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Macro Uncertainties and Tests of Capital Structure Theories across Renewable and Non-Renewable Resource Companies*

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Executive Summary

Capital structure is one of the most critical decisions for firms in business. This study examines the role of macro (economic and non-economic) uncertainties in affecting firms' capital structure management. Three prominent capital structure theories are tested for global resource firms: (1) static trade-off, (2) pecking order, and (3) market timing theory. The results suggest that no single theory prevails, although both pecking order and market timing theories have certain explanatory power to explain sample firms' financing behaviour. The pecking order theory is strongly supported by the results of the leverage target adjustment model. However, the downward cyclical patterns of pecking order coefficients suggest that the resource firms tend to choose debt financing less and less over time, particularly after 2008. The market timing theory holds strong, as indicated by the significance of macro condition (uncertainties) variables in determining sample firms' capital structure, especially after 2008 and for non-renewable firms. However, the main proxies of the cost of debt are not statistically significant. In conclusion, this study finds that resource firms have a particular pecking order preference when they need financing, and the influence of macro uncertainties are vital in determining their capital structure.

JEL Classification: E32; G32

Keywords

capital structure — trade-off theory — pecking order theory — market timing theory — macro uncertainties

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1. Introduction

It could be argued that capital structure is one of the most critical decisions for firms in business. It determines the cost of capital that firms bear, which influences their profitability and the return that shareholders receive. Since debt is related to firms' solvency, the capital structure also determines their survival during the different business cycle phases. In addition, it is important to note that firms are doing business under the pressure of both global and country-level uncertainties. Therefore, examining how these uncertainties influence firms' financing behaviour is of utmost importance.

Historically, the evolution of capital structure theories starts with Modigliani & Miller (1958)'s study. They argue that firms' financing source is irrelevant because the cost of capital from debt or equity is the same in the perfect capital market condition. Later, Kraus & Litzenberger (1973) argue that tax benefits from debt and costs of financial distress and bankruptcy are relevant. Therefore, firms' financing decisions are a trade-off between these two offsetting factors. Furthermore, Donaldson (1961)'s survey finds that there is a particular pecking order preference where firms prefer internal to external funding sources because of the cost associated with the asymmetric information. This behaviour is then theoretically modelled by Myers (1984) and Myers & Majluf (1984) and is known as the pecking order theory. Then, Baker & Wurgler (2002) argue that firms' financing decisions are driven by their attempts to reap the most benefit from the fluctuating market condition, which is known as the market timing theory. Each theory relies on different assumptions, and their implications on corporate finance are quite different. Therefore, it is very meaningful to examine which theory is more plausible to describe a firm's financing decision. This study examines this issue for resource firms, which is one of the most important sectors in the global economy.

Although its share in terms of GDP might decrease, the resource sector is still prominent for the macroeconomic stability of many countries, primarily through the export channel. Figure 1 shows the share of natural resource exports in many countries' total export in the G20 area. Natural resource export accounts for more than 50% of the overall export of Saudi Arabia, Russia, and Australia. It accounts for more than 20% of the total export of Brazil, Greece, Indonesia, Canada, South Africa, and Cyprus. Even in the United States, the world largest economy, natural resource export accounts for 14% of the total export. Thus, the dominant role of natural resource export for many large economies provides a strong reason for analysing the natural resource sector. Furthermore, the resource sector is unique compared to other sectors. This sector is highly influenced by the business cycle and commodity price cycle.

Many studies empirically examine firms' financing be-

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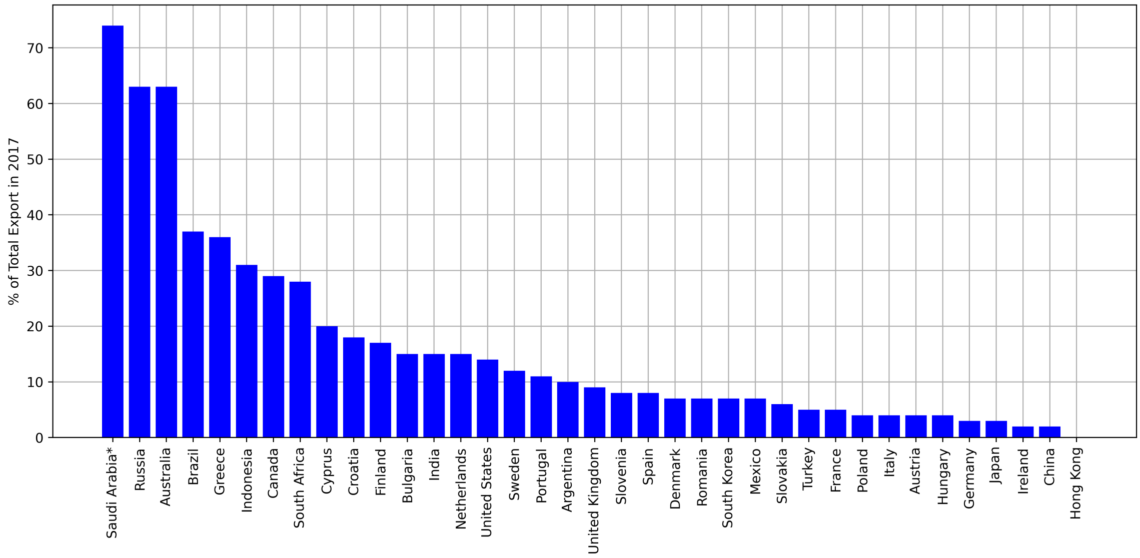

Figure 1. Natural Resource Export as a Percentage of Total Export by Country in 2017
Note: Data from 2016 for Saudi Arabia. The calculation is based on exports of Crude Materials and Fuels (SITC 2 and 3)
Source: UN COMTRADE

haviour. However, most of them are concerned with multiple sectors, and few pay specific attention to the resource sector. Most studies use data from a single country, mainly the US, or are limited to developed countries. Moreover, few studies have tested how macro uncertainties affect firms' financing behaviour. One exception is Begenau & Salomao (2019), who show that large US firms generally substitute debt and equity financing over the business cycle. In contrast, small US firms adhere to a procyclical financing policy for debt and equity. Furthermore, their study does not examine how other macro uncertainties affect firms' financing behaviour.

Against this background, it is instructive to examine natural resource firms' financing behaviour for three reasons. First, financing behaviour is closely related to resource firms' survival and failure, which affect the stability of the commodity supply. Second, financing behaviour determines resource firms' financial performance, thus deciding the availability of capital supply to this sector, which is crucial for its business sustainability. Third, these firms' capital structure decisions affect their production cost, which affects the aggregate supply of commodities globally.

This study conducts empirical tests of three prominent capital structure theories (static trade-off, pecking order, and market timing) to data of 2,699 resource firms during the 1988–2017 period. The firms in the sample are spread across 75 countries in four resource sectors: (1) alternative energy, (2) forestry and paper, (3) mining, and (4) oil and gas producers. The sectors are classified into two, where the first two sectors are renewable and the other two are non-renewable. Four analyses are conducted in this study. First, this study tests the static trade-off theory by adopting the framework used by Shyam-Sunder & Myers (1999). Second, this study employs a leverage target adjustment model to examine sample firms' preference for static trade-off versus pecking order theories. The framework presented by Fama & French (2002) is adopted and extended for this purpose. Third, this study tests and analyses the firms' pecking order preference dynamics and how macro uncertainties influence it by adopting and extending a framework from Huang & Ritter (2009). Finally, this study tests whether the equity market timing theory can explain the behaviour of the sample firms.

The results suggest that no single theory prevails, although both pecking order and market timing theories have certain explanatory power to explain sample firms' financing behaviour. The results of leverage target adjustment model estimations strongly favour the pecking order theory over static trade-off. Analysis of the pecking order coefficients across time shows downward cyclical patterns for the full sample and sub-sample analyses, indicating the pecking order theory holds strongly only during early period of the sample. It is observed that a few years after the global financial crisis (GFC) in 2008, the pecking order coefficients were at their lowest. In addition, some anomalies are also observed around the 2015 commodity crash. Meanwhile, market timing theory holds strongly as indicated by the significance of macro condition (uncertainties) variables in determining sample firms' capital structure, especially for non-renewable firms (mining and oil and gas) after the GFC.

Furthermore, from the extended leverage target adjustment model, country-level governance is found to be significant in explaining firms' financing behaviour. The extended pecking order estimation finds lending risk premium, commodity price uncertainty, world and country business cycles, and country-level governance significant. Meanwhile, from the market timing test, commodity price uncertainty, world and country business cycles, and geopolitical and global economic policy uncertainties are found to be significant. These findings strongly indicate the vital role of macro uncertainties in affecting firms' financing behaviour. The results also highlight that macro uncertainties' influence toward sample firms capital structure are strong after 2008 and for non-renewable resource firms.

The remainder of this paper proceeds as follows. Section 2 provides an overview of the three prominent capital structure theories, methods to test them, and related empirical literature. Section 3 describes the methodological specifications and details of data used in this study. Section 4 presents the estimation results and discusses the relevance of the results to the current literature. Section 5 concludes the paper.

2. Literature Review

It can be argued that the evolution of capital structure theories starts from Modigliani & Miller (1958).They show that under very strict assumptions of a perfect and efficient capital market, such as no taxation of corporate profit and penalty cost from bankruptcy, the choice of financing source is irrelevant. Both options cost the same. The central argument is that the cost of capital for firms is independent of their capital structure and is based only on the equity class's capitalisation rate.

Subsequently, Kraus & Litzenberger (1973) document that both taxation of corporate profit and penalty cost arise from bankruptcy in a real, imperfect world. Therefore, these two factors may affect the capital cost, depending on firms' choice of a financing source. Their argument, which was later known as the 'Static Trade-Off' theory, states that firms balance tax benefit against debt (arising from tax-deductible interest) and potential costs from insolvency. These costs arise from financial distress and bankruptcy, including legal, restructuring, and credit costs (Bessler et al., 2011).This trade-off drives a firm's capital structure decision. On the one hand, the tax-deductibility of interest charge makes firms favour debt over equity, which might drive firms to debt financing. On the other hand, higher leverage is associated with a higher probability of financial distress and bankruptcy, which are very costly (Haugen & Senbet, 1978), inducing equity financing.

In addition to the trade-off argument, Myers (1984) and Myers & Majluf (1984) discuss that asymmetric information between firms and investors outside the firm increases the cost of financing and induces firms to behave following the pecking order financing behaviour. This behaviour has been explored earlier by Donaldson (1961). Pecking order behaviour refers to firms' preference for internal rather than external financing, or in the context of issuing instrument class, debt rather than equity. This theory's central argument lies in the asymmetric information and adverse selection problem (Bessler et al., 2011). Firm managers, as insiders, know more about their firms' financial condition and investment opportunities compared to outside investors. When managers perceive a good investment opportunity for the firm, they use internal funding (cash) to finance the investment. By so doing, current (old) shareholders can reap the most benefit from it. If the firm does not have adequate cash, then debt is the next option. Issuing new equity will be avoided since it will dilute old shareholders' ownership to new shareholders. This situation is particularly true when a firm is undervalued. The only condition in which managers agree to issue new equity is when the firm is overvalued.

Furthermore, Baker & Wurgler (2002) argue that firms tend to issue equity when they have high market capitalisation (overvalued). This theory, known as market timing theory, believes in the market's inefficiency, resulting in temporary fluctuations in equity issuance cost compared to other capital sources. Therefore, it is very likely that firms will have a different preference for a financing source based on market conditions. In addition, Bessler et al. (2011) explain that market timing theory suggests that firms do not adjust their leverage ratio to a specific target because capital structure dynamics in the firm reflects the cumulative outcome of their effort to benefit from the fluctuation of the market condition.

Many empirical studies have examined these theories and various factors that may influence their portability into real-world data. Some studies have focused on testing static trade-off and/or pecking order theories. Shyam-Sunder & Myers (1999) test static trade-off against pecking order theory and find that pecking order theory has a greater time-series explanatory power in explaining the sample's behaviour. Fama & French (2002) investigate trade-off against pecking order theory and their predictions about dividends and debt. They find mixed results regarding the predictions of each theory. Furthermore, the authors conclude that in parts where both theories predict well, they cannot conclude whether it is caused by trade-off or pecking order forces. Lemmon & Zender (2010) examine the impact of controlling debt capacity when testing the pecking order theory. They confirm that pecking order theory can better explain firms' financing behaviour when the debt capacity is controlled. Frank & Goyal (2003) test the pecking order theory and find that equity follows financing deficit closer than debt, which counters the standard pecking order theory.

Other studies focus on the market timing theory. Huang & Ritter (2009) test the pecking order and market timing theories by estimating firms' leverage and the speed of adjustment. They find that US firms tend to fund their financing deficit with equity when the cost of equity is low. Baker & Wurgler (2002) show the important role of market-to-book ratio in explaining the observed firm capital structure, thus supporting their equity market timing theory. Mahajan & Tartaroglu (2008) investigate market timing theory in major industrialised (G-7) countries. They find inconsistent behaviour among the sample with market timing theory and, instead, more leanings toward dynamic trade-off theory. Hovakimian (2006) examines the important role of the market-to-book ratio and finds that its importance is not caused by equity market timing.

Several studies analyse the relationship between capital structure and the business cycle. One of the most prominent is Covas & Den Haan (2012), who show that debt and equity issuance are both procyclical. In addition, Karabarbounis et al. (2014) report the strong procyclicality of debt issuance, while equity issuance is countercyclical. Meanwhile, Baker & Wurgler (2002) find that fluctuations in market valuations have significant effects on the capital structure. Furthermore, Crouzet (2018) confirms that shock toward banks' lending cost encourages companies to take more equity issuance than debt. Begenau & Salomao (2019) document that large public firms in the US generally substitute between debt and equity financing over the business cycle. In contrast, small firms adhere to a procyclical financing policy for debt and equity. Other studies include Bhamra et al. (2010), Hackbarth et al. (2006), Chen (2010), Jõeveer (2013), Cook & Tang (2010), and Korajczyk & Levy (2003).

Some studies explore the important determinants of firms' capital structure. For examle, Frank & Goyal (2009) examine factors that are important for capital structure decisions. They find that the most reliable factors are median industry leverage (+), market-to-book assets ratio (−), tangibility (+), profits (−), log of assets (+), and expected inflation (+). Öztekin & Flannery (2012) investigate how institutional determinants affect capital structure adjustment speed and identify legal and financial traditions as prominent factors. Booth et al. (2001) examine the portability of capital structure theory in 10 developing countries with different institutional structures. They confirm that the determining factors for these countries are the same as those for developed countries. Furthermore, persistent country-specific factors determine the portability of the capital structure theory.

3. Data and Methodology

3.1 Data

The primary purpose of this study is to test the three capital structure theories for the resource firms. Moreover, this study examines whether macro uncertainties, both economic and non-economic, influence resource firms' decision regarding capital structure. This study employs both firm- and macro-level data. Specifically, the data consists of resource firms data of 2,669 companies in 75 countries worldwide during the 1988–2017 period in annual frequency.

All firm-level data are obtained from Refinitiv Datastream. Descriptive statistics for the data are presented in Table 1. The variable $DEBT$ is the ratio of total debt to total assets. $NTAX$ is a negative income tax to total assets ratio and it is zero if the firm's income tax is positive. This variable is a proxy for the tax loss carryforward. RND is the total R&D expenses to total assets ratio. $TANG$ is tangible assets, technically net property, plant, and equipment to total assets ratio. $EARN$ is earnings, calculated as net income to total assets ratio. $CAPX$ is capital expenditures to total assets ratio. Meanwhile, $OINC$ is the ratio of operating income to total assets.

Furthermore, variables σLEV, $\Delta INVT$, and $\Delta EARN$ are adopted from from Fama & French (2002) and employed for leverage target adjustment estimation. Meanwhile, variables $\Delta DEBT$ and DEF are adopted from Huang & Ritter (2009) and employed for pecking order estimation. Further details of these variables are explained in the related methodology subsections.

Macro-uncertainty data are comprised of both global and country-level data and are accessed from various sources. Descriptive statistics for the data are presented in Table 2. The variable $\sigma COMM$ is the annual standard deviation of the daily Goldman Sachs Commodity Index (GSCI), representing commodity price uncertainty. The GSCI is chosen as a proxy of commodity price for its popularity in the market and its forward-looking and future-based characteristics. Thus, the index can also proxy the market expectation of future commodity price. The variables $WGDP$ and $HGDP$ are annual world and home-country real GDP growth rates, representing global and home-country business cycle uncertainties, respectively. The variable GPR is the log of the geopolitical risk (GPR) index, as in Caldara & Iacoviello (2019), representing global geopolitical uncertainty.[1] The variable $GEPU$ is the log of the Global Economic Policy Uncertainty (GEPU) index from Davis (2016).[2] WGI is the country-level Worldwide Governance Index (WGI). The WGI index is an aggregate of six sub-indices: (1) voice and accountability, (2) political stability and the absence of violence/terrorism, (3) government effectiveness, (4) regulatory quality, (5) the rule of law, and (6) control of corruption. The WGI ranges from -2.5 to 2.5, where a higher value refers to lower uncertainty. To simplify the analysis, WGI is multiplied by -1 such that a higher value represents higher uncertainty. The variable $INFL$ denotes the annual country inflation rate. RIR is the country's real interest rate. Finally, LRP is country lending risk premium, calculated as the country lending rate minus the US Treasury Bill three months rate.

In Huang & Ritter (2009), equity risk premium (ERP) is used as a proxy for equity cost. However, their analysis uses only US firms, which makes the estimation of ERP convenient. In contrast, this study uses cross-country data. Therefore, LRP is employed instead of ERP. Conceptually, ERP represents the cost of equity, while LRP represents the cost of debt. Although representing different costs, both variables can serve the same purpose. The interpretation of the results is, therefore, adjusted following this setting.

The dataset employed in this study comprises firms from many countries. This causes several econometric and statistical issues. First, the firm-level variables in the dataset are prone to outliers. Therefore, the dataset is censored at the top and bottom 1% based on each firm-level variable, as listed in Table 1. Second, there is a significant concern of heterogeneity and heteroskedasticity in the dataset. To address this, firm fixed-effect and Huber/White robust standard errors are implemented for every analysis. In addition, to make a rigorous inference, the analyses conducted in this study are classified as the total sample, renewable, non-renewable, and sectorial sub-samples.

Furthermore, Figure 2 presents dynamics of cash, debt and equity of sample firms for the full sample set, as ratios to book assets. The three plots presented in this figure are important to see general financing behaviour of sample firms. Cash is generally higher after 2000, although noticeable contraction can be seen during the 2007–2008 period. In line with that, debt shows a downward pattern with median nearly zero during the 2006–2012 period. During the same period, equity is noticeably high. It is important to note that the commodity price bubble happens during 2000–2015. The patterns shown by these plots somehow give resemblance to the commodity price pattern. In addition, focusing on debt, it can be seen that sample firms have relatively low leverage since median of debt to assets never exceeded 0.3. This pattern reveals the financial characteristics of resource firms in general. Boxplots for sub-samples are presented in appendix (Figures 12–15).

[1] The GPR index is updated regularly by Caldara & Iacoviello (2019) and provided on their website.

[2] The GEPU index is updated regularly by Davis (2016) and provided on their website.

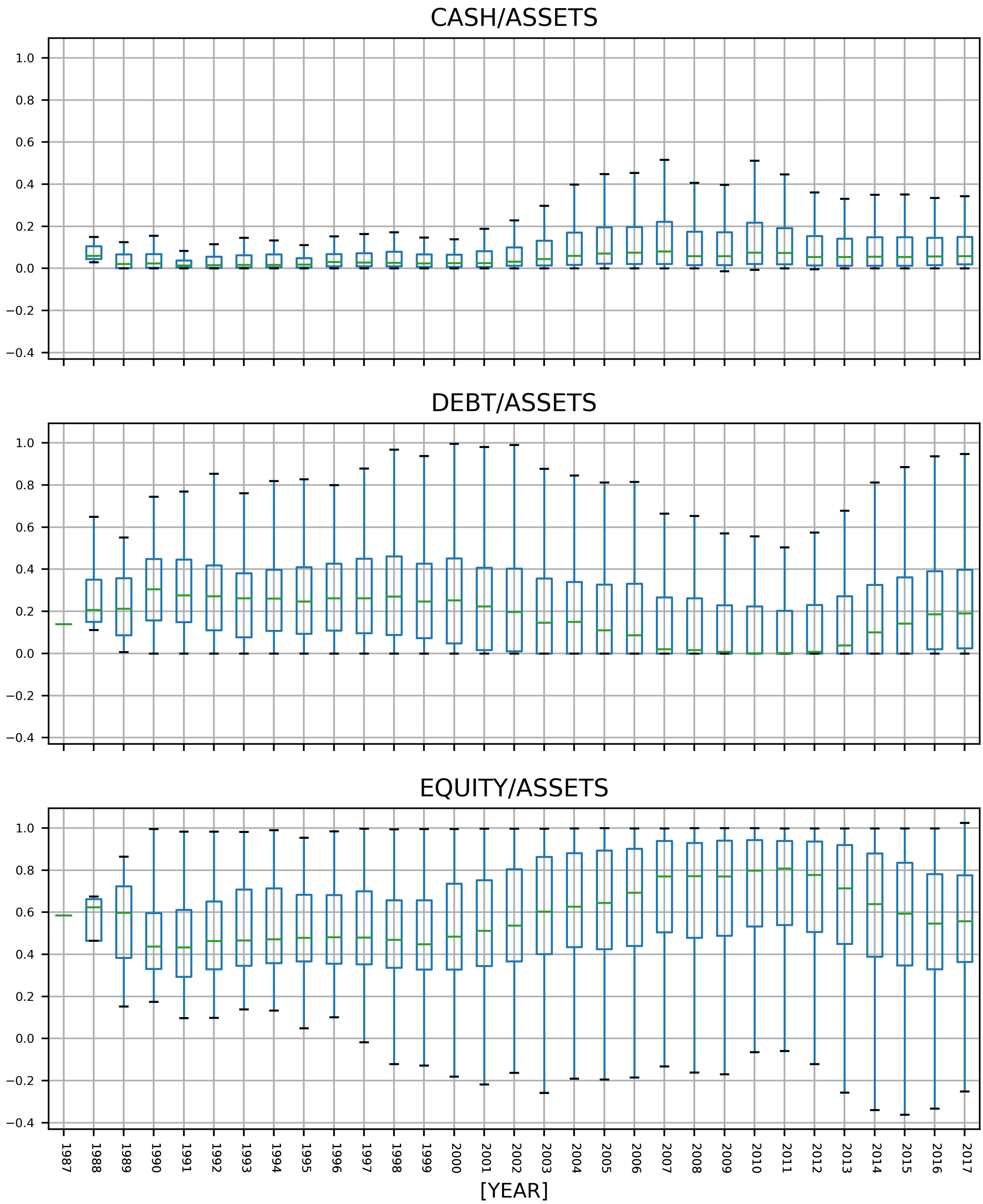

Figure 2. Dynamics of Cash, Debt and Equity of Sample Firms - Full Sample

Table 1. Descriptive Statistics of Firm-level Variables

Variable	Description	Obs	Mean	Std. Dev.	Min	Max	Source
DEBT	Total Debt to Total Assets	22,819	0.22	0.44	0.00	9.63	Refinitiv Datastream
NTAX	Negative Income Tax to Total Assets	22,819	0.00	0.01	0.00	0.13	Refinitiv Datastream
RND	Total R&D to Total Assets	22,819	0.01	0.05	0.00	0.69	Refinitiv Datastream
TANG	Net Property, Plant and Equipment to Total Assets	22,819	0.51	0.30	0.00	0.99	Refinitiv Datastream
EARN	Net Income to Total Assets	22,819	-0.26	0.92	-23.82	0.75	Refinitiv Datastream
CAPX	Capital Expenditures to Total Assets	22,819	0.10	0.12	0.00	0.84	Refinitiv Datastream
SALE	Net Sales to Total Assets	22,819	0.38	0.53	0.00	4.03	Refinitiv Datastream
OINC	Operating Income to Total Assets	22,819	-0.16	0.67	-19.14	0.48	Refinitiv Datastream

Table 2. Descriptive Statistics of Macro Variables

Variable	Description	Obs	Mean	Std. Dev.	Min	Max	Source
$\sigma COMM$	Log of Annual Standard Deviation of GSCI Index	22,819	5.73	0.71	4.10	7.58	Refinitiv Datastream
WGDP	Annual World Real GDP Growth	22,819	2.76	1.43	-1.69	4.62	World Bank
HGDP	Annual Country Real GDP Growth	22,819	2.76	1.43	-1.69	4.62	World Bank
GPR	Log of Geopolitical Risk Index	22,819	4.40	0.37	3.50	5.32	Caldara & Iacoviello (2019)
GEPU	Log of Global Economic Policy Uncertainty Index	22,120	4.75	0.30	4.14	5.24	Davis (2016)
WGI	Inverted Country Worldwide Governance Index	21,969	-1.16	0.75	-1.97	1.61	World Bank
INFL	Annual Country Inflation Rate	22,517	2.75	20.10	-4.48	2947.73	World Bank
LRP	Country Lending Rate minus Treasury Bill Rate	20,715	4.49	3.87	-3.75	66.07	IMF
RIR	Country Real Interest Rate	20,714	3.00	3.44	-26.22	48.34	IMF

3.2 Static Trade-Off Test

The first capital structure theory examined is the static trade-off theory, which considers the trade-off between the tax benefit from debt and potential costs from financial distress and bankruptcy. To test the static trade-off theory, a framework from Shyam-Sunder & Myers (1999) is adopted as follows:

$$DEBT_{i,t} = \beta_0 + \beta_1 NTAX_{i,t-1} + \beta_2 RND_{i,t-1} + \beta_3 TANG_{i,t-1} + \beta_4 EARN_{i,t-1} + \Sigma FRID + e_{i,t} \quad (1)$$

Here, the term i refers to a firm, and t refers to time. The dependent variable is $DEBT$, and there are four independent variables in the framework. The first is $NTAX$, which is a proxy for the tax loss carryforward. The second is RND, representing the total research and development expenditures. Both $NTAX$ and RND are proxies for non-debt tax shields. Third, $TANG$ represents the proportion of fixed assets to total assets. Fourth, $EARN$ represents profitability. Finally, $\Sigma FRID$ is the firm fixed effect, and e is the residual. Equation (1) is estimated using a panel ordinary least squares (OLS) with the Huber/White robust standard errors. All independent variables are lagged by one period to address the endogeneity concern.

3.3 Leverage Target Adjustment Model

The second capital structure theory examined is the pecking order theory, which claims that the cost of financing increases with asymmetric information. To this end, the target adjustment model is employed to test firms' tendency to either trade-off or display pecking order behaviour. In the present study, the leverage target adjustment model, as in Fama & French (2002) and Shyam-Sunder & Myers (1999), is adopted and extended by accommodating macro uncertainties. Specifically, the basic version of the model based on Fama & French (2002) is given by the following equation:

$$\Delta LEV_{i,t} = \beta_0 + \beta_1 \sigma LEV_{i,t} + \beta_2 \Delta INVT1_{i,t-1} + \beta_3 \Delta INVT2_{i,t-1} + \beta_4 \Delta EARN1_{i,t-1} + \beta_5 \Delta EARN2_{i,t-1} + \Sigma FRID + e_{i,t} \quad (2)$$

Here, the variable ΔLEV is calculated as $DEBT_{i,t} - DEBT_{i,t-1}$. Meanwhile, σLEV is the deviation of leverage, technically $AVGDEBT - DEBT_{i,t-1}$, where $AVGDEBT$ is the average of $DEBT$ for every firm. This variable serves as the target leverage. Furthermore, $\Delta INVT$ is investment, calculated as $\Delta INVT1_{i,t} = \frac{(ASSETS_{i,t} - ASSETS_{i,t-1})}{ASSETS_{i,t}}$ and $\Delta INVT2_{i,t} = \frac{(ASSETS_{i,t-1} - ASSETS_{i,t-2})}{ASSETS_{i,t}}$, where $ASSETS$ is total assets. The variable $\Delta EARN1$ is the change in earning, calculated as $\Delta EARN1_{i,t} = \frac{(NINC_{i,t} - NINC_{i,t-1})}{ASSETS_{i,t}}$ and $\Delta EARN2_{i,t} = \frac{(NINC_{i,t-1} - NINC_{i,t-2})}{ASSETS_{i,t}}$, where $NINC$ is the net income. The variables σLEV, $\Delta INVT$, and $\Delta EARN$ are adopted from Fama & French (2002). The target leverage $AVGDEBT$ follows Shyam-Sunder & Myers (1999). Finally, $\Sigma FRID$ is the firm fixed-effect, and e is the residual. As outlined by Fama & French (2002), if the static trade-off theory holds, then σLEV will statistically not be different from zero, whereas if σLEV is significantly positive, then the pecking order theory holds. The estimations are conducted using panel OLS with firm fixed-effect. Further, the framework is extended by accommodating macro uncertainties, as in Equation (3). For Equations (2) and (3), $\Delta INVT$ and $\Delta EARN$ are lagged by one period to address the endogeneity concern. For σLEV and its interaction terms, endogeneity is not a concern because $AVGDEBT$ is constant over time for each firm.

$$\begin{aligned}\Delta LEV_{i,t} = \beta_0 + \Big(\beta_1 &+ \beta_2 \sigma COMM_{i,t-1} + \beta_3 WGDP_{i,t-1} \\ &+ \beta_4 HGDP_{i,t-1} + \beta_5 GPR_{i,t-1} \\ &+ \beta_6 GEPU_{i,t-1} + \beta_7 WGI_{i,t-1} \\ &+ \beta_8 INFL_{i,t-1}\Big) \times \sigma LEV_{i,t} + \beta_9 \Delta INVT1_{i,t-1} \\ &+ \beta_{10} \Delta INVT2_{i,t-1} + \beta_{11} \Delta EARN1_{i,t-1} \\ &+ \beta_{12} \Delta EARN2_{i,t-1} + \Sigma FRID + e_{i,t}\end{aligned} \quad (3)$$

3.4 Pecking Order Test

To test the pecking order theory's ability to explain the firms' financing behaviour in the sample in more detail, the framework from Huang & Ritter (2009) is adopted and extended. Specifically, the basic framework to measure the pecking order coefficient is given by the following equation:

$$\Delta DEBT_{i,t} = \beta_0 + \theta_1 DEF_{i,t} + e_{i,t} \tag{4}$$

The term θ is the pecking order coefficient. The calculation of $\Delta DEBT$ and DEF follows Huang & Ritter (2009);[3] Specifically, the variable $\Delta DEBT$ is change in $DEBT$, calculated as follows:

$$\Delta DEBT_{i,t} = \frac{(DEBT_{i,t} - DEBT_{i,t-1}) + (PFSTK_{i,t} - PFSTK_{i,t-1})}{ASSETS_{i,t-1}}, \tag{5}$$

where the variable $PFSTK$ is the preferred stock. In addition, the variable DEF is the financial deficit, calculated as follows:

$$DEF_{i,t} = \Delta DEBT_{i,t} + \frac{(EQTY_{i,t} - EQTY_{i,t-1}) + (CDEBT_{i,t} - CDEBT_{i,t-1}) - (REARN_{i,t} - REARN_{i,t-1})}{ASSETS_{i,t-1}} \tag{6}$$

Here, the variable $EQTY$ is total shareholders' equity, $CDEBT$ is convertible debt, and $REARN$ is retained earnings. The estimation of Equation (4) is conducted cross-sectionally per year for the entire period covered by the dataset to determine the dynamics of the coefficient of the pecking order theory.

Furthermore, the framework (4) is extended by accommodating the macro uncertainties in the analysis, as follows:

$$\begin{aligned}\Delta DEBT_{i,t} = \beta_0 + \theta_1 NDEF_{i,t} + \Big(&\theta_2 + \theta_3 LRP_{i,t-1} \\ &+ \theta_4 RIR_{i,t-1} + \theta_5 \sigma COMM_{i,t-1} \\ &+ \theta_6 WGDP_{i,t-1} + \theta_7 HGDP_{i,t-1} \\ &+ \theta_8 GPR_{i,t-1} + \theta_9 GEPU_{i,t-1} + \theta_{10} WGI_{i,t-1} \\ &+ \theta_{11} INFL_{i,t-1}\Big) \times PDEF_{i,t} + \Sigma FRID + e_{i,t}\end{aligned} \tag{7}$$

As in Huang & Ritter (2009), the variable DEF is separated into $NDEF$ and $PDEF$, which refer to the negative and positive financial deficits, respectively. The value of $NDEF$ is equal to that of DEF if $DEF < 0$, and zero otherwise. In contrast, $PDEF$ is equal to DEF if $DEF > 0$, and zero otherwise. To determine whether macro uncertainties can explain firms' pecking order behaviour in the sample, all macro variables are interacted with $PDEF$. Finally, $\Sigma FRID$ is the firm fixed-effect, and e is the residual. The estimations are conducted using panel OLS with firm fixed effect.

3.5 Market Timing Test

The last exercise in this study tests the market timing theory. More specifically, the last analysis aims to see whether the market timing theory is more (or less) prominent than the pecking order theory to explain the firms' financing preference. For this purpose, a framework from Huang & Ritter (2009) is adopted and extended as follows:

$$\begin{aligned}DEBT_{i,t} = \beta_0 &+ \beta_1 Q_{i,t-1} + \beta_2 RND_{i,t-1} + \beta_3 CAPX_{i,t-1} \\ &+ \beta_4 SALE_{i,t-1} + \beta_5 OINC_{i,t-1} + \beta_6 TANG_{i,t-1} \\ &+ \beta_7 LRP_{i,t-1} + \beta_8 RIR_{i,t-1} + \beta_9 \sigma COMM_{i,t-1} \\ &+ \beta_{10} WGDP_{i,t-1} + \beta_{11} HGDP_{i,t-1} \\ &+ \beta_{12} GPR_{i,t-1} + \beta_{13} GEPU_{i,t-1} \\ &+ \beta_{14} WGI_{i,t-1} + \beta_{15} INFL_{i,t-1} + \beta_{16} PDEF_{i,t} \\ &* LRP_{i,t-1} + \beta_{17} PDEF_{i,t} + \Sigma FRID + e_{i,t}\end{aligned} \tag{8}$$

The dependent variable, $DEBT$, is total debt to total assets ratio, which refers to firm capital structure. The market timing theory argues that firms will try to optimize their financing by following market condition when they take the financing. The firm capital structure is therefore an accumulated result of firm financing decisions from previous periods. The focus of (8) is on two proxies of cost of debt: lending risk premium (LRP) and real interest rate (RIR). They are expected to be significant and negative if the strict definition of market timing theory applies, implying that higher cost of debt will lower debt issuance by firm. Furthermore, this means firms will prefer equity issuance as source of financing.

Firm-level variables (Q, RND, $CAPX$, $SALE$, $OINC$, and $TANG$) serve both as control variables and proxies of internal factors, which are generally influential as firm capital structure determinants. Macro uncertainties variables, both economic ($\sigma COMM$, $WGDP$, $HGDP$, $INFL$) and non-economic (GPR, $GEPU$, WGI), are important proxies of uncertainty and market condition in general. If the interpretation of market timing theory is relaxed, it could be argued that these variables are also a form of costs. Therefore, the significance of these variables can be interpreted as the validity of market timing theory.

Furthermore, $PDEF$ and its interaction with LRP explain how significant firms use debt to finance their financial deficit. Lastly, $\Sigma FRID$ is the firm fixed-effect, and e is the residual. The estimations are conducted using panel OLS with firm fixed-effect.

[3] Definition of DEF follows Table 3 in Huang & Ritter (2009).

4. Results

4.1 Static Trade-Off Test

The first analysis focuses on the test of the static trade-off theory. This test is adopted from Shyam-Sunder & Myers (1999), which is then applied to the dataset consisting of annual resource firms data of 2,669 companies in 75 countries worldwide during 1988–2017. Specifically, the test follows Equation (1).

Table 3 presents the results of the static trade-off tests. The variable $NTAX$ is significantly negative only for the forestry and paper panel. Meanwhile, the variables RND and $TANG$ are not significant for all panels. The variable $EARN$ is significantly negative for almost all panels. The negative sign suggests that firms with higher profitability have lower leverage.

It could be inferred that the static trade-off theory does not hold for the sample because of two reasons. First, among the four independent variables, only $EARN$ is significant. Two proxies of non-debt tax shields, $NTAX$ and RND, are not significant. Second, the R^2 for all the panels are very low. Thus, it could be inferred that, generally, the model does not fit well to explain the sample resource firms' financing behaviour.

4.2 Leverage Target Adjustment Model

The standard target adjustment model assumes that firms have a specific leverage target and adjust gradually to achieve the target. One advantage of this model is its ability to test both static trade-off and the sample's pecking order tendency. Specifically, the leverage target adjustment model (2) adopted in this study refers to Fama & French (2002) and Shyam-Sunder & Myers (1999). As outlined by Fama and French (2002), if the static trade-off theory holds, then σLEV will statistically not be different from zero. Meanwhile, if σLEV is significant and reliably positive, the pecking order theory holds.

Table 4 presents the estimation results of the basic target adjustment model (2). Following Shyam-Sunder & Myers (1999), the target leverage in this framework is the average of debt ($AVGDEBT$) for each firm across time. The results show that σLEV is significant for all panels and reliably positive. These results strongly indicate the tendency of firms in the sample toward the pecking order theory, thus neglecting the static trade-off theory's ability to explain the sample financing behaviour. Furthermore, R^2 for all panels is relatively high compared to results from static trade-off tests, showing the model's ability to explain the variation in leverage of firms in the sample. Other independent variables in this framework are controls as in Fama & French (2002). The results show that only $\Delta INVT1$ is significant.

Table 5 presents estimation results of the extended leverage target adjustment model, as in Equation (3). In this model, σLEV is made to interact with macro uncertainties variables to determine whether any of these variables influence firms' financing behaviour. As can be seen, σLEV as a stand-alone variable is significantly positive for the full sample, non-renewable, alternative energy, and mining panels. This indicates the strong tendency of alternative energy and mining firms toward pecking order behaviour, which somewhat diverges from the findings of Fama & French (2002) and aligns with those of Lemmon & Zender (2010). Regarding the interaction of macro variables, most are not significant. The interaction of $GEPU$ is significant and positive only for the oil and gas panel, indicating that higher global economic policy uncertainty drives oil and gas firms toward pecking order financing behaviour. The country-level governance, WGI, is significantly positive for the full sample, non-renewable, alternative energy, and mining panels. This strongly suggests that poor country governance drives alternative energy and mining firms to follow pecking order behaviour.

Based on these two estimations, several insights can be inferred. First, the strongly significant and positive results of σLEV are a clear indication of the leanings of the resource firms in the sample toward pecking order behaviour. Second, macro uncertainties at the country level, represented by WGI, drive firms toward this pecking order financing behaviour. In contrast, global macro variables are generally not significant in this context. In the next subsection, the pecking order behaviour of firms in the sample is explored further.

4.3 Pecking Order Test

Adopting the frameworks of Huang & Ritter (2009), this study further examines the pecking order behaviour of firms in the sample. The tests are conducted in two steps. First, annual pecking order coefficients of firms in the sample are estimated, which shows the inter-temporal behaviour of firms in every sector toward the pecking order theory. Second, the framework is extended to determine how macro uncertainties contribute to firms' tendency toward the pecking order theory.

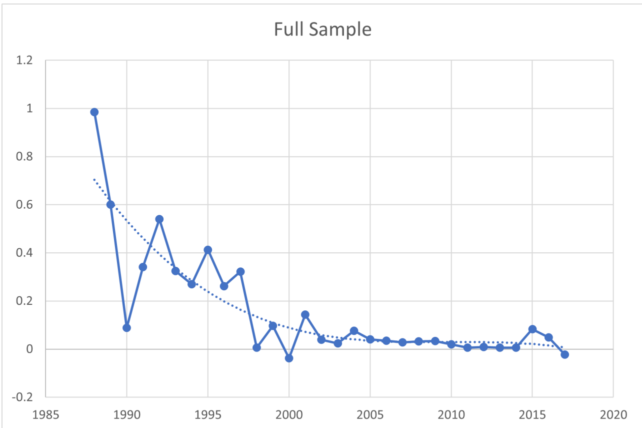

Figure 3. Annual Pecking Order Coefficient - Full Sample

Figures 3–9 plot the estimation results of the pecking order coefficient in Equation (4) for every sample year. The dashed dot line in each figure is a third-degree polynomial moving average, which helps to analyse the general patterns in every figure. Figure 3 shows the results for full sample estimation. The earliest data are from 1988, where the pecking order coefficient (θ) is near 1. One clear inference can be made here. The pattern clearly shows a downward one. By decade, it ranges from 0 to 0.54 in the 1990s, from -0.03 to 0.14 in the 2000s, and from -0.02 to 0.08 in the 2010s. After 2000, the θ is practically near zero, meaning that firms' financing deficit since this period are no longer financed by debt, indicating their tendency toward equity financing. It is

Table 3. Static Trade-Off Test

Dep. Variable = $DEBT_{i,t}$

Variable	Full Sample	Renewable	Non-Renewable	Alternative Energy	Forestry and Paper	Mining	Oil and Gas
$NTAX_{i,t-1}$	-0.0847	-0.3975	-0.0746	-0.1062	-1.1729**	-0.0529	-0.1625
$RND_{i,t-1}$	0.0919	-0.1541	0.0792	-0.1071	-3.9824	0.0776	0.12
$TANG_{i,t-1}$	0.0166	-0.1182	0.023	-0.3357	0.0044	0.0274	0.0183
$EARN_{i,t-1}$	-0.0260*	-0.2318***	-0.0224*	-0.2267***	-0.3054	-0.0192	-0.0511**
$CONS$	0.2069***	0.3925***	0.1697***	0.4113***	0.3595***	0.1476***	0.2154***
OBS	22,757	4,590	18,167	1,369	3,221	12,703	5,464
R^2	0.0169	0.1241	0.0146	0.207	0.0261	0.0151	0.0208

Note: The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10%.

Table 4. Leverage Target Adjustment Model

Dep. Variable = $\Delta LEV_{i,t}$

Variable	Full Sample	Renewable	Non-Renewable	Alternative Energy	Forestry and Paper	Mining	Oil and Gas
$\sigma LEV_{i,t}$	0.6389***	0.5975***	0.6385***	0.5557***	0.6675***	0.7080***	0.4664***
$\Delta INVT1_{i,t-1}$	-0.0166***	-0.1263***	-0.0159***	-0.1577**	-0.0537	-0.0109**	-0.0278**
$\Delta INVT2_{i,t-1}$	0.0032	0.0039	0.0034	-0.0198	0.0368*	-0.0048	0.0062*
$\Delta EARN1_{i,t-1}$	0.003	0.0056	0.0036	-0.0461	0.0529	0.0018	-0.0009
$\Delta EARN2_{i,t-1}$	-0.0041	0.0242	-0.0043	0.0340**	0.0453	-0.0045	-0.0038*
$CONS$	-0.1013***	-0.0280***	-0.1188***	-0.0307***	-0.0310***	-0.1484***	-0.0601***
OBS	20,911	4,369	16,542	1,285	3,084	11,466	5,076
R^2	0.2878	0.3076	0.2885	0.3734	0.2658	0.337	0.179

Note: The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10%.

Table 5. Extended Leverage Target Adjustment Model

Dep. Variable = $\Delta LEV_{i,t}$

Variable	Full Sample	Renewable	Non-Renewable	Alternative Energy	Forestry and Paper	Mining	Oil and Gas
$\sigma LEV_{i,t}$	0.7552***	0.3098	0.7614***	2.6223*	-0.0432	0.9253***	-0.2479
$\sigma LEV_{i,t} * \sigma COMM_{i,t-1}$	-0.0045	0.0143	-0.0031	-0.1129	0.0306	0.0014	-0.027
$\sigma LEV_{i,t} * WGDP_{i,t-1}$	-0.0078	0.0183	-0.0079	0.0578	-0.0079	-0.0097	0.0018
$\sigma LEV_{i,t} * HGDP_{i,t-1}$	0.0034	-0.0083	0.0044	-0.0434	0.0021	0.004	0.0057
$\sigma LEV_{i,t} * GPR_{i,t-1}$	-0.014	0.0055	-0.0134	-0.0581	0.0337	-0.0226	0.0757
$\sigma LEV_{i,t} * GEPU_{i,t-1}$	0.0198	0.0284	0.0238	-0.215	0.0523	0.0042	0.1354*
$\sigma LEV_{i,t} * WGI_{i,t-1}$	0.0794*	0.0286	0.0996**	0.2547*	-0.1144	0.0882**	0.084
$\sigma LEV_{i,t} * INFL_{i,t-1}$	0.0007	0.0172	-0.0021	0.0316	0.0231**	-0.0045	0.0079
$\Delta INVT1_{i,t-1}$	-0.0162***	-0.1332***	-0.0155***	-0.1603***	-0.0514	-0.0107**	-0.0277**
$\Delta INVT2_{i,t-1}$	0.0028	0.0033	0.003	-0.0148	0.0312	-0.005	0.0067*
$\Delta EARN1_{i,t-1}$	0.0029	0.0048	0.0035	-0.0419	0.0542	0.0017	0.0002
$\Delta EARN2_{i,t-1}$	-0.004	0.0235	-0.0043	0.0333**	0.0458	-0.0043	-0.0041*
$CONS$	-0.1072***	-0.0303***	-0.1239***	-0.0244*	-0.0378***	-0.1503***	-0.0681***
OBS	19,820	3,906	15,914	1,198	2,708	11,200	4,714
R^2	0.2945	0.3165	0.2963	0.3904	0.2913	0.3441	0.1922

Note: The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10%.

important to note that the period after 2000 coincides with both economic and commodity booms. The economic boom continued until the GFC in 2008. Meanwhile, the commodity boom continued until the 2015 commodity crash. In 2015 and since, there have been signs of increased θ, although still below 0.1. This downward pattern is also observed by Huang & Ritter (2009), who test the model for the US firms' sample during the 1963–2001 period.

As the dataset is dominated by mining firms, it is very useful to observe the sub-sample estimation patterns. For the renewable estimation (Figure 4), θ has a downward cyclical pattern based on the polynomial line, with the lowest point observed around 2009/10, and then it starts to increase years later. It is believed that the lowest point of the cycle is caused by the GFC. For the non-renewable estimation (Figure 5), the downward cyclical pattern can be seen clearly, with the lowest point of the cycle around 2010. However, there is a noticeable increase in θ in 2015 and then 2016, before falling again in 2017. The increase in 2015/16 is believed to have been caused by the 2015 commodity market crash.

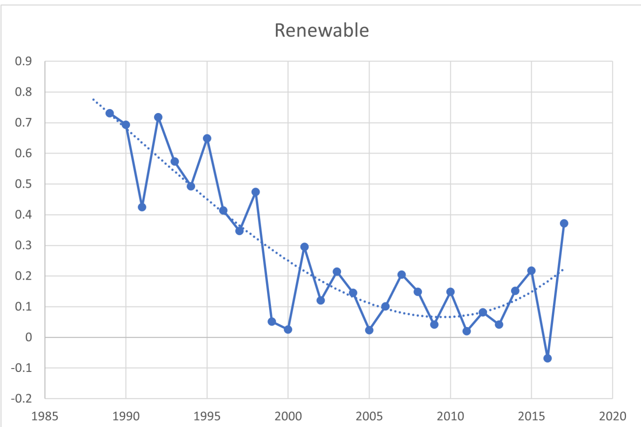

Figure 4. Annual Pecking Order Coefficient - Renewable

The downward pattern of the pecking order coefficients could be explained by three causes. First, asymmetric in-

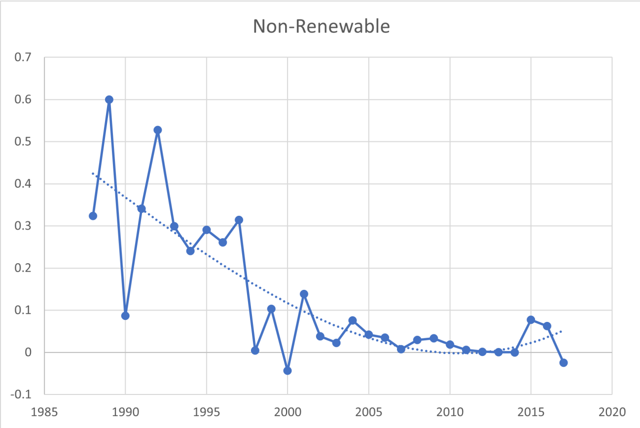

Figure 5. Annual Pecking Order Coefficient - Non-Renewable

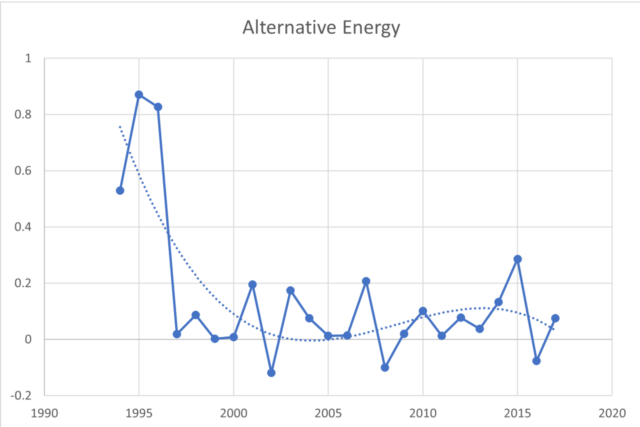

Figure 6. Annual Pecking Order Coefficient - Alternative Energy

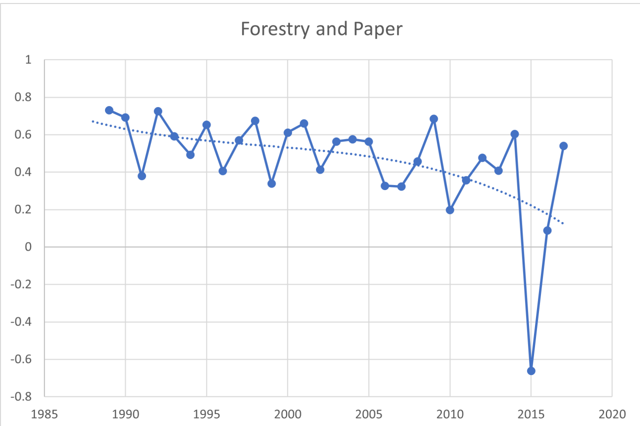

Figure 7. Annual Pecking Order Coefficient - Forestry and Paper

formation, which is the central argument of the pecking order theory, becomes less prominent in the recent period along with the advancement of information technology. Second, along with the previous factor, modernization of the financial market reduces the cost of equity issuance. Third, as can be observed in Figure 2, after 2000, sample firms have relatively low debt and thus high equity. This period also coincides with the commodity boom period. Aligned with this argument is Frank & Goyal (2009), who argue that during the expansion period firms are cash rich and thus pecking order theory predicts firms will be less debt-reliant.

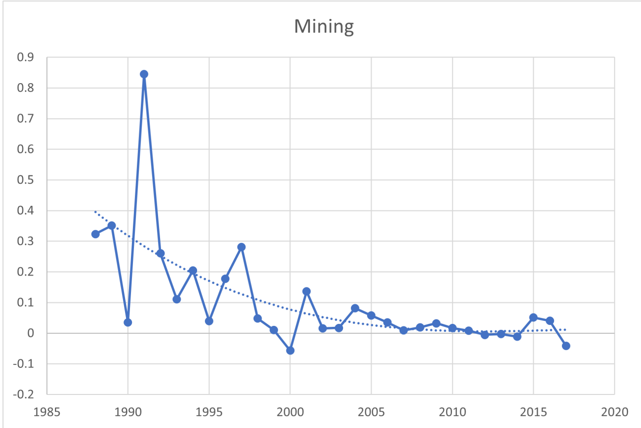

Figure 8. Annual Pecking Order Coefficient - Mining

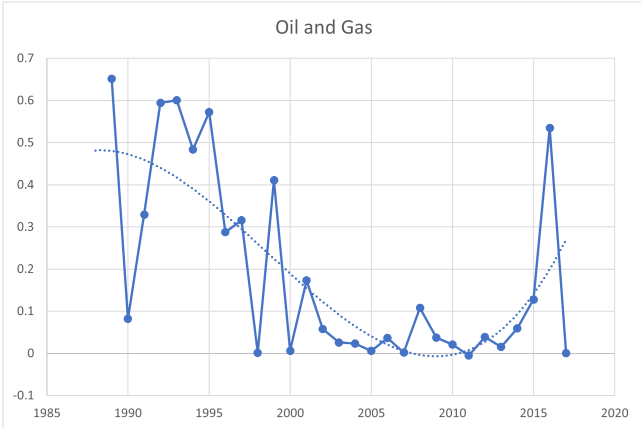

Figure 9. Annual Pecking Order Coefficient - Oil and Gas

These three factors are believed to explain the low (near zero) pecking order coefficients since the early 2000s until 2015/16.

Following the patterns of the pecking order coefficients, extended pecking order analysis (7) and market timing test (8) are conducted using two divided periods. These are: (1) before 2008, which includes the years 1998–2007, and (2) after 2008, which includes the years 2008–2017. The starting point of the analyses for (7) and (8) is 1998 because some macro uncertainties variables ($GEPU$, GPR, and WGI) are available from 1996/7 and one lag period is implemented for independent variables. Furthermore, 2008 is a crucial year owing to the significant effect of the 2008 GFC on the world economy. Thus, using 2008 as a cut-off is believed to be fruitful.

Developing from Huang & Ritter (2009)'s strategy, this study extends the pecking order test to accommodate the macro uncertainties in Equation (7). The results are presented in Tables 6 and 7. In this framework, DEF is separated into $NDEF$ and $PDEF$, with a special focus on $PDEF$. $PDEF$ then interacts with the macro variables. $NDEF$ is significant for almost all panels, both before and after 2008. Meanwhile, $PDEF$ is significant and positive only for the alternative energy panel before 2008.

The lending risk premium interaction, LRP, is significantly negative for the renewable panel before 2008, and the full sample, non-renewable, and mining panels after 2008. The results suggest a higher lending premium will lower the tendency of the sample resource firms to increase debt.

Table 6. Extended Pecking Order Test - Before 2008

Dep. Variable = $\Delta DEBT_{i,t}$

Variable	Full Sample	Renewable	Non-Renewable	Alternative Energy	Forestry and Paper	Mining	Oil and Gas
$NDEF_{I,t}$	0.4134***	0.3400***	0.4268**	0.2576**	0.3316**	0.5270*	0.2680**
$PDEF_{I,t}$	-0.5792	1.5631	-0.4441	2.5836*	-2.684	-1.1678	-0.3205
$PDEF_{i,t}*LRP_{i,t-1}$	0.011	-0.0431**	0.0144	-0.007	-0.0074	0.0141	-0.0109
$PDEF_{i,t}*RIR_{i,t-1}$	0.0062	0.017	0.0048	0.0277	0.0027	0.0014	0.0275
$PDEF_{i,t}*\sigma COMM_{i,t-1}$	0.0466	-0.1242*	0.0434	-0.2100**	0.008	0.1125*	0.0424
$PDEF_{i,t}*WGDP_{i,t-1}$	0.0109	0.1194**	0.0074	0.1287**	0.1274	-0.004	0.0013
$PDEF_{i,t}*HGDP_{i,t-1}$	0.0017	-0.0046	-0.0044	-0.039	-0.008	0.0184	0.0049
$PDEF_{i,t}*GPR_{i,t-1}$	0.0311	0.1011	0.0232	0.1566*	-0.1715*	0.0840**	0.0748
$PDEF_{i,t}*GEPU_{i,t-1}$	0.0351	-0.2572	0.0237	-0.493	0.8388*	0.0262	-0.0993
$PDEF_{i,t}*WGI_{i,t-1}$	0.0308	0.3834***	0.0222	0.293	0.1622	0.0221	-0.0696
$PDEF_{i,t}*INFL_{i,t-1}$	-0.0042	0.0422*	-0.011	0.0664**	-0.0194	-0.0095	0.0015
$CONS$	0.0236**	0.0029	0.0206*	-0.0172	-0.006	0.0084	0.0437***
OBS	5,058	1,030	4,028	203	827	2,712	1,316
R^2	0.123	0.4093	0.1224	0.4317	0.6216	0.1852	0.0526

Note: The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10%.

Table 7. Extended Pecking Order Test - After 2008

Dep. Variable = $\Delta DEBT_{i,t}$

Variable	Full Sample	Renewable	Non-Renewable	Alternative Energy	Forestry and Paper	Mining	Oil and Gas
$NDEF_{I,t}$	0.3811***	0.2746	0.3850***	0.7150***	-0.0917	0.3508***	0.4428***
$PDEF_{I,t}$	-0.0072	0.7578	-0.0382	0.7632	1.3646	0.0885	-0.2423
$PDEF_{i,t}*LRP_{i,t-1}$	-0.0110***	-0.0371	-0.0089**	0.0094	0.0257	-0.0123***	0.0006
$PDEF_{i,t}*RIR_{i,t-1}$	0.0046*	0.0388	0.0039	-0.0321	-0.0505	0.0049*	-0.0027
$PDEF_{i,t}*\sigma COMM_{i,t-1}$	0.0184**	-0.1022	0.0201**	-0.0515	-0.0367	0.0217**	-0.0028
$PDEF_{i,t}*WGDP_{i,t-1}$	-0.0112**	-0.0563***	-0.0092**	-0.0111	0.0661	-0.0145***	0.0024
$PDEF_{i,t}*HGDP_{i,t-1}$	0.0161***	0.0430**	0.0144**	0.0202	0.0049	0.0210***	-0.0105
$PDEF_{i,t}*GPR_{i,t-1}$	0.0046	0.0245	0.0077	0.0464	-0.3075	-0.0335	0.1774**
$PDEF_{i,t}*GEPU_{i,t-1}$	-0.0056	-0.0288	-0.0061	-0.108	0.1359	0.0052	-0.1104*
$PDEF_{i,t}*WGI_{i,t-1}$	0.0368*	0.084	0.0323*	0.1735**	0.0095	0.0346	-0.0109
$PDEF_{i,t}*INFL_{i,t-1}$	0.0009	0.0602**	-0.0018	0.0428	-0.0355	-0.0036	0.0248*
$CONS$	0.0355***	0.0259*	0.0336***	0.0888***	-0.0197	0.0330***	0.0351***
OBS	14,958	2,321	12,637	785	1,536	9,330	3,307
R^2	0.0684	0.2184	0.0627	0.2329	0.4288	0.076	0.1434

Note: The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10%.

The interaction of RIR is significant and positive only after 2008 for the full sample and mining panels, indicating that a higher real interest rate increases firms' tendency toward the pecking order behaviour. The results are generally consistent with those of Huang & Ritter (2009) for the 1981–2001 period.

The interaction of $\sigma COMM$ is significant before 2008 for the renewable (−), alternative energy (−), and mining (+) panels, and after 2008 for the full sample (+), non-renewable (+), and mining (+) panels. The interaction of $WGDP$ is significant before 2008 for the renewable (+) and alternative energy (+) panels, and after 2008 for the full sample (−), renewable (−), non-renewable (−), and mining (−) panels. The results indicate changes in the influence of the business cycle toward the firms' pecking order preference, from positive before 2008 to negative after 2008. The impact of the GFC has become clearer with these results. The interaction of $HGDP$ is significantly positive only after 2008 for the full sample, renewable, non-renewable, and mining panels. The results support the pattern from $WGDP$, which indicates that the GFC has changed the impact of the business cycle on financing behaviour.

The interaction of GPR is significant before 2008 for the alternative energy (+), forestry and paper (−), and mining (+) panels, and after 2008 for the oil and gas (+) panel. These indicate that the influence of GPR is mixed across sectors and periods. The interaction of $GEPU$ is significant before 2008 for the forestry and paper (+) panel, and after 2008, only for the oil and gas (−) panel. These indicate that the influence of $GEPU$ is also mixed across sectors and periods with more insignificant results. In general, these results suggest that GPR and $GEPU$ are not important factors to explain the resource firms' financing behaviour.

The interaction of WGI is significant before 2008 only for the renewable (+) panel, and after 2008 for the full sample (+), non-renewable (+), and alternative energy (+) panels. The results indicate a positive influence of country-level governance uncertainty on firms' financing preference toward the pecking order, particularly after the GFC. In addition, these also indicate the tendency of sample firms to use debt to finance their deficit when country-level governance is poor. Finally, $INFL$ is significantly positive for several panels before and after 2008.

The estimations in this section provide some valuable insights. First, annual cross-section estimations provide a clear picture of a downward cyclical pattern of pecking order coefficients. It is observed that the lowest point of the coefficient was around 2010, a few years after the GFC. This pattern is also consistent with dynamics of debt and equity of sample firms, which show debt is relatively low after 2000. Second, macro situations play an important role in explaining the resource firms' capital structure preference, with LRP, $\sigma COMM$, $WGDP$, $HGDP$, and WGI found to be significant, especially after 2008. These behavioural patterns are crucial for policy formulation in the management of aggregate/sectoral leverage, especially for central banks. From the macroeconomic perspective, the aggregate capital structure profile of a sector describes the business cycle phase of the sector, among considerable other information it can provide.

Some inferences can be made regarding the portability of pecking order theory based on the second and third analyses. First, results from the basic and extended leverage adjustment models in the previous subsection strongly show sample firms' tendency to follow the pecking order theory, in contrast to the static trade-off. Based on this finding, it could be argued that the pecking order theory tends to hold. Second, the downward cyclical pattern of pecking order coefficients reported in this subsection can be interpreted as the pecking order theory becoming relatively weak after 2000, indicating that firms' preference to use debt is low during this period. This argument is based on Shyam-Sunder & Myers (1999), who argue that the ideal version of the pecking order theory suggests that the pecking order coefficient is exactly one, or firms entirely rely on debt to finance the deficit. Although, on the contrary, as argued by Frank & Goyal (2009), during the expansion period, the pecking order coefficient is expected to be lower because firms tend to be cash-rich and then will prefer to use cash instead of debt. This pattern is observed in this study, as outlined by Figures 2 and 3, which show that the period of low pecking order coefficients coincides with the period of high cash and equity. Therefore, it can be inferred that the superiority of the pecking order theory is not conclusive, although some findings suggest the validity of the theory.

4.4 Market Timing Test

The previous sections have shown the prominence of the pecking order theory in explaining firms' financing behaviour. To complement the analysis, this section discusses the results of the market timing test. The aim is to determine whether the market timing theory is more (or less) prominent than the pecking order theory to explain the firms' financing preference. The test conducted in this analysis is adopted from Huang & Ritter (2009) and extended to accommodate macro uncertainties. The framework is presented in Equation (8).

Tables 8 and 9 present the market timing estimation results. *LRP* is not significant for all panels either before or after 2008. Meanwhile, *RIR* is significant only before 2008 for the alternative energy (+) and forestry and paper (−) panels. Both *LRP* and *RIR* play important roles for the market timing theory as these variables proxy the cost of debt. The theory argues that firms' financing source decision results from comparing the costs of debt and equity. The results show that costs of debt do not influence firms' financing decision. Therefore, in general, it could be argued that the market timing theory cannot explain the financing behaviour of the sample resource firms.

The variable $\sigma COMM$ is significant before 2008 for the full sample (−) and forestry and paper (−) panels, and after 2008 for the full sample (−), non-renewable (−), and oil and gas (−) panels. The variables $WGDP$ (−) and $HGDP$ (+) are significant only after 2008 for non-renewable-related panels, indicating a strong influence of business cycles on the non-renewable firm capital structure after the GFC. The results also strongly suggest that the capital structure of the non-renewable firms are strongly influenced by business cycles. The negative signs of $\sigma COMM$ and $WGDP$ after 2008 can be interpreted as the evidence of firms' less preference for debt during the expansion period. As argued by Frank & Goyal (2009), during expansion, firms less prefer to use debt because they are cash-rich, and the equity market is capital-abundance. Higher $\sigma COMM$ and $WGDP$ indicate economic expansion and commodity boom, thus referring to lower firm debt level.

The variable *GPR* is significantly positive for many panels before 2008 (−) and after 2008 (+), suggesting changes in the influence of global geopolitical instability on resource firms' capital structure after the GFC. *GEPU* is more significant after 2008, with positive signs for the non-renewable firms. Both *GEPU* and *GPR* are political-based uncertainty measures. Their positive signs after 2008 can be interpreted that resource firms prefer to use debt when political uncertainty is high. These findings are both logical and representative in explaining resource firms' financing behaviour, especially because this sector is by nature political-sensitive. However, WGI is generally not significant, meaning that resource firms are more sensitive toward global instead of country-level political uncertainties.

Furthermore, $INFL$ is generally significant with mixed signs after 2008. The interaction between *PDEF* and *LRP* is generally insignificant. *PDEF* is generally significant after 2008, with positive signs, confirming the prevalence of the pecking order theory. For firm-level control variables, mixed results of signs and significance are observed.

It is interesting to compare results in Tables 7 and 9. Table 7 refers to sample firms' preference toward debt issuance; meanwhile Table 9 focuses on influence of macro uncertainties on sample firms capital structure. $\sigma COMM$ is positive in 7, but negative in 9. These results might seem to contradict each other, although not exactly. It means that higher commodity price uncertainty increases firms' preference toward debt, although generally resource firms' debt level after 2008 are lower due to economic expansion and careful debt management. Furthermore, *GPR* and *GEPU* are generally not significant in 7, but significant in 9. These findings imply that *GPR* and *GEPU* generally increase sample firms leverage, although do not change their preference toward debt or equity issuance.

Another important pattern that could be inferred from results in Table 9 is that macro uncertainties are generally significant for non-renewable related panels. This finding strongly indicates the vital influence of macro uncertainties on non-renewable resource firms' capital structure, but not to renewable firms. One possible explanation is the difference in macro uncertainties' impact on demand of renewable and non-renewable resource products. For instance, Narayan & Doytch (2017) find economic growth induces consumption of non-renewable energy, but not renewable energy. This relationship describes that global dependence is still very high toward non-renewable energy supplied by non-renewable resource firms. Thus, it is not unexpected if this study finds that macro uncertainties have a vital influence on non-renewable firms' capital structure, but not on renewable firms.

Table 8. Market Timing Test - Before 2008

Dep. Variable = $DEBT_{i,t}$

Variable	Full Sample	Renewable	Non-Renewable	Alternative Energy	Forestry and Paper	Mining	Oil and Gas
$LRP_{i,t-1}$	-0.0002	0.0035	-0.0006	-0.0211	0.0038	0.0038	-0.0072
$RIR_{i,t-1}$	0.0001	0.0015	-0.0007	0.0301*	-0.0027*	-0.0016	0.0008
$\sigma COMM_{i,t-1}$	-0.0307*	-0.0154	-0.0332	0.0107	-0.0208*	-0.038	-0.0296
$WGDP_{i,t-1}$	-0.0099	0.0045	-0.0108	0.0201	0.0065	-0.0053	-0.0224
$HGDP_{i,t-1}$	0.0011	-0.0002	0.0001	-0.0175	-0.0003	0.0024	-0.0046
$GPR_{i,t-1}$	-0.0381**	-0.0261	-0.0431**	0.0038	-0.0364***	-0.0373	-0.0797***
$GEPU_{i,t-1}$	0.0369	-0.0379	0.0668	-0.0432	0.0362	0.0091	0.1878**
$WGI_{i,t-1}$	-0.108	0.0208	-0.1632*	0.3608	0.0899	-0.0966	-0.1113
$INFL_{i,t-1}$	-0.0019	-0.0038	-0.002	0.033	-0.0064***	-0.0038	0.0016
$PDEF_{i,t} * LRP_{i,t-1}$	0.0058	-0.0066	0.0059	-0.0426	0.0034	0.0072*	0.0041
$PDEF_{I,t}$	0.0131	0.1453	0.0122	0.2427	0.4202***	0.0064	0.0272
$Q_{i,t-1}$	0.0024	-0.0283**	0.0035	-0.0289	-0.0279***	0.0085***	-0.0125***
$RND_{i,t-1}$	0.3993	0.0495	0.5221	0.2186	1.4459***	-0.0113	0.9045*
$CAPX_{i,t-1}$	0.0512	0.6495***	0.0358	1.7170**	0.2374*	0.0029	0.0333
$SALE_{i,t-1}$	0.0132	-0.0093	0.0179	0.0389	-0.0248	-0.0141	0.0268
$OIBD_{i,t-1}$	0.0178	-0.1617	0.0264	-0.1837	-0.0326	-0.0296	0.0491
$TANG_{i,t-1}$	0.0189	-0.1816	0.0266	-0.704	0.1485	0.0632	0.0073
$CONS$	0.2948	0.7801***	0.1003	0.7448	0.4633**	0.3599	-0.0664
OBS	4816	971	3845	190	781	2,573	1272
R^2	0.0771	0.189	0.0846	0.2511	0.463	0.1138	0.1922

Note: The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10%.

Table 9. Market Timing Test - After 2008

Dep. Variable = $DEBT_{i,t}$

Variable	Full Sample	Renewable	Non-Renewable	Alternative Energy	Forestry and Paper	Mining	Oil and Gas
$LRP_{i,t-1}$	0.0013	0.0019	0.0023	0.0327	0.0011	0.0018	0.0043
$RIR_{i,t-1}$	-0.0002	-0.0002	-0.0003	-0.0108	0.0011	-0.0002	-0.0004
$\sigma COMM_{i,t-1}$	-0.0104**	-0.0014	-0.0128**	-0.0116	0.002	-0.0054	-0.0312**
$WGDP_{i,t-1}$	-0.0087***	-0.0014	-0.0095***	0.0154	-0.0015	-0.0076***	-0.0144***
$HGDP_{i,t-1}$	0.0070***	0.0009	0.0071***	-0.011	0.0011	0.0045	0.0130***
$GPR_{i,t-1}$	0.1340***	0.0750*	0.1484***	0.1636*	0.0212	0.1392***	0.1671***
$GEPU_{i,t-1}$	0.0367**	-0.006	0.0466**	0.0889	-0.0338	0.0545**	0.0263
$WGI_{i,t-1}$	0.0484	0.1126	-0.0264	0.181	-0.0172	0.0284	-0.1421
$INFL_{i,t-1}$	0.002	0.0011	0.0026	-0.0305*	0.0067**	0.0016	0.0053*
$PDEF_{i,t} * LRP_{i,t-1}$	0.0027	-0.0089	0.0026	-0.0142	-0.0192	0.0025	0.0022
$PDEF_{I,t}$	0.0159	0.2955***	0.0123	0.2886**	0.4047***	0.0126	0.0169
$Q_{i,t-1}$	0.0018	-0.0124***	0.0028	-0.0122***	0.0041	0.0032	-0.0016
$RND_{i,t-1}$	-0.0642	0.3021	-0.0742*	0.3824	0.0103	-0.0603	-0.0746
$CAPX_{i,t-1}$	0.0608	0.05	0.0687	0.8512***	-0.0017	0.0183	0.1477
$SALE_{i,t-1}$	0.017	0.0738	0.0055	0.1190*	-0.0098	-0.0176	0.0388*
$OINC_{i,t-1}$	-0.0455**	0.1118	-0.0445**	0.0963	0.0369	-0.0328	-0.0756*
$TANG_{i,t-1}$	0.0179	0.0805	0.0052	-0.2659	0.1282	0.0204	-0.0345
$CONS$	-0.4978***	0.0101	-0.7082***	-0.6704	0.274	-0.6841***	-0.6865***
OBS	14,397	2,230	12,167	734	1,496	8,979	3,188
R^2	0.0739	0.3046	0.0774	0.3918	0.2618	0.0644	0.1341

Note: The significance level is shown by ***, **, *, to denote respectively 1%, 5%, and 10%.

From the analysis in this subsection, several conclusions could be drawn. First, if the market timing theory is interpreted strictly, the theory only considers the cost of debt and equity as determinants of its validity. Therefore, based on the results of *LRP* and *RIR*, it could be inferred that the market timing theory cannot explain the sample resource firms' financing behaviour. Second, many macro uncertainty variables are significant, especially after 2008, and thus have the power to explain the resource firms' financing behaviour. If macro uncertainties are considered as a form of costs and the definition of market timing theory is relaxed, it could be argued that market timing theory tends to hold. Therefore, it could be argued that market timing theory can partially explain sample firms' financing behaviour. The results are somewhat aligned with those of previous studies, such as Huang & Ritter (2009) and Baker & Wurgler (2002). Furthermore, the after 2008 estimation results show that the influential role of macro uncertainties to sample firms leverage level is found mainly in non-renewable resource firms.

5. Conclusion

The role of macro uncertainties in affecting resource firms' financing behaviour is an important issue, considering these firms' vital role in many large economies. This study analyses this issue by examining three prominent capital structure theories for resource firms in four resource sectors across 75 countries. The data cover the period of 1988–2017 in annual frequency. The three theories tested are static trade-off, pecking order, and market timing.

The results show that there is no single theory that can fully explain sample firms' financing behaviour. However, some findings partially support the portability of pecking order and market timing theories. The pecking order theory is strongly supported by results from the leverage target adjustment model estimation. However, the downward cyclical pattern of pecking order coefficients lowers the validity of the theory. Meanwhile, the market timing theory is supported by the significant influence of macro uncertainties and condition, although proxies of cost of debt are found statistically insignificant. The mixed results found in this study somewhat resemble results of Huang & Ritter (2009).

Concerning the pecking order theory, it is observed that the pecking order coefficients have downward cyclical patterns during the analysis period, with the lowest point being around 2010, a few years after the GFC. In 2010s, some increasing trends are observed, especially during the 2015–2016 period, which is believed to have been caused by the 2015 commodity market crash.

Furthermore, macro uncertainties are found to be significant in explaining resource firms' financing behaviour, which supports the findings of many previous studies such as Covas & Den Haan (2012), Karabarbounis et al. (2014), Baker & Wurgler (2002), Crouzet (2018), Öztekin & Flannery (2012), Booth et al. (2001), and Begenau & Salomao (2019). From the extended leverage target adjustment model, country-level governance is significant in explaining resource firms' financing behaviour. From the extended pecking order estimation, lending risk premium, commodity price uncertainty, world and country business cycles, and country-level governance are found to be significant, especially after 2008. Meanwhile, from the market timing test, commodity price uncertainty, world and country business cycles, and geopolitical and global economic policy uncertainties are significant, especially after 2008 and for non-renewable firms.

The extension of the tests by including macro uncertainty factors is vital to connect how macro uncertainties might influence the resource firms' financing behaviour. This concern is valid because firms in the resource sector are by nature connected with global and country-level macro variables, such as global geopolitics, country-level governance, and commodity price uncertainty.

From the macroeconomic perspective, the results of this study have some implications. The financing behaviour of firms in the resource sector can be explained by the pecking order and market timing theories. In other words, resource firms have a particular pecking order preference when they need financing, and the influence of macro uncertainties is vital in determining their capital structure. Understanding this behaviour is vital for central bankers and financial sector authorities worldwide, as the resource sector's financial health is closely connected with the financial sector stability. Furthermore, as mentioned by Bhamra et al. (2010), at an aggregate level, firms' financing behaviour is vital for the economy as it determines aggregate financial conservatism, constraints, path dependence in leverage, and future default probability.

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APPENDIX

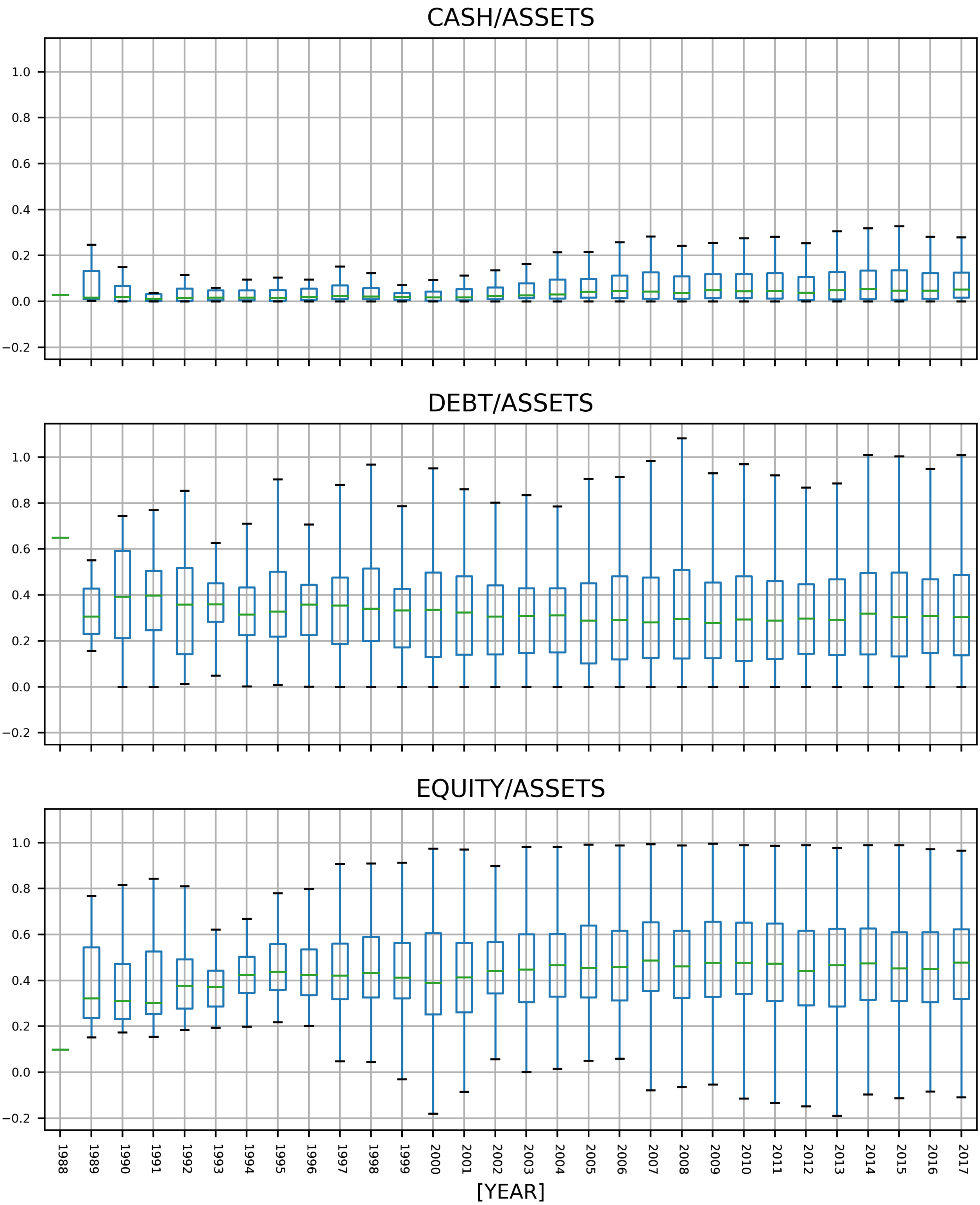

Figure A1. Dynamics of Cash, Debt and Equity of Sample Firms - Renewable

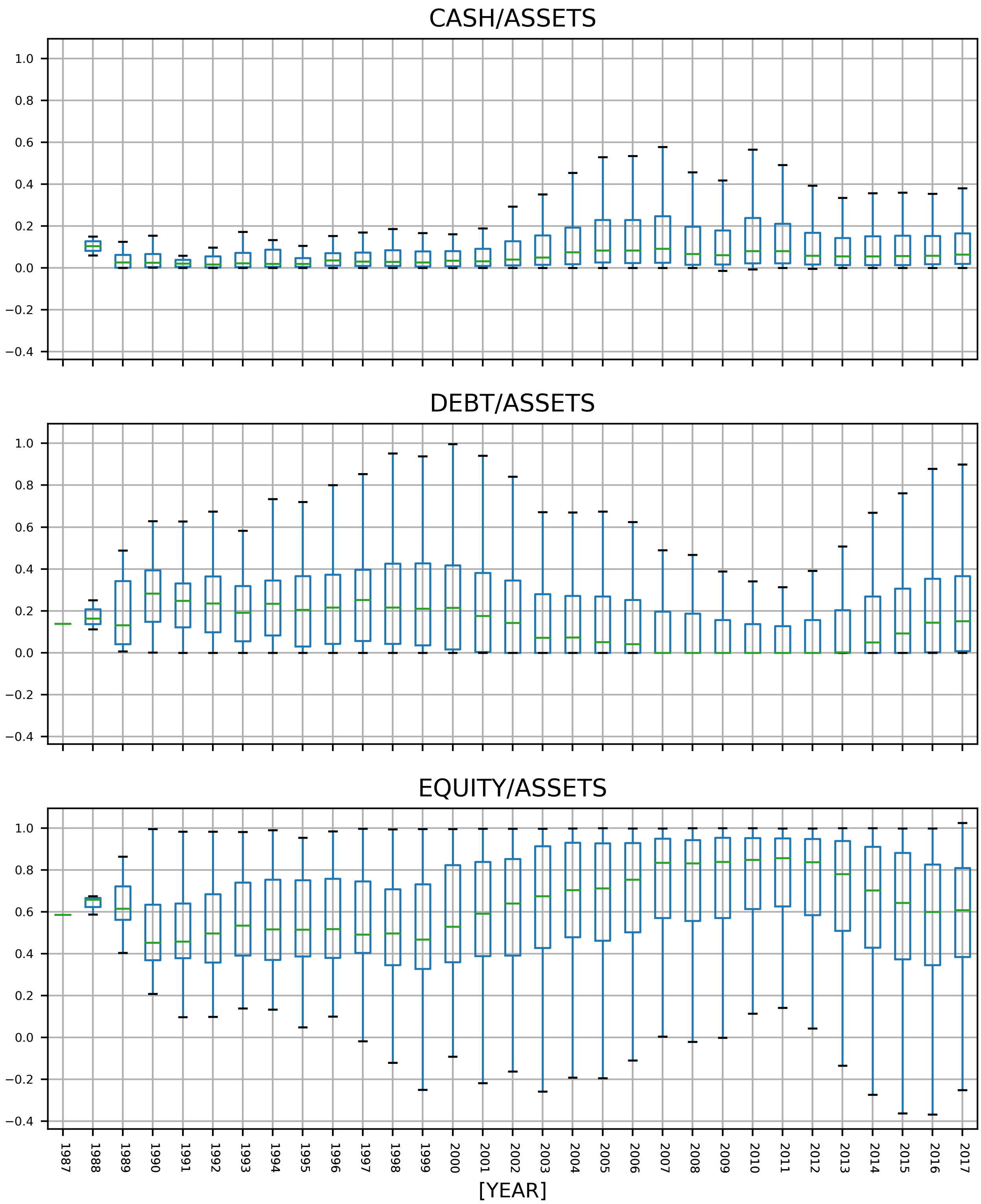

Figure A2. Dynamics of Cash, Debt and Equity of Sample Firms - Non-Renewable

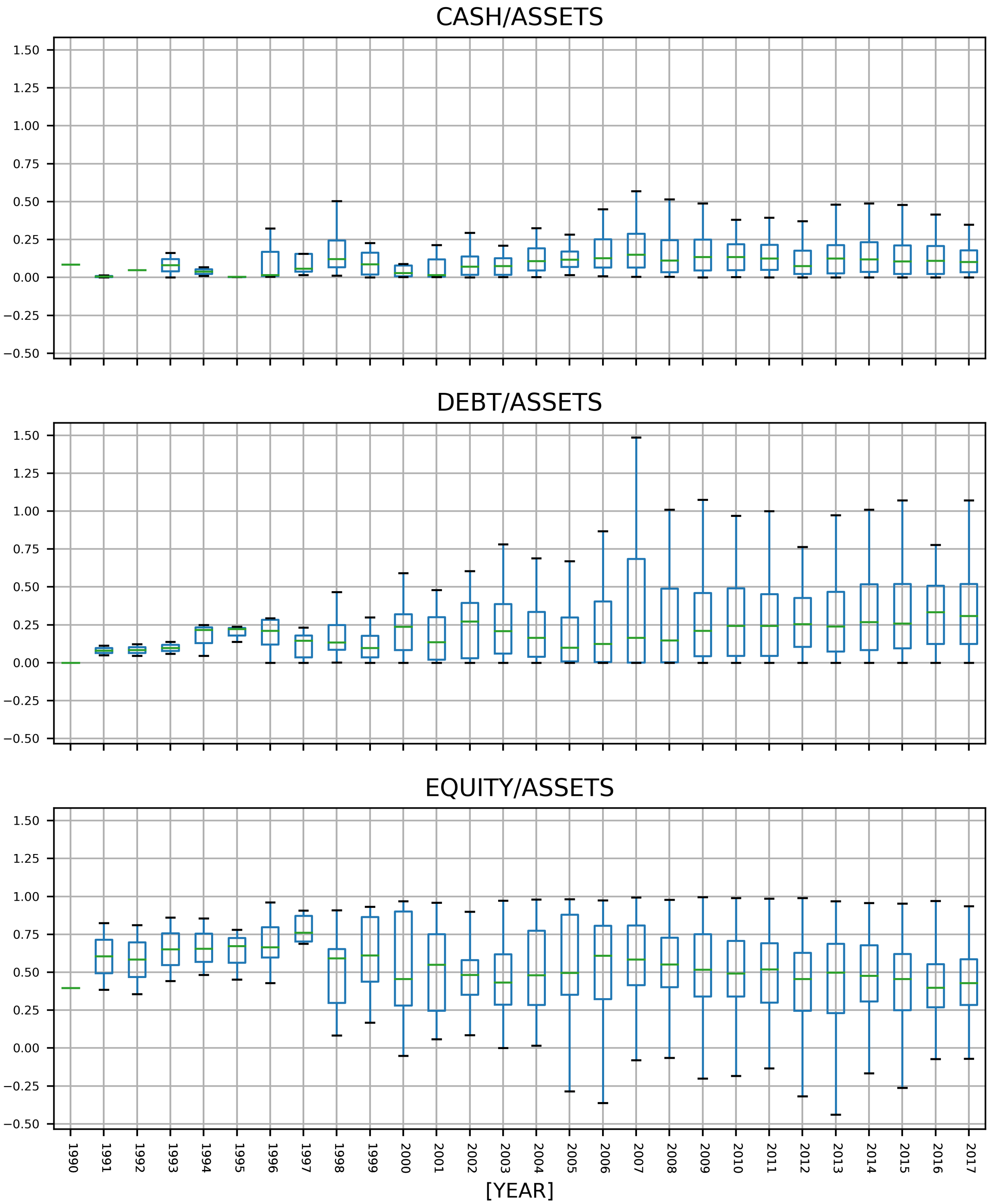

Figure A3. Dynamics of Cash, Debt and Equity of Sample Firms - Alternative Energy

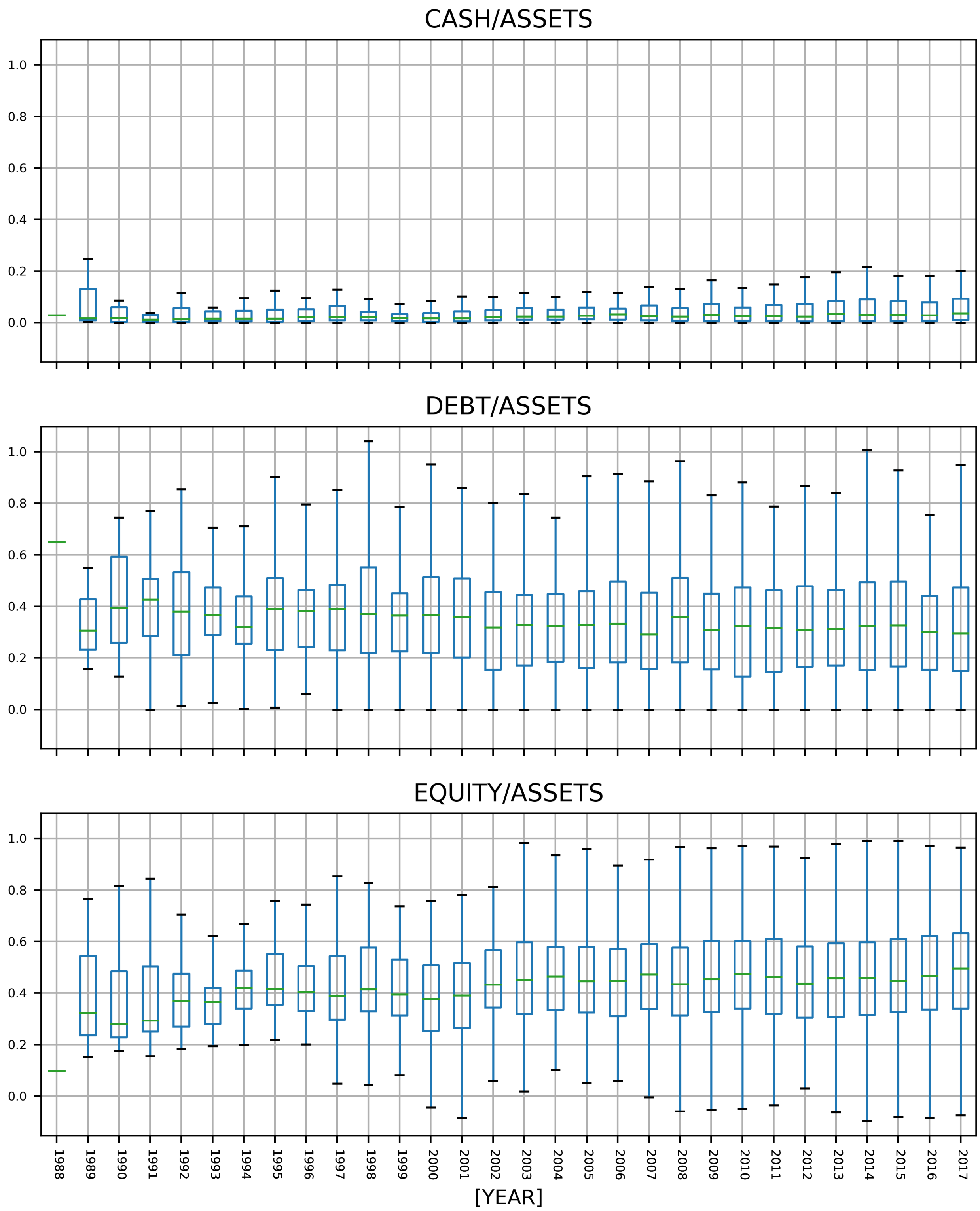

Figure A4. Dynamics of Cash, Debt and Equity of Sample Firms - Forestry and Paper

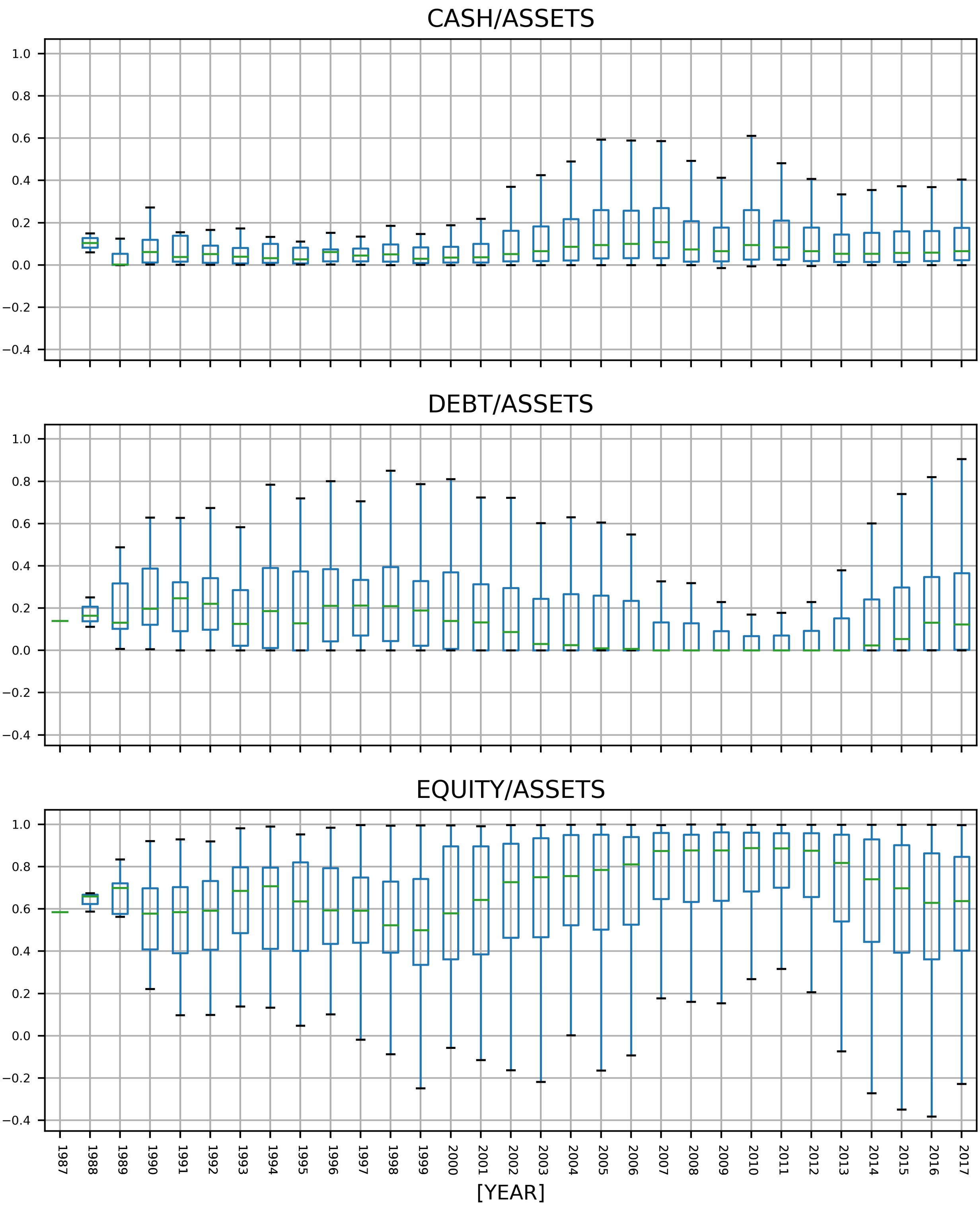

Figure A5. Dynamics of Cash, Debt and Equity of Sample Firms - Mining

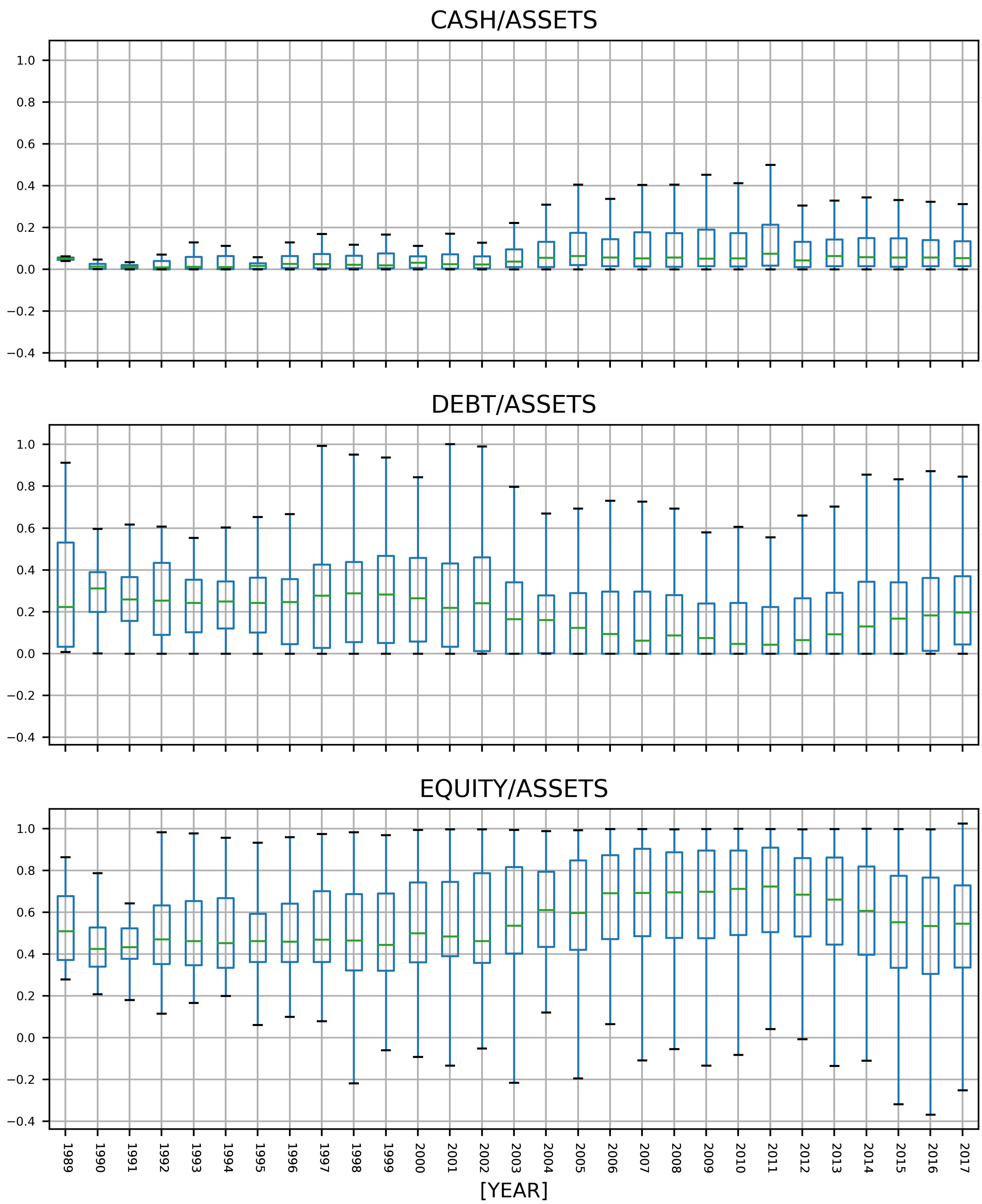

Figure A6. Dynamics of Cash, Debt and Equity of Sample Firms - Oil and Gas

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