	**sGMM 4-way**
FMB 2-way	1,000			
FMB 4-way	0,982	1,000		
sGMM 2-way	0,957	0,941	1,000	
sGMM 4-way	0,960	0,944	0,999	1,000

Table 6: Standardized dominance statistics for the estimated effects of firm, macroeconomic and institutional variables on the speed of adjustment

The Table reports the the standardized dominance statistics (*SDS*) for the corresponding coefficients from Table 4, calculated net of the contribution of the lagged dependent variable. Columns (1) and (2) report the *SDS* for models allowing only for individual variables and for two-way interactions affecting the speed of adjustment, while Columns (3) and (4) report the *SDS* for models allowing also for 3-way and 4-way interactions. All *SDS* are obtained based on a regression model estimated using the Fama-MacBeth procedure.

Coefficient:	(1) $\Gamma(D^a = 0)$	(2) $\Gamma^1(D^a = 1)$	(3) $\Gamma(D^a = 0)$	(4) $\Gamma^1(D^a = 1)$
$\overline{\textbf{TD}}$	0,1715	0,2904	0,1073	0,1539
$\overline{\textbf{TD}}$***Surplus**	0,0024	0,0325	0,0127	0,0481
$\overline{\textbf{TD}}$***O-score**	0,0163	0,16	0,0871	0,2367
$\overline{\textbf{TD}}$***GFCIa**	0,0006	0,0195	0,0033	0,0288
$\overline{\textbf{TD}}$***Heritage**	0,0029	0,0116	0,0154	0,0172
$\overline{\textbf{TD}}$***Surplus*O-score**	0,0108	0,0388	0,0106	0,0281
$\overline{\textbf{TD}}$***Surplus*GFCIa**	0,0006	0,0061	0,0006	0,0044
$\overline{\textbf{TD}}$***Surplus*Heritage**	0,0026	0,0318	0,0025	0,0231
$\overline{\textbf{TD}}$***O-score*GFCIa**	0,0025	0,0226	0,0024	0,0164
$\overline{\textbf{TD}}$***O-score*Heritage**	0,0135	0,1436	0,0132	0,1008
$\overline{\textbf{TD}}$***GFCIa*Heritage**	0,0006	0,0187	0,0006	0,0136
$\overline{\textbf{TD}}$***Surplus*O-score*GFCIa**			0,001	0,0085
$\overline{\textbf{TD}}$***Surplus*O-score*Heritage**			0,0012	0,0031
$\overline{\textbf{TD}}$***Surplus*Heritage*GFCIa**			0,0069	0,042
$\overline{\textbf{TD}}$***O-score*GFCIa*Heritage**			0,0003	0,0051
$\overline{\textbf{TD}}$***Surplus*O-score*GFCIa*Heritage**			0,0008	0,0043

Table 7: Mean differences by speed of adjustment deciles

Mean comparison tests for deciles based on the estimated speed of adjustment of firms below their target leverage (*Part a*) and above it (*Part b*). *S.O.A.* is the estimated speed of adjustment. *Slack* is the ratio of financial slack to total assets. *O-score* is the Ohlson's O-score. *GFCIa* is an index of global financial conditions. *Heritage* is the Heritage index of Economic Freedom.

Panel 1: Blundell-Bond system-GMM estimates

	S.O.A.	**Slack**	**O-score**	**GFCIa**	**Heritage**
Part a: firms below target leverage					
Decile 1	-0.0589	0.3364	-4.5955	1.4158	71.2762
Decile 10	0.4673	-0.0240	3.375	1.8297	67.5039
Difference	-0.5262	0.3605	-7.9703	-0.4139	3.7723
t-stat	-0.023	108.89	-0.022	-15.17	30.49
p-value	0.00	0.00	0.00	0.00	0.00
Part b: firms above target leverage					
Decile 1	-0.1832	0.2388	-2.5782	1.7081	72.3608
Decile 10	0.5456	-0.2013	4.3418	0.8930	67.6992
Difference	-0.7288	0.4401	-6.9200	0.8151	4.6616
t-stat	-0.002	198.28	-240.01	27.28	32.20
p-value	0.00	0.00	0.00	0.00	0.00

Panel 2: Fama-MacBeth estimates

	S.O.A.	**Slack**	**O-score**	**GFCIa**	**Heritage**
Part a: firms below target leverage					
Decile 1	-0.1497	0.4981	-5.5755	1.0842	72.5212
Decile 10	0.3151	-0.0226	0.0676	2.2475	68.8156
Difference	-0.4648	0.5207	-5.6431	-1.1633	3.7055
t-stat	-0,025	208,44	-0,023	-45.53	32.61
p-value	0.00	0.00	0.00	0.00	0.00
Part b: firms above target leverage					
Decile 1	-0.0514	0.2805	-1.0731	0.3204	73.3179
Decile 10	0.4421	-0.2357	2.9482	1.6966	65.5158
Difference	-0.4935	0.5162	-4.0213	-1.3762	7.8021
t-stat	-0.012	174.01	-94.14	-48.52	57.60
p-value	0.00	0.00	0.00	0.00	0.00

Table 8: The estimates of asymmetric speeds of adjustment as a function of deviations from target, financial slack, and credit risk

Target leverage is measured using historical targets and market debt ratios. *Below target* indicates that the firm was below target leverage at the end of the previous period, *Above target* that the debt ratio was instead greater than the optimal leverage at the end of the previous period. *Panel 1* reports Blundell-Bond system-GMM estimates with Windmeijer (2005) robust standard errors. *Panel 2* reports estimates obtained using the Fama-MacBeth method. In *Part b*, *deficit* indicates that the firm capital expenditure in the year is greater than internal funds, *surplus* that the firm internal funds exceed capital expenditure. In *Part c*, *Rating* equal to 0 corresponds to the sub-sample of *investment grade* firms, 1 to the *risky* group and 2 to the *junk* debt group. Coefficient estimates significantly different from zero at the 1%, 5%, and 10% level are marked with ***, **, and *, respectively. Standard errors are reported in parenthesis.

Panel 1: Blundell-Bond system-GMM regressions

	Below target		**Above target**	
Part a				
Full sample	-0.0232		0.2778***	
	(0.002)		(0.018)	
Part b				
Deficit	0.2226***		0.5166***	
	(0.012)		(0.035)	
Surplus	-0.0162***		0.1553***	
	(0.003)		(0.049)	
Part c				
"Rating"	**Deficit**	**Surplus**	**Deficit**	**Surplus**
0	0.1458***	0.0072	0.2986***	0.1725**
	(0.04)	(0.013)	(0.100)	(0.074)
1	0.2177*	0.0437	0.3234***	0.1745*
	(0.113)	(0.044)	(0.042)	(0.093)
2	0.2870***	0.0552***	0.5428***	0.1962***
	(0.007)	(0.005)	(0.022)	(0.051)

Panel 2: Fama-MacBeth regressions

	Below target		**Above target**	
Part a				
Full sample	-0.0086		0.2462***	
	(0.011)		(0.046)	
Part b				
Deficit	0.1937***		0.4694***	
	(0.026)		(0.054)	
Surplus	-0.0049		0.1313***	
	(0.010)		(0.043)	
Part c				
"Rating"	**Deficit**	**Surplus**	**Deficit**	**Surplus**
0	0.1190***	-0.0024	0.2449**	0.1675**
	(0.027)	(0.011)	(0.090)	(0.066)
1	0.1989*	0.0341	0.2949**	0.1679**
	(0.103)	(0.061)	(0.134)	(0.064)
2	0.2560***	0.0394**	0.5017***	0.1840***
	(0.033)	(0.017)	(0.054)	(0.025)

Table 9: Asymmetric adjustment under different market conditions

In *Part a*, we use the GFCIa financial conditions index to divide our sample in three sub-groups based on the bottom, middle and top tercile; in *Part b*, we use the GDP growth rate, with terciles calculated on the global sample. In *Part c* and *Part d*, we use the IFO index, with terciles calculated on the overall sample and country-by-country, respectively. All estimates are obtained using the Fama-MacBeth procedure. Leverage is measured using market debt ratios. Coefficient estimates significantly different from zero at the 1%, 5%, and 10% level are marked with ***, **, and *, respectively. Standard errors are not reported to save on space.

	Below target		Above target			Below target		Above target	
Rating	**Surplus**	**Deficit**	**Surplus**	**Deficit**	**Rating**	**Surplus**	**Deficit**	**Surplus**	**Deficit**
Part a					***Part b***				
Hot market					**Expansion**				
0	0.0131	0.2094	0.1821**	0.4079***	**0**	-0.0207	0.1213*	0.2094	0.3321**
1	0.0041	0.5416***	0.4248*	0.0396	**1**	-0.0804	0.4973**	0.1371	0.1689
2	-0.0026	0.3245***	0.1974***	0.5318***	**2**	0.0097	0.1146	0.2592***	0.4274***
Normal market					**Normal**				
0	-0.0109	0.1581	0.1306	0.2085**	**0**	-0.0008	0.1234**	0.2378***	0.1801*
1	-0.0192	0.1853	0.1479	-0.0849	**1**	0.1601	-0.6738	0.0928	-0.0862
2	0.0438	0.2601***	0.0989*	0.4627***	**2**	0.0401***	0.2967***	0.2298***	0.5624***
Cold market					**Recession**				
0	-0.0109	0.0573	0.2194	0.1345	**0**	-0.0201	-0.0791	0.0576	0.0413
1	0.0574	0.1261	0.1904	0.5242**	**1**	0.0305	4.1009	0.1496*	0.1185
2	-0.0201	0.3375***	0.2087**	0.5601***	**2**	-0.0523	-0.0501	0.0749*	0.4004***
Part c					***Part d***				
Positive					**Positive**				
0	-0.0019	0.1294*	0.3108**	0.3834***	**0**	-0.0209	-0.7541	0.3142**	0.1754
1	0.5001	0.1837	-0.4014	0.3027	**1**	-2.4092	0.5628***	0.1034	-0.0252
2	0.0971***	0.0875	0.2298***	0.5401***	**2**	0.0010	0.2673***	0.2594***	0.4113***
Neutral					**Neutral**				
0	-0.0146	0.0307	0.1864**	0.2686**	**0**	-0.0095	0.1013	0.2308**	0.2943*
1	-0.1474*	0.0517	0.0649	0.6371**	**1**	0.0473	-1.3496*	0.1145	0.0998
2	0.0447**	0.3016***	0.2141***	0.4619***	**2**	0.0491**	0.2083***	0.2047***	0.5038***
Negative					**Negative**				
0	0.0094	0.0417	0.1094	0.0737	**0**	-0.0183	0.0349	0.1097	0.1402
1	0.1967	0.7313	-0.0408	0.7248**	**1**	0.1557*	0.5209	-0.1058	0.5204*
2	-0.0014	0.1726**	0.1274**	0.3061***	**2**	-0.0263	0.2001**	0.2114***	0.4803***

Table 10: Asymmetric speed of adjustment as a function of firm, macroeconomic, and institutional variables

All estimates are obtained using the Fama-MacBeth procedure. Leverage is measured using market debt ratios. Group 1 is defined as the bottom 33% of the distribution of the Heritage Index; therefore, it includes firms based in countries with less market-friendly institutions. Group 2 is the middle 33% and Group 3 is the top 33%, including firms in more pro-market countries. *Hot*, *Normal* and *Cold* markets are defined according to the value of the GFCIa index: hot markets have smaller values of the index, indicating better financial market conditions, while cold markets have bigger values, corresponding to periods of financial tensions. *Rating* measures the credit risk of the company determined with the Ohlson's O-score, with bigger values of rating indicating higher credit risk. Coefficient estimates significantly different from zero at the 1%, 5%, and 10% level are marked with ***, **, and *, respectively. Standard errors are not reported to save on space.

	Below target		**Above target**		**Below target**		**Above target**		**Below target**		**Above target**	
Rating	**Deficit**	**Surplus**	**Deficit**	**Surplus**	**Deficit**	**Surplus**	**Deficit**	**Surplus**	**Deficit**	**Surplus**	**Deficit**	**Surplus**
	Group 1				**Group 2**				**Group 3**			
Hot market												
0	0.237*	0.0125	0.476**	0.212**	0.701**	0.0177	0.421*	0.185*	0.129	0.025	0.501***	0.223*
1	0.315	0.003	0.487*	0.508	0.441	0.408	0.436	0.117	1.176*	0.030	0.398*	0.198
2	0.175*	-0.022	0.519***	0.195**	0.492**	0.058	0.905**	0.218*	0.417**	0.071*	0.843***	0.245*
Normal market												
0	0.105	-0.0104	0.463**	0.194**	0.387*	0.012	0.302*	0.254*	0.238	0.019	0.198*	0.207*
1	0.381	-0.013	0.513*	0.0101	1.018	0.134	0.297	0.202	0.372	0.024	0.514	0.174
2	0.153*	-0.136	0.527**	0.208**	0.342*	0.206	0.517**	0.193*	0.386*	0.0731	0.757***	0.336*
Cold market												
0	0.106	-0.030	0.434**	0.187**	0.007	0.003	0.080	0.271*	-0.103	0.018	-0.010	0.192*
1	0.504	-0.127	0.479	0.031	1.209	0.247	0.310	0.384	0.398	0.041	0.794*	0.167
2	0.928**	0.541*	0.542**	0.216**	0.232**	0.071	0.443**	0.219*	0.072	0.013	0.807***	0.462*