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Leverage Ratio and Asset Intangibility: Effects on the Cross-Country and Firm level

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ABSTRACT

This research investigates the relationship between leverage ratio and asset intangibility in the context of firms across countries. The growing investments into intangible assets have been shifting firms to focus more on knowledge-based production while firms using debt financing have been declining. The study aims to uncover how asset intangibility influences the level of leverage ratio with the inclusion of financial development as a moderator. Our empirical findings revealed that a positive correlation between identifiable intangible assets and leverage both on a firm- and country-level, with financial development influencing the relationship. Over our sample period, the relationship becomes less pronounced in recent years, while the impact of financial development on the sensitivity of the relationship becomes enhanced. Beyond a certain level of financial development, the relationship becomes negative as financial development would allow firms to have more variation in sources of funding.

Keywords: Asset Intangibility, Leverage Ratio, Financial Development, Capital Structure

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Table of Contents

ABSTRACT iii
LIST OF TABLES v
LIST OF FIGURES vi
1. Introduction 1
2. Theoretical Framework 3
2.1 Capital Structure 3
2.2 Capital Structure: Theories and Empirical Evidence 4
2.2.1 Debt Financing 4
2.2.2 Market Imperfections 5
2.3 Intangible Assets 7
2.4 Capital Structure and the Role of Asset Intangibility 9
2.4.1 Cross country analysis 11
2.4.2 Identifiable assets as collaterals 11
3. Data 13
3.1 Sample Description 13
3.2 Variable Description 14
3.3 Summary Statistics 15
4. Methodology 18
4.1 Base Model 18
4.2 OLS Assumptions 18
4.3 Hypotheses Testing 20
5. Results & Discussion 22
5.1 Country Level Analysis 22
5.2 Robustness Check 26
5.2.1 Multicollinearity Concern 26
5.2.1 Aggregation Bias: Firm-Level Analysis 27
6. Conclusion 29
7. References 31
8. Appendix 33

LIST OF TABLES

Table 1	Debt category and classification	5
Table 2	Computation of the dependent, independent variable, and firm-variant control variables.	13
Table 3	Summary Statistics for the variables	17
Table 4	Summary Statistics for the variables in natural logarithms	17
Table 5	Regression results applicable to Hypothesis 1 & 2	22
Table 6	Regression results applicable to Hypothesis 3	25
Table 7	Regression results with categorical variable of Financial Development	27
Table 8	Regression results with firm-level sample	28

LIST OF FIGURES

Figure	1	Scatter plot and prediction linear fit of Ln (Leverage Ratio) vs. Year	36
Figure	2	Histogram of Ln (Leverage Ratio)	37
Figure	3	Scatter plot and prediction linear fit of Ln (Intangibility) vs. Year	37
Figure	4	Histogram of Ln (Intangibility)	38
Figure	5	Scatter and data points of Ln (Current Ratio) vs. Year	38
Figure	6	Histogram of Ln (Current Ratio)	39
Figure	7	Scatter and data points of Ln (Profitability) vs. Year	39
Figure	8	Histogram of Ln (Profitability)	40
Figure	9	Scatter and data points of Ln (Inflation) vs. Year	40
Figure	10	Histogram of Ln (Inflation)	41
Figure	11	Scatter and data points of Ln (Private Credit to GDP) vs. Year	41
Figure	12	Histogram of Ln (Private Credit to GDP)	42
Figure	13	Scatter and data points of Stock Market Growth vs. year	42
Figure	14	Histogram of Stock Market Growth	43
Figure	15	Scatter and data points of Ln (GDP per Capita) vs. year	43
Figure	16	Histogram of Ln (GDP per Capita)	44
Figure	17	Scatter and data points of Government Effectiveness	44
Figure	18	Histogram of Government Effectiveness	45
Figure	19	Linear slopes of Ln (Leverage Ratio) for Ln (Intangibility) with the interaction of Ln (Private Credit to GDP)	45
Figure	20	Linear slopes of Ln (leverage ratio) for Ln (Intangibility) with the interaction of Financial Development	46

1. Introduction

Modigliani and Miller (1958) famously stated that the financing of capital of firms does not matter in firm value in the perfect and frictionless capital market. However, in the real financial market, it can matter due to the following financial constraints, such as information asymmetry, agency costs, taxes, and regulations. Internal factors like firm-specific and industry-specific factors as well as external factors, like macro-scale and institutional factors, can change the decision-making in firms' financing choices. Surrounded by these factors, firms always seek to maximize their firm value for the benefit of shareholders and other stakeholders by optimizing their capital allocation between equity and debt usage, adjusted to each firm's business. One of the conventional corporate behaviors to fund capital is through debt financing in which firms take loans from banks or other private entities to finance their investments or spending. However, the proportion of firms with less than 5% debt in their capital structure has increased to 34.42% from 14.01% between 1977 and 2010 among U.S. public firms (D'Mello & Gruskin, 2014). In the meantime, the average percentage of intangible assets to total assets increased from 1.5% to 30% between 1983 and 2017 (Wu & Lai, 2020). Asset tangibility is an important consideration in the choice of debt financing as it represents the degree of collaterals that firms manage to provide in the form of security to banks to guarantee repayments. The rate of available collaterals to total assets determines the cost of debt at which firms can take loans. The decline in debt financing, followed by the growth of intangible assets, shows the growing relevance to how asset intangibility affects firms' financing choices and banks in assessing firms' creditworthiness.

Previous research investigated the effect of asset intangibility on firm debt policies, facilitating the rate of intangible assets as the independent variable and leverage ratio as the dependent variable. The result showed that asset intangibility is negatively correlated with leverage ratio (Gamayuni, 2015). It explains that higher asset intangibility would be correlated with higher agency costs between debtholders and managers, hence a higher cost of debt. Another research suggested that the degree of intangible asset-intensity of an industry moderates the sensitivity of the relationship between asset intangibility and leverage ratio, explaining the potential difference in the debt financing usage among industries (Lim, Macias, & Moeller, 2014). Furthermore, firm-specific factors affect the degree of leverage ratio firms take as these factors would influence the degree of financial constraints, like information asymmetry and agency costs, hindering a higher cost of debt. Those firm characteristics include firm size, age, profitability, and liquidity ratio (D'Mello & Gruskin, 2014). External factors have also been proven to influence the sensitivity of the relationship. For instance, the financial development of country in which firms are operating shows a positive correlation with the sensitivity because financially developed countries would provide better creditor rights and transparency in transactions (Lei, Qiu, & Wan, 2018).

The relationship between leverage ratio asset intangibility has extensively been studied on a firm level. Multiple firm-specific and macroeconomic factors could affect the leverage ratio of firms. However, the following relationship has not been in the spotlight on a country level. As it is widely known that excessive leverage by banks would contribute to the global financial crisis because of the credit risk of the economy, countries' creditworthiness could affect the leverage ratio of country as much as firms' creditworthiness on a firm level. Therefore, it would be worthwhile to investigate the relation of asset intangibility to leverage ratio on a country level.

The objective of this study is to investigate, firstly, how asset intangibility affects leverage ratio on a country level. Second, this paper will investigate further into possible differences in the relationship between countries by facilitating financial development as a moderator. Having our independent variable as asset intangibility (database between 2002-2021 from Orbis), we take non-financial firms' leverage ratio (database between 2002-2021 from Orbis) as the dependent variable and other firm-variant and macro-variant variables from the World Bank, OECD Statistics, and Bank for International Settlements (BIS). With the use of the panel data that compiles 39 countries with 20 years, the fixed effect OLS model analysis will be applied to see the difference by country and year.

Intangible assets are still considered to contain higher uncertainty and credit risk relative to tangible assets when taking loans from banks. On a firm level, despite the growing adoption of using identifiable intangible assets as collaterals in commercial and industrial sectors, the sensitivity would vastly deviate with respect to the degree of financial development of country. Therefore, on a country level, the relationship might also be correlated with the financial development of country. This research would give more insights into the optimal national capital structure in the future within the economy that is becoming more knowledge based. Our research will focus on asset intangibility specific to non-financial firms because of the difference in the capital structure between financial and nonfinancial firms.

Our paper is organized as follows: Section 2 presents Theoretical Framework that formalizes the central theories and ideas to conduct our analyses and formulate hypotheses. Section 3 describes the data that we apply in our analyses and reports the summary statistics of variables chosen. Section 4 presents the methodology of our analyses and Section 5 presents the results for the country-level analysis and discusses the results we obtained with the correlation with our theoretical framework. Section 6 presents robustness checks to our models and discuss the validity and reliability of our analyses. Lastly, Section 7 reports our conclusion to our research and gives implications for future studies in this topic.

2. Theoretical Framework

2.1 Capital Structure

A firm's capital structure defines the mix of securities and financing sources that firms use to finance their real investments (Myers, 2001). Given that firms always seek to maximize their firm value, namely market value, for the benefit of shareholders and other stakeholders, firms make their financing choices of their investments. Most of the previous research on capital structure has focused on debt and equity as financing choices and discussed the optimal mix of debt-to-equity ratio in capital structure.

From the equity side, if firms attempt to raise funds from internal sources, they can issue their shares. Existing shareholders and new investors would be entitled to purchase newly issued shares so that firms' profits would be distributed as dividends to them unless firms offer no dividends to shareholders. From the debt side, one of the most conventional corporate behaviors to fund capital is through debt financing in which firms take loans externally from banks or other private debts to finance their investments and spendings. When firms decide to borrow money externally, they would be under the agreement where firms need to promise to make interest payment at an agreed rate as well as the principal which is the initial amount borrowed. In maximizing shareholders' benefit firms finance more through debt capital since the interest paid is tax-deductible and lowers the debt's effect (Abeywardhana, 2017).

If a firm manages to make profits, the debtholders will be able to constantly receive a fixed interest and principal at maturity and shareholders receive the gains. However, it could go other ways too. If profits of the firm decline, shareholders bear the loss. Debt increases returns to shareholders when profits rise and reduces otherwise, it creates "financial leverage" (Kumar, 2007).

Durand (1952) conducted one of the first studies on the debt-to-equity optimization to maximize a firm's value, focusing on a firm's overall cost of capital. This research highlighted the importance of balancing debt and equity to minimize the firm's cost of capital. It argued that debt financing lowers the cost of debt due to the tax deductibility by interest payments while higher rate of debt financing would expose the firm to financial risks and negative credibility by lenders. In contrast, equity financing would give more flexibility in its term despite possible higher costs of equity due to the expected returns anticipated by shareholders.

However, Modigliani and Miller (1958) made a seminal shift in the traditional view that the capital structure can be optimized by the right mix of debt and equity. The paper proposed capital structure irrelevance that firm's value is isolated from its debt-to-equity ratio given the assumptions that there

are no taxes, transaction costs, and market inefficiency. It claimed that a firm's value is independently determined purely by cash flows generated through its business operation. However, the paper acknowledged that the real-world market is running under market imperfections such as taxes and bankruptcy costs, that can affect firms' financing choices between debt and equity. Modigliani and Miller introduced the concept of capital structure irrelevant and heralded the study of the impact that market imperfections have on firms' financing decisions.

2.2 Capital Structure: Theories and Empirical Evidence

Discussing the capital structure of firms, it is inevitable to proceed with our discussion without the concept of leverage ratio. The leverage ratio explains the extent to which a firm relies on debt as a source of financing, commonly calculated by the total debt of a firm divided by the total equity of the firm (Berk & Demarzo, 2020). As the corporate capital structure consists of debt and equity, the leverage ratio enables shareholders and other stakeholders to observe the proportion of debt relative to the equity that firms use to finance their capital. Hulster (2009) explained that on a balance sheet, when a firm's total assets surpass its equity, its balance sheet is considered to be leveraged because it implies that the firm is carrying out debt financing to borrow external funds to acquire assets more than what is covered by its equity owned by managers and shareholders.

Not only does the leverage ratio expresses the relative ratio of debt to equity, but also it can take other variables in the denominator to observe the relative proportion of debt, and sometimes other variables are preferred to be chosen to see firms' profitability against debt and solvency. Examples include debt-to-assets ratio and debt-to-surplus ratio. The debt to surplus ratio indicates the capacity of firms to meet the cost of debt repayments with the operational profits made through their business operations (OECD, 2023).

2.2.1 Debt Financing

Firms are motivated to take financial leverage because it would amplify the expected rate of returns on the equity investment if the firm raises profits (Santos & Veronesi, 2022). In funding firms' capitals through debt, there are multiple types of debt available for firms to take and each of them would have different features, terms, and sources. Rauh and Sufi (2008) classified debt into 7 categories based on 10-K financial footnotes and SDC Platinum and Dealscan of 1889 credit-rated non-financial firms, including 1) bank debt, 2) bonds, 3) program debt, 4) private placements, 5) mortgage or equipment debt, 6) convertible debt, 7) other debt. Colla, Ippolito, and Li (2013) further developed a spread of debt types within a firm, finding that most firms possess only one of these debt types, and the spread of debt types negatively correlates with credit quality of firms.

Table 1: Debt category and classification (Rauh and Sufi, 2008)

Debt Type	Classification
Bank Debt	Revolving bank debt and bank debt
Bonds	Public debt issues, industrial revenue bonds
Program Debt	Commercial paper, shelf registration debt, and medium-term notes
Private Placements	Privately placed debt issues, ambiguous notes, debentures
Mortgage or Equipment Debt	Mortgage bonds, mortgage loans, equipment trust certificates, and other equipment-based debt
Convertible Debt	Firm-specific convertible debt
Other Debt	Acquisition notes, capitalized leases, and unclassified debt

2.2.2 Market Imperfections

Ever since the remarkable finding of capital structure irrelevance (MM theorem), many researchers have attempted to understand how firms' specific factors and external factors affect their financing choices. Other theories on capital structure have been built upon MM theorem to see the influence of market imperfections on capital structure. This section discusses how corporate debt financing is affected by other factors, resulting in a different leverage ratio of firms.

2.2.2.1 Trade-off Theory:

Myers and Majluf (1984) first proposed the trade-off theory that the optimal debt level falls under the point where the benefit of the tax shield is equal to the financial distress cost of taking debts. This theory assumes the existence of tax in the market and identifies tax as a market imperfection which leads firms to optimize their leverage ratio. Fama and French (2002) identified that the tax shield is derived from tax deductibility that interest payments of debt possess, and the financial distress cost as the risk of bankruptcy and agency costs to shareholders. Furthermore, Graham (2003) presented the evidence that firms facing a higher tax rate tend to have more debt-intensive capital structure than firms with a low tax rate, implying that firms' leverage ratio might be positively correlated with tax rate due to the benefit of the tax shield.

2.2.2.2 Agency Costs Theory:

Jensen and Meckling (1976) argued that financial policies, including debt financing and dividend policy, are primarily determined by agency costs. The study identified two types of conflicts between entities. One conflict arises between shareholders and managers because managers would not be able to capture the entire gains from the effort that they put to generate cash flow while shareholders do. Conflicts between debtholders and shareholders arise because if a firm chose debt financing for an investment and the investment made a high return, most of the gains will be captured by shareholders while the risk of the investment, the cost of debts is borne by debtholders. On the other hand, if the investment had a poor result, the loss of the value of the equity would be borne by the shareholders

whereas debtholders would still be able to receive fixed payments of interest. Especially Myers (2001) explained that when a firm is at risk of default, the conflict between equity holders and debtholders will be more visible due to their different interpretations of the financial distress of the firm. Shareholders would be more interested in recovering the firm's value by investing in risk assets and development at the expense of debtholders. However, debtholders would prioritize the most fixed interest payment that the firm owes debtholders. Therefore, equity finance would be preferred for riskier investments.

Within the conflict between managers and shareholders, the cost of debt would be amplified due to lack of information shared between the entities and hidden actions (Gamayuni, 2015). For the conflict between shareholders and debtholders, the cost of debt would be enhanced through asset substitution effect where managers make risky investment decisions to maximize shareholders at the expenses of debtholders. Also, a higher cost of debt is caused by underinvestment of the firm, where the firm reaches an excessive level of debt at which it is no longer able to make investments for growth (Gamayuni, 2015). Therefore, an optimal capital structure of firms would be captured by trading off the agency cost of debt against the benefit of debt.

2.2.2.3 Information Asymmetry Theory:

Myers and Majluf (1984) argued that the information asymmetry between a firm and external entities that fund the firm causes cost of finance to be different between debt and equity financing. If firms hide their private information about the true firm value, issuing equity, described as equity financing, may provide a negative signal to shareholders as that would dilute their stock and lead to an undervaluation of their stock. Even if firms decide to issue equity, new shareholders would incur a higher cost of equity. Therefore, firms would prefer to choose debt financing as the cost of debt is expected to be lower than the cost of equity. Gao and Zhu (2015) further explored the sensitivity of the information asymmetry has on firms' financing choices. The magnitude of information asymmetry in financing choices is influenced by multiple institutional factors. The effect of information asymmetry is more visible in countries with strong banking systems and developed bankruptcy codes whereas the effect is smaller in countries with strong institutional environments, like disclosure taxonomy and law enforcement.

2.2.2.4 Pecking Order Theory:

Myers and Majluf (1984) proposed pecking order theory which suggests that firms prefer internal financing, namely retained earnings, to debt and equity financing. Firms' preference goes internal financing, debt financing, debt-equity financing, and equity financing as the last resort in order. Within this theory, the degree of leverage ratio would heavily be dependent on firm-specific characteristics, including profitability, asset tangibility, firm size, growth opportunities, tax considerations. First,

Titman & Wessels, (1988) argued that profitability negatively correlated with debt financing as profitable firms would be able to finance capitals with their own internal sources. In contrast, Maszur (2007) suggested that profitable firms, at the same time, can borrow money at low cost of debt because of a lower credit risk profile. Concerning asset tangibility, Qureshi et al (2012) claimed that firms with a higher asset tangibility own more collateralizable assets to raise funds in return for debt, resulting in a positive correlation with the leverage ratio.

2.2.2.5 Legal Environment Theory:

La Porta et.al. (1997) found that the legal system of a country decides the availability of external financing in debt and equity. They explained with the evidence that shareholders reside in countries with less protections, the costs of equity tend to be higher than countries with better shareholder protections. In other words, Bancel and Mittoo (2004) pointed out countries with strong legal systems tend to have firms with lower levels of debt financing because a better organized legal system provides greater protections of shareholder, reducing the need for firms to depend on debt.

2.2.2.6 Credit Rating Theory:

Cantillo and Wright (2000) presented a positive relation of firms' credit rating to firms' public debt outstanding. Kisgen (2006) associated this relationship with the existing trade-off theory that a firm's credit rating would change the magnitude of cost and benefit of debt financing, which might result in a change in the corporate capital structure. Relating to the legal environment theory, Huang and Shen (2015) empirically discovered that the effect of credit rating on capital structure is prone to be more pronounced in countries with better legal and institutional characteristics. On a country level, national sovereign credit ratings could be raised as an indicator of a country's financial stability. Butler and Fauver (2006) defined it as a country's perceived ability to repay its sovereign debts – an indicator of its financial system and development, and openness. In their paper, they found that the quality of a country's legal and political institutions and government effectiveness have a positive correlation with country's sovereign credit ratings. Therefore, both on a country and firm level, the credit rating would be correlated with the leverage ratio and financial development/legal development might impact the sensitivity of the relationship.

2.3 Intangible Assets

IAS 38 Intangible assets states "An intangible asset is an identifiable, non-monetary asset, without physical substance." "non-monetary asset" implies that assets classified as intangible assets do not have future inflow of benefits at present, instead they own a property of the potential to gain benefits in the future. Blair and Wallman (2003) made progress in more articulated definition that includes more precise features of intangible assets, stating "intangibles are non-physical factors that contribute

to, or are used in, the production of goods or the provision of services or that are expected to generate future productive benefits to the individuals or firms that control their use (p.451)."

Under Statement of Financial Accounting Standards (SFAS) 141 and 141R, intangible assets are first divided into two segments: identifiable and unidentifiable intangible assets. Unidentifiable intangible assets merely include goodwill which is recognized by an acquirer when the company make an acquisition of a target. Identifiable intangible assets can further be categorized into three components:

1) Technology-related intangibles – developed technologies, patents, and research & development (R&D)
2) Marketing-related intangibles – trademarks, tradenames, customer-related assets, customer relationships, and customer contracts
3) All other identifiable intangibles – long-term lease agreements, unproved oil and gas reserves (Lim, Macias, & Moeller, 2020)

In the literature, Galbraith (1969) introduced, for the first time, the concept of intangible assets/intellectual capital (IC). Although he did not explicitly discuss the concept of intellectual capital, he highlighted the importance of knowledge and expertise of managers in the operation of business. Stewart (1997) further defined IC as intellectual material – knowledge, information, intellectual property, experience – that can be put to use to create wealth. The contribution of IC to the value creation of firms emphasized its significance to firm's growth, performance, competitive advantages, and innovation (Davenport, 1999).

The difficulty in the recognition of intangible assets is derived from their characteristics. Huegh-Krohn & Knivsfla (2000) listed out some of the pronouncing characteristics that intangible assets tend to be firm-specific and not applicable to others. Continued that, intangible assets do not stand by themselves but rather create value with the existence of tangible assets, and there exists a great uncertainty of their potential to future cash flow and economic value generation. However, the uncertainty of intangible assets is derived not only by their characteristics themselves, but also by the delay in the adjustment of accounting measurement process to the knowledge-based economy (Huegh-Krohn & Knivsfla, 2000). There are different definitions by different academia because of its difficulty in conceptualizing and quantifying intangible assets. The spread in its interpretation comes from outdated defined characteristics of economy based on labor and capital, which is no more applicable for the current state of the economy based on knowledge, technologies, artificial intelligence (AI), and internet of things (Blair & Wallman, 2001).

Despite the difficulty in its recognition, Chen et al. (2018) found that within the knowledge-based economy, information on knowledge and social contexts affect significantly analysts' behavior and

perceptions. As Hirshleifer (2015) claimed that, in the finance field, there needs to be a transition from behavioral finance which focuses mainly on firms' and countries' capital to social finance, including social norms/knowledge/information in the study. Therefore, it shows that the economic valuation of firms has also been influenced by the impact of intangible assets.

It is clear that the growth of intangible assets has contribute to the economic growth at a great extent, seen from the statistics that the aggregate amount of intangible assets held by U.S. listed firms grew from almost zero in 1983 to above 80 billion in dollar in 2017 (Wu & Lai, 2020). However, it seems that its contribution has not yet been fully recognized by the current accounting and financial methods/process and that might create a distortion between the hopeful expectation on intangible assets and uncertainty/risks that stakeholders perceive towards intangible assets. Dell'Ariccia el. al. (2020) empirically found that due to the transition to a knowledge-based economy where firms increase intangible assets in their capital profile, banks are being exposed more to intangible assets, resulting in curtailing commercial lending and reallocating lending to other stable securities. Statistically proven that since the 1980s there has been about 30% decline in the share of commercial lending in banks' loan portfolios, showing a large effect on financial intermediary profitability and a possible instability in the banking sector. This implies that due to the uncertainty that intangible assets entail, banks are exposed more to financial risks in their capital portfolio, resulting in a higher cost of debt.

OECD research (2019) indicated that at macro-level intangible assets have experienced a fast rate of growth in all countries observed, namely Ireland, the UK, the US, Australia, Switzerland, Netherlands, Finland, Denmark, Greece, Portugal, Italy, and Germany. However, in conducting a cross-country comparison between the listed countries, it revealed significant differences in the stock of intangibles and the composition of types of intangibles that each country possesses. Furthermore, under the same research, it found that the rate of intangible assets to total assets varies greatly across industry as being pharmaceutical at 70%, machinery and equipment at 60%, and basic metals at 15%. For service-related business, programming/information services are operated about 75% of its business by intangible assets while mining services only have less than 5% of intangible assets in its business. Based on the vast variations of intangible intensity by industry and country, Demmou, el.al (2019) stated that part of these differences depends on sectoral specialization of country adding to on financing constraints due to regulations and taxes.

2.4 Capital Structure and the Role of Asset Intangibility

Asset intangibility refers to the ratio of intangible assets to total assets owned by a firm. Building up the following theories regarding capital structure, especially on debt financing, the intangibility of

firms can be applied in the theories to explain the correlation between the leverage ratio and intangibility.

Harris and Raviv (1991) made a prediction on the relation of tangibility to the leverage ratio of firms, stating "leverage increases with fixed assets, nondebt tax shields, investment opportunities, and firm size and decreases with volatility, advertising expenditure, and the probability of bankruptcy, profitability and uniqueness of the product (p.315)." In this context, fixed assets can be a proxy of tangibility of a firm, meaning that a higher rate of tangibility implies a lower rate of intangible assets to the total assets of a firm. Gamayuni (2015) conducted an empirical investigation, facilitating leverage ratio as a dependent variable and intangible assets (human capital, structural capital, customer capital) as an independent variable, with the database of manufacturing firms listed on Indonesia Stock Exchange between 2007-2009. The result shows the negative correlation between intangibility and leverage ratio of firms.

The most conventional theory that is known as to why a high rate of intangibility hinders a lower leverage ratio of firms stems from intangible assets not being able to work as collaterals (Alkhatib, 2012). To raise more funds for additional investments, firms are required to own a certain amount of tangible assets that can be collateralized to lower the risk of bankruptcy. Li, Whited, & Wu (2016) investigated the relation of collaterals to the leverage ratio of firms based on U.S. listed firms between 1965 and 2012, and they found out that creditors' collateral constraint against firms is highly correlated with a degree of asset tangibility.

Gamuyani (2015) associated its empirical findings with agency costs caused by intangible assets. Since investments in intangible assets obtain a higher risk than tangible assets due to uncertainty and risks on its characteristics, debtholders would detest the decision on riskier investment, especially when the firm is at risk of default, the firm would choose equity financing to turn back its business. Therefore, under the agency cost theory, intangibility would be negatively correlated with the leverage ratio of firms. Agency costs between managers and shareholders as well as managers and debtholders would also arise from asymmetric information between the entities. Asymmetry, in general, occurs not only because managers try to hide unfavorite/adverse news about their firms until the bad news came out in the market, but also because many firms are not capable of making a correct valuation of intangible assets that firms own (Wu & Lai, 2020). Dahmash, Durand & Watson (2009) investigated the relevance and reliability of identifiable intangible assets under Australian GAAP from 1994 to 2003, using firms on the Australian Stock Exchange. Their finding suggested that identifiable intangible assets tend to be reported as having a higher valuation than it is due to its inflexibility of GAAP in measuring identifiable intangible assets. Furthermore, Wu and Lai (2020) investigated the correlation between intangibility and stock price crash risk, using U.S. listed firm between 1983-2017,

and their paper concluded that intangible-intensive firms could be associated with high risk of price cash due to overvaluation of intangible assets caused by asymmetric information.

Therefore, having explored the relationship between intangibility and leverage ratio, this paper formulates a hypothesis stating that:

H1: asset intangibility is negatively correlated with the leverage ratio.

Our research will investigate the same relationship on a country level, unlike previous studies which were conducted under the database of individual firms.

2.4.1 Cross country analysis

On a cross-country level, Rajan & Zingales (1995) concluded that tangibility is positively correlated to leverage for all countries (United States, Canada, Germany, France, United Kingdom, Italy, and Japan). Lei, Qui, & Wan (2018) further developed the sensitivity of leverage ratio to tangibility by facilitating the cash holding of firms as a dependent variable, tangibility as an independent variable, and financial development as a moderator. The two papers explained that the decline of tangibility could limit a firm's debt capacity and force firms to hold cash. Using listed companies in 45 countries from 1990 to 2013, they found that financial development reduces the sensitivity of the leverage ratio to tangibility, implying that countries with a developed financial market tend to promote investments by firms with high intangibility. Naeem & Li (2019) explain that financial development would mitigate financing constraints and boosts corporate investment efficiency. Simultaneously, improved transparency functions as a monitoring tool between investment firms and managers. Therefore, on the cross-country analysis, this paper formulates a hypothesis stating that:

H2: The negative correlation between asset intangibility and leverage ratio is more pronounced in countries with less financial development.

The previous study on the relationship across countries was limited to the G7 countries in 1995. In addition, Lei, Qui, &Wan (2018) did not investigate the direct relationship between intangibility and leverage ratio, instead the research had cash-holding of firms as a dependent variable which affects the leverage ratio of firms. My research will conduct a cross-country analysis under the database with more countries (39 countries) available and more recent years (2002-2021).

2.4.2 Identifiable assets as collaterals

Although intangible assets have been conceptualized to limit debt capacity of firms because of its inability to be collateralized, Lim, Macias & Moeller (2020) found out that there is a strong positive relationship between identifiable intangible assets and leverage ratio, using all U.S. listed firms between 2002 and 2014. It implies that identifiable intangible assets can be used as collaterals to take debt as they are separately identifiable, measurable, and are proven to be generating cash flows. They further demonstrated whether the results were time-period specific, splitting the database into the periods 2002 to 2007 and 2007 and 2014. The results showed that identifiable assets have a higher

level of significance in the latter period of the years, implying the importance of intangible assets in the current knowledge-based economy and the more pronounced effect of intangible assets on capital structure (Lim, Macias & Moeller, 2020).

Lastly, on a time-specific analysis, my hypothesis would be formulated as:

H3: The correlation between asset intangibility and leverage ratio is becoming less pronounced in recent years.

Although the research by Lim, Macias & Moeller (2020) showed a positive correlation between intangibility and leverage ratio of firms, the selected firms were specified to firms that once became targets of acquisitions, meaning that the valuation of the firms including intangible assets might have been computed more precisely. Therefore, it is not conclusive to solidify the result into my research. However, it is true that the ratio of intangible assets has been increasing in recent years as the economy has further progressed to be knowledge-based. Hence, time could explain possible changes in the dynamics of the relationship between leverage and asset intangibility.

3. Data

3.1 Sample Description

This section describes the data sources and summarizes the variables used in my empirical analysis.

Our sample forms panel data which consists of the total of 700 observations made of 35 countries for the years from 2002 to 2021 on the annual basis. Consistent with Irem, Jennifer, and Clemens (2017), our country-level was populated by aggregating all the individual non-financial firms located each country. As raw data of our sample, we collected 46684 individual non-financial firms from 39 different countries that were publicly listed on stock exchange during that time period from the Orbis database provided by Bureau van Dijk. However, due to the lack of data availability during the time period of 20 years, the number of firms used in our analysis was refined to 5315. In order to create a country-level dataset, among those non-financial firms retrieved, I merged the values of the firms by country in which they are located and made the aggregate of all non-financial firms located in each country. Selected countries include Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Denmark, Finland, France, Germany, Greece, Hong Kong, India, Indonesia, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Peru, Philippines, Poland, Portugal, Russia, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, and United States. Appendix A shows that Brazil, New Zealand, Peru, and Russia contain less than 10 individuals' firms for the aggregate country level data. Since it would violate the central limit theorem if we populated the country level data merely with few individual firms, the following countries will be removed from our analysis. This still leaves us with the enough number of observations, amount of the total 700 observations in total.

Our country-level analysis uses *Leverage Ratio* as the dependent variable and *Intangibility* as the independent variable to see the relationship of our interest. Control variables are selected from two types: firm-variant variables and macro-variant variables. Firm-variant variables, *Profitability* and *Current ratio* have also been populated by aggregating individual firms by each country, allowing us to obtain on a country-level.

Table 2: Computation of the dependent, independent variable, and firm-variant control variables

Variable	Computation
Leverage Ratio	Total Debt / Total Equity
Intangibility	Total Intangible Assets / Total Assets
Profitability	Gross Profit / Total Assets
Current Ratio	Current Assets / Current Liability

Macro-variant variables were collected from the World Bank, OECD Statistics, and Bank for International Settlements (BIS). The variables include 1) *Inflation Rate* (%), 2) *GDP per capita* (US dollars), 3) *Private Credit to GDP* (%), and 4) *Stock Market Change* (%) 5) *Government Effectiveness*. Consistent with the firm-variant variables, each variable was collected for the countries for the same period of time.

Regarding the data selection, countries have been selected to have a geographical and economical variation in our sample with the inspiration of the country selection (Demirci, Huang, and Sialm, 2017). The inspiration is also derived from the data availability of those countries, therefore, our sample includes a wide range of years (2002-2021). In terms of the firm classification, our dataset excludes the financial sector and focuses only on the non-financial sectors as the capital structure of the two are different in a way that the financial sector plays as lenders whereas the non-financial sectors play as borrowers in the financial market (Tebrake & O'Hagan. 2017).

3.2 Variable Description

Our independent variable *Intangibility* is defined as how much, in percentage, a firm possesses identifiable intangible assets against the total assets, calculated as a ratio of identifiable intangible assets to the total assets of a firm. Within the two categories of goodwill and intangible assets on the Orbis database, our analysis applies the values of intangible assets. Consistent with the classification of intangible, the values are the sum of technology related, marketing-related, and all other identifiable intangibles (Lim, Macias, & Moeller, 2020). The country level variables follow the same definitions as firm-level ones' and are all computed by aggregating the values for all firms in a given year and country. The ratio is computed by the formula:

$$\text{Intangibility} = \frac{TotalIntangibleAssets}{TotalAssets} \quad (1)$$

Our dependent variable *Leverage Ratio* is defined as how much a firm uses debt in its capital structure as compared to equity. a ratio of the total debt to the total equity of a firm. From the Orbis database, we took a variable Debtors as a representation of the total debt of a firm and a variable total shareholders' equity as the representation of the total equity of a firm.

$$\text{Leverage Ratio} = \frac{TotalDebt}{TotalEquity} \quad (2)$$

Other firm-variant variables are also calculating in the same way to convert the firm-level data to country-level data and the following variables were selected as leverage ratio is considered to be dependent on these firm-specific variables (D'Mello & Gruskin, 2014). In our analysis, *Profitability* is defined as the ratio of gross profits to the total assets, described as return on asset. It represents how productive the firm is to manage its assets to generate profits. The higher the return on asset is, the more productive the firm to use its assets to generate positive cash flows. From the Orbis database, I

took gross Profit, leftover of revenue after deducting cost of goods sold as the numerator and the total assets as the denominator.

$$\text{Profitability} = \frac{GrossProfit}{TotalAssets} \quad (3)$$

Current Ratio is defined as a ratio of total current assets to current liabilities of a firm. Current assets include cash, account receivables, inventory, and other assets that are expected to convert into cash within one year. Current liabilities include short-term obligations such as account payables and short-term debt that a firm is expected to finish repaying within one year. This variable helps to indicate whether a firm would be able to complete its short-term obligations with its current assets, explaining the liquidity position of the firm.

$$\text{Current Ratio} = \frac{CurrentAssets}{CurrentLiabilities} \quad (4)$$

For macro-variant variables, first of all, *Inflation Rate* is defined as a percentage of increase in the general consumer prices over a period of one year. This variable allows us to observe the price level of each country and could help us explain different firm behaviours driven by different states of the economy. *GDP per capita* is defined as gross domestic products divided by the population of the country. It tells how much each individual contributes to the production of the national income and is used as a proxy of the economic development of the country. *Private Credit to GDP* is defined as a ratio of total private credit to GDP of the country. Private credit represents the amount of credit extended by the financial sector to the private sector. This variable is a commonly used proxy of financial development as it shows the availability of funds and financial intermediation of funds and explains the depth and accessibility of taking credit for private firms (Rajan & Zingales, 1995). Lastly, *Stock Market Growth* is defined as a percentage change in the equity indices over a period of one year by each country. It is a proxy of the market performance of the individual firms that were included in our raw data and monitors how confident firms are in their equity financing.

3.3 Summary Statistics

Table 3 reports the country wide summary statistics of the variables presented in the absolute values and *Table 4* shows the variables in natural logarithms. Expressing in natural logarithms allows to reduce skewedness and make a better distribution of the data points. Also, it will mitigate the influence of outliers and can make the model robust to extreme observations. Due to the skewness of the distribution and high standard deviation, all variables except *Stock Market Growth* and *Government |Effectiveness* will be analyzed in natural logarithms. There was no need to be reported in natural logarithms for the two variables as *Stock Market Growth* already obtain a clear normal distribution (*Figure 10*) and also contains negative values that are not close to zero. Government Effectiveness contain negative values hence decided to keep it in absolute term.

Leverage ratio is the ratio of debt to equity of firms, computed in our analysis as the total debt of a firm divided by equity held by its shareholders. This means that negative leverage ratio shown as the minimum (-0.337) is unrealistic to make interpretations. The negatives could imply that a firm owns negative loans and debts, which is, most likely to be accounting errors in debt reclassification or loan receivables. Therefore, all data points below zero will be removed from our sample. *Leverage ratio* seems to be on a decreasing trend over the observing years between 2002 and 2021, starting at 0.298 in 2002 and recording 0.191 in the latest year with a steady decrease over the years (Appendix C). *Figure 1* shows a prediction best fit and data points. It backs up the possible negative trend as the prediction best fit shows a downward trend with the data points. *Intangibility* seems to be increasing within the sample period, which is in line with the recent increase in intangible assets/intellectual property products in the economy (*Figure 3*). Although there is a lower magnitude in the standard deviation, the data points seem to be highly skewed to the lower tail, implying that there might be a risk of heteroskedasticity as intangibility goes up due to the non-constant variance of errors. Furthermore, there might be a possibility of violating one of the assumptions of the ordinary least square (OLS) that is to have observations in the normal distribution (Ui ~ N(0, σ^2)). Therefore, the variable is expressed in the natural logarithms that solved the violation of the assumptions (*Figure 4*). Belgium, Israel, and Switzerland are the three countries with the higher intangibility, which could imply the correlation between intangibility and economic/financial development (Appendix B). *Ln* (*Current Ratio)* and *Ln* (*Profitability)* present a relatively normal distribution of the data points with the standard deviations of 0.16 and 0.32 respectively (*Figure 6* & *8*). There is one data point on *Profitability* that is a negative value that describes that costs of production exceed its total sale. Since the value is extremely close to zero, it will be assumed to be zero.

When we have a look at the macroeconomic variables, *Inflation* is highly skewed to the left as the value of *Inflation* densely concentrates on around 0 and 4% that is in line with the economic target of inflation rate and reports some of the high outliers. The skewness is solved by applying the natural logarithm in the variable (*Figure 10*). The average ratio of inflation is relatively stable both across year and country except some countries, for example Argentina and Turkiye report the average inflation rate of 16636% and 12.432% respectively. *Private Credit to GDP* reports a higher standard deviation with the mean value of 68.351. There is a general upwards trend in the value, implying a gradual development of the financial market. In addition, there is a great difference in the level of *Private Credit to GDP* with Argentina (27.625%) being the lowest and Hong Kong (252.750%) the highest, proving the point that there is a gap in the financial development among countries. *Stock Market Growth* has the clear normal distribution of the data points and a great spread of the data points with the standard deviation at 31.043 (*Figure 14*). *Figure 13* shows that there does not seem to be a clear trend of Stock Market Growth over the years, instead, the variable is time-specific and the variation of the data points within one year is relatively small. This could be explained that the world

tends to experience recession and boom simultaneously despite different magnitudes among countries, such as the financial crisis in 2008 and the Covid-19 crisis between 2019 and 2020. *GDP per Capita* is expressed in the natural logarithms because of the extreme higher standard deviation in the absolute form. The coefficient will be interpreted as a 1% increase in the *GDP per Capita* causes Leverage Ratio to increase by the coefficient × 0.01. *Figure 15* shows an upward trend of GDP per Capita over the years, implying an economic development of the world over the year although there is a higher variation among the countries.

Table 3: Summary Statistics for the variables. Table 3: Summary Statistics for the variables. Leverage ratio is computed by total debt divided by total equity of a firm, intangibility computed by intangible assets divided by total assets, current ratio computed by total current assets divided by total current liabilities, and profitability computed by gross profits divided by total assets. Inflation is an increase in the price level on an annual basis, Private Credit to GDP is computed by total private credit in the economy divided by GDP of a country, GDP per capita computed by GDP divided by the population, and Government effectiveness is estimated in the range between -2.5 and 2.5.

Variable	Observation	Mean	Std. Dev.	Median	Minimum	Maximum
Leverage Ratio	700	0.241	0.131	0.223	-0.337	2.188
Intangibility	700	0.143	0.107	0.118	0.003	0.591
Current Ratio	700	1.296	0.270	1.271	0.288	2.926
Profitability	700	0.291	0.113	0.271	-0.016	1.241
Inflation	700	3.194	4.576	2.200	-3.000	53.500
Private Credit to GDP	700	139.828	68.351	145.800	17.755	384.000
Stock Market Growth	700	10.749	31.043	10.758	-73.431	147.180
GDP per Capita	700	29267.862	21760.221	29077.182	468.844	102913.451
Government Effectiveness	700	1.050	0.791	1.221	-0.765	2.426

**Data points from Brazil, New Zealand, Peru, and Russian have already been removed*

Table 4: Summary Statistics for the variables in natural logarithms

Variable	Observation	Mean	Std. Dev.	Median	Minimum	Maximum
Ln (Leverage Ratio)	700	-1.51	0.49	-1.47	-2.49	-0.54
Ln (Intangibility)	700	-2.22	0.87	-2.10	-5.23	-0.53
Ln (Current Ratio)	700	0.23	0.16	0.24	-0.34	0.79
Ln (Profitability)	700	-1.33	0.32	0.35	-2.39	-0.43
Ln (Private Credit to GDP)	700	4.83	0.63	5.02	2.98	5.95
Ln (GDP per Capita)	700	9.92	1.11	10.35	6.15	11.54

**Data points from Brazil, New Zealand, Peru, and Russian have already been removed*

4. Methodology

4.1 Base Model

To investigate how intangibility associate with leverage ratio on a country level, we formulate the following linear regression:

$$Ln\,(Leverage)_{i,t} = \alpha + \beta_1 Ln\,(Intangibility)_{i,t} + \beta_2 DM_{i,t} + \beta_3 Ln\,(Intangibility)_{i,t} \times DM_{i,t}$$
$$\beta_4 X_{i,t} + \beta_5 Y + \mu_i + \delta_t + \varepsilon_{i,t} \quad (5)$$

Where $Ln\,(Leverage)_{i,t}$ is the natural logarithms of the country *i*'s leverage ratio at year *t*. $Ln\,(Intangibility)_{i,t}$ represents the proportion of intangible assets in the total asset portfolio. $DM_{i,t}$ (Development Measurement) is the proxy for financial and economic development of the country e.g., Private Credit to GDP and GDP per capita. Although both the variables are part of country-level control variables, by analyzing the interaction effect between $Ln\,(Intangibility)_{i,t}$ and $DM_{i,t}$, we will able to observe the sensitivity of the relationship between leverage ratio and intangibility affected by financial and economic development of country. β_4 in the equation represents the coefficients of the traditional driving factors of leverage that are aggregated among firms within a country. Control variables, include $Ln\,(Current\ Ratio)_{i,t}$ and $Ln\,(Profitability)_{i,t}$. The coefficient, β_5, in the regression equation represents the coefficients of macro control variables $Inflation_{i,t}$, $Stock\ Market\ Growth_{i,t}$, $Ln(GDP\ per\ Capita)_{i,t}$, and $Government\ Effectiviness_{i,t}$. μ_i denotes the fixed effects that controls for country specific variables. It affects across countries but do not vary within a country over time e.g., geographical location of country and specific culture that country has on its own. δ_t denotes time-fixed effects that would allow to vary over time but be assumed to be the same across all countries such as shocks and economic downturns. $\varepsilon_{i,t}$ denotes the white noise that varies over year and country and are left unexplained about the dependent variable.

4.2 OLS Assumptions

For the normality assumption described as $U_i \sim N(0, \sigma 2)$, both error terms and beta variables follow a normal distribution. Having 700 observations in total allows to follow the central limit theorem in the distribution, in addition, taking the natural logarithms in some of the variables allows a better fit of the normal distribution (Appendix D). The panel data of 700 observations consists of 35 countries with the time period of 20 years. To examine the variation between countries and years and conduct whether the observed variations are statistically significant or due to random chance, we will conduct the ANOVA test for country and year that proves the independence of each country and year. For the ANOVA test for country, we facilitated:

H0: Mean values of $Ln\,(Leverage)_{i,t}$ *of each country is equal (*$m_1 = m_2 = m_3 = m_4 \ldots = m_{35}$*)*
HA: at least one country has a different mean of the Ln(leverage)

The p-value becomes 0.000 <0.01 implies that we can reject the null hypothesis that all countries are independent of each other at a 1% significant level. We apply the same to year, facilitating.

H0: Mean values of $Ln\ (Leverage)_{i,t}$ *of each country is equal (*$k_1 = k_2 = k_3 = k_4 \ldots = k_{35}$*)*
HA: at least one country has a different mean of the $Ln\ (Leverage)_{i,t}$*,*

The p-value becomes 0.000 < 0.05, which implies that we can reject the null hypothesis that all times are independent of each other at a 5% significant level. Therefore, it is proven that observed between-country variations and between-year variations are statistically significant.

For the heteroscedasticity problem described as Var (μ_i) = $\sigma^2 < \infty$, introducing fixed effect model allows us to control unobserved country specific variables that stay constant over time but could have an effect on the dependent variable. Conducting the Hausman test to see whether our regression model should take fixed effect and random effect, the p-value < 0.05 rejects the null hypothesis that random effects model is consistent, therefore our regression model introduces fixed effects model. It removes the fixed country specific effects and allows us to focus on the within-country variation. Applying the fixed effect demeaned the time-invariant factors among countries and set the mean value to be zero, however the regression still experienced non-constant variances in the error term within a country. Therefore, we decided to introduce robust standard errors that cluster observations by country and address possible autocorrelation among data points within a country. In addition to time-invariant factors, it is important to consider time-specific factors that are constant across all countries but may vary across different time periods. Including time-specific factors helps us control for time-related events like shocks and time-related trends and allow us to focus on a country-specific variation. To see if time-specific factors exist in our panel data, we compared the regression with/without clustering through the likelihood test that examines the goodness-of-fit between two panel data regressions. It gave the p-value < 0.05, rejecting the null hypothesis that adding a time-dummy variable does not improve the goodness-of-fit. Also, the R-squared improved from 0.2739 to 0.4601, therefore we will grant the existence of time-specific factors and decide to have the time fixed effect. After the following testing, our regression model is proxied under two-way fixed effects for country- and time-specific factors.

Exogeneity of the independent variable and the white noise also needs to be held described as Assumption: Cov ($x_{i,t}$, $\varepsilon_{i,t}$) = 0. In order to obtain the condition, our regression applied multiple control variables that are time-varying to mitigate possible omitted variables. Including the independent variable and control variables added, the multicollinearity test namely variance inflation test (VIF) was performed with the threshold of VIF value < 10.

4.3 Hypotheses Testing

As three hypotheses have been established in the Theoretical Framework, we will use three different regression models for each hypothesis. To investigate the existence of correlation between $Ln(Leverage)_{i,t}$ and $Ln(Intangibility)_{i,t}$, given the OLS assumptions, our regression facilitates control variables for firm-variant and macro-variant variables and interpret the coefficients at a 5% statistically significant level.

$$Ln\,(Leverage)_{i,t} = \alpha + \beta_1 Ln\,(Intangibility)_{i,t} + \beta_2 Ln\,(Current\ Ratio)_{i,t} + \beta_3 Ln\,(Profitability)_{i,t} +$$
$$\beta_4 Ln\,(Private\ Credit\ to\ GDP)_{i,t} + \beta_5 Ln\,(GDP\ per\ Capita)_{i,t} + \beta_6\ Inflation_{i,t} +$$
$$\beta_7\ Stock\ Market\ Growth_{i,t} + Government\ Effectiveness_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (6)$$

Since the regression model is a mix of log-log model and semi-log model, the interpretation of the coefficient differs for variable in natural logarithms and absolute value. For the log-log model that facilitates both independent and dependent variables in natural logarithms, the coefficients are interpreted as $\beta\%$ percentage change in the leverage ratio against 1% change of explanatory variables. For the semi-log model that contains explanatory variables in absolute value while a dependent variable in natural logarithms. The coefficients can be interpreted as $\beta\%$ change in the dependent variable against a one-unit change in explanatory variables.

The first regression equation allows us to observe the effect of each independent and explanatory variables on the leverage, which enable us to answer the first hypothesis that there is a negative correaltion between the leverage ratio and intangible assets. However, the feasibility only limits to the effect of each variable on the dependent variable and it does not present changes in the effect of intangibility with the level of financial development. In the second regression model, the interaction effect between $Ln\,(Leverage)_{i,t}$ and $Ln\,(Private\ Credit\ to\ GDP)_{i,t}$ is included as a moderator of the relationship. Financial development can enhance accessibility of capital as it would reduce frictions as such information asymmetry and transactions costs between borrowers and lenders. As discussed in the Theoretical Framework, intangible assets would be one of the driving factors of higher transaction costs and costs of debt due to inability to use as collaterals. Therefore, the interaction effect could allow us to see the effect on financial development on the sensitivity of the correlation between leverage ratio and intangibility. The regression equation is formulated as:

$$Ln\,(Leverage)_{i,t} = \alpha + \beta_1 Ln\,(Intangibility)_{i,t} + \beta_2 Ln\,(Intangibility)_{i,t} \times$$
$$Ln\,(Private\ Credit\ to\ GDP)_{i,t} + \beta_3 Ln\,(Current\ Ratio)_{i,t} + \beta_4 Ln\,(Profitability)_{i,t} +$$
$$\beta_5 Ln\,(Private\ Credit\ to\ GDP)_{i,t} + \beta_6 Ln\,(GDP\ per\ Capita)_{i,t} + \beta_7\ Inflation_{i,t} +$$
$$\beta_8\ Stock\ Market\ Growth_{i,t} + Government\ Effectiveness_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (7)$$

The interaction effect contains two continuous numerical variables. It means that the slope of dependent variable for the independent variable changes as the values of the second continuous change. To observe how the slope of this relationship changes depending on the value of the second continuous, we will take the derivative of the regression equation with respect to $Ln\ (Intangibility)_{i,t}$ while holding the values of $Ln\ (Private\ Credit\ to\ GDP)_{i,t}$ within the range of 2.98 and 5.95, representing the minimum and maximum value of the variable. This allows us to see the slope of the relationship at different values of the second explanatory variable. Denoting $Ln\ (Leverage)_{i,t}$ as y, $Ln\ (Intangibility)_{i,t}\ as\ x_{1,t}$, and $Ln\ (Private\ Credit\ to\ GDP)_{i,t}\ as\ x_{2,t}$, the computation will be formulated as:

$$Slope = \frac{dy}{dx_1} = \beta_1 + \beta_2 \times x_2 \quad (8)$$

Facilitating the interval of 0.5 for the range between 2.95 and 5.95, we will collect 6 different slopes of the relationship to see how the effect of intangibility on leverage ratio changes with the existence of financial development. The interpretation of the intercept, α, would be considered to be meaningless. Having to facilitate both logarithm and absolute values in the explanatory variables in the regression equation, the intercept would experience a mix between the interpretation of log-log model and semi-log model. In the log-log model, the intercept usually represents the expected value of the dependent variable assuming that the absolute value of all the explanatory variables is 1. However, in the semi-log, the intercept is interpreted as the expected value of the dependent variable when the absolute value of the explanatory variables is zero. Therefore, it would not be relevant to take that coefficient into account in our analysis.

To check whether our results are time-period specific, we equally split the panel data into two intervals of time period in which one is between 2002 and 2011 (period 1) and the other is between 2012 and 2021 (period 2). By conducting separate analyses for period 1 and period 2, we will be able to gain insights into how the relationship between the leverage ratio and intangibility have evolved over time, allowing us to answer our hypothesis 3. This analysis is inspired by the finding by (Stahle 2015) that the economy has become more knowledge-based due to a drastic increase in investment into intangible assets, for example, in 2015, intangible capital accounts for approximately 45% of the world GDP. Furthermore, the interaction effect between $Ln\ (Intangibility)_{i,t}$ and $Ln\ (Private\ Credit\ to\ GDP)_{i,t}$ will similarly be included in both the regressions for the sensitivity analysis of the relationship of our interest. Based on the asymmetric information theory (Gao and Zhu, 2015) that a strong financial system would remove frictions between lenders and borrowers, leading to a lower cost of borrowing and making intangible assets less relevant in cost of borrowings.

5. Results & Discussion

5.1 Country Level Analysis

Table 5 reports the correlation of intangibility and leverage ratio and explores how the sensitivity of leverage ratio to intangibility varies with financial, economic, and institutional development. The dependent variable is the natural logarithm of leverage ratio and the independent variable is the natural logarithm of intangibility. Column (1) reports the OLS estimates of the relationship between leverage ratio and intangibility with firm-variant control variables included and column (2) shows the OLS estimates with the inclusion of both firm-variant and macro-variant control variables. Column (3) reports the regression equations with the interaction term included. Values of t-statistics, presented in parentheses, are based on standard errors robust to heteroscedasticity and the two-way fixed effect.

Table 5: Regression results applicable to Hypothesis 1 & 2. Column (1) reports the regression results of Ln (Leverage Ratio) for Ln (Intangibility) and firm-variant control variables. Column (2) adds macro-variant variables from Column (1) and Column (3) reports the interaction effect of Ln (Private Credit to GDP). Coefficients of log variables represents β% change in 1% in explanatory variables and coefficient of semi-log variables represents β% change in the dependent variable against a one-unit change in explanatory variables.

	(1) Ln (Leverage Ratio)	(2) Ln (Leverage Ratio)	(3) Ln (Leverage Ratio)
Ln (Intangibility)	0.055	0.016	0.586*
	(0.060)	(0.051)	(0.290)
Ln (Current Ratio)	-0.563***	-0.593***	-0.627***
	(0.168)	(0.145)	(0.147)
Ln (Profitability)	0.053	0.251*	0.250*
	(0.153)	(0.145)	(0.133)
Ln (Private Credit to GDP)		0.263	-0.143
		(0.208)	(0.258)
Ln (GDP per Capita)		0.312**	0.299**
		(0.131)	(0.127)
Government Effectiveness		0.061	0.028
		(0.105)	(0.104)
Inflation (%)		0.005	0.005
		(0.004)	(0.003)
Stock Market Growth		-0.015	-0.024
		(0.343)	(0.337)
Ln (Intangibility) × Ln (Private Credit to GDP)			-0.128*
			(0.068)
Constant	-0.993***	-5.059***	-3.048***
	(0.285)	(1.101)	(1.051)
Observations	700	700	700
R^2	0.323	0.419	0.443
Adjusted R^2	0.30	0.40	0.42

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Column (1) and (2) report the estimation results of the regression equation (5) with the interaction term excluded. In Column (1), the coefficient of $Ln\ (Intangibility)_{i,t}$ shows a positive value of 0.055, which can be interpreted that a 1% increase in the level of identifiable intangible assets to total asset leads to a 0.055% increase in the leverage ratio on average. However, this regression model is not significant and a low goodness-of-fit to the data, shown as in the R-squared of 0.323 that only 30% of the variation in leverage ratio can be attributed to intangibility. A possible violation of endogeneity,

especially omitted variables should be considered for robustness. Column (2) applied the complete form of equation (5) which includes both firm-variant and macro-variant control variables. In consistent with Column (1), there is a slight positive correlation between leverage ratio and intangibility with the coefficient of 0.016 although the coefficient is insignificant. The coefficient indicates that a 1% increase in the level of identifiable intangible assets leads to a 0.016% increase in the leverage ratio. Adding more control variables has improved the R-squared to 0.419, implying that a large portion of the variation in the leverage ratio is explained by the independent and control variables in the regression model. The insignificance in the coefficients and lower value of the effect on leverage than the firm-level are possibly due to the use of country-level. OECD research (2019) revealed that there is a different level of intangibility in industries and each country has different concentration level of industry types that they focus on. Expanding our analysis on a country-level that includes all types of industries except for the financial sector might offset intangible intensive industries and tangible intensive industries with each other and made it harder to visualize the relationship of leverage ratio.

Our results of the coefficients indicate the opposite prediction to the conventional theory of the relationship between leverage ratio and intangibility. As it was predicted by Harris and Raviv (1991) that firms with higher intangible assets would have to take a higher cost of debt due to the inability to deposit collaterals. Also, Dahmash, Durand & Watson (2009) suggested, using the Australian Stock Exchange between 1994 and 2003, that identifiable intangible assets tend to be overly reported and that would lead to a higher agency cost between mangers and stakeholders. However, our results are consistent with more recent research on the relationship (Lim, Macias, & Moeller, 2020), in which the research sample was based on the data collected after the introduction of SFAS 141R (2001). They proposed a positive correlation between leverage ratio and identifiable intangible assets because of collateralizability and potential cash flow generation. It is also aligned with the agency cost theory (Jensen and Meckling, 1976) and the information asymmetric theory (Myers and Majluf, 1984). Accounting improvement in valuation and identification of intangible assets would enable firms to provide more accurate/reliable valuation of the assets, leading to less frictions between debtors and creditors as well as more transparency between mangers and debtholders. Therefore, we reject the first hypothesis that leverage ratio is negatively correlated with intangibility.

Column (3) introduces the interaction term of financial development, economic development, and institutional development, respectively. In Column (3), the regression takes the interaction effect between $Ln\ (Leverage)_{i,t}$ and $Ln\ (Private\ Credit\ to\ GDP)_{i,t}$. The interaction term influenced at a great degree to the coefficient of the coefficient of $Ln\ (Intangibility)_{i,t}$, which indicates a possible problem with the multicollinearity between private credit to GDP and intangibility. We will detail the robustness check of the models in the later chapter. The coefficient of intangibility indicates that a 1%

increase in intangibility is associated with 0.586% increase in leverage ratio at 10% significant level. The coefficient of the interaction term is -0.128 which is interpreted as the change in the slope of leverage ratio for every 1% increase in intangibility at 10% significant level. *Figure 19* presents changes in the slope of the relationship vs. the level of private credit to the GDP of country. The graph explains that the less positive the slope of leverage ratio becomes, the more financial development the country is. In addition, the slope becomes negative above $Ln\ (Private\ Credit\ to\ GDP)_{i,t}$ at 4.95 that is equivalent to the private credit to GDP of 141.17%. This means that, on average, above private credit to GDP of 141.7%, intangibility has a negative correlation with leverage ratio. The decrease in the magnitude of the sensitivity is consistent with the previous research that stronger financial development would reduce market frictions and lower information asymmetry, making asset tangibility as a criterion of borrowers' credibility less relevant (Naeem and Li, 2019). Aligned with the information asymmetry theory and credit rating theory, if intangibility of firms becomes less relevant as a cause of information asymmetry and determinant of credit rating, the sensitivity of the slope of leverage ratio for intangibility becomes closer to zero. However, it has not been explicitly explained in previous research that a higher level of financial development would change the slope of leverage ratio from a positive to negative sign. This implies that on a country level, the higher rate of intangible assets to total assets, the lower leverage ratio the aggregate of non-financial firms in the country becomes. Previous research has found out that investment in intangible assets has been increasing and firms with less than 5% of debt in their capital structure has increased over the years (Stahle, 2015; D'Mello & Gruskin, 2014). In align with the upward trend of private credit to GDP over the sample period (*Figure 11*), it could imply that a higher level of financial development offers more financing sources rather than debt for investment into intangible assets, which might be one of the causes of the slope of leverage ratio. However, further research on how financial development would change corporate financing decisions will be needed to explain our results. Regarding the second hypothesis that the negative correlation between the level of intangible assets and leverage ratio is more pronounced in countries with less financial development, our results support the higher sensitivity of the relationship in countries with less financial development and lower in countries with higher financial development.

Moving to the third hypothesis, we conduct a difference-in-differences analysis between two time period: 2002-2011 and 2012-2021. *Table 6* reports results of our analysis. Column (1) and (2) report the regression models based on the time period between 2002-2011 and Column (3) and (4) report the regression models based on the time period between 2012-2021. Comparing the regression (1) and (3), both the regression models are not established statistically significant as the coefficients are both insignificant as well as the goodness-of-fit is low at 0.120 and 0.081. Given that the variable $Ln\ (Intangibility)_{i,t}$ does not follow a perfect normal distribution, a lower number of observations for each regression made the quality of our samples worse than it was with 700 observations. The

coefficient has become smaller in (3) related to (1) by 0.007 in magnitude although the coefficients are very close zero. The negative correlation shows the opposite direction of the relationship to our first analysis.

Table 6: Regression results applicable to Hypothesis3. Column (1) and (2) reports the regression results from the time period (2002-2011) and (3) and (4) reports the results from the time period (2012-2021). Coefficients of log variables represents β% change in 1% in explanatory variables and coefficient of semi-log variables represents β% change in the dependent variable against a one-unit change in explanatory variables.

Time Period	2002-2011		2012-2021	
Dependent Variable	(1) Ln (Leverage Ratio)	(2) Ln (Leverage Ratio)	(3) Ln (Leverage Ratio)	(4) Ln (Leverage Ratio)
Ln (Intangibility)	-0.017	0.396*	-0.010	0.942
	(0.054)	(0.214)	(0.107)	(0.660)
Ln (Current Ratio)	-0.472***	-0.488***	-0.355	-0.407*
	(0.161)	(0.157)	(0.221)	(0.217)
Ln (Profitability)	0.336**	0.273*	0.274	0.283
	(0.161)	(0.145)	(0.185)	(0.182)
Ln (GDP per Capita)	-0.051	0.006	0.091	0.071
	(0.077)	(0.090)	(0.132)	(0.133)
Ln (Private Credit to GDP)	0.045	-0.270	-0.022	-0.532
	(0.175)	(0.205)	(0.205)	(0.360)
Government Effectiveness	0.167	0.131	-0.013	-0.051
	(0.105)	(0.096)	(0.167)	(0.161)
Inflation (%)	-0.008	-0.006	0.000	-0.001
	(0.005)	(0.006)	(0.002)	(0.002)
Stock Market Growth	-0.055**	-0.053**	0.040	0.019
	(0.021)	(0.021)	(0.040)	(0.031)
Ln (Intangibility) × Ln (Private Credit to GDP)		-0.095*		-0.211
		(0.050)		(0.136)
Constant	-0.786	0.036	-1.968	0.679
	(1.131)	(1.114)	(1.739)	(2.162)
Observations	350	350	350	350
R^2	0.120	0.146	0.081	0.110
Adjusted R^2	0.10	0.12	0.06	0.09

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

If we have a look at the regression (2) and (4) that include the interaction term of $Ln\ (Private\ Credit\ to\ GDP)_{i,t}$, the regressions have improved at a slight extent seem from the goodness-of-fit increased to 0.146 and 0.110, respectively, and the coefficient of the regression (2) significant at 10% level. Similar to our first analysis, there is a potential issue of multicollinearity between private credit to GDP and intangibility due to a great change in the coefficient with/without the interaction term. The estimated coefficient is higher in (4) than (2) at 0.942 and 0.396, implying that intangible assets have become more important to take debts, that is consistent with the previous research that the economy is shaping more knowledge-based economy thanks to an increase in investment in intangible assets over the years. Furthermore, there might be an improvement in the

valuation of identifiable intangible assets which have increased the rate of identifiable intangible assets used as collaterals (Lei, Qiu, & Wan, 2018). The coefficient of the interaction term has also increased to -0.211 from -0.095 although only the estimate from the column (2) is significant at 10% level. This implies that the later period has experienced a higher extent of financial development that improved investment efficiency and frictions between debtors and creditors. Given the upward trend of financial development over the years (*Figure 11*), our result is consistent with the data and previous research (Lim, Macias, & Moeller). Therefore, to answer our third hypothesis that the correlation between the level of intangible assets and leverage ratio is becoming less pronounced in recent years, we reject the hypothesis that it shows a positive correlation with each other because of the ability of identifiable intangible assets as collaterals. The ability seems to be increasing compared to period 1 and period 2. Due to the insignificance to the models, it is challenging to interpret the results, comparing period 1 and period 2, it is fair to conclude the information asymmetry and agency cost caused by intangible assets have improved in response to the shift to the knowledge-based economy and the continues upward trend of financial development.

5.2 Robustness Check

This section discusses the validity and reliability of our models and results obtained from the models.

5.2.1 Multicollinearity Concern

The multicollinearity between $Ln\,(Intangibility)_{i,t}$ and $Ln\,(Private\ Credit\ to\ GDP)_{i,t}$ was the main concern in our regression model. Although our regression model passed the variance inflation factor test (VIF test), due to a potential linear relationship between the two variables, it became challenging to explain each independent variable's contribution in explain the variation of the dependent variable. To mitigate the multicollinearity of the two variables, we transformed the current continuous variable of $Ln\,(Private\ Credit\ to\ GDP)_{i,t}$ into the categorical variable which takes 0 if private credit to GDP is below the median and 1 if it is above the median. We split the category into "weak financial development" and "strong financial development". This would help to reduce the correlation by providing a more articulated differentiation between the levels of financial development. As a result, the correlation decreased from 0.4167 to 0.310. *Table 7* reports the results of the regression model with and without the interaction term between $Ln\,(Intangibility)_{i,t}$ and Financial Development. Although the coefficient of $Ln\,(Intangibility)_{i,t}$ is still insignificant, the inclusion of the interaction term influences at a lower extent to the coefficient compared to the models using the continuous variable of $Ln\,(Private\ Credit\ to\ GDP)_{i,t}$. The coefficient -0.199 of the interaction term indicates that if the financial development is strong, the slope of leverage ratio decreases by 0.199 at 1% significance level while it was only 10% significant at our previous model. *Figure 20* shows a consistent result with our previous models that a positive correlation turns to a negative correlation, indicating that the multicollinearity concern has improved, and this model enables us to obtain more significant coefficients.

Table 7: Regression results with categorical variable of Financial Development. Taking a categorical variable of Financial Development, which takes 0 below the median of Private Credit to GDP (Weak) and 1 above the median (Strong). The coefficient of the interaction term represents the sensitivity impact when Financial Development is strong.

	(1) Ln (Leverage Ratio)	(2) Ln (Leverage Ratio)
Ln (Intangibility)	0.013	0.063
	(0.050)	(0.044)
Ln (Current Ratio)	-0.574***	-0.545***
	(0.153)	(0.143)
Ln (Profitability)	0.180	0.136
	(0.145)	(0.128)
Financial Development	0.054	-.417***
	(0.046)	(0.165)
Ln (GDP per Capita)	0.302**	0.226*
	(0.122)	(0.123)
Government Effectiveness	0.068	0.072
	(0.107)	(0.107)
Inflation (%)	0.005	0.004
	(0.005)	(0.005)
Stock Market Growth	-0.054	-0.051
	(0.051)	(0.051)
Financial Development		-0.417**
		(0.165)
Financial Development × Ln (Intangibility)		-0.199***
		(0.072)
Constant	-3.885***	-3.112***
	(1.037)	(1.077)
Observations	700	700
R^2	0.396	0.428
Adjusted R^2	0.37	0.40

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.2.1 Aggregation Bias: Firm-Level Analysis

As part of populating my country-level sample, we have aggregated all the individual non-financial firms by country to capitalize the variables. However, due to the possible existence of aggregation bias, conclusions drawn at the country level might not hold true at the firm level. Within the country-level sample, our database does not allow parameter heterogeneity across individual firms but rather generate heterogeneity across countries by the aggregation of firms. Therefore, it is worthwhile to conduct a regression analysis on a firm-level as well to see the consistency and reliability of our country-level results. Using individual firms from 35 different country between 2002-2021, as referred to the Data section, we have made a regression model based off the panel data. Column (1) reports the OLS estimates of the relationship between leverage ratio and intangibility and column (2) shows the OLS estimates with the inclusion of firm-variant and country-variant control variables.

Table 8: Regression results with firm-level sample. We disaggregate our country-level sample and take all individual non-financial firms in our panel data sample. Column (1) reports the firm-level effect of intangibility on leverage ratio with all firms from 39 countries for 20 years and Column (2) reports the same but our sample is refined to 35 countries, excluding Brazil, New Zeeland, Peru, and Russia. The exclusion mitigates the bias in our macro-variant variables as those countries contain less than 10 firms in our sample.

	(1)	(2)
	Ln (Leverage Ratio)	Ln(Leverage Ratio)
Ln (Intangibility)	0.028	0.021
	(0.021)	(0.014)
Ln (Profitability)		0.261***
		(0.045)
Ln (Current Ratio)		-0.482***
		(0.031)
Ln (Private Credit to GDP)		-1.420**
		(0.649)
Ln (GDP per Capita)		0.608
		(0.504)
Government Effectiveness		-0.298
		(0.346)
Stock Market Growth		-0.208
		(0.132)
Inflation (%)		-0.033
		(0.021)
Constant	-1.181***	1.118
	(0.093)	(2.199)
Observations	106280	106040
R^2	0.001	0.111
Adjusted R^2	0.00	0.11

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The results obtained from the firm-level analysis turned out to be insignificant but resembling to results obtained from the country level analysis in terms of the direction and magnitude of the relationship between leverage ratio and intangibility. The coefficient of 0.021 in column (2) indicates that 1% increase in intangibility is associated with 0.021% increase in the level of leverage ratio. The firm-variant control variables are also consistent with the country-level analysis at 1% significant level. Higher profitability shows more credibility in cash flow generation, allowing firms to take more leverage, consistent with previous studies. Whereas higher current ratio indicates that firms own more current assets relative to liabilities in their capital structure, implying a negative correlation between current ratio and leverage ratio. One noteworthy aspect from the country-variant variables is a strong correlation between $Ln\ (Private\ Credit\ to\ GDP)_{i,t}$ and $Ln\ (Leverage\ Ratio)_{i,t}$, indicating that 1% increase in private credit to GDP leads to 1.4% decrease in the level of leverage ratio. The greater difference in the magnitude of coefficient between firm-level and country-level could possibly be derived from the firm-specific variation. Consistent with the study by Arellano, Bai, & Zhang (2010), small firms tend to use less debt financing in less financially developed economies while as financial development improves, bigger firms tend to have lower leverage and smaller firms have higher leverage. To conclude, our country-level and firm-level analyses show the similar results in the relationship between leverage ratio and intangibility, hence our country-level analysis hold true.

6. Conclusion

In the economy where the asset profile has been shifting to more intangible asset-intensive, accounting rules on the valuation of intangible assets have shown improvement in accuracy recent years such as an introduction SFAS 141 and 141 R. Yet, there has been more and more firms that take less debt in the capital structure partially due to a high level of intangible assets, resulting in the growth mitigation of the economy. As one of the determinants of cost of debt when taking loans and credits, intangibility of firms has emerged as an important element in correctly identifying risk profiles of firms as well as obtaining the best capital structure to maximize profits of firms. As such, the objective of this study is to answer, "how does intangibility affect leverage ratio of non-financial firms across countries". Our study was centered to three hypotheses that examined: "H1: asset intangibility is negatively correlated with the leverage ratio.", "H2: The negative correlation between asset intangibility and leverage ratio is more pronounced in countries with less financial development", and "H3: The correlation between asset intangibility and leverage ratio is becoming less pronounced in recent years."

Using the panel data of 35 countries × 20 years, we modeled a OLS regression with the inclusion of interaction effect to answer the relationship of leverage ratio and intangibility. Furthermore, we split the panel data into two periods to observe the potential change in the relationship over time.
The empirical findings and analysis offer unique results that leverage ratio is positively associated with identifiable intangible assets and this relationship varies systematically from country to country due to variation in the level of financial development. The correlation of intangibility with leverage ratio is less positive for countries with stronger financial development and the correlation becomes negative when financial development is strong enough. Furthermore, our time difference-in-differences analysis shows a stronger effect of financial development on the sensitivity changes. These findings are deviated from the theoretical expectations given by various researchers who have proposed a negative correlation due to information asymmetry and frictions between managers and debtholders. However, the positive correlation obtained from our research is consistent with the study that focuses on the relationship between leverage ratio and identifiable intangible assets. This implies that identifiable intangible assets can be identified similar as tangible assets that can be used as collaterals and proof of cash flow generations. In terms of the cross-country difference, it is consistent with previous research that financial development makes the sensitivity of the relationship less pronounced as countries with stronger financial development improve investment efficiency and reduce financial frictions between debtors and creditors, making intangibility less relevant in the capital structure of firms. However, the negative slope of leverage ratio for identifiable intangible assets has not been presentenced in previous research. Therefore, our result offers new predictions that, in the knowledge-based economy, investment into intangible assets is more likely to be financed through different capital findings especially in countries with stronger financial development as strong

financial system would provide more financing sources other than debt financing. This prediction is in align with the previous research that the benefit of debt financing has been decreasing.

Our research enabled to expand the conventional theory of intangibility to leverage ratio within the firm level to the cross-country level and presented differences in the sensitivity of the relationship. Also, our findings present the advancement of intangible assets valuation/identification and give insight into the importance of intangible assets in optimizing the capital structure. Our research is one of the first studies that focused on the sensitivity analysis of leverage ratio and identifiable intangible assets with financial development as a moderator, which leaves a lot of space to further develop the relationship. It would be more insightful to take panel data that consists of more countries with more recent years as the relationship has been changing over the years. Additionally, the cross-country analysis could be expanded to different indicators as well such as institutional development and economic development to fully capture cross-country variations.

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8. Appendix

Appendix A: Summary Statistics of Our Sample

This table reports the descriptive data of counties in our sample. Out of 39 countries in our raw data, we filter out firms who data is not available for the years between 2002 and 2021, which left us with 5314 individual firms from 35 countries.

Country	Raw Data - Number of Firms	Processed Data - Number of Firms	Sample Year
Argentina	81	13	2002-2021
Australia	1781	71	2002-2021
Austria	134	29	2002-2021
Belgium	340	42	2002-2021
Brazil	2944	1	2002-2021
Canada	150	86	2002-2021
Chile	11486	40	2002-2021
China	164	863	2002-2021
Denmark	167	33	2002-2021
Finland	667	71	2002-2021
France	585	206	2002-2021
Germany	139	214	2002-2021
Greece	209	13	2002-2021
Hong Kong	733	30	2002-2021
India	489	67	2002-2021
Indonesia	365	20	2002-2021
Israel	3841	21	2002-2021
Italy	2393	58	2002-2021
Japan	954	1272	2002-2021
Korea	147	414	2002-2021
Malaysia	131	101	2002-2021
Mexico	110	13	2002-2021
Netherlands	242	29	2002-2021
New Zealand	647	1	2002-2021
Norway	48	30	2002-2021
Peru	791	4	2002-2021
Philippines	909	13	2002-2021
Poland	231	22	2002-2021
Portugal	775	18	2002-2021
Russia	425	6	2002-2021
Singapore	1254	42	2002-2021
South Africa	61	36	2002-2021
Spain	302	37	2002-2021
Sweden	4859	87	2002-2021
Switzerland	120	83	2002-2021
Thailand	264	63	2002-2021
Turkiye	565	25	2002-2021
United Kingdom	6978	167	2002-2021
United States	203	973	2002-2021
Total	46684	5314	2002-2021

Appendix B: Average of the Variables by Country

This table reports the descriptive summary of the dependent, independent, firm-variant, and country-variant control variables by each year.

Country	Leverage Ratio	Intangibility	Current Ratio	Profitability	Inflation	Private Credit to GDP	Stock Market Growth	GDP per Capita	Ln (GDP per Capita)
Argentina	0.148	0.019	1.273	0.291	16.635	27.625	23.708	9466.858	9.055
Australia	0.134	0.131	1.275	0.443	2.390	182.010	9.541	48882.258	10.749
Austria	0.266	0.107	1.249	0.284	1.890	141.305	12.524	45606.561	10.714
Belgium	0.212	0.429	1.072	0.281	1.885	192.570	7.354	42647.222	10.648
Brazil	0.341	0.028	1.671	0.268	6.225	64.485	15.091	8278.723	8.935
Canada	0.222	0.282	1.201	0.241	1.870	187.690	9.905	43452.174	10.660
Chile	0.191	0.058	1.515	0.178	3.200	120.755	8.232	74825.766	9.326
China	0.149	0.042	1.073	0.198	2.345	160.180	14.596	11969.350	8.437
Denmark	0.252	0.192	1.236	0.513	1.410	233.010	16.229	5842.841	10.920
Finland	0.305	0.130	1.438	0.383	1.500	164.205	5.255	55983.903	10.710
France	0.321	0.241	1.139	0.292	1.525	181.135	6.393	45387.928	10.556
Germany	0.304	0.182	1.193	0.259	1.555	128.460	10.815	38804.563	10.627
Greece	0.403	0.070	1.293	0.160	1.635	111.785	1.507	41822.494	9.983
Hong Kong	0.043	0.050	1.171	0.288	1.915	252.750	8.384	22087.750	10.476
India	0.141	0.079	1.372	0.324	6.425	95.795	20.128	36476.130	7.112
Indonesia	0.222	0.035	1.269	0.288	6.000	35.170	18.588	1347.270	7.837
Israel	0.322	0.358	1.348	0.287	1.465	115.855	9.513	2829.105	10.362
Italy	0.370	0.207	1.079	0.240	1.625	112.815	8.410	32996.471	10.416
Japan	0.376	0.059	1.415	0.256	0.175	164.625	3.774	33659.198	10.582
Korea	0.334	0.040	1.211	0.176	2.255	171.875	9.517	39605.462	10.096
Malaysia	0.136	0.085	1.412	0.148	2.090	128.850	12.236	25091.982	9.013
Mexico	0.194	0.230	1.046	0.329	4.245	33.540	6.655	8603.022	9.133
Netherlands	0.297	0.216	1.234	0.268	1.720	255.675	9.608	9325.686	10.778
New Zealand	0.236	0.213	0.939	0.627	2.150	175.435	10.058	48529.324	10.441
Norway	0.239	0.185	1.296	0.414	2.040	219.295	11.008	35412.528	11.252
Peru	0.182	0.103	1.218	0.333	2.700	31.240	11.559	78918.961	8.444
Philippines	0.142	0.086	1.627	0.182	3.685	36.208	18.746	5024.977	7.687
Poland	0.204	0.106	1.259	0.263	2.235	69.465	13.970	2350.189	9.351
Portugal	0.257	0.157	0.913	0.217	1.585	190.885	8.494	12111.592	9.943
Russia	0.071	0.066	2.018	0.333	8.805	74.015	2.667	21041.194	9.079
Singapore	0.159	0.051	1.320	0.183	1.565	176.680	17.089	9770.049	10.730
South Africa	0.242	0.096	1.464	0.334	5.455	70.790	8.810	48333.599	8.737
Spain	0.349	0.120	1.096	0.257	1.925	181.960	11.586	6402.436	10.238
Sweden	0.324	0.218	1.431	0.322	1.500	216.725	4.505	28261.988	10.833
Switzerland	0.252	0.259	1.447	0.423	0.355	221.965	12.393	51369.003	11.200
Thailand	0.171	0.086	1.391	0.237	1.885	146.055	8.998	5027.147	8.456
Turkiye	0.367	0.053	1.416	0.244	12.432	59.055	16.875	9306.846	9.097
United Kingdom	0.191	0.252	1.088	0.279	2.120	166.050	11.675	42162.576	10.643
United States	0.312	0.272	1.428	0.291	2.160	155.310	4.004	52431.474	10.854

Appendix C: Average of the Variables by Year

This table the dependent, independent, firm-variant, and country-variant control variables by each country.

Year	Leverage Ratio	Intangibility	Current Rate	Profitability	Inflation	Private Credit to GDP	Stock Market Growth	GDP per Capita	Ln (GDP per Capita)
2002	0.298	0.093	1.266	0.296	4.655	115.528	-9.042	16852.749	9.191
2003	0.279	0.095	1.303	0.312	3.331	116.281	51.901	19668.129	9.346
2004	0.282	0.098	1.341	0.315	2.867	117.238	24.506	22492.410	9.489
2005	0.315	0.107	1.307	0.317	3.333	120.478	20.061	23953.100	9.582
2006	0.255	0.119	1.282	0.315	3.402	124.081	30.999	25898.353	9.684
2007	0.263	0.135	1.388	0.312	3.260	129.452	16.304	29373.772	9.832
2008	0.259	0.146	1.285	0.304	4.868	135.892	-30.793	30781.549	9.890
2009	0.232	0.148	1.351	0.296	2.601	139.821	48.697	28938.674	9.847
2010	0.235	0.153	1.325	0.297	3.335	139.974	7.121	30990.113	9.957
2011	0.245	0.153	1.276	0.292	3.707	142.545	-11.109	33374.805	10.033
2012	0.237	0.156	1.275	0.313	3.072	145.301	17.489	33004.433	10.030
2013	0.230	0.158	1.274	0.297	2.456	147.485	5.569	33471.980	10.046
2014	0.224	0.161	1.312	0.278	2.196	150.402	-4.011	32096.122	10.014
2015	0.217	0.169	1.284	0.276	1.879	151.637	-4.045	29877.235	9.943
2016	0.209	0.175	1.263	0.268	2.399	151.986	13.876	30717.210	9.972
2017	0.210	0.173	1.271	0.285	3.227	150.980	7.315	32317.456	10.026
2018	0.202	0.168	1.289	0.272	3.714	151.189	-1.200	33017.213	10.047
2019	0.198	0.160	1.247	0.254	2.902	156.886	13.656	32320.637	10.021
2020	0.206	0.153	1.274	0.257	3.348	161.068	5.767	33476.811	10.048
2021	0.191	0.156	1.297	0.246	4.140	155.239	4.791	35657.972	10.059

Appendix D: Relevant Figures

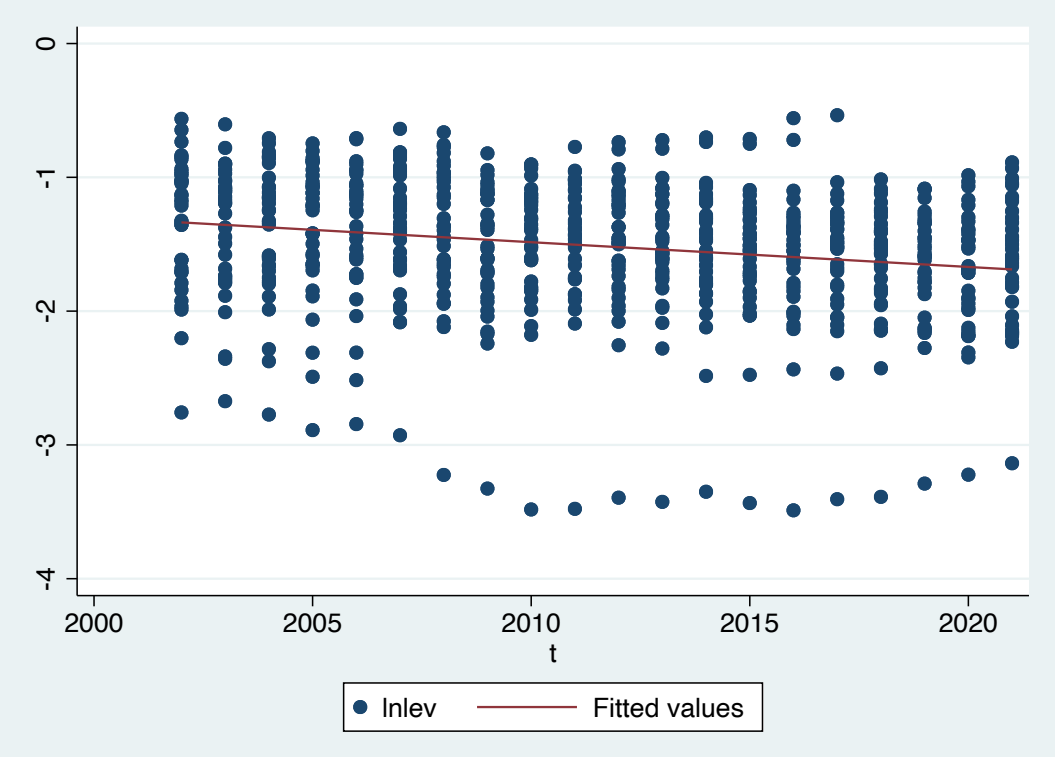

Figure 1: Scatter plot and prediction linear fit of Ln (Leverage Ratio) vs. Yea

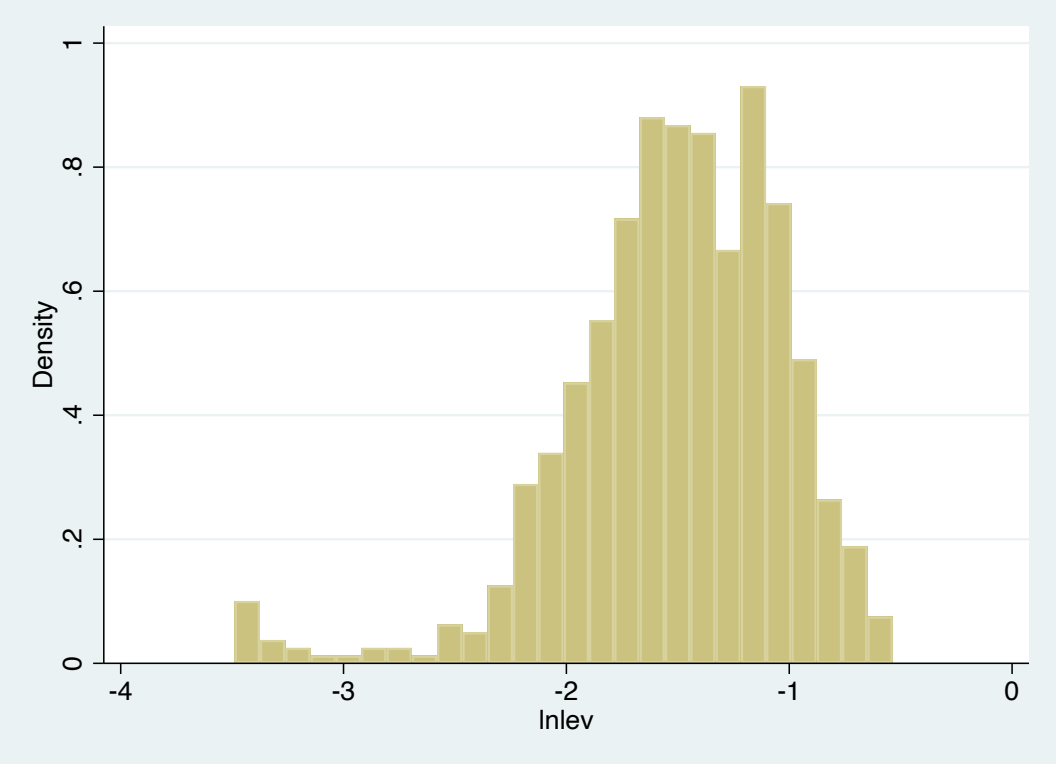

Figure 2: Histogram of Ln (Leverage Ratio)

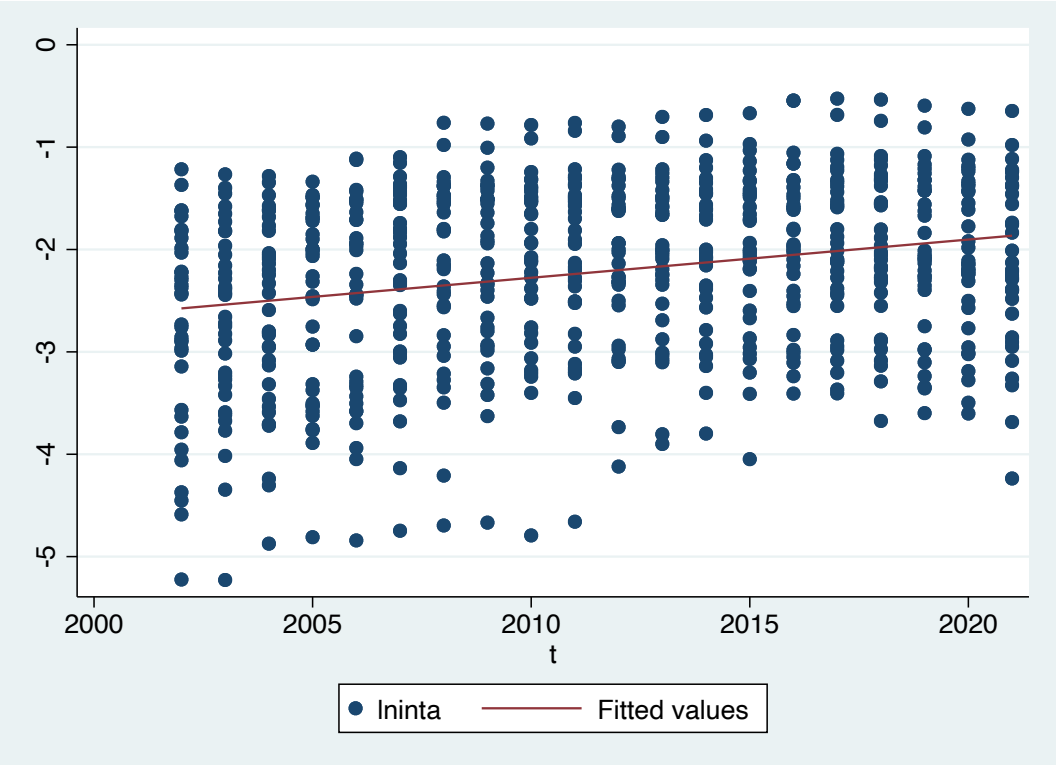

Figure 3: Scatter plot and prediction linear fit of Ln (Intangibility) vs. Year

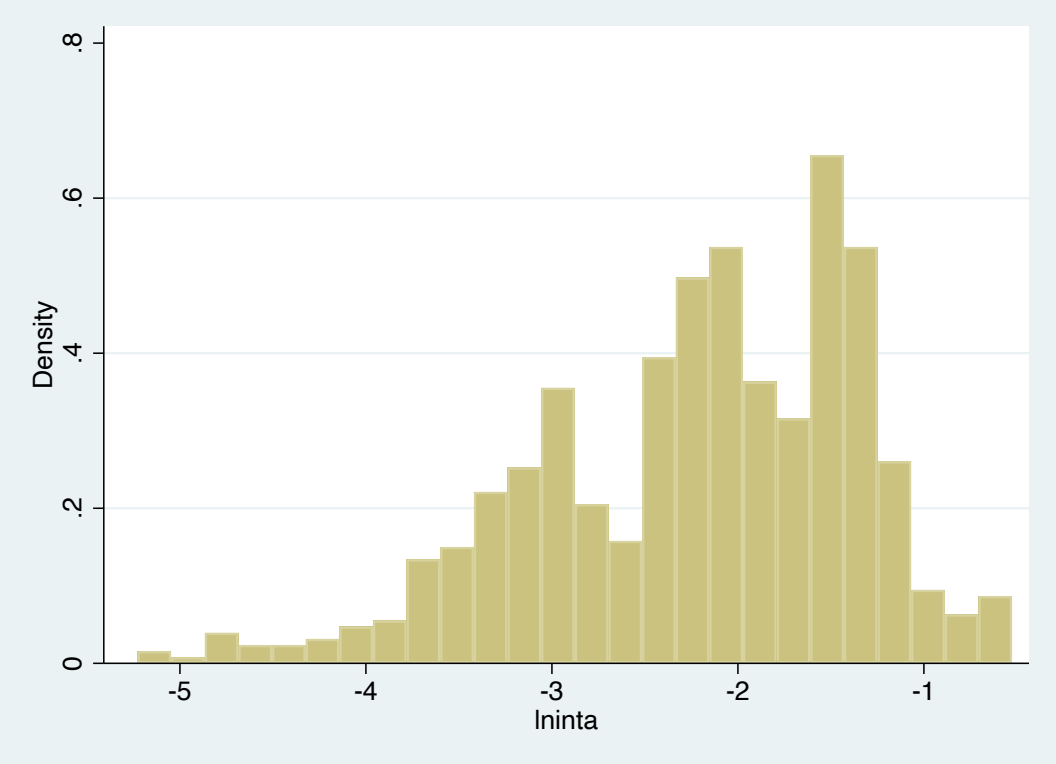

Figure 4: Histogram of Ln (Intangibility)

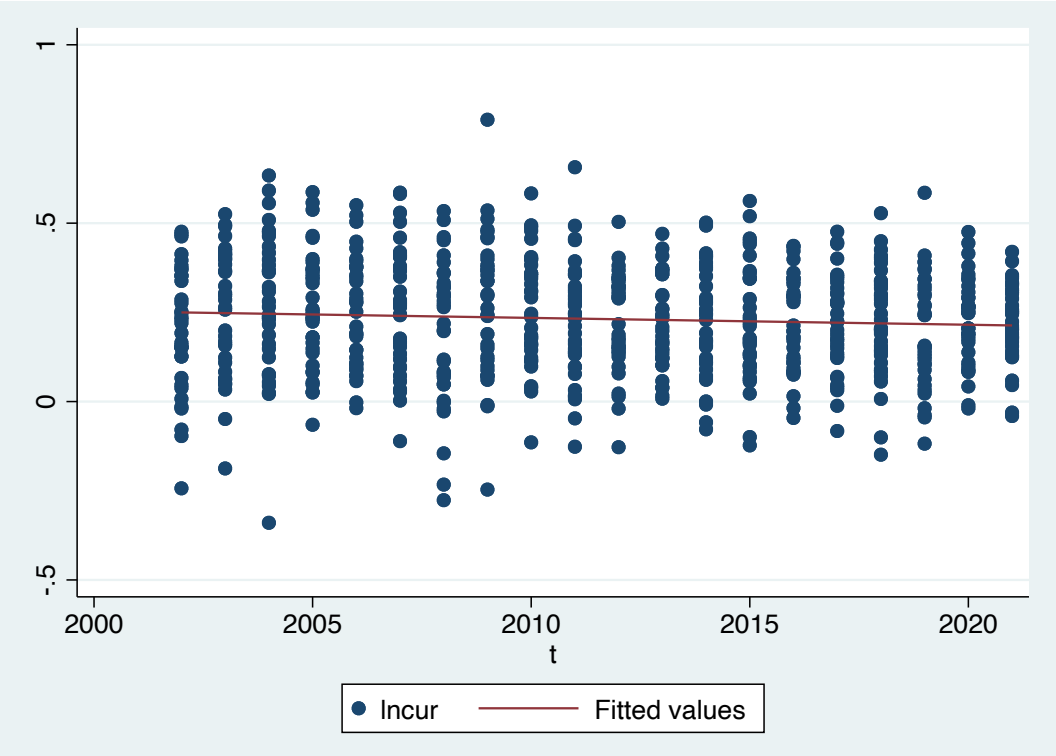

Figure 5: Scatter and data points of Ln (Current Ratio) vs. Year

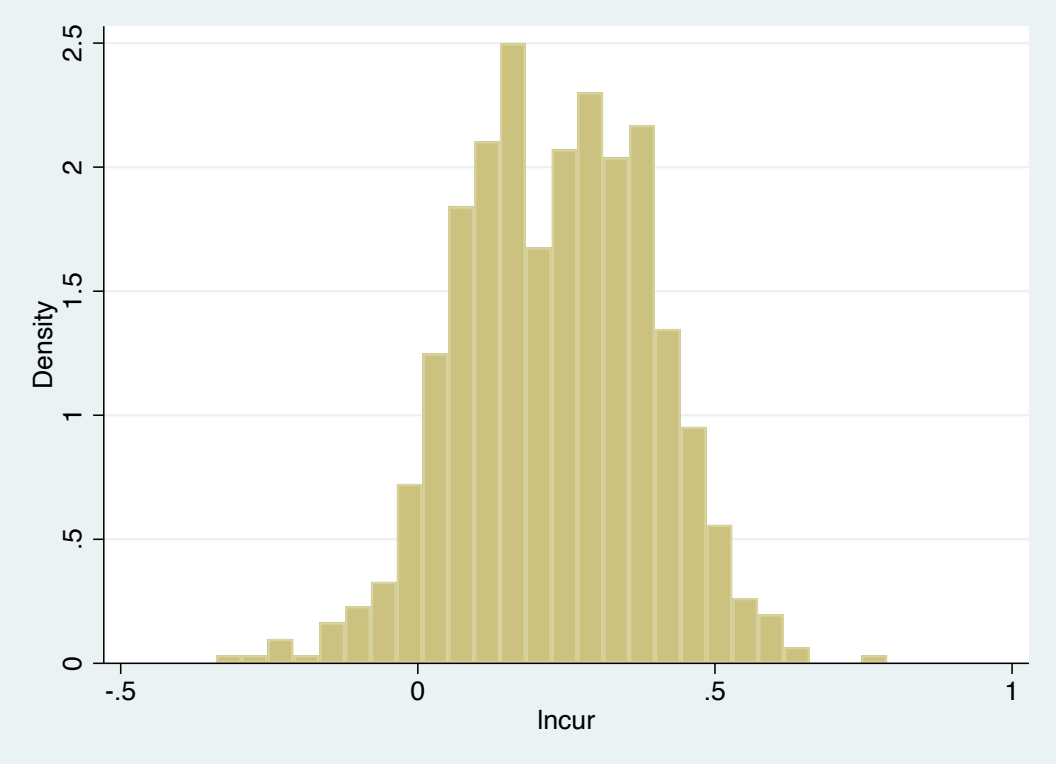

Figure 6: Histogram of Ln (Current Ratio)

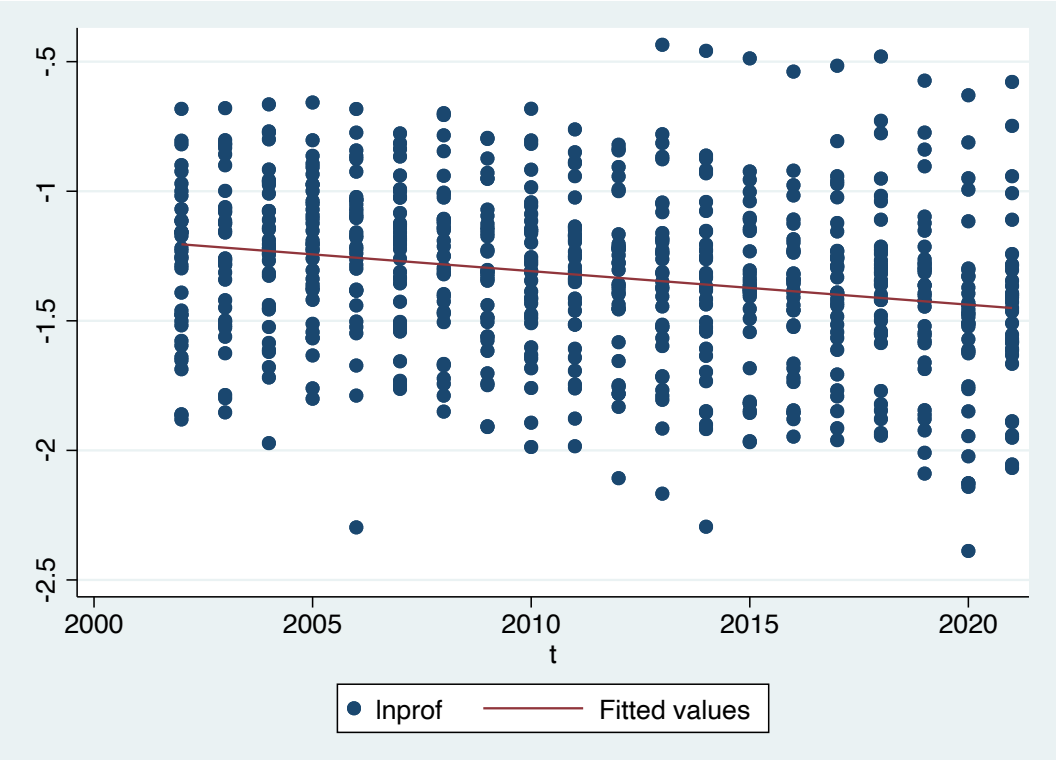

Figure 7: Scatter and data points of Ln (Profitability) vs. Year

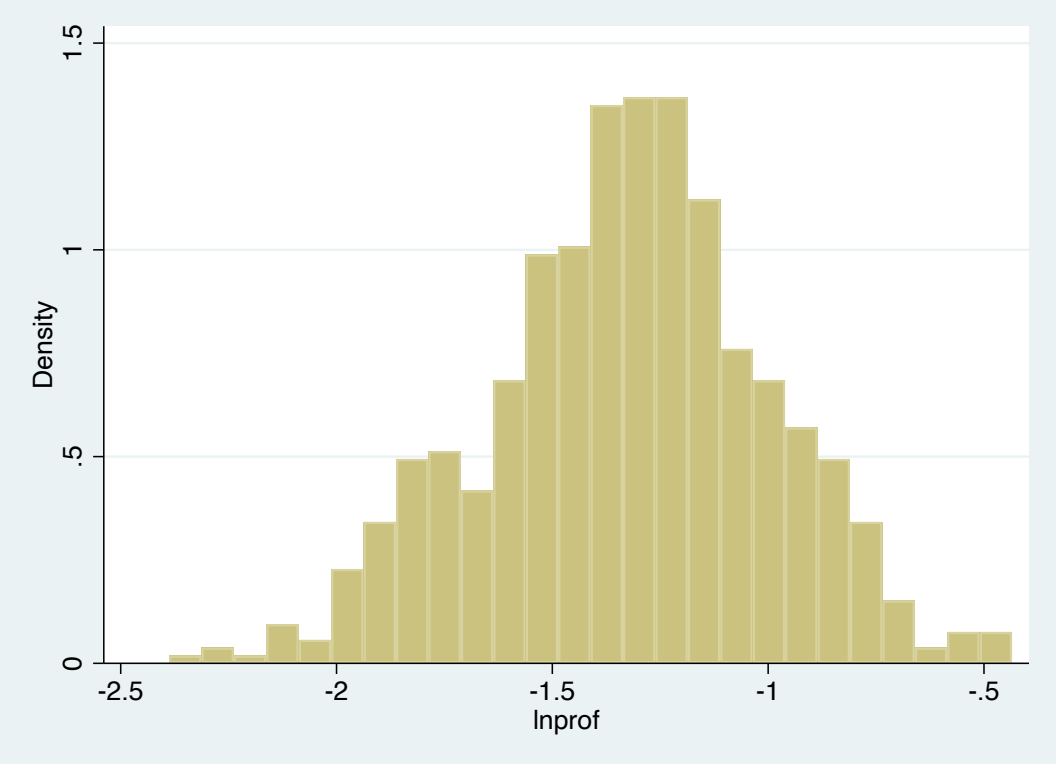

Figure 8: Histogram of Ln (Profitability)

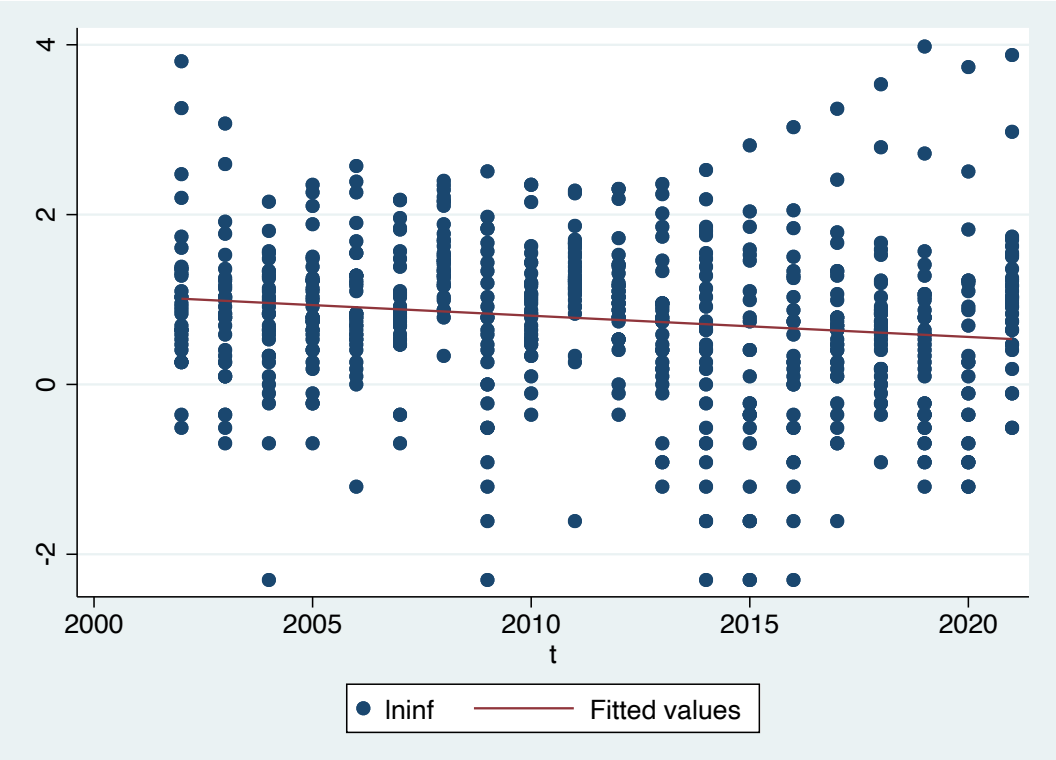

Figure 9: Scatter and data points of Ln (Inflation) vs. Year

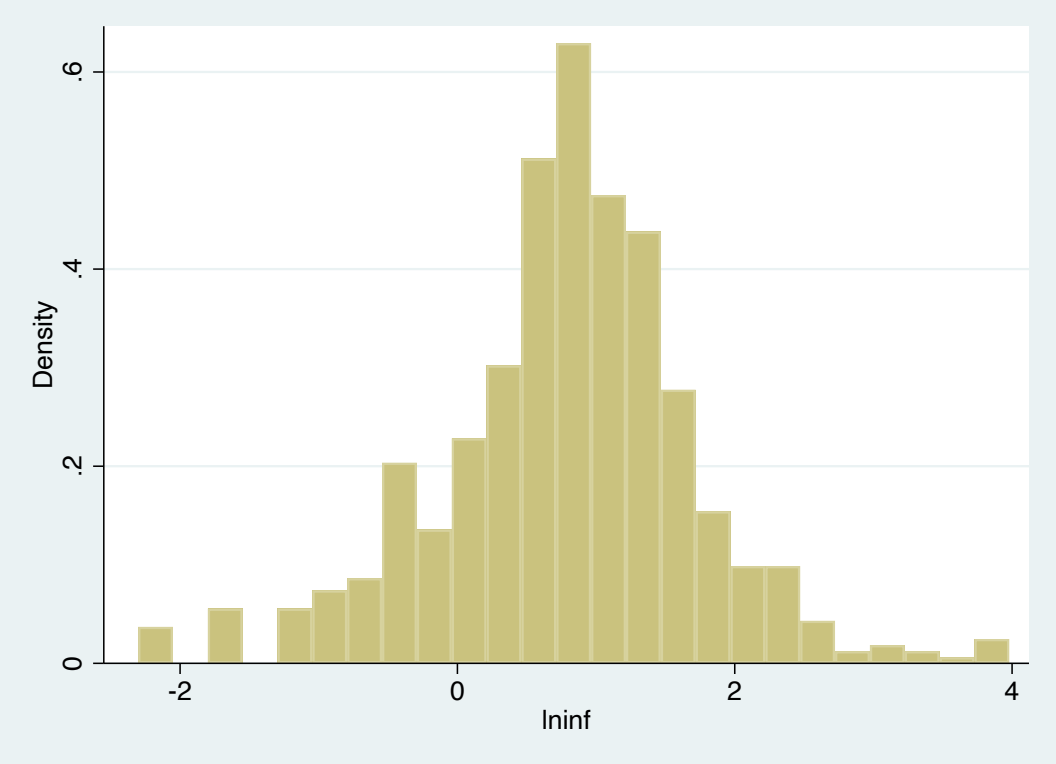

Figure 10: Histogram of Ln (Inflation)

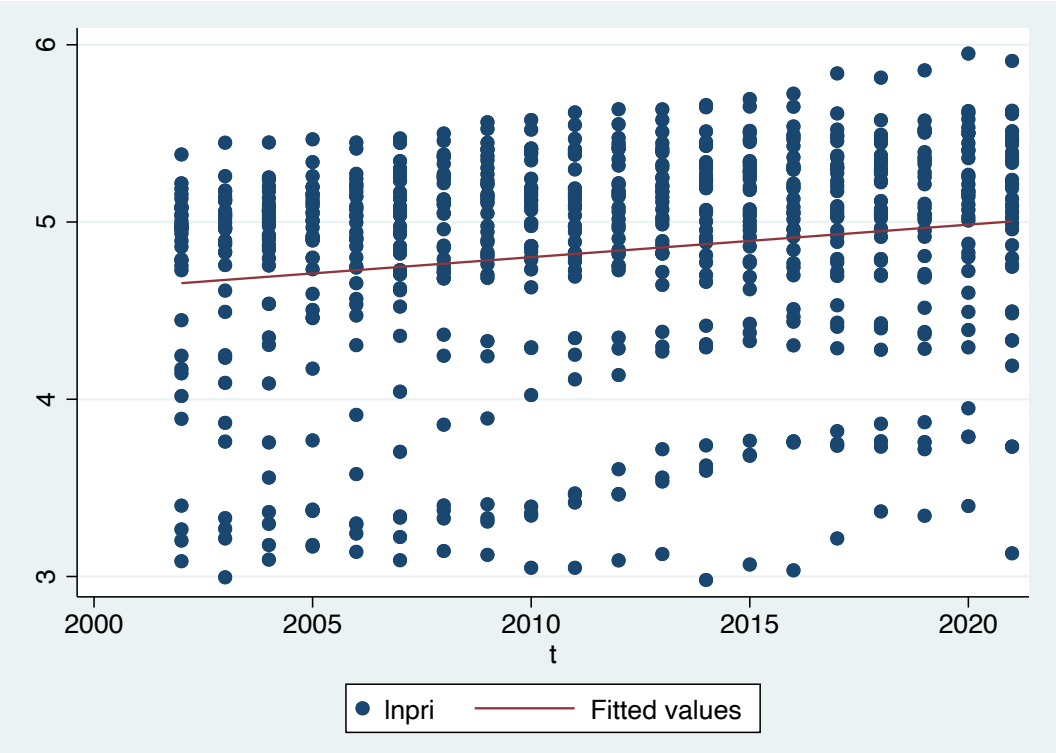

Figure 11: Scatter and data points of Ln (Private Credit to GDP) vs. Year

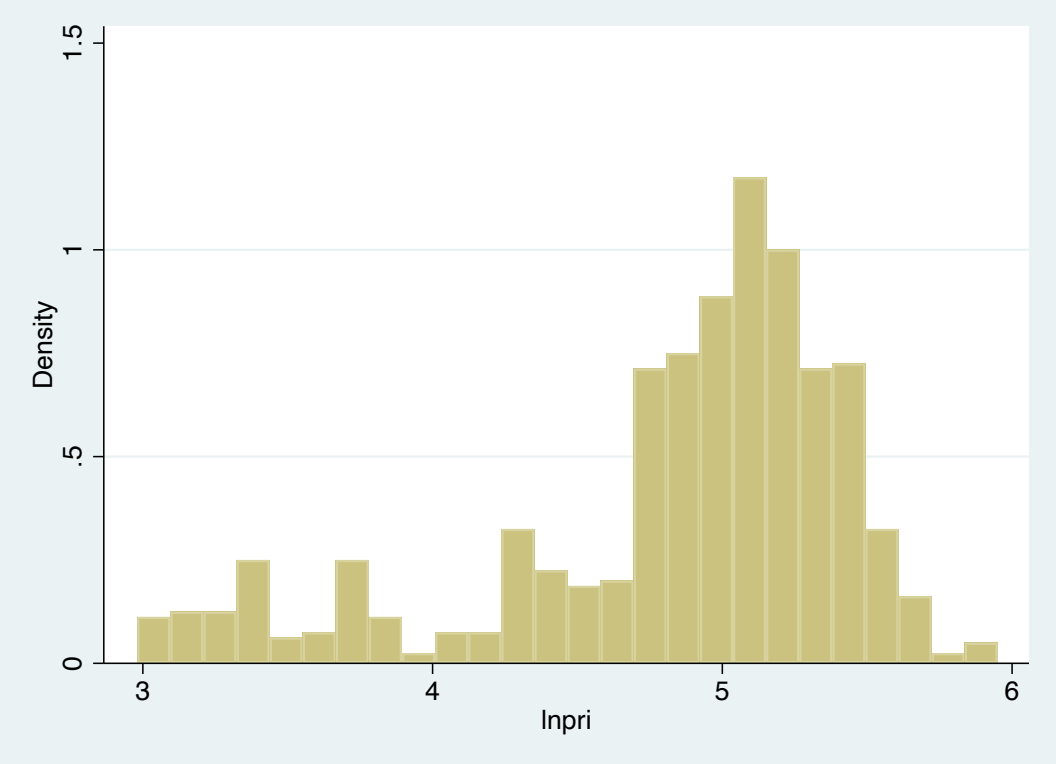

Figure 12: Histogram of Ln (Private Credit to GDP)

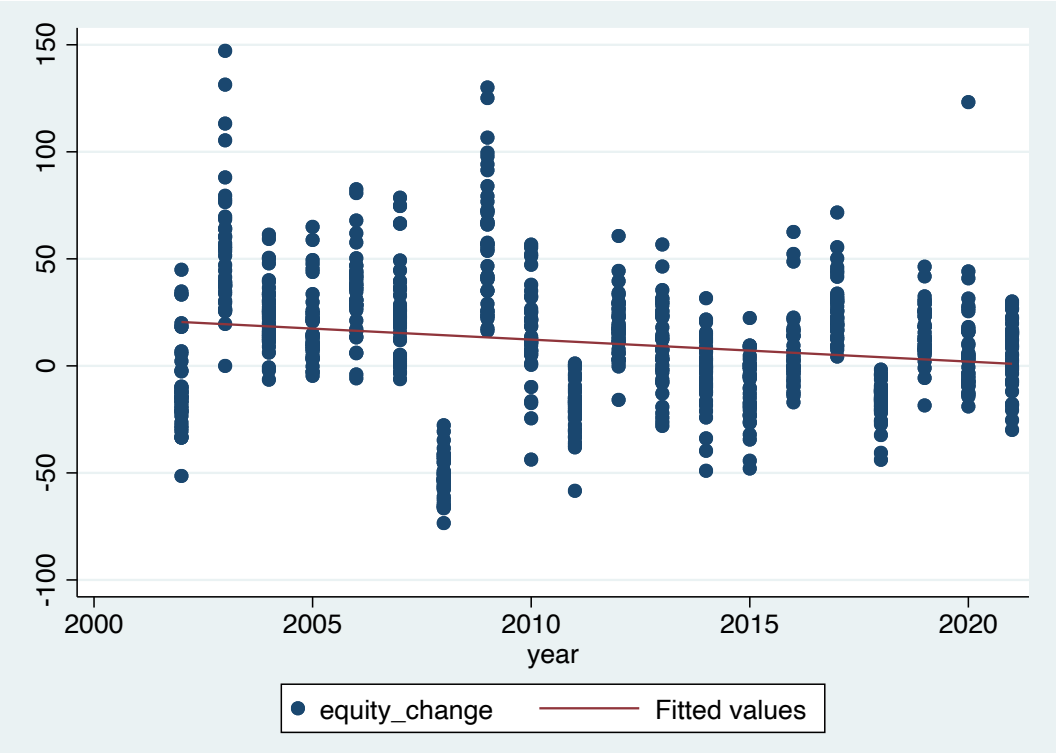

Figure 13: Scatter and data points of Stock Market Growth vs. Year

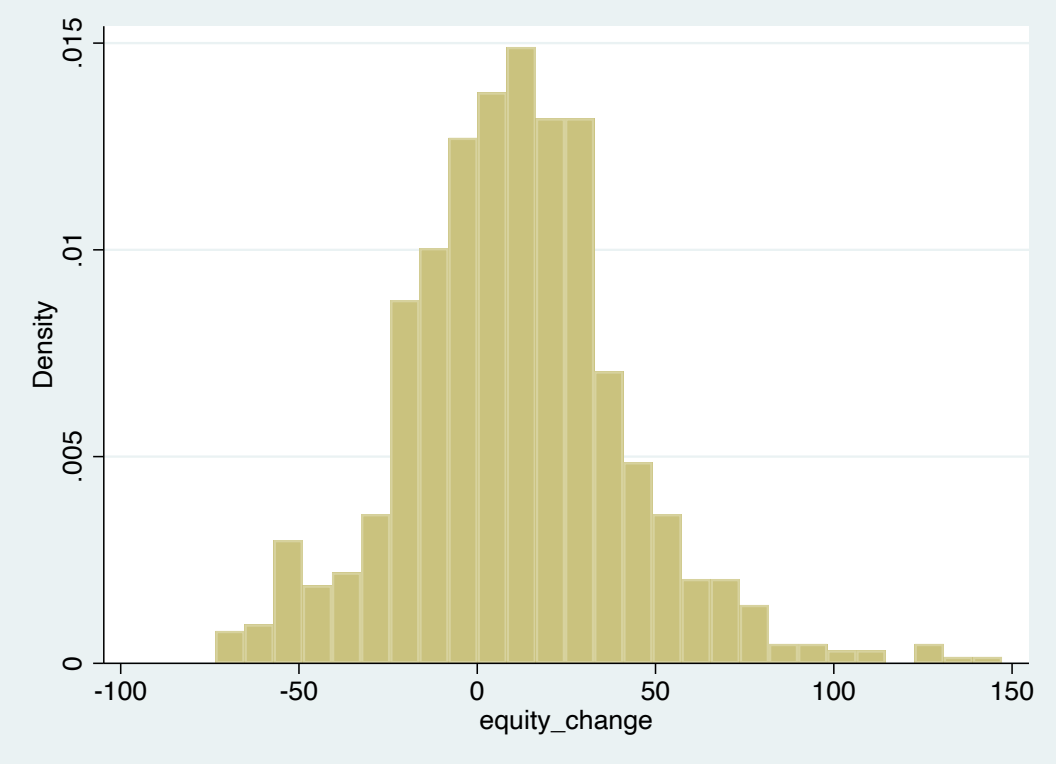

Figure 14: Histogram of Stock Market Growth

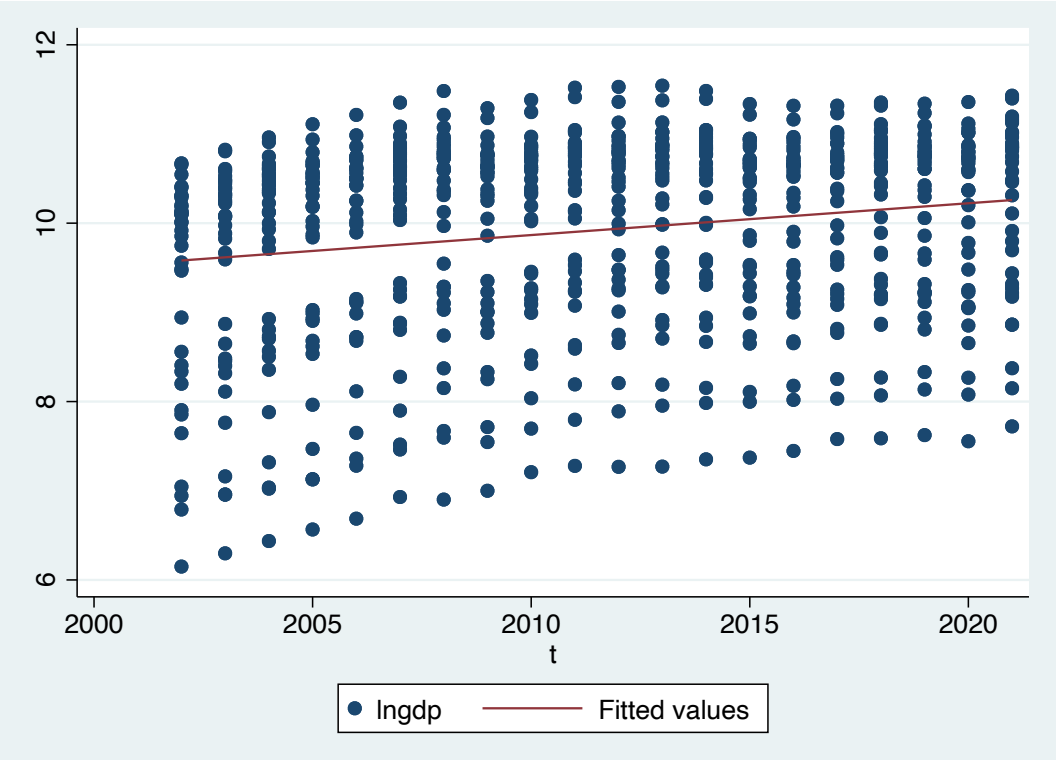

Figure 15: Scatter and data points of Ln (GDP per Capita) vs. Year

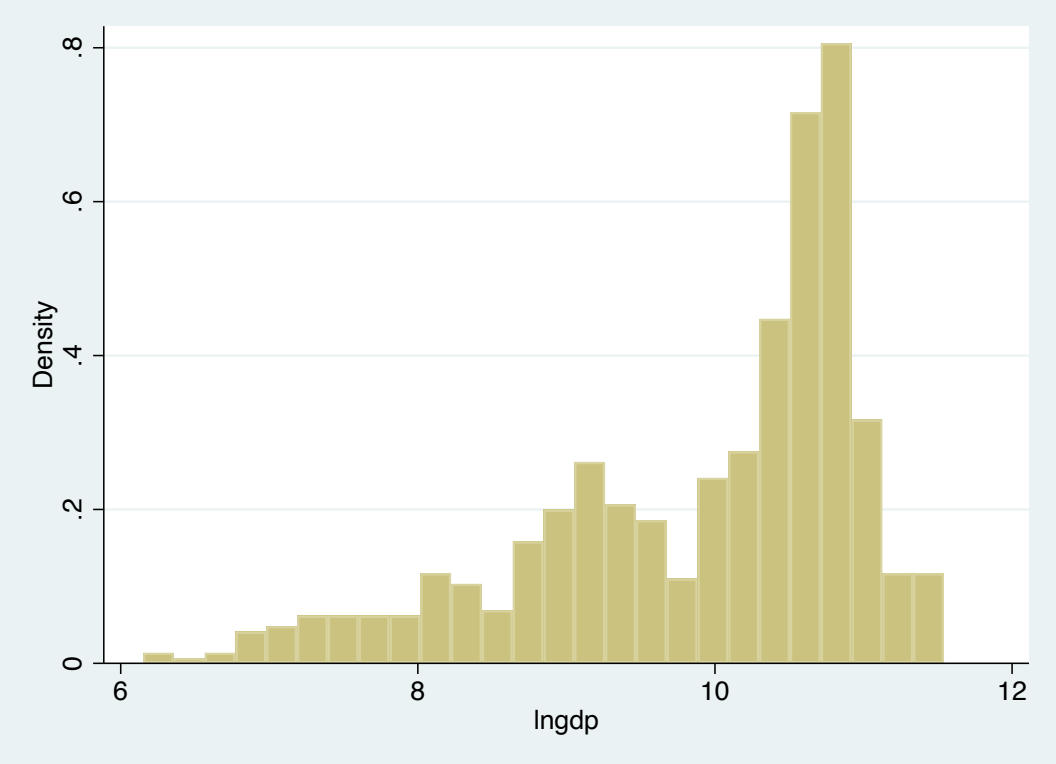

Figure 16: Histogram of Ln (GDP per Capita)

Figure 17: Scatter and data points of Government Effectiveness vs. Year

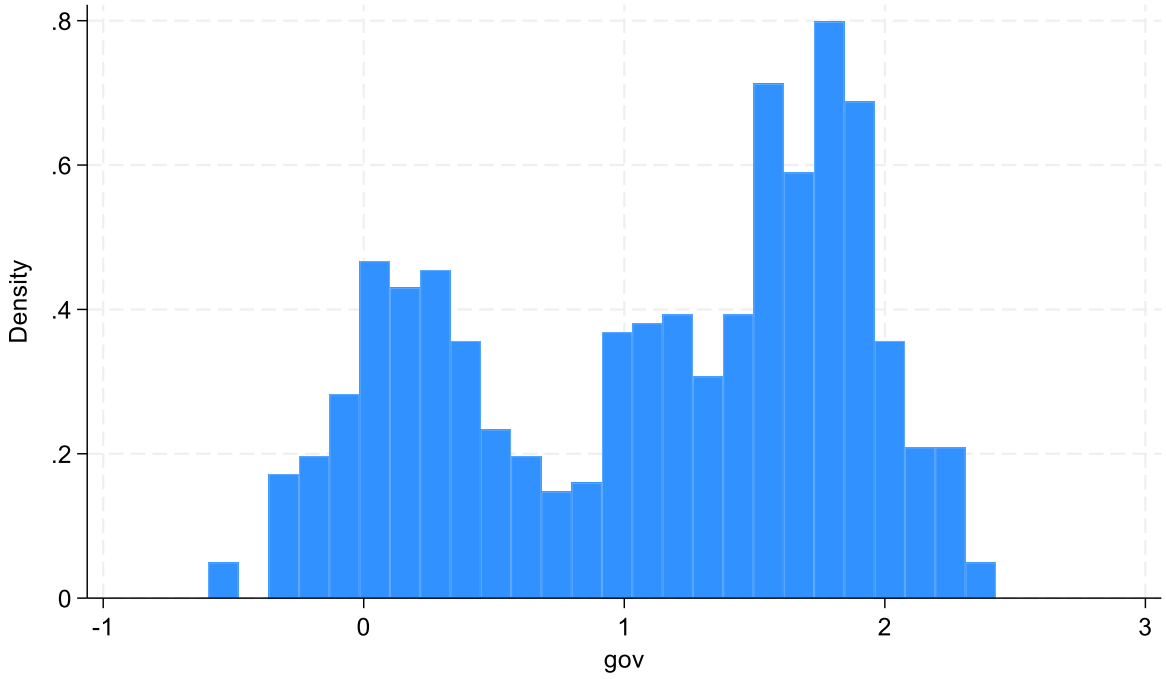

Figure 18: Histogram of Government Effectiveness

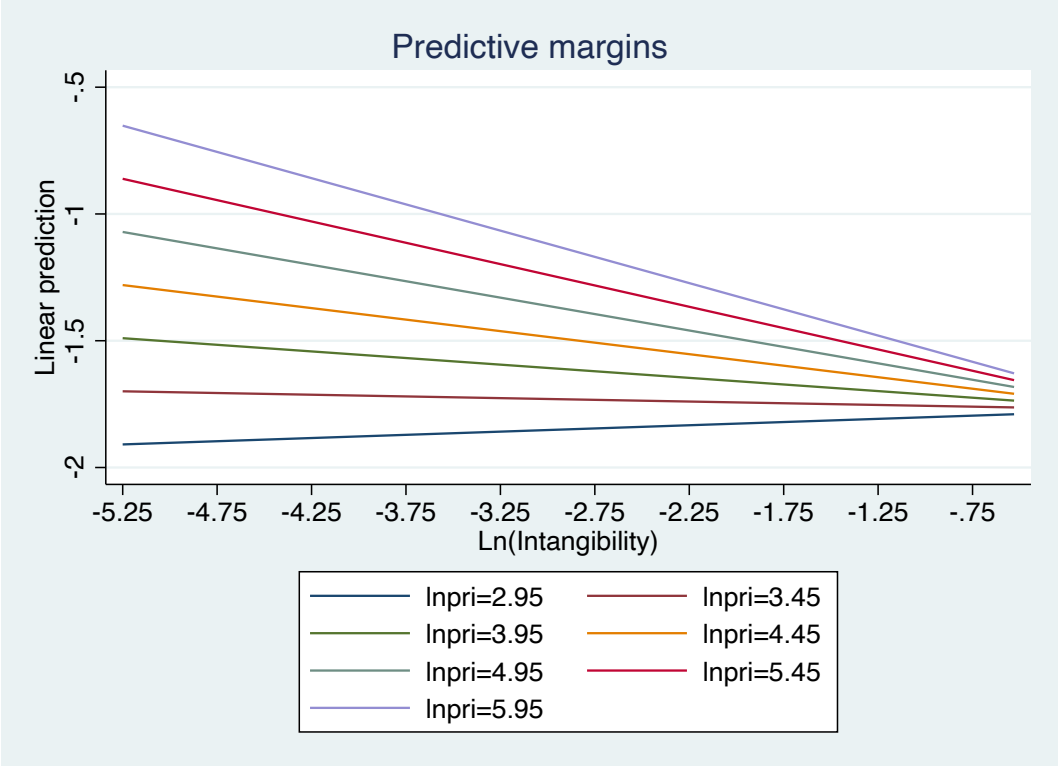

Figure 19: Linear slopes of Ln (leverage Ratio) for Ln (Intangibility) with the interaction of Ln (Private Credit to GDP)

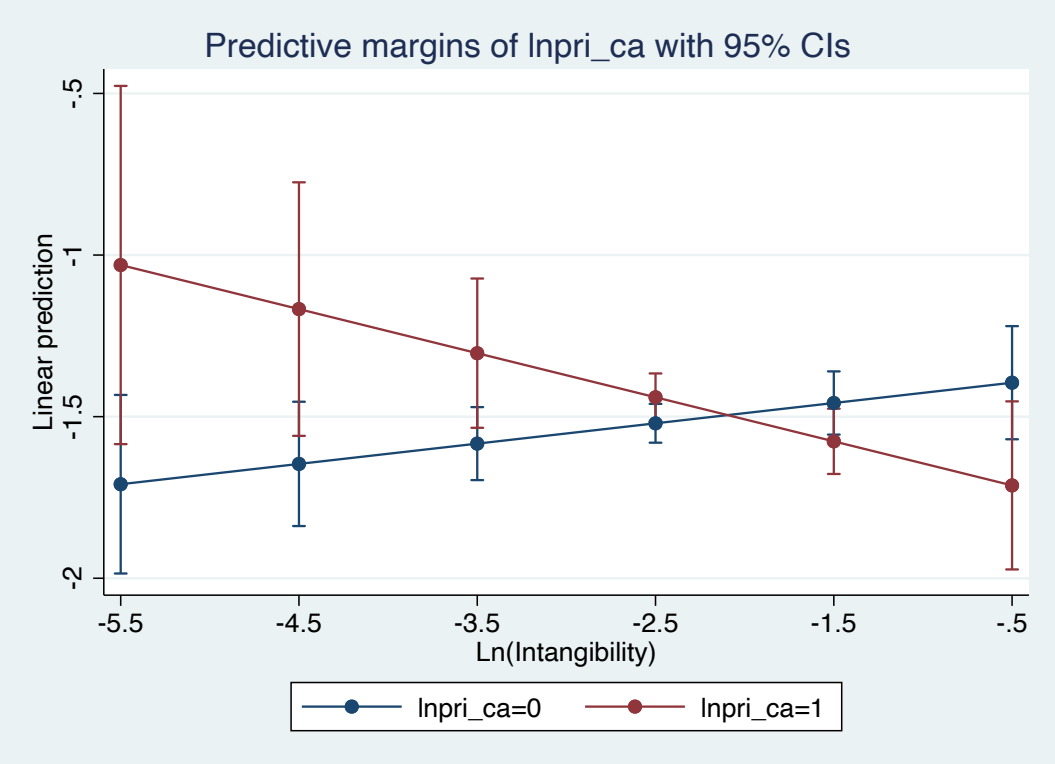

Figure 20: Linear slopes of Ln (Leverage Ratio) for Ln (Intangibility) with the interaction of Financial Development