Debt Contracts, Outside Equity and Financial Development

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Abstract

How important are different financial contracts for economic development? Using cross-country firm-level data, I document the extensive usage of alternative debt contracts and ownership structure patterns for public firms. At the aggregate level, development in each segment of the financial system is significantly linked to GDP per capita and wealth inequality. To quantify the aggregate consequences, I develop a heterogeneous agent model of entrepreneurs who face asset-based or cash flow-based debt and outside equity frictions. The model is calibrated to a large set of countries in vastly different stages of financial development. Quantitatively, with asset-based debt (cash flow-based debt), reducing debt frictions in the low debt low equity country group to the average level of the high debt high equity benchmark group raises output per capita by 20.2% (8.3%), compared to a 5.7% (6.5%) increase when reducing equity frictions.

Keywords: Financial development; cash flow-based debt; equity market; wealth inequality.

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1 Introduction

A strand of the macroeconomics literature analyzes the quantitative impacts of financial frictions on aggregate outcomes (Buera, Kaboski, and Shin, 2011; Midrigan and Xu, 2014; Moll, 2014). A classic borrowing constraint used in the literature is bounded by the liquidation value of assets posted as collateral, which is linked to the resources firms own in the present. However, as pointed out by Lian and Ma (2021), 80% of U.S. non-financial firms' debt is cash flow-based, which depends on firms' continuing operation value in the future. Moreover, firms can directly raise fund from the equity market by selling claims against their future dividends. The development of cash flow-based lending and equity market demonstrates the important role financial system plays in shifting resources across different states of the world and from future to present. Yet little is known about the aggregate importance of these different financial sources.

This paper aims to fill this gap by quantifying the aggregate and distributional consequences of financial frictions in a model that captures more realistically firms' financing sources. The model structure combined with financial development indicators enables calibration exercise for countries with largely different degrees of financial development. I find that the relative roles of debt and equity frictions change with different debt contracts. With asset-based debt, debt frictions have a larger impact on output and accounts more for the cross-country difference in wealth inequality. The result is driven by the distortion in production from asset-based debt and the concentrated benefits to high productivity firms when reducing equity frictions. With cash flow-based debt, the impact of debt frictions for output is less pronounced and cross-country variation in top wealth share is more attributable to equity frictions.

The empirical section starts by documenting firms' usage of alternative financing sources. I link individual firm's debt profile to firm balance sheet information and firm ownership structure information. Using information of firm debt profile, I show the extensive usage of both asset-based debt and cash flow-based debt by firms across country. This evidence suggests the importance of both types of debt contracts and the relevance of considering them in a spectrum of countries in different stages of financial development. Ownership information of public firms shows that insider share accounts for a significant portion of firm share, which motivates modelling firm's outside equity choice as a continuous variable rather than a binary choice.

Then the empirical analysis moves from the firm level to country level to document the relationship between different financial sources and aggregate outcomes. While it is

more established that debt and equity markets are significant components of the financial system, the prevalence of alternative debt lending practice across countries is less discussed. This section starts by demonstrating the significant presence of cash flow-based lending in a broader set of countries. Direct categorization of firm debt profile shows that the sum of syndicated loans and corporate bonds accounts for a large fraction of firm cash flow-based debt usage.[1] At the aggregate level, the sum of syndicated loan and corporate bond volume to GDP ratio provides an estimate of aggregate cash flow-based borrowing by public firms, which supports the presence of alternative lending practice across countries. Regressions using country-level financial development indicators and aggregate outcomes show that total debt, equity market, and cash flow-based lending, normalized by country GDP are each significantly associated with output per capita and top wealth share.

Motivated by the set of empirical facts, I develop a model which admits different types of debt contracts and outside equity choice. Asset-based borrowing constraint is limited by the liquidation value of assets which does not change regardless of the bankruptcy procedure of liquidation or reorganization. Cash flow-based lenders take a more active role in monitoring firm performance. Contingent on the realization of operation earnings, cash flow-based lenders obtain the control rights and reorganize the firm in the case of covenant violation. Debt limit of cash flow-based debt is constrained by the going-concern value of firm which is approximated by a multiple of firm revenue obtained in the case of firm reorganization.[2] While asset based debt only specifies the debt capacity, cash flow-based debt specified both the debt limit and the restrictiveness of covenant. Following Peter (2021), access to outside equity is introduced via firm's choice of going public. Issuing outside equity involves a decision at the extensive margin of whether or not to go public, and a decision at the intensive margin of how much to sell.

The model illustrates that debt type could change firm's debt and equity choice. Smaller firms with fewer resources in hand have limited access to asset-based debt, but can rely more heavily on cash flow-based debt to borrow against their future profitability. The degree of relaxation in debt limit from cash flow-based debt is larger for firms of higher productivity level, which is a combination of higher future value, larger optimal scale and more accurate covenant test. Debt type also interacts with the usage of outside equity and changes firm's choice of ownership structure. Cash flow-based borrowing constraint relaxes the borrowing capacity for firms with higher productivity and lower cash in hand, which are the firms with

[1] Specific categories of syndicated loans and all corporate bond are categorized into cash flow-based debt in the debt profile categorization process.

[2] This follows the usage of earning-based covenants in practice which is discussed in more detail in Appendix A.1.

the highest need for issuing outside equity.

The model structure allows employing country-level financial development indicators of debt and equity markets to calibrate model parameters determining the underlining contracts faced by firms. The model is calibrated to a large set of countries with significantly different degrees of financial development. I categorize countries into four groups depending on their relative positions in the cross-country distributions of debt and equity market development. Most developed countries display above median development in debt market, while most developing countries have below median debt market development. The pattern of equity market development is different, both developed and developing countries display a large degree of variation in equity market development.

The model is calibrated separately to the case of asset-based debt and cash flow-based debt. Calibration results illustrate how different debt types could impact the estimation of equity frictions. When cash flow-based debt is considered, the borrowing capacity of high productivity firms with limited cash-on-hand is relaxed, reducing their need to rely on the equity market. Therefore, if estimation of equity frictions remains the same as the scenario of asset-based debt, the ratio of stock market capitalization to GDP would drop. To achieve the calibration target, costs associated with equity contracts are estimated at a lower level when cash flow-based debt are considered. In addition, the quantitative model reproduces the relationship between financial development and aggregate outcomes documented in the empirical analysis, which is not targeted in the calibration.

The first set of counterfactual exercises examine the impact of debt and equity frictions on output per capita. I conduct two sets of counterfactual analysis by reducing debt and equity frictions to the average level of the high debt high equity benchmark group. With asset-based debt, the average increase in output per capita for the group of countries with low debt low equity development is 20.2% when reducing debt market frictions compared to 5.7% increase when reducing equity market frictions. The result is driven by the asymmetric change in output per capita when improving the less developed market of an unbalanced financial system. When debt market is less developed, the development of equity market benefits those firms with higher productivity, which are already the firms that accumulated more resources in the less developed debt market.

The difference in output per capita change is less significant when considering cash flow-based debt, reducing debt frictions increases output per capita by 8.3% for the low debt low equity group. While displaying same level of credit to GDP ratio before the adjustment, the majority of firms which have lower productivity grow into larger size in the economy with cash flow-based debt. Both total credit and total output is higher in the cash flow-

based debt scenario before adjustment. Cash flow-based borrowing constraint relaxes the borrowing limit in the less financially developed countries for smaller firms, leading to a less dramatic increase in output per capita when equalizing debt frictions.

Finally, I examine how debt and equity frictions can account for cross-country difference in wealth inequality. I decompose the cross-country difference into variation from debt frictions and variation from equity frictions. With asset-based debt, debt frictions dominate entrepreneurs' choice of asset accumulation especially in less developed debt markets and account for a larger portion of cross-country difference in top wealth share. On the other hand, cash flow-based debt reduces the distortion from debt frictions in less developed markets, while enlarging the contribution to wealth inequality from equity frictions in more developed markets. The two forces jointly lead to the result that equity frictions contribute more to cross-country difference in wealth inequality under the scenario of cash flow-based debt.

Related Literature This paper is related to several strands of literature in macroeconomics and corporate finance.

Theoretically, this paper is closely related to the strand of macroeconomics literature which examines the importance of financial frictions for aggregate outcomes. In particular, it is related to studies of misallocation (Buera, Kaboski, and Shin, 2011; Buera and Shin, 2011, 2013; Midrigan and Xu, 2014; Buera and Moll, 2015) and wealth inequality (Quadrini, 2000; Cagetti and De Nardi, 2006). My contributions is to quantitatively examine the impact of financial frictions with a set of enriched parameters capturing features of different firm financial contracts. In particular, the paper extends the framework of Peter (2021) in two directions. The first extension is to discuss the aggregate consequences of financial frictions in a larger set of countries with largely different degrees of financial development. The other extension is to explore the role of different debt contracts in how they affect the interaction between debt and equity markets.

Empirically, this paper is related to the literature studying the heterogeneity in debt contracts. First and foremost, it concerns the emphasis of categorization of debt into asset-based and cash flow-based debt (Lian and Ma, 2021; Ivashina, Laeven, and Moral-Benito, 2021; Cloyne, Ferreira, Froemel, and Surico, 2018). Lian and Ma (2021) provide detailed classification of firm debt according to the determination of debt value, and show the prevalence of cash flow-based debt in U.S. non-financial corporations. There are also other forms of debt heterogeneity studied in the empirical corporate finance literature. The documentation on the heterogeneous use of debt covenant is of particular interest to this paper in motivating the model assumption of cash flow-based borrowing depending on firm earnings

(Chava and Roberts, 2008; Roberts and Sufi, 2009; Nini, Smith, and Sufi, 2012). I implement the algorithm from the literature to provide evidence on cash flow-based borrowing and earning-based covenants in a broader set of countries and link the result to the aggregate measure of financial development.

The emphasis of cash flow-based borrowing constraint in this paper follows the long tradition of the literature highlighting the importance of borrowing constraints in macro-finance models. Cash flow-based borrowing constraint is emphasized in addition to the classical asset-based borrowing constraint (Kiyotaki and Moore, 1997; Bernanke, Gertler, and Gilchrist, 1999). There are also several recent papers examining the macroeconomic consequences of cash flow-based borrowing constraint as an alternative type of borrowing constraint. Greenwald (2019) focuses on one type of earning-based covenant which restricts firms' interest coverage ratio and studies its impact on monetary policy transmission. Drechsel (2021) studies the impact of earning-based covenants on corporate credit cycles. While the two papers mentioned above focus on the U.S. economy, this paper examines the macroeconomic implications of cash flow-based borrowing constraint in a large group of countries with different degress of financial development.

This paper is also closely related to the law and finance literature which links legal infrastructure to contract enforcement, property rights, and financial development (La Porta, Lopez-de Silanes, Shleifer, and Vishny, 1997; Djankov, Hart, McLiesh, and Shleifer, 2008; Becker and Josephson, 2016). The nature of asset-based and cash flow-based debt is tied to the country's bankruptcy law procedures. The procedure difference and the difference in the enforcement of the contracts are intertwined in affecting a country's financial market development. The model provides a quantitative assessment of the importance of different legal infrastructure in shaping aggregate outcomes.

Structure of the paper The paper is organized as follows. Section 2 describes the data source and presents empirical patterns. Section 3 develops a model of entrepreneur with access to asset-based debt, cash flow-based debt and outside equity. Section 4 employs financial development indicators to estimate the set of parameters describing alternative financing contracts. Section 5 presents the aggregate implications of financial frictions. Section 6 concludes.

2 Empirical Analysis

This empirical section documents the importance of different financial contracts across countries at both the firm level and the aggregate level. Firm-level evidence employs cross-country data to document the patterns of firm debt composition and ownership structure for firms of different sizes. Country-level regression analysis demonstrates the significant relationship between development in different segments of financial system and aggregate outcomes. This section starts by introducing data sources at the firm- and country-level, and proceeds to present the empirical evidences.

2.1 Data

2.1.1 Firm-Level Data

Firm-level dataset contains information on firm debt composition and outside equity choice. The objective is to document firms' usage patterns of different financial contracts. The dataset merges firm debt profile, ownership structure and balance sheet information for public firms across countries.

Firm-level debt profiles comes from the CapitalIQ dataset. CapitalIQ provides detailed information on each outstanding debt contract for firms in different countries. I follow the categorization procedure in Lian and Ma (2021) to classify the outstanding debt of firms into asset-based or cash flow-based debt.[3] The key distinction between asset-based and cash flow-based debt is the difference in determinant of debt value. While asset-based debt relies on the liquidation value of particular fixed assets, cash flow-based debt depends on the continuation operation value of the entire firm. Debt that explicitly states asset-based, or specifies fixed assets as collateral in the description is categorized into asset-based debt. Debt that explicitly states cash flow-based in its description, or unsecured debt or debt secured by all assets of the firm are considered as cash flow-based debt. All corporate bonds and convertible bonds are categorized into cash flow-based debt.[4] The same categorization procedure is applied to all firms in the CapitalIQ dataset.

The next step merges firm debt composition with firm balance sheet information. The merge is established through merging firms' Compustat identifier. Firms are grouped into

[3]See Internet Appendix IA3 of Lian and Ma (2021) for the complete classification procedure.

[4]The classification of corporate bonds into cash flow-based debt is supported by information obtained from Fixed Income Securities Database (FISD). Information on U.S. corporate bonds and Yankee bonds (dollar-denominated bonds issued by foreign corporations traded in U.S.) indicates that less than 1 percent of these bonds are asset-based bonds.

different countries according to their country of incorporation. Finally, I obtain firm ownership information from Bureau van Dijk Orbis. The Orbis dataset provides a yearly screenshot of firm ownership information. The matching of firm financial information from Compustat to firm ownership information in Orbis is through the match of stock tickers for U.S. firms and ISIN number for public firms in other countries. Firm level measures are collected for year 2000-2018. The firm-level patterns are presented using data from year 2015, which is among the years of the highest data coverage. The firm-level patterns remain robust when changing to other year in the data sample. Summary statistics of firm-level measures are presented in Appendix Table A1. The coverage of public firms for each sample country is calculated by dividing number of observations by total listed firms in the country. On average, the firm sample covers 76.1% of listed firms in each country.

2.1.2 Country-Level Data

Country-level data collects information of development in different financial segments and the aggregate outcomes. The objective is to explore the relationship between the two. In addition to aggregate measures of different financial segment development and macroeconomic outcomes, country institutional features are also collected to provide evidence for tests of cross-country prevalence of alternative debt contracts.

Financial development data comes from the World Bank Global Financial Development Database. Different measures capturing development of debt and equity markets are included. Private credit to GDP ratio captures the development of debt financing institutions. Number of listed companies per million people is related to firm's choice of going public at the extensive margin. Stock market capitalization aggregates firms' choice of how much outside equity to issue at the intensive margin. Debt heterogeneity in terms of development in cash flow-based lending practice is approximated using the sum of syndicated loan volume to GDP ratio and corporate bond volume to GDP ratio

The development of cash flow-based lending practice will be discussed in further detail in the following section. One of the supporting evidence presents the use of cash flow-based lending measure in countries of different insolvency procedures. Countries with insolvency procedure preserving firms to continue operate encourages the usage of cash flow-based lending. The insolvency procedure indicator comes from World Bank Doing Business Dataset section 'Resolving insolvency'.

Aggregate outcome measures include output per capita and wealth inequality. Output per capita comes from World Bank World Development Indicator dataset. Wealth inequality

measure comes from the World Inequality Database. All country-level measures ranges from 2000-2018. The countries included in the analysis accounts for around 93.7% of world GDP on average during the sample period. Summary statistics of country-level measures are presented in Appendix Table A2. The coverage of region and income group of countries in the sample are presented in Appendix Table A3.

2.2 Firm Debt Composition and Ownership Structure

This section documents firms' debt composition and ownership structure choice across the firm size distribution to illustrate firms' usage patterns of alternative financial contracts. The patterns are presented for the public firm sample for two reasons. First, detailed debt description data is available for public firms, which allows the decomposition of firm debt into asset-based and cash flow-based debt. Second, the usage of outside equity is more relevant in public firms since private firms are mainly owned by insiders.[5]

Left panel of Figure 1 below presents the usage of asset-based and cash flow-based debt across the firm size distribution for public firms in developed countries and developing countries. Right panel of Figure 1 plots the mean insider share. Categorization of developed and developing countries follows World Bank definition.

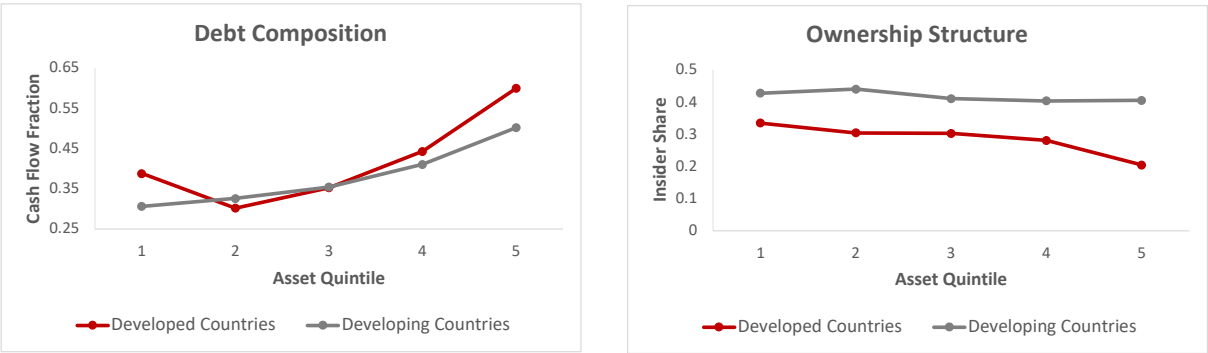


Figure 1: Debt Composition and Ownership Structure

This figure plots the debt composition and ownership structure for public firms of different sizes. Left panel plots the fraction of cash flow-based debt and right panel plots the mean insider share. The horizontal axis shows the asset quintile. Debt categorization is based on information from CapitalIQ, and firm insider share information comes from Orbis. Firm asset information comes form Compustat. Figure is plotted using data from 2015. Firm sample covers Compustat firms which has debt information in CapitalIQ and ownership information from Orbis.

Debt Composition Left panel of Figure 1 plots the mean usage of cash flow-based debt as a fraction of total debt for public firms. The horizontal axis shows the asset quintile ranging

[5] As shown in Peter (2021), according to the Eurosystem Household Finance and Consumption Survey (HFCS), 90% of the firms are owned at least 50% by a single household.

from smallest to largest first in terms of total assets. For firms in the developed country sample, the fraction of cash flow-based debt displays a U-shape across firm size. Both small and large firms display a higher fraction of cash flow-based debt out of total debt. On the other hand, the fraction of cash flow-based debt is monotonically increasing with firm size for the developing country sample. Larger firms in developing countries are also able to rely more heavily on cash flow-based debt compared to small firms.

Apart from the difference in the shape of debt fraction between developed and developing countries, the magnitude of increase in cash flow-based debt fraction with firm size is also different. The difference along the size distribution for firms in developed countries is more significant than the difference for for firms in developing countries especially for large firms. For firms in the largest quintile, cash flow-based debt fraction is more than 30 percent larger than asset-based debt fraction in developed countries, while their counterpart firms in developing countries sees a difference around 10 percent.

2.2.1 Ownership Structure

To shed light on firms' decisions to issue outside equity at the intensive margin, I use the information on firms' aggregate insider share. Following Peter (2021), I calculate insider share as the sum of shares held by top three shareholders who are considered to be insiders.[6] A shareholder indicating the type "Corporate" can be classified into insider or outsiders depending on whether this corporate is recorded in BvD as a private or public corporate. If the corporate is a public enterprise, the shareholder will be considered as outsider, while a private corporate shareholder will be considered as insider.

Right panel of Figure 1 plots the mean insider share. In both country groups, smaller public firms has higher insider share. For firms of all asset quintiles, insider share of public firms in developing countries is higher than developed countries indicating less outside share issued by firms in developing countries.

2.3 Financial Segments Development and Aggregate Outcomes

Last section demonstrates the importance of different financial sources by showing firms' extensive usage of different financial contracts. This section moves from the firm-level to country-level. The development in different financial segments is measured by aggregate

[6]Shareholders are considered to be insiders if their type recorded in Orbis belong to one of the following categories:"One or more named individuals or families", "Employees,managers, directors", "Self ownership", "Corporate"(private).

usage of different financial sources . I document the relationship between the development of different financial segments and aggregate outcomes. While the choice of aggregate measures for total debt and outside equity are more straight-forward, the aggregate measure for alternative debt contract usage is less so. This section starts by introducing the proxy measure for aggregate cash flow-based lending and proceeds to present the regression analysis.

2.3.1 Prevalence of Cash Flow-Based Debt Across Country

This section justifies using the sum of corporate bonds and syndicated loans to GDP ratio as a proxy for the lower bound of aggregate cash flow-based lending. This proxy supports the prevalence of cash flow-based lending practice in a broader set of countries. Two sets of evidence are presented to support this proxy. First, direct categorization procedure of debt classifies a large fraction of firms' syndicated loans and all corporate bonds as cash flow-based debt, which contributes to a significant proportion of all cash flow-based debt. Further evidence compares the proxy in countries with different insolvency procedures. The proxy is higher in countries which preserves entities as going concern out of bankruptcy. The result is consistent with the prediction that cash flow-based lending are more popular in countries whose insolvency institutions preserve firms' continuing operation.

Direct Debt Categorization A large fraction of syndicated loans us considered as typical category of cash flow-based debt with strong creditor monitoring through the usage of financial covenants. Corporate bonds are also categorized into cash flow-based debt and are subject to weaker creditor monitoring. Using the debt profile built from CapitalIQ, I present two sets of debt categorization statistics for a group of countries. The countries are selected based on the higher number of observations available in the sample. Panel A of Table 1 presents average cash flow-based debt ratio if categorized according to the procedure of Lian and Ma (2021). Panel B of Table 1 presents the average ratio of cash flow-based loans to total debt only considering cash flow-based loans which belong to syndicated loans or corporate bonds.

As can be observed from the comparison of panel A and B, syndicated loans and corporate bonds contributes to a significant portion of cash flow-based debt cross country. The average fraction of syndicated loan and corporate bond sum out of total cash flow-based debt is 87.2 %, which suggests that using the sum of the two financial development indicators is a good proxy for the development of cash flow-based borrowing in the country. In Appendix Section A.1, I provide further robustness check supporting the application of categorization

Table 1: Cross-Country Usage of Cash Flow-Based Borrowing (Different Categorization)

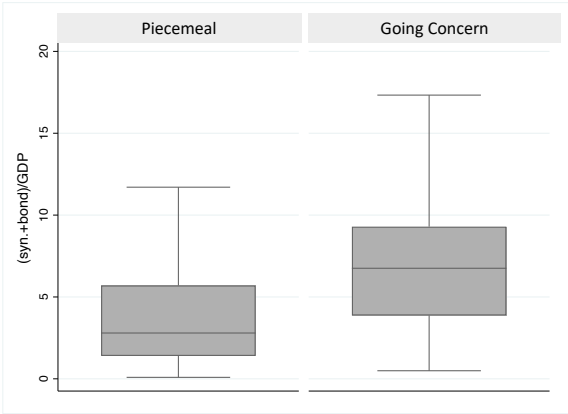
	KOR	ITA	IND	SGP	NOR	DEU	CAN	JPN	FRA	USA	MEX
Panel A: Fraction of cash flow-based debt out of total debt in CapitalIQ (year 2015)											
cfl/debtciq	0.236	0.328	0.328	0.332	0.360	0.392	0.455	0.467	0.473	0.510	0.515
no.obs	1293	288	2865	541	154	481	1158	2706	584	3881	94
Panel B: Fraction of syndicated loans and corporate bonds out of total debt in CapitalIQ (year 2015)											
(syn.+bond)/debtciq	0.097	0.209	0.280	0.243	0.349	0.392	0.418	0.751	0.415	0.413	0.405
no.obs	1282	288	2831	531	153	472	1128	2695	581	3799	68

This table presents cross-country usage of cash flow-based debt with two categorization criteria. The upper panel presents the average fraction of debt categorized into cash flow-based debt out of firm's total debt outstanding in CapitalIQ in year 2015 following categorization procedure of Lian and Ma (2021). The countries are arranged such that from left to right the average fraction of cash flow-based debt is increasing. The lower panel presents the sum of cash flow-based debt which belongs to syndicated loans or corporate bonds to total debt outstanding in CapitalIQ in year 2015.

procedure of asset-based and cash flow-based debt to the cross-country sample.

Cash-Flow Based Debt and Insolvency Outcome The distinction between asset-base debt and cash flow-based debt is between the determination of debt value. The value of asset-based debt depends on the recovery rate of the asset posted as collateral, while the value of cash flow-based debt depends on the value of the firm with continuation of operation. A direct implication of this difference in determinant of debt value is that a country's insolvency procedure preserving firm as going concern would protect the cash flow-based lenders.

Figure 2: Box Plot of (Syn.+ Bond) to GDP ratio



This figure presents the box plots for the sum of syndicated loan and corporate bond volume to GDP ratio. Countries are categorized into two groups. The left has an insolvency outcome indicator of being sold piecemeal. The right has an outcome of insolvency likely to be going concern. The vertical axis is the ratio in percentage terms. Outside values are excluded.

Therefore, we would expect to see a higher fraction of cash flow-based debt used in countries with firm insolvency outcome being preserved as going concern. The insolvency

procedure indicator comes from World Bank Doing Business Dataset section 'Resolving insolvency'. The indicator employed is the outcome indicator, which takes a value of 0 if firm emerge from proceeding as piecemeal and 1 if going concern. Figure 2 shows the box plot for the sum of syndicated loans and corporate bonds to GDP ratio for countries with different insolvency outcomes. For countries with insolvency outcome preserving firms as going concern, the fraction of syndicated loans and corporate bonds volume to GDP is higher.

Further evidence on the difference between usage of syndicated loans and corporate bonds in countries with different insolvency procedures can be found in Appendix Section A.2. Appendix Figure A1 presents the box plot for syndicated loans and corporate bonds to GDP ratio respectively. Appendix Table A6 shows the regression results of the respective debt usage to the insolvency indicator.

2.3.2 Financial Segments Development and Output per capita

Table 2 below presents the regression result of GDP per capita on the set of financial development measures. The time period covers 2000-2018, a total of 139 countries are included. A more detailed breakdown of the sample can be found in Appendix Table A3.

Table 2: Financial Development and GDP per capita

	Dependent Variable: Log GDP per capita				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Credit to GDP (%)	0.019***				0.010***
	(0.0006)				(0.0007)
Stk. Mkt. Cap. to GDP (%)		0.008***			-0.005***
		(0.0009)			(0.0004)
Listed Firms per Million			0.016***		0.011***
			(0.0037)		(0.0011)
(Syn. Loan+Corp. Bond)/GDP (%)				0.125***	0.089***
				(0.0056)	(0.0055)
Year FE	Y	Y	Y	Y	Y
No. Obs	1598	1131	1202	1093	751
R^2	0.42	0.15	0.22	0.29	0.46

This table presents the regression of GDP per capita on financial development indicators. The dependent variable is GDP per capita. Independent variables are included in percentage terms. Time period is 2000-2018. Year fixed effect is included and standard error is clustered at year level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

As can be observed from the regression result, higher debt usage and higher cash flow-based lending is correlated with higher output per capita. This suggests that the development of efficient debt market and cash flow-based lending practice is positively related to output.

The development of equity market is also positively related to output. More firms going public and issuing outside equity is positively related to output per capita. If not controlling other financial indicators, stock market capitalization is positively related to aggregate output. After controlling for aggregate credit usage, stock market capitalization is negatively correlated to aggregate output. This is partly affected by the positive correlation of debt and equity market development in the broad set of countries, and the excessive amount of stock capitalization to GDP ratio in some countries with less developed debt institutions.

2.3.3 Financial Segments Development and Wealth Inequality

Table A7 below presents the regression result of wealth inequality on the set of financial development measures.

Table 3: Financial Development and Top 10% Wealth Share

	Dependent Variable: Top 10% Wealth Share				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Credit to GDP (%)	-0.041***				-0.051***
	(0.004)				(0.0069)
Stk. Mkt. Cap. to GDP (%)		0.019***			0.087***
		(0.0038)			(0.0051)
Listed Firms per Million			-0.0721***		-0.121***
			(0.0134)		(0.0136)
(Syn. Loan+Corp. Bond)/GDP (%)				-0.302***	-0.360***
				(0.031)	(0.0788)
Year FE	Y	Y	Y	Y	Y
No. Obs	1598	1131	1202	1093	751
R^2	0.04	0.01	0.07	0.02	0.28

This table presents the regression of top 10% wealth share on financial development indicators. The dependent variable is top 1% wealth share. Independent variables are included in percentage terms. Time period is 2000-2018. Year fixed effect is included and standard error is clustered at year level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

As can be observed from the regression result, higher cash flow-based debt and higher credit to GDP ratio is correlated with lower wealth held by the top 10 percent of population. On the other hand, the development of equity markets is negatively correlated with wealth inequality. More firms going public at the extensive margin lowers the top wealth share. Higher insider share, which indicates lower average outside equity choice in the intensive margin, is correlated with higher top wealth share. The regression results using top 1 percent wealth share as dependent variable can be found in Appendix Table A7. The results are similar with the set of regression results by employing top 1 percent wealth share as dependent variable.

3 Model

The empirical section demonstrates the importance of different financing contracts to firms and the aggregate economy. In this section, I develop a heterogeneous agent model of workers and entrepreneurs who have access to asset-based debt, cash flow-based debt and outside equity. Outside equity financing is introduced following the model developed by Peter (2021). Asset-based debt is modelled in the form of a collateral constraint. The cash flow-based debt contract is set up to follow closely the role of cash flow-based lenders in practice.[7] The cash flow-based debt contract captures the shift of control right in the case of covenant violation.

3.1 Model Primitives

Types Time is discrete and agents are infinite-lived, subject to idiosyncratic death shocks with probability π_d. Agents draw idiosyncratic productivity type at birth. Agents are born either as workers with productivity η or as entrepreneurs with productivity z. In the case of a business failure, the entrepreneur becomes a worker.

Preferences Agents maximizes discounted sum of future expected utility from consumption. The expected future utility is specified below:

$$\mathbb{E}_t \sum_{t=0}^{\infty} [\beta(1-\pi_d)]^t \frac{c^{1-\sigma}}{1-\sigma}$$

Worker's Problem Worker problem is kept simple in the model framework. Workers solve a standard consumption-saving problem with uninsurable income risk. The worker's problem is presented below:

$$\begin{aligned} V_w(X;\eta) &= \max_{c,a',X'} u(c) + \beta(1-\pi_d)\mathbb{E}_{\eta'}[V_w(X';\eta')] \\ \text{s.t.} \quad c + a' &= X \\ X' &= w\eta' + Ra' \\ a' &\geq 0 \end{aligned}$$

workers earn wages at the rate of w and can save in terms of bonds, which has a gross return of R. Worker's productivity level is subject to idiosyncratic shocks.

[7] Kermani and Ma (2021) presents a three-period model capturing heterogeneity in debt contracts.

3.2 Timeline of Firm's Problem

Firm starts with a draw of productivity z, enters the period as a private firm and starts production. Productivity remains constant unless the firm is liquidated. Each period, the private firm faces the option to go public and sell a fraction of its equity to outside shareholders. If the firm chooses to go public and sell a fraction of its equity, the firm becomes a public firm and the fraction remains constant afterwards. If the firm stays private, they still have the option to go public and issue outside equity.

After the choice of outside equity, firm enters the period to choose debt and investment. The realization of firm state θ is uncertain and not observable to the lenders. There are two possible realizations of the state high or low. Lender observes operation earnings which depends on the realization of state. If covenant is violated, firm would be reorganized. If covenant is satisfied, lenders take no action. The detailed events for the firm with and without the use of cash flow-based debt in one period is illustrated below in Figure 3.

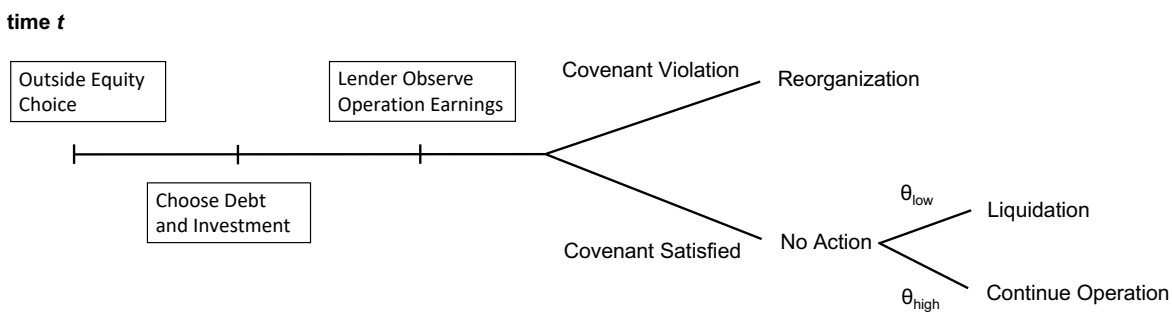


Figure 3: Timeline

3.2.1 Choice of Going Public and Issue Outside Equity

At the beginning of the period, before making the arrangement of debt and investment, the private firm makes the decision on the usage of outside equity. The decision involves both the extensive and intensive margin. The firm needs to decide whether to go public and the fraction ϕ it wants to sold to outsiders if it chooses to go public.

If the firm chooses to remain private, its cash-on-hand will not change, and the firm will enter production with the current cash-on-hand. If the firm chooses to go public, it will receive a payment from the outside shareholders whose value depends on the firm's productivity z, cash-on-hand X and fraction of equity sold ϕ. The valuation of the firm by outside shareholders will be discussed in more detail when introducing the equity contract.

3.2.2 Choice of Debt and Investment

After the choices of going public and share sold to outsiders have been made, firms will make choices of debt and investment. The timing of events is summarized below.

1. Raise capital for production k through net worth X, asset-based debt b_{AB}, cash-flow based debt b_{CF}.

2. Firm chooses labor l for production.

3. Production shock θ realized, but not observable, where $\theta \in \{\theta_{low}, \theta_{high}\}$. Earnings $\pi = \theta z k^{\nu}$ will be observed with noise as $\tilde{\pi} = \pi + \epsilon$ where $\epsilon \sim N(0, \sigma_{\pi})$.

4. Consider the case when $b_{CF} > 0$. If $\pi < \pi^*$, the firm will be reorganized. If $\pi > \pi^*$, lenders take no action. If state is realized high, firm will continue operation into next period. If state is realized low, firm will be liquidated. Firm pays back b_{AB} and b_{CF} contingent on the state realization.

The repayment schedules of asset-based or cash flow-based debt under different firm outcomes are different. The repayment schedule is summarized in Figure 4.

		Asset-Based Debt (Choose b_{AB})	**Cash Flow-Based Debt** (Choose b_{CF} and Covenant Threshold)	
Covenant Violation	**Reorganization**	Repay	Repay	
Covenant Satisfied	**Liquidation**	Repay	No Payment	← θ_{low}
	Continue Operation	Repay	Repay	← θ_{high}

Figure 4: Repayment Schedule

The value of collateral in the case of reorganization or liquidation is the same. Therefore, the repayment to asset-based lenders is the same in reorganization, liquidation or continuing operation. The repayment to cash flow-based lenders is different in the case of reorganization and liquidation. While reorganization could preserve the value of the firm as a going concern, liquidation would only preserve the liquidation value of firm's assets rather than its continuation value. There is no repayment value to cash flow-based lenders in the scenario of liquidation.

3.3 Financing Contracts

This section introduces the different types of financial contracts in more details. The specification of asset-based debt and cash flow-based debt follows the definition of the two types of debts by lenders in practice. Limit of asset-based debt depends on liquidation value of specific asset, while limit of cash flow-based debt depends on firm's value of continuing operations. Cash flow-based debt is modelled with an earning-based covenant structure. Outside equity contract is introduced following Peter (2021) and is modified to the model scenario.

3.3.1 Asset-Based Debt Contract

Asset-based borrowing constraint is determined by the liquidation value of collateral posted. In the model context, it is the value recoverable from the capital investment, which is defined below:

$$b_{AB} \leq \lambda_{AB} \frac{(1-\delta)}{R} k'$$

The recovery of collateral value in the case of liquidation and reorganization are the same which is $\lambda_{AB}(1-\delta)k$. The recovery of collateral value determines the limit of the asset-based borrowing constraint. The parameter λ_{AB} captures the friction of imperfect value recovery of collateral in the case of firm liquidation.

3.3.2 Cash Flow-Based Debt Contract

Cash flow-based borrowing constraint is determined by a multiple λ_{CF} of firm earnings which is a proxy for the firms' value of continuing operation. The implementation of cash flow-based constraint closely follows the design of cash flow-based contract in real life. The contract specifies the threshold of earnings below which the creditor would obtain control rights to reorganize the firm. Lenders would not take action if realization of earnings above the threshold. At the end of the period, firm would go in liquidation if the state is realized low, and continue operation if state is realized high. In the model setup, only collateral value is recoverable under the scenario of liquidation. Below is the description of the loan contract in more detail.

Definition of Earnings The contract of cash flow-based lending is implemented in the form of earning-based covenant. Earning-based covenants in practice is based on the operat-

ing earnings measure EBITDA. Therefore, the definition of operation earnings in the model closely follows the definition of EBITDA, which is sales subtract labor costs but includes interests, taxes and depreciation. Sales subtracting labor cost in the model context is as following:

$$\pi_t = \max_{l_t} y_t - w_t l_t = \tilde{z}_t^{1-\psi}(k_t^{\alpha} l_t^{1-\alpha})^{\psi} - w_t l_t = z_t k_t^{\nu}$$

where $z_t = \tilde{z}_t^{1-\psi} 1 - (1-\alpha)\psi \left(\frac{(1-\alpha)\psi}{w}\right)^{\frac{(1-\alpha)\psi}{1-(1-\alpha)\psi}} (1 - \psi(1-\alpha))$ and $\nu = \frac{\alpha\psi}{1-(1-\alpha)\psi}$.[8]

Shift of Control Right The design of the contract requires the following conditions to hold. The first condition guarantees that when the realization of earnings $\tilde{\pi}$ is larger than π^*, the lender would choose to let the project continue rather than reorganize the firm.

$$H_{CF} Pr(\theta = \theta_{high} | \tilde{\pi} > \pi^*) \geq Q_{CF}$$

Similarly, the second condition below guarantees that when earnings $\tilde{\pi}$ is smaller than π^*, the lender would rather take control and reorganize the firm than let it continue operating

$$H_{CF} Pr(\theta = \theta_{high} | \tilde{\pi} < \pi^*) \leq Q_{CF}$$

For the above two conditions to hold, we need

$$Pr(\theta = \theta_{high} | \tilde{\pi} < \pi^*) \leq Pr(\theta = \theta_{high} | \tilde{\pi} > \pi^*)$$

which is achieved in proposition 1 below.

Proposition 1 *The shift of control is incentive compatible if the following holds:*

$$F_{high}(\pi^*) \leq F_{low}(\pi^*)$$

As long as the expected profit in the low state is lower than the expected profit in the high state, the lender would always reorganize the firm when earnings fall below the threshold and let the firm continue to operate otherwise.

[8] The production function has decreasing return to scale and follows the specification in Peter (2021).

Zero Profit Condition Also, I assume the lender is risk neutral and the loan market is competitive. The zero profit condition stands below,

$$H_{CF}Pr(\theta = \theta_{high}|\tilde{\pi} \geq \pi^*)Pr(\tilde{\pi} \geq \pi^*) + Q_{CF}Pr(\tilde{\pi} < \pi^*) = Rb_{CF}$$

Suppose the expected payment of borrowers under reorganization and continuation is the same, it implies the following payment schedule:

$$Q_{CF} = H_{CF}Pr(\theta = \theta_{high}|\tilde{\pi} \geq \pi^*) = Rb_{CF} \leq \lambda_{CF}zk^{\nu}$$

The payment in the case of reorganization is Q_{CF}, which can not exceed the value recoverable of the firm in the scenario of reorganization. This defines the debt limit condition to the cash flow-based lending contract.

Violation Threshold The threshold π^* is another essential part of the cash flow-based loan contract. Since the focus in the firm's problem and the lenders is assumed to be risk-neutral, I consider the design of the cash flow-based borrowing contract aims at maximizing the borrowers' utility. The threshold π^* is chosen such that it maximizes the following:

$$\begin{aligned}
\max_{\pi^*} \max_{c,b_{AB},b_{CF},k'} & u(c) + \beta(1-\pi_d)\Big\{ Pr(\tilde{\pi} < \pi^*)\mathbb{E}_{\eta'}[V_w(X^Q;\eta')] \\
& + Pr(\tilde{\pi} \geq \pi^*)\big[Pr(\theta = \theta_{low}|\tilde{\pi} \geq \pi^*)\mathbb{E}_{\eta'}[V_w(X^w;\eta')] \\
& + Pr(\theta = \theta_{high}|\tilde{\pi} \geq \pi^*)V(X^H, z)\big]\Big\} \\
\text{s.t.} \quad c + k' &= X + b_{AB} + b_{CF} \\
\tilde{\pi} &= zk'^{\nu}\theta + \epsilon \quad \text{where,} \quad \epsilon \sim N(0, \sigma_\pi) \\
X^H &= zk'^{\nu} + (1-\delta)k' - Rb_{AB} - H_{CF} \\
X^Q &= \lambda_{CF}zk^{\nu} + (1-\delta)k' - Rb_{AB} - Q_{CF} + w\eta' \\
X^w &= (1-\delta)k' - Rb_{AB} + w\eta' \\
b_{AB} &\leq \lambda_{AB}\frac{(1-\delta)}{R}k' \\
b_{CF} &\leq \lambda_{CF}\frac{zk'^{\nu}}{R}, \text{ and } b_{CF} > 0
\end{aligned}$$

the violation threshold is chosen such that the borrower's utility is maximized given that they choose to use positive amount of cash flow-based debt. The optimal choice of covenant threshold is described by the following proposition.

Proposition 2 *The optimal choice of covenant thresholds is determined by:*

$$\frac{Pr(\theta = \theta_{high})\left(V_e(X^H, z) - \mathbb{E}_{\eta'}[V_w(X^Q; \eta')] - V_{ex}(X^H, z)\frac{F_{low}(\pi^*)}{F_{high}(\pi^*)}\right)}{Pr(\theta = \theta_{low})\left(\mathbb{E}_{\eta'}[V_w(X^Q; \eta')] - \mathbb{E}_{\eta'}[V_w(X^w; \eta')] - V_{ex}(X^H, z)\right)} = \frac{f_{low}(\pi^*)}{f_{high}(\pi^*)}$$

$f_{low}(\cdot)$ and $f_{high}(\cdot)$ are the probability density function of $F_{low}(\cdot)$ and $F_{high}(\cdot)$, which are the conditional distribution operational earnings.

The optimal choice of the violation threshold is a trade-off between the cost of false positive detection of firm in bad status and the cost of false negative judgement of firm in good status.[9] The cost of false positive detection is the difference in value between the entrepreneur continuing successful operation and going into reorganization. The cost of false negative detection is the difference in value between the entrepreneur going into reorganization and liquidation.

3.3.3 Equity Contracts

IPO cost for Going Public Following the literature (Lowry, Michaely, and Volkova, 2017; Doidge, Karolyi, and Stulz, 2017), the choice of going public for firms is modelled with the payment of a fixed cost. Firms going public is subject to a fixed IPO cost c_{IPO}, which would affect the extensive margin of whether the firm chooses to go public, while the intensive margin of how much equity to sell would depend on the following financial friction.

Flow Cost for Being Public After the firm has become a public firm, they are subject to regulatory requirement for disclosure of their operating information. Outside shareholders need to monitor the behavior of the inside shareholder who has control over the firm's investing and financing decisions. The monitoring cost is linear in the operation earnings with a multiple of c_M capturing the effectiveness of the monitoring technology and a fraction ϕ which is owned by the outside shareholders. The monitoring technology would affect the pricing of firm shares from the outside shareholders, which in turn determines how much the firm would receive when going public. The value paid by the outside shareholder is determined by the value generated by the firm depending on its cash-on-hand X, productivity

[9] Griffin, Nini, and Smith (2021) also discuss the choice of optimal covenant design with false positive and false negative rate.

z and fraction sold ϕ. The value of shares is defined below:

$$V_{OI}(\tilde{X}, z, \phi) = \phi k(\tilde{X}, z, \phi)\left(-1 + \frac{1-\delta}{R}\right) + \frac{Pr[\theta = \theta_{high}, \tilde{\pi} \geq \pi^*(\tilde{X}, z, \phi)]}{R}\left(\phi z k(\tilde{X}, z, \phi)^{\nu}(1 - c_M) + V_{OI}(X'^{H}(\tilde{X}), z, \phi)\right)$$

And the value for the outside shareholders is linked one to one to what the firm will receive at the time they go public:

$$V_{OI}(\tilde{X}, z, \phi) = V_{IPO}(\tilde{X} - (V_{OI}(\tilde{X}, z, \phi) - c_{IPO}), z, \phi)$$

The value entrepreneurs can receive at IPO is value of the sum of discounted future dividend to the outside shareholder.

3.4 Firm's Problem

3.4.1 Private Firm's Problem

Choice of Going Public The private firm's value function includes the option value of choosing to go public. The firm chooses whether to stay private or the optimal share to sell to outside investors by maximizing the value function. The private firm's choice problem of staying private or going public is stated below:

$$V_E(X, z) = \max_{i \in \{PRIV, PUB\}} \{V_{PRIV}(X, z), \max_{\phi}\{V_{PUB}(\underbrace{X + V_{IPO}(X, z, \phi) - c_{IPO}}_{\tilde{X}}, z, \phi)\}\}$$

where c_{IPO} is the fixed cost of going public and V_{IPO} is the value transferred to the inside shareholders from the outside shareholders upon selling of equity. With the outsider and insider split, there is separation of ownership and control. Therefore, the outsider shareholder's valuation changes with the difficulty of monitoring insider's behavior, which depends on firm's productivity, ownership structure and firm's cash-in-hand.

Choice of Debt and Investment The firm has access to both asset-based and cash flow-based borrowing contract. The asset-based debt limit depends on the liquidation value of capital. The cash flow-based debt limit depends on a multiple of firm earnings to proxy firm's value of continuing operation. The cash flow-based debt contract is implemented in

the form of a earning-based covenant. Below is the private firm's problem:

$$
\begin{aligned}
V_{PRIV}(X,z) = \max_{c,b_{AB},b_{CF},k',\pi^*} & u(c) + \beta(1-\pi_d)\Big\{ Pr(\tilde{\pi} < \pi^*)\mathbb{E}_{\eta'}[V_w(X^Q;\eta')] \\
& + Pr(\tilde{\pi} \geq \pi^*)\big[Pr(\theta = \theta_{low}|\tilde{\pi} \geq \pi^*)\mathbb{E}_{\eta'}[V_w(X^w;\eta')] \\
& + Pr(\theta = \theta_{high}|\tilde{\pi} \geq \pi^*)V_E(X^H,z)\big]\Big\} \\
\text{s.t.} \quad c + k' &= X + b_{AB} + b_{CF} \\
\tilde{\pi} &= zk'^{\nu}\theta + \epsilon \quad \text{where,} \quad \epsilon \sim N(0,\sigma_\pi) \\
X^H &= zk'^{\nu} + (1-\delta)k' - Rb_{AB} - H_{CF} \\
X^Q &= \lambda_{CF} zk^{\nu} + (1-\delta)k' - Rb_{AB} - Q_{CF} + w\eta' \\
X^w &= (1-\delta)k' - Rb_{AB} + w\eta' \\
b_{AB} &\leq \lambda_{AB}\frac{(1-\delta)}{R}k' \\
b_{CF} &\leq \lambda_{CF}\frac{zk'^{\nu}}{R}, \text{ if } b_{CF} > 0
\end{aligned}
$$

3.4.2 Public Firm's Problem

When the firm chooses to go public, it also makes the choice of its ownership structure. It chooses the share ϕ to sell to outside investors, and the ownership structure would remain constant after the firm become public. The public firm's problem is similar to the private firm's problem. The only difference is that while the private firms bear the full capacity of debt and investment, the public firms with share ϕ sold to outsiders only need to contribute the $(1-\phi)$ portion they own to the debt and investment arrangements.

3.5 Equilibrium

The firm's problem is described in detail above, and I keep the worker's problem to be simple. I treat the case of liquidation and reorganization as bankruptcy and the entrepreneur would turn to a worker. Workers are described by their cash-on-hand. They make consumption and saving choices, and earn wage each period. The equilibrium wage is determined through labor market clearing.

I study the choices and allocations in a stationary competitive equilibrium. Gross rate of return is exogenous, wage is pinned down in the domestic labor market. The stationary competitive equilibrium consists of the following: (i) firm's value functions $\{V_E, V_{PUB}, V_{PRIV}\}$,

worker's value function $\{V_w\}$, investment fund's value function $\{V_{OI}\}$; (ii) firm's choices $\{b_{AB}, b_{CF}, c, k', l'\}$, worker's choices $\{c, a'\}$; (iii) equilibrium wage; (iv) distribution of firm over type space $\{X, z, PUB/PRIV\}$ and distribution of worker over type space $\{a, z\}$, such that

1. Given rate of return and wage, firm and worker's policy functions and value functions solves their optimization problem.
2. $\{V_{OI}\}$ solves the investment fund's optimization problem.
3. Labor market clears
$$S_w = \int_i l_{PUB}(i)di + \int_i l_{PRIV}(i)di$$
4. Distribution of worker and firm types are stationary.

3.6 Comparison of Debt Types

3.6.1 Debt Choice

Figure 5 plots the level of cash flow-based debt and asset-based debt chosen by firms of different levels of cash-on-hand, and by firms of different productivity levels.

For firms of the same productivity level, in the range of low cash-on-hand, cash flow-based debt allows firms to borrow against their future profitability and provides a higher borrowing limit than asset-based debt. As the firm accumulates more assets and become relatively less constrained, debt limit of asset-based constraint is higher. This mechanism justifies the empirical pattern documented above that smallest firms in developed countries tend to employ relative high degrees of cash flow-based debt due to the lack of assets. When the level of cash-on-hand is high enough, the firm becomes unconstrained and starts saving.

Comparing firms of lower productivity to firms of higher productivity, the range in which the cash flow-based debt provides a higher borrowing limit changes. The higher productivity level firm has higher future profitability, and provides a larger cash flow-based debt limit for the same cash-on-hand level. The investment need of higher productivity firms are also higher, and results in the choice of higher debt level. Moreover, higher productivity firms are able to choose higher violation threshold, which lowers their repayment in the case of continuing operation and enables higher usage o cash flow-based debt. The comparison of debt usage between firms of different productivity levels explains the empirical pattern that large firms employ more cash flow-based debt to borrow beyond liquidation value in order

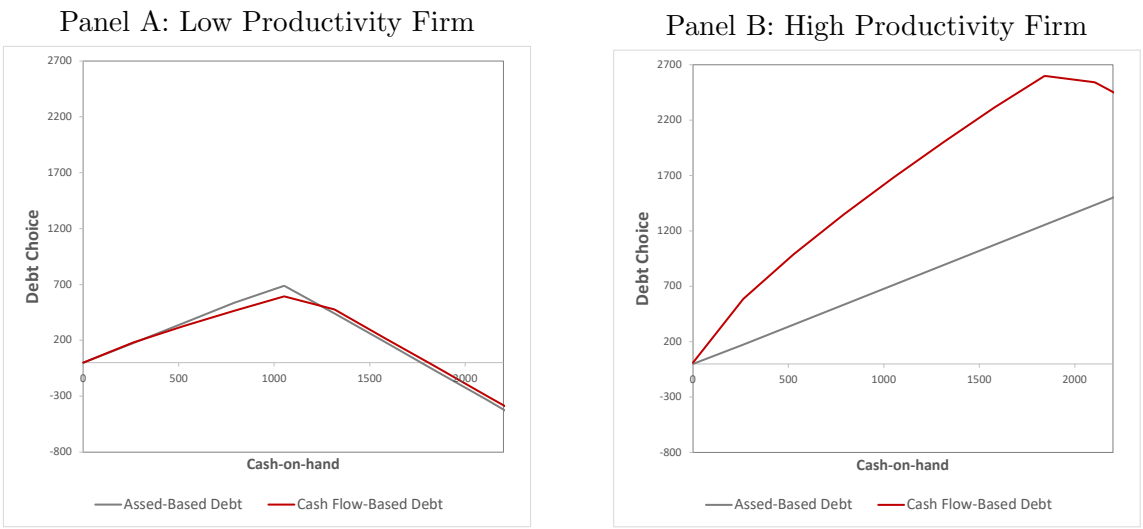


Figure 5: Debt Choice

This figure plots the usage of cash flow-based debt and asset-based debt for firms of different levels of cash-on-hand and productivity. The debt usage are plotted under the scenario that firms only have access to one type of the debt. The parameter governing the constraint is calibrated to the same economy under the two different debt type specifications. Panel A plots the level of debt usage for low productivity firm. Panel B plots debt usage for high productivity firms. The red line plots the use of cash flow-based debt while the gray line plots the use of asset-based debt.

to fulfill their higher need of investment and are able to do so with the larger relaxation of cash flow-based constraint from higher operating earnings.

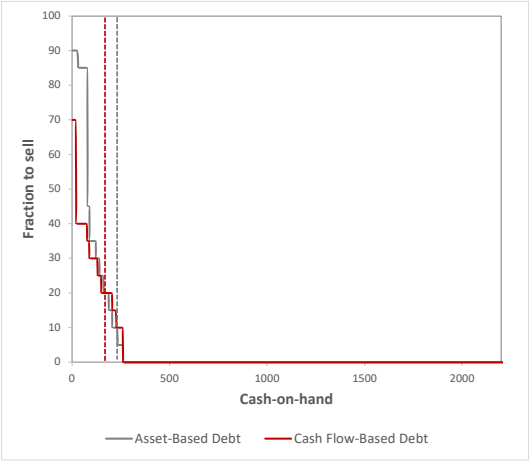
3.6.2 Outside Equity Choice

This part presents how the cash flow-based borrowing contract can change the firm's optimal decision of going public and firm's optimal choice of the fraction ϕ to sell to outsiders. The effect is summarized in Figure 6 below:

The red line plots the case under cash flow-based debt. The gray line plots the case under asset-based debt. At the intensive margin, the optimal choice of ϕ which the firm chooses to sell to outside shareholders decreases. The borrowing constraint of firms with lower cash-in-hand is relaxed by the cash flow-based borrowing constraint. These are the firms which cash flow-based debt benefited the most, leading to a lower need of issuing outside equity. The extensive margin of whether the firm chooses to go public indicated by the dotted line also changes. The threshold below which the firm is choosing to go public decreases, affecting firm's choice of whether to issue outside equity.

The left figure plots the case where the firm's productivity is low and the right figure plots the case where the firm's productivity is high. For a firm with higher productivity, the

Panel A: Low Productivity Firm



Panel B: High Productivity Firm

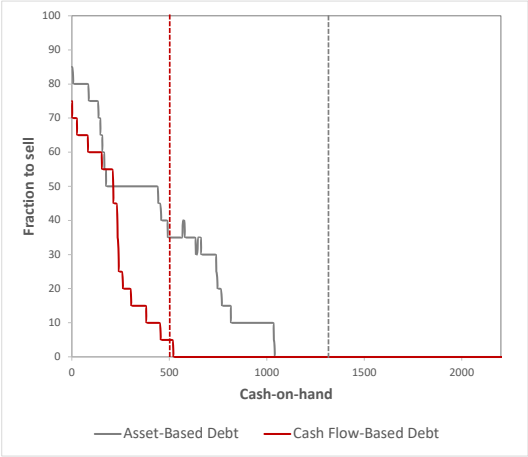


Figure 6: Outside Equity Choice

This figure plots the choice of going public and fraction of share to sell for firms of different levels of cash-on-hand and productivity. The choices are plotted under the scenario that firms only have access to one type of the debt. The parameter governing the debt constraint is calibrated to the same economy under the two different debt type specifications. The equity parameters are the same in the two scenarios. Panel A plots the level of debt usage for low productivity firm. Panel B plots debt usage for high productivity firms. The red line indicates the choice under cash flow-based debt while the gray line plots the choice under asset-based debt. The solid line indicates the choice of optimal ϕ. The dotted line indicates the optimal choice of whether to go public, left the dashed line firms will choose to go public, and right to the line firms will remain private.

borrowing constraint is more relaxed from the cash flow-based debt. The firm with higher productivity would also choose higher debt level due to its higher investment need and it ability to choose higher violation threshold. Therefore, the impact of introducing cash flow-based debt has a larger impact on the outside equity choice of firms with higher productivity both on the intensive and extensive margin.

4 Quantitative Analysis

This section combines the model structure and the data moments to provide a quantitative description of the country's development in different financial segments. The calibration exercise focuses on the set of parameters describing debt and equity contracts available to the firm. Two sets of estimation are delivered. The first is the baseline case where only asset-based debt is available. The second case is when only cash flow-based debt is available. The calibration results illustrate how different debt contracts could affect the quantitative estimation of parameters, and the interaction between the debt and equity markets.

The key data moments come from World Bank's Global Financial Development Database. Simulation of the model produces aggregate usage of debt and equity financing, allowing com-

parison to aggregate outcome described by financial development indices. This link between model and data moments enables calibration exercises in a large set of countries. Therefore, we can use the model to describe costs to alternative financing contracts and their aggregate implications in countries with highly different degrees of financial development.

4.1 Assigned Parameters

Same Across Countries The parameters with exogenously given values that remained the same across countries are reported in Appendix Table C1. The value of assigned parameters closely follow the specification of Peter (2021). Most assigned parameter values follow standard values in the literature. The probability of agent dying and firm failure is selected to match workers' average working life and firm's average living age. The share of workers comes from the Eurosystem Household Finance and Consumption Survey.

The productivity distribution is approximated by three different levels of productivity. The dispersion of productivity levels and fraction of entrepreneurs born with each level of productivity follows the specification of productivity distribution of France in Peter (2021). France is also used as the benchmark country in the counterfactual analysis of next section. The level of type 2 and type 3 firms' productivity is pinned down through matching the employment share of top 1% and top 10% firms in the French economy. And the split of z_1, z_2, z_3 firms is 80/18/2.

The high state multiplier θ_{high} is normalized to one. Therefore, the calibration exercise using asset-based debt is identical to calibration under the model setup where low state realization implies firm exit and high state realization implies firm survival. The variance of operation earnings observation σ_π is chosen to match standard deviation of operating earnings to total assets in data. Given the noise in operation earnings observation, low state multiplier θ_{low} is chosen such that average earnings normalized by investment in the model matches operating earnings normalized by total assets in data.

Worker productivity follows the AR(1) process in logs: $\log(\theta_t) = \rho_\theta \log(\theta_{t-1}) + (1 - \rho_\theta)\mu_\theta + \sqrt{(1-\rho_\theta^2)}\sigma_\theta \epsilon_t$ where $\epsilon \sim N(0,1)$, and is approximated using Tauchen (1986) method with a five-state Markov chain. Agent who was hit by a death shock is replaced by a new agent who inherit portion χ of the parent's wealth and $(1-\chi)$ of the population average wealth.

Different Across Countries Since the calibration exercise features a set of countries with vastly different degrees of economics development, the impact of financial frictions

on aggregate outcome could possible change with different country's level of productivity. Therefore, the average productivity is calibrated to individual country level according to each country's TFP normalized to the level of TFP in France. The average productivity in France is normalized to one. TFP for each country is calculated using information on GDP, capital and employment from Penn World Table 10.0.[10]

4.2 Calibrated Parameters

Debt Contracts When comparing the collateral constraint with cash flow-based constraint, there is only one parameter governing debt friction to be calibrated. In this case, the tightness of asset-based and cash flow-based debt contracts will be calibrated endogenously to match private credit to GDP ratio. The tightness of debt constraints will directly affect the amount of debt firms could obtain. At the aggregate level, the usage of debt by firms in the economy will contribute to the private credit to GDP ratio. In generating the model moments, private credit is the sum of debt used by firms. GDP is the total raw production of the firm not deducting labor costs.

In calibration the case of firms with access to both types of debts, there are two parameters related to debt friction to be calibrated. In this case, the target for asset-based constraint parameter is the credit to GDP ratio. And the target for cash flow-based constraint is the sum of syndicated loan and corporate bond to GDP ratio. Through the combination of cash flow-based debt to output ratio and total credit to GDP ratio, we can pin down the two parameters related to debt friction respectively.

Equity Contracts The two costs c_M and c_{IPO} related to the equity financing contract respectively affect the firm's choice of going public at the extensive margin and firm's choice of optimal fraction of share to sell at the intensive margin. The targeted moment for IPO cost is the listed number of firms per million normalized as a fraction to the French level. The number of listed firms measures the number of firms that have crossed the extensive margin and choose to go public. This measure is directly linked to the entry cost as it measures the outcome at the extensive margin.

The targeted data moment for the monitoring cost is stock market capitalization value to GDP. The model moment is calculated by dividing the sum of public firm value to sum

[10]Total output is measured by output-side real GDP at chained PPPs(rgdpo), employment is measured using number of people engaged(emp), and capital is measured using capital stock at constant national prices(rnna). See more details from Feenstra, Inklaar, and Timmer (2015).

of total firm value. Monitoring cost affects firms' choice of outside equity at the intensive margin and would in turn affect the ratio of public firm value to total firm value.

4.3 Calibration Results

In this section, I provide calibration results for a set of countries with largely different degrees of development in debt and equity markets. The sample is constructed using countries which has non-missing information on credit to GDP ratio, stock market capitalization to GDP ratio, and number of public firms per million from World Bank's Global Financial Development Database for the year 2009. Countries are categorized into four groups: high debt financing low equity financing, high debt high equity, low debt high equity and low debt low equity. Ratio above the sample median is classified as high, and below the sample median is classified as low. The distribution of country's debt and equity market development is presented below in figure 7.

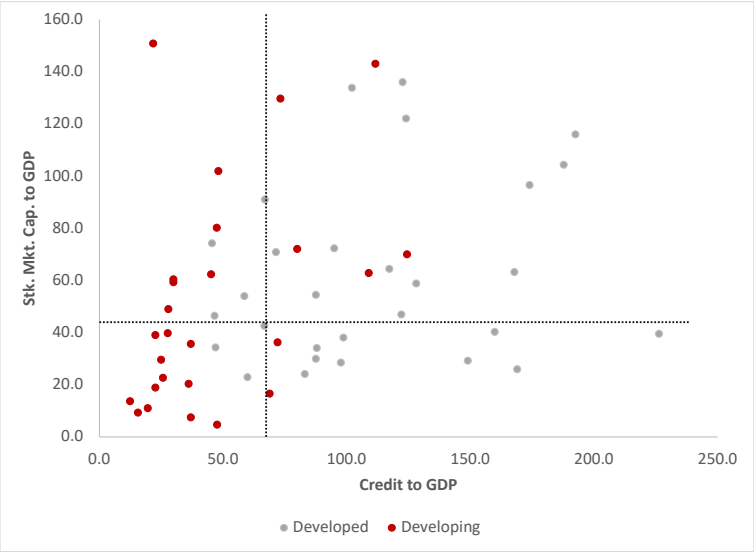


Figure 7: Categorization of Country Financial Development

This figure presents the scatter plot of country's debt and equity financing development. Horizontal axis measures credit to GDP ratio, and vertical axis measures stock market capitalization to GDP ratio. The dotted lines plot the median of corresponding measures and categorizes all the countries into four categories. Red dots indicates developing countries, gray dots plots developed countries.

The dotted lines marks the sample median of credit to GDP ratio and stock market capitalization to GDP ratio. Red dots mark countries with middle income according to World Bank classification, while gray dots mark countries with high income. As can be observed from the graph, middle income countries are mostly in the regions of low credit to GDP ratio, while the degree of stock market capitalization are more dispersed. In contrast,

high income countries are mostly in the regions of high credit to GDP ratio, while the degree of stock market capitalization are dispersed. The full list of countries included in the calibration exercise is presented in Appendix Table C2 and C3.

4.3.1 Asset-Based Debt

Table 4 below presents the calibration results for the case where only asset-based debt is available. The four countries each comes from a different category explained above.

Table 4: Calibration Results (Asset-Based Debt)

	Low Debt Low Equity (MEX)	**Low Debt High Equity (IND)**	**High Debt Low equity (DEU)**	**High Debt High equity (CAN)**
Panel A: Calibration Results				
λ_{AB}	0.17	0.31	0.59	0.83
c_M	0.39	0.35	0.24	0.06
c_{IPO}	0.02	0.01	0.03	0.00
Panel B: Data Targets				
Credit to GDP	22.6	47.2	98.8	124.1
Stock Mkt. Cap. to GDP	39.1	101.1	38.0	122.1
Listed Firms per Million	1.1	4.1	8.6	107.8

This table compares the calibration result for the case with only asset-based debt in different countries. c_{IPO} is reported as a fraction to the value of type 2 firms. Upper panel is the value of the calibrated parameters. Lower panel is the value of the target data moments. Private credit to GDP ratio, stock market capitalization to GDP ratio and listed firms per million come from Global Financial Development Database of World Bank.

The comparison of calibration results across the four country groups illustrates the interaction of debt and equity frictions in shaping the aggregate outcome. Mexico has below median value of both credit to GDP and stock market capitalization to GDP ratio. India shows high usage of equity but low credit to GDP ratio. Germany shows a high level of debt usage and modest usage of outside equity. Canada shows high usage of both debt and equity.

The estimation result for Mexico arrives at a high level of both debt and equity frictions. Although India shows a high level of stock market capitalization ratio, due to the relative low debt financing development which pushes the firms to refer to outside equity, the calibrated costs of equity financing is still modest. Calibration result of Germany shows a high recovery rate of collateral and modest costs for referring to outside equity. While for the case of Canada, the highly developed debt financing institutions further lowers the need for issuing

outside equity and resulted in low costs of issuing outside equity to target a high level of equity financing.

4.3.2 Cash Flow-Based Debt

Table 5 below presents the calibration results for the case where only cash flow-based debt is available. Comparing with Table 4, this set of calibration exercises arrives at different estimates of equity frictions and also produces different counterfactual results presented in the next section.

Table 5: Calibration Results (Cash Flow-Based Debt)

	Low Debt Low Equity (MEX)	**Low Debt High Equity (IND)**	**High Debt Low equity (DEU)**	**High Debt High equity (CAN)**
Panel A: Calibration Results				
λ_{CF}	1.6	3.8	5.1	7.4
c_M	0.36	0.12	0.23	0.04
c_{IPO}	0.010	0.008	0.070	0.000
Panel B: Data Targets				
Credit to GDP	22.6	47.2	98.8	124.1
Stock Mkt. Cap. to GDP	39.1	101.1	38.0	122.1
Listed Firms per Million	1.1	4.1	8.6	107.8

This table compares the calibration result for the case with only cash flow-based debt in different countries. c_{IPO} is reported as a fraction to the value of type 2 firms. Upper panel is the value of the calibrated parameters. Lower panel is the value of the target data moments. Private credit to GDP ratio, stock market capitalization to GDP ratio and listed firms per million come from Global Financial Development Database of World Bank.

In the analysis of the model solution, I show that the introduction of cash flow-based debt would reduce the firm's need to issue outside equity holding everything else constant. The reduction in need for equity financing is most pronounced for firms with lower level of cash-in-hand, which are the firms most likely to go public and issue a higher portion of outside equity. If the equity frictions remain unchanged with the use of cash flow-based debt, the share of private firms and insider share would be lower than the data moments. Therefore, the estimates of equity frictions would be lower with the introduction of cash flow-based debt to compensate the decrease in equity financing need.

4.4 Model Fit

This section evaluates the model fit of calibration exercise for the list of countries included in Appendix Table C2 and C3. This section first evaluates the model fit for the parameters that are targeted and then evaluates the relationship between financial development indicators and aggregate outcomes which are not targeted in the calibration exercise.

4.4.1 Financial Development Indices

Figure 8 below presents the model fit of targeted moments for the list of countries included in the calibration exercise.

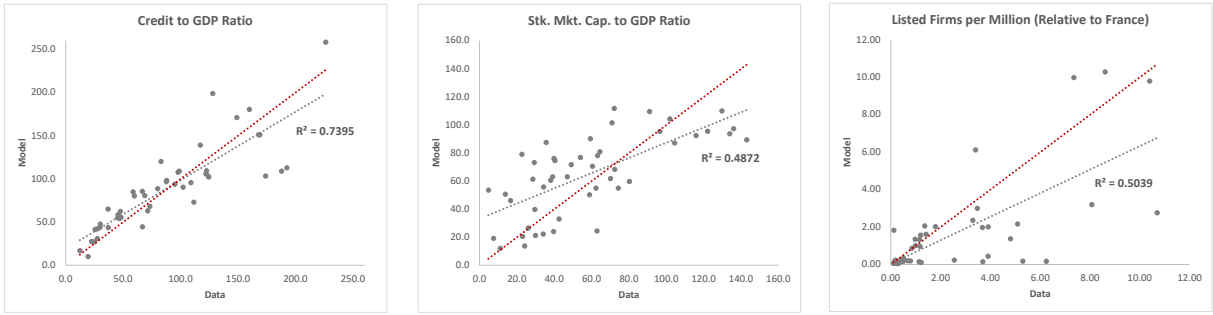


Figure 8: Model Fit (Targeted Moments)

This figure plots model fit for targeted moments in the list of countries included in the calibration exercise under asset-based debt. Left figure plots the fit of credit to GDP ratio. Middle figure plots the fit of stock market capitalization to GDP ratio. Right figure plots the fit of listed firms per million relative to France. The dotted grey line is the regression line of the scatter plot. The red line is the 45 degree line.

The three parameters calibrated targets the respective financial development indicators. The left figure plots the model credit to GDP ratio against data counterparts. The middle figure plots stock market capitalization to GDP ratio. The right figure plots listed firms per million relative to France. Model fit for specification of asset-based debt and cash flow-based debt are presented in two separate panels. The red dotted line is the 45 degree line, while the gray dotted line is the regression line of data to model scatter plot. R-square is reported in the graph. In general, the model estimation matches the targeted moments and produces a relatively large R-square.

However, the match is not perfect, especially for the parameters related to outside equity contract. This is due to the difficulty of the model to capture the scenario of unbalanced extensive margin and intensive margin of outside equity usage. Figure 8 above shows the result for the specification under asset-based debt. The model fit for targeted moments under cash flow-based debt can be found in Appendix Figure C1.

4.4.2 Financial Development and Aggregate Outcomes

Table 6 below presents model fit for the relationship between financial development and aggregate outcome which is not targeted in the calibration exercise.

Table 6: Model Fit (Untargeted Moments)

	(1) GDP	(2) GDP	(3) GDP	(4) Wealth 10	(5) Wealth 10	(6) Wealth 10
Panel A: Data						
CredittoGDP	0.51***			-0.07***		
	[0.32, 0.69]			[-0.11, -0.02]		
StktoGDP		0.13			0.02	
		[-0.22, 0.47]			[-0.05, 0.09]	
ListedFirmsperMil			4.79***			-1.34***
			[0.52, 9.06]			[-2.19, -0.47]
No. Obs.	51	51	51	51	51	51
R^2	0.37	0.01	0.08	0.14	0.01	0.15
Panel B: Model						
CredittoGDP	0.36***			-0.02		
	[0.21, 0.50]			[-0.08, 0.04]		
StktoGDP		0.20			0.01	
		[-0.09, 0.49]			[-0.10, 0.11]	
ListedFirmsperMil			3.50***			-1.08***
			[0.19, 6.81]			[-2.10, -0.06]
No. Obs.	51	51	51	51	51	51
R^2	0.33	0.02	0.07	0.01	0.02	0.07

This table presents the model fit for untargeted moments under the specification of asset-based debt. The relationship between financial development and aggregate outcome is evaluated in data and model. The first three columns present the regression results using GDP per capita relative to France. The last three columns use top 10 percent wealth share as the dependent variable. The upper panel shows the regression results from data and the lower panel shows the regression results from model. 95% confidence interval is presented in the parentheses. *$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The first three columns present the regression results using GDP per capita relative to France as dependent variable regressing against credit to GDP ratio, stock market capitalization to GDP ratio and listed firms per million relative to France. The last three columns use top 10 percent wealth share as the dependent variable. The upper panel shows the regression results from data and the lower panel shows the regression results from model.

The regression results shows that the model reproduces the empirical relationship between financial development and aggregate outcome without targeting aggregate outcomes in the calibration exercise. The coefficients from model and data regressions are consistent in levels and significance. And the R-square from the regressions are also comparable. Table 6 above shows the result for the specification under asset-based debt, while the regression results for specification under cash flow-based debt can be found in Appendix Table C4.

5 Aggregate Implications

This section quantifies the aggregate implications of the financial frictions. The first set of exercise is to analyze the role of different financial frictions in shaping the aggregate output. Output per capita from the calibrated case is compared to the counterfactual cases of equalizing debt or equity frictions to the benchmark group of high debt and equity market development. The second exercise presents how parameters associated with different financial contracts can account for cross-country difference in wealth inequality. The cross-country difference is decomposed into variation arising from difference in debt market development and variation from difference in equity market development. The counterfactual analysis is conducted for both specification of debt contracts: the baseline case where there is only access to asset-based debt, and the second case where there is only access to cash flow-based debt.

5.1 Output per capita

Table 7 presents the aggregate implications of financial frictions on aggregate output. The table shows the change in total output given the adjustment in respective financial frictions. The first row displays the result when equalizing debt frictions to the average of the high credit high equity benchmark group level. The second row displays the result when equalizing equity frictions to the benchmark group level. The upper panel presents the result when considering asset-based debt, the lower panel presents the result when considering cash flow-based debt. The five columns displays the average change in output per capita of the four respective group and the sample average.

In the case of access to only asset-based debt, the average increase in output per worker is significantly higher when equalizing debt market frictions. This is driven by the asymmetric increase in output when one of debt or equity market is less developed. Comparing the two columns in the middle, we could observe that when debt market development is low and equity market development is high, the increase in output from improving debt market development is higher than the opposite scenario. When debt market is less developed, a relatively developed equity market further benefits firms of higher productivity, leaving the smaller firms with lower productivity financially constrained. An improvement in debt access in this scenario releases the constraint for smaller firms, which account for a large proportion of firms in the economy, contributing to large increase in output per worker. On the other hand, in a country with highly developed debt market, the firms with lower

Table 7: Change in Output: Equalizing Financial Frictions

	Low Debt Low Equity	**Low Debt High Equity**	**High Debt Low equity**	**High Debt High equity**	**Whole Sample**
Panel A: Asset-Based Debt Only					
Same Debt Frictions	20.2%	14.4%	5.1%	-0.9%	11.4%
Same Equity Frictions	5.7%	3.8%	6.8%	-0.4%	4.2%
Panel B: Cash Flow-Based Debt Only					
Same Debt Frictions	8.3%	7.6%	6.1%	0.6%	6.5%
Same Equity Frictions	6.5%	1.0%	3.1%	0.3%	3.6%

This table presents the implications of different financial frictions on aggregate output. The upper panel shows the change in the calibration case where only asset-based debt is available. The lower panel shows the change in the calibration case where only cash flow-based debt is available. The first row shows the change from adjusting debt frictions, the second row shows the change from adjusting equity frictions.

productivity are already operating at optimal scale and are less constrained. Firms with higher productivity are also not severely constrained. The improvement in equity market benefits the high productivity firms with fewer resources, and increases output per capita to a modest degree.

Another factor contributing to the difference in output change when equalizing debt or equity frictions is the larger increase in output per worker when improving debt availability in developing countries. From the direct categorization of country groups shown in Appendix Table C2 and C3, developing countries mostly lie in the categories of low credit to GDP ratio, which translates into high debt market frictions, while the degree of development in equity market is more dispersed. This leads to consistently higher increase in output when improving debt market development in developing countries.

The degree of change in output per capita is less significant by improving debt market development for developing countries when cash flow-based debt is considered. For a simulated economy with less developed debt market, while achieving the same credit to GDP ratio, credit and output are both higher in firms with lower productivity under the specification of cash flow-based debt. The cash flow-based borrowing constraint provides a higher limit than asset-based constraint for the same given level of cash-on-hand in the range of smaller size firms. Therefore, the increase in output from relaxing debt frictions is less significant in countries with low credit to GDP ratio compared to the scenario where asset-based debt is considered and the resource allocation is more distorted towards large firms.

5.2 Wealth Inequality

The previous exercise shows the impact of removing financial frictions on aggregate outcomes. In this section, I examine how much do debt and equity frictions contribute to cross-country differences in aggregate outcome. I conduct two sets of counterfactual analysis to evaluate the contribution from difference in debt and equity frictions. In the first set of analysis, the level of debt frictions are held constant as in the benchmark country while keep equity frictions varying according to the calibrated level at each country. In the second set of analysis, the level of equity frictions are held constant as in the benchmark country while keep debt frictions vary according to the calibrated level. Each counterfactual exercise provides a way of decomposing difference in aggregate outcome to difference arising from debt or equity frictions. The counterfactual exercise is summarized below:

$$\log \frac{\text{Top 10 Wealth}_i(D_i, E_i)}{\text{Top 10 Wealth}_b(D_b, E_b)} = \underbrace{\log \frac{\text{Top 10 Wealth}_i(D_b, E_i)}{\text{Top 10 Wealth}_b(D_b, E_b)}}_{\text{contribution by equity friction diff.}} + \underbrace{\log \frac{\text{Top 10 Wealth}_i(D_i, E_i)}{\text{Top 10 Wealth}_b(D_b, E_i)}}_{\text{contribution by debt friction diff.}}$$

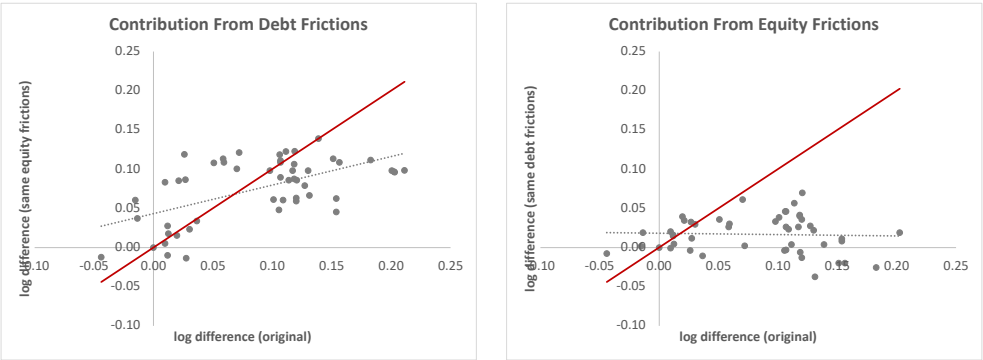
$$\log \frac{\text{Top 10 Wealth}_i(D_i, E_i)}{\text{Top 10 Wealth}_b(D_b, E_b)} = \underbrace{\log \frac{\text{Top 10 Wealth}_i(D_i, E_b)}{\text{Top 10 Wealth}_b(D_b, E_b)}}_{\text{contribution by debt friction diff.}} + \underbrace{\log \frac{\text{Top 10 Wealth}_i(D_i, E_i)}{\text{Top 10 Wealth}_b(D_i, E_b)}}_{\text{contribution by equity friction diff.}}$$

Figure 9 below shows how debt and equity frictions each could account for the cross-country difference in output per worker. The upper panel presents the case when asset-based debt is considered, the lower panel presents the case when cash flow-based debt is considered. Left figure shows the contribution of debt frictions by holding constant the level of equity frictions as illustrated by the first equation above. Right figure shows the contribution of equity frictions by holding constant debt frictions as illustrated by the second equation above.

The explanatory power of debt and equity frictions changes with the different specification of debt types. In the case of asset-based debt, debt frictions drives the cross-country difference in top wealth share since debt frictions distort firms' incentive to accumulate capital and concentrate resources in the hands of the wealthiest.

The pattern changes in the case of cash flow-based debt where equity frictions account for a large fraction of cross-country difference in top wealth share. The presence of cash flow-based debt reduces the difference between production choices of lower productivity firms in countries with different degrees of debt market development, which reduces the distortion in production from debt frictions. On the other hand, for firms of higher productivity, the debt

Panel A: Asset-Based Debt



Panel B: Cash Flow-Based Debt

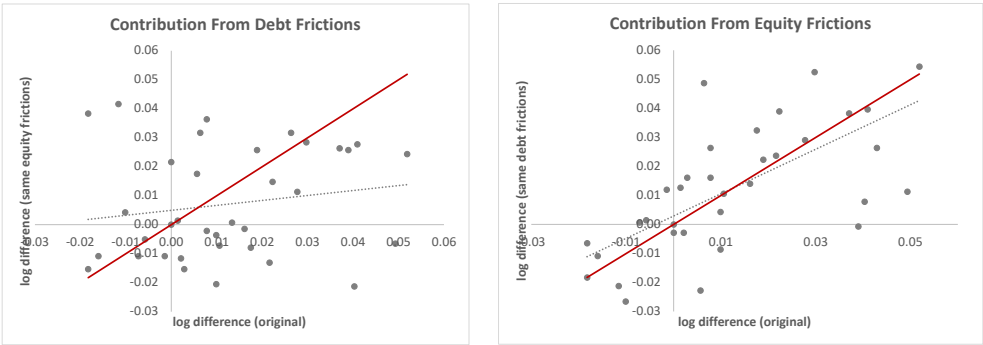


Figure 9: Cross-Country Difference in Top 10 Wealth Share and Financial Frictions

This figure plots the log difference of top 10 wealth share across country against the log difference in top 10 wealth share if holding equity or debt frictions to be same as the benchmark country. The upper panel plots the case when asset-based debt is considered. The lower panel plots the case when cash flow-based debt is considered. Left figure plots the contribution to from debt frictions by holding equity market frictions constant as France. Right figure plots the contribution from equity frictions by holding debt frictions constant as France. The dotted grey line is the regression line of the scatter plot. The red line is the 45 degree line.

capacity relaxation from cash flow-based debt is more significant in countries with higher debt market development. The high productivity firms are also the group of firms who rely most on outside equity contracts. Lower levels of equity frictions allow firms to diversify risks and reduce firms' need of precautionary saving. Under cash flow-based debt, the distortion in wealth inequality from debt frictions is reduced in less developed markets, and the impact of equity frictions on firms' saving behavior is enlarged. The two forces jointly contribute to the higher explanatory power of equity frictions in accounting from cross-country difference in wealth inequality.

6 Conclusion

This paper quantifies the impacts of debt and equity frictions for aggregate and distributional outcomes in a large set of countries with different degrees of financial development. With different debt contract specifications, the aggregate consequences of debt and equity frictions change. With asset-based debt, production is more distorted in less financially developed countries. The increase in output per capita with asset-based debt is more than twice of the increase with cash flow-based debt when reducing debt frictions. Reducing equity frictions only benefits firms which optimally operates at a larger scale, leading to a less pronounced increase in output per capita. The consideration of different debt contracts also changes the role of debt and equity frictions in accounting for wealth inequality. Debt frictions contribute more to cross-country difference in wealth inequality when asset-based debt is considered, and equity frictions carry more explanatory power with cash flow-based debt specification.

For policy implications, as pointed out in the counterfactual analysis, frictions associated with different financial contracts change resource allocations differently for heterogeneous firm groups. While syndicated loans and corporate bonds are more accessible to firms of larger size, the rise of Fintech could significant increase the availability of cash flow-based debt for firms of smaller size. Moreover, there is an ongoing trend of bankruptcy reforms in European countries. The reform moves towards insolvency procedures that preserve entity value as going-concern. The reform in bankruptcy procedure is closely linked to firms' choice of cash flow-based debt since the debt limit of which depends on firm's value of continuting operation. The examples of Fintech development and European bankruptcy law reforms are promising applications of the model framework to study policy effectiveness.

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A Empirical Appendix

Table A1: Summary Statistics and Sample Coverage (Firm-Level Measures)

Country	Listed Firms	No. of Obs.	Coverage	mean_cfl	mean_lev	mean_ins
Argentina	93	58	62.37	0.60	0.44	0.66
Australia	1989	1148	57.72	0.41	0.43	0.24
Austria	79	58	73.42	0.44	0.27	0.47
Belgium	117	94	80.34	0.50	0.27	0.38
Canada	3501	1158	33.08	0.46	0.51	0.39
Switzerland	234	177	75.64	0.47	0.22	0.39
Chile	223	134	60.09	0.32	0.31	0.27
China	2827	3200	113.19	0.46	0.19	0.41
Cyprus	84	62	73.81	0.16	2.68	0.55
Germany	555	481	86.67	0.39	0.23	0.47
Denmark	200	106	53.00	0.29	0.21	0.38
Egypt	250	136	54.40	0.34	0.20	0.50
Spain	3623	144	3.97	0.51	0.34	0.30
Finland	150	141	94.00	0.51	0.30	0.33
France	490	584	119.18	0.47	0.22	0.35
United Kingdom	1860	996	53.55	0.37	0.25	0.19
Greece	236	172	72.88	0.41	0.50	0.51
Croatia	186	75	40.32	0.20	0.29	0.50
Indonesia	521	417	80.04	0.27	0.33	0.57
India	5835	2865	49.10	0.33	0.39	0.42
Ireland	43	73	169.77	0.55	0.23	0.18
Israel	440	303	68.86	0.37	0.29	0.48
Italy	300	288	96.00	0.33	0.28	0.55
Jordan	228	96	42.11	0.16	0.22	0.39
Japan	3504	2706	77.23	0.47	0.18	0.16
Korea	1948	1293	66.38	0.24	0.23	0.30
Kuwait	150	78	52.00	0.22	0.19	0.39
Sri Lanka	294	179	60.88	0.29	0.39	0.43
Luxembourg	27	50	185.19	0.42	0.40	0.39
Mexico	136	94	69.12	0.51	0.25	0.44
Malaysia	892	735	82.40	0.30	0.19	0.49
Nigeria	183	76	41.53	0.40	0.29	0.43
Netherlands	100	131	131.00	0.43	0.31	0.31
Norway	171	154	90.06	0.36	0.31	0.33
New Zealand	171	112	65.50	0.37	0.24	0.27
Oman	116	64	55.17	0.32	0.33	0.48
Pakistan	600	314	52.33	0.30	0.32	0.42
Peru	212	75	35.38	0.34	0.24	0.53
Philippines	262	140	53.44	0.54	0.32	0.35
Poland	872	629	72.13	0.19	0.19	0.53
Romania	82	92	112.20	0.35	0.22	0.56
Russian Federation	251	213	84.86	0.43	0.33	0.44
Saudi Arabia	171	113	66.08	0.34	0.28	0.23
Singapore	483	541	112.01	0.33	0.24	0.39
Sweden	300	544	181.33	0.43	0.20	0.29
Thailand	639	552	86.38	0.34	0.24	0.38
Turkey	392	286	72.96	0.31	0.48	0.57
United States	4381	3881	88.59	0.51	0.50	0.26
Vietnam	684	283	41.37	0.23	0.28	0.32
South Africa	316	189	59.81	0.32	0.21	0.32

This table presents summary statistics of firm-level measures and sample coverage for each country. Sample coverage is calculated using number of observations for each country divided by number of listed firms in the country. The average values of cash flow-based debt ratio, leverage ratio, and insider share are presented for each country using the merged CapitalIQ-Compustat-Orbis dataset. Number of listed firms comes from World Bank. The sample year is 2015.

Table A2: Summary Statistics (Country-Level Measures)

	No. of Obs.	**Mean**	**Std. Dev.**	**25 Perc**	**Median**	**75 Perc**
Credit to GDP (%)	1598	65.7	46.6	28.7	51.9	191.2
Stk. Mkt. Cap. to GDP (%)	1131	62.1	55.3	25.2	45.7	269.8
Listed Comp. per Million	1202	22.6	32.7	3.3	8.6	32.2
Syndicated Loan Vol. to GDP (%)	1795	3.3	4.2	0.7	1.8	4.5
Corp. Bond Vol to GDP (%)	1134	1.7	1.7	0.6	1.3	2.5
1% Wealth Share (%)	1836	29.4	8.5	23.7	26.8	33.7
10% Wealth share (%)	1836	62.2	8.2	56.9	59.9	66.9
GDP per capita	1836	18127.9	21055.2	2799.8	8627.4	28291.4
Insolvency Outcome	1374	0.3	0.5	0	0	1

This table presents summary statistics of country-level measures. The first five measures are from the World Bank Global Financial Development Database. The two wealth inequality measures are from World Inequality Database. All measures above are presented in percentage terms. GDP per capita is from World Bank World Development Indicators Database and is presented in dollar terms. Insolvency Outcome is from the World Bank Doing Business dataset, and takes 0 if proceeding from insolvency is piecemeal sale and 1 if going concern. All data is from year 2000 to 2018.

Table A3: Country Sample Summary

Region	**obs.**	**Income Group**	**obs.**
East Asia & Pacific	13	Low Income	6
Europe & Central Asia	35	Lower Middle Income	23
Latin America & Caribbean	16	Higher Middle Income	28
Middle East & North Africa	11	High Income	32
North America	2		
South Asia	6		
Sub-Saharan Africa	16		
Total	99	**Total**	99

This table presents the sample coverage of the countries included in the country-level analysis. The average number of country observations for a year is 87, the maximum observation for a year is 99, the minimum yearly observation is 77. The region and income group categorization follows the categorization of World Bank.

A.1 Sensitivity of Debt Issuance to Earnings

Earning Based Covenants This appendix section serves as a robustness check of applying the debt categorization to the cross-country sample. As highlighted in Lian and Ma (2021), a standard implementation of cash flow-based borrowing constraint is the use of earning based covenants. I show that earning based covenant is not only a highly prevalent form of financial covenants in the U.S. context, but also carries to the context of other countries.

DealScan provides the type of financial covenants and net worth covenants applicable to the loan package. The first category includes financial covenants which are variations of earning based covenants that place restrictions on firm operation earnings (EBITDA). The other categories place restrictions on measures related to book leverage, book equity and liquidity ratios. Table A4 documents the percentage of firms which has active loan packages restricted by financial covenants in year 2015 and conditional on having financial covenants, which categorization does the covenants belong to. As presented in Table A4, in most countries, the most prevalent form of financial covenant is earning based covenant and its variations.

Regression Specification Having established the importance of firm operation earning for determination of cash flow-based debt value, this section proceeds to validate the categorization results with the regression analysis of debt issuance sensitivity to earnings. The regression specification is specified below:

$$\text{Debt Issuance}_{i,t} = \beta \text{EBITDA}_{i,t} + \gamma X'_{i,t} + \alpha_t + \epsilon_{i,t}$$

The focus is on the impact of current EBITDA in relaxing the borrowing limit of the firm. The dependent variable is the new debt issuance this period, measured as the change in book long-term debt. The main independent variable of interest is EBITDA this period. Other firm controls are included,[11] and all firm level variables are normalized by total assets. In particular, net cash receipts (OCF) is controlled to separate the effect of internal fund. The time period is 2000 to 2018, and year fixed effects are included. Country-level regression results are shown in Table A5, Panel B. From left to right, countries are arranged with an increasing average fraction of cash flow-based debt to total outstanding debt. As can be seen from the regression results, borrowing sensitivity to earnings increases with the increasing use of cash flow-debt.

[11] Other firm controls include cash holding, leverage, PPE, inventory, EBITDA last period, depreciation, and firm size.

Table A4: Percentage of Firms with Different Financial Covenant Types

Country	**No. of Obs**	**% with Fin. covenants**	**% of earnings covenant**	**% of leverage covenants**	**% of liquidity covenants**
Australia	1194	1.8	76.2	47.6	0.0
Brazil	248	0.0	0.0	0.0	0.0
Canada	1207	4.0	89.6	27.1	0.0
China	1990	2.2	74.4	88.4	53.5
France	1225	3.1	84.2	34.2	0.0
Germany	1135	2.6	93.3	40.0	3.3
India	1259	3.5	45.5	75.0	6.8
Indonesia	257	4.7	66.7	50.0	8.3
Italy	736	1.5	100.0	18.2	0.0
Japan	4843	0.1	66.7	33.3	0.0
South Korea	349	3.4	66.7	66.7	0.0
Malaysia	204	2.0	75.0	25.0	0.0
Mexico	210	0.5	100.0	0.0	0.0
Netherlands	440	4.5	95.0	20.0	0.0
Norway	232	6.5	80.0	33.3	0.0
Singapore	376	3.5	92.3	61.5	23.1
Spain	1199	2.4	93.1	10.3	0.0
UK	1573	7.9	86.4	17.6	0.0
USA	12047	17.7	88.6	25.5	3.3
Mean	1617	3.8	77.6	35.5	5.2

This table presents the average percentage of firms in DealScan with financial covenants in year 2015 and the covenant category. The first column is the number of firms for each country in year 2015 with active loan packages documented in DealScan. Second column is the percentage of firms with at least one active loan packages restricted by financial covenants. The third column is the percentage of firms with earning based financial covenants conditional on having a financial covenant. The fourth and fifth column presents the percentage for book leverage covenants and liquidity covenants respectively.

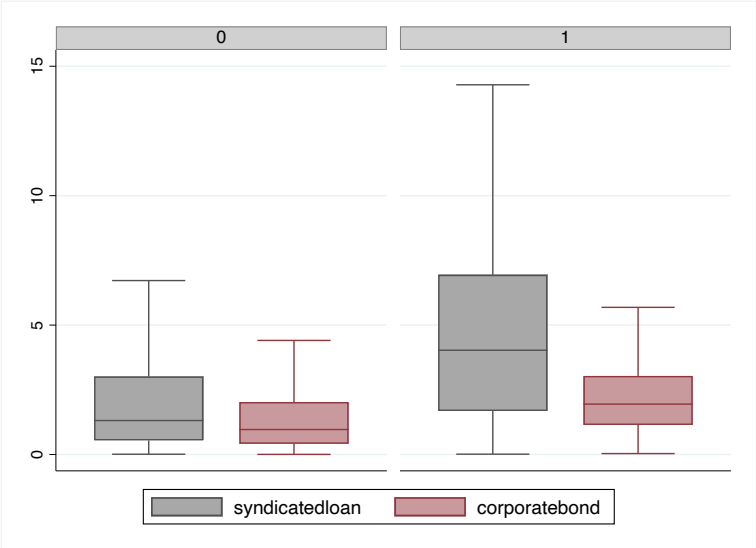
Table A5: Cross-Country Usage of Cash Flow-Based Borrowing

	KOR	**ITA**	**IND**	**SGP**	**NOR**	**DEU**	**CAN**	**JPN**	**FRA**	**USA**	**MEX**
Panel A: Fraction of cash flow-based debt out of total debt in CapitalIQ (year 2015)											
cfl/debtciq	0.236	0.328	0.328	0.332	0.360	0.392	0.455	0.467	0.473	0.510	0.515
no.obs	1293	288	2865	541	154	481	1158	2706	584	3881	94
Panel B: Sensitivity of debt issuance to earnings (year 2000-2018)											
EBITDA	0.079	0.248**	0.081***	0.227***	0.362**	-0.028	0.141***	-0.146***	0.351**	0.378***	0.790***
	(0.042)	(0.113)	(0.035)	(0.056)	(0.115)	(0.120)	(0.033)	(0.029)	(0.159)	(0.032)	(0.304)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
no.obs	5264	1733	19463	3787	1138	3982	7095	19116	4293	26862	449

This table presents cross-country usage of cash flow-based debt. The upper panel presents the average fraction of debt categorized into cash flow-based debt out of firm's total debt outstanding in CapitalIQ in year 2015. The countries are arranged such that from left to right the average fraction of cash flow-based debt is increasing. The lower panel stands as a cross-validation of the result in the upper panel. The lower panel presents the country level regression results of debt issuance sensitivity to firm earnings, financial information is from Compustat. The dependent variable is the issuance of debt this period, and the main independent variable of interest is the current EBITDA. Cash receipts, cash flows and other firm controls are included, all variables are normalized by total assets. The regression is a panel regression from year 2000 to year 2018, year fixed effects are included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

A.2 Comparison of Countries with Different Insolvency Outcome

Figure A1: Box Plot of Syn.(Bond) to GDP ratio



This figure presents the box plots for syndicated loan and corporate bond volume to GDP ratio respectively. Countries are categorized into two groups. The left has a value of 0 for the insolvency outcome indicator, representing outcome of insolvency likely to be sold piecemeal. The right has a value of 1, representing outcome of insolvency likely to be going concern. The vertical axis is the ratio in percentage terms. Outside values are excluded.

Table A6: Cash Flow-Based Debt and Insolvency Outcome

	Syn. Loan/GDP	**Corp. Bond/GDP**	**(syn+bond)/GDP**
GG	0.887***	0.504***	0.583**
	(0.249)	(0.107)	(0.253)
Log GDP per Capita	0.940***	0.262***	2.297***
	(0.140)	(0.053)	(0.148)
Year FE	Y	Y	Y
No. Obs	1337	859	822
R^2	0.161	0.112	0.289

This table presents relationship between syndicated loans(corporate bond) volume to GDP ratio and insolvency outcome. GG is the insolvency outcome indicator, representing outcome of insolvency likely to be sold piecemeal with value of 0, and outcome of insolvency likely to be going concern with value of 1. Year fixed effect is included and standard error clustered at year level. Sample period is 2000-2018. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

A.3 Financial Development and Aggregate Outcome

Table A7: Financial Development and Top 1% Wealth Share

	Dependent Variable: Top 1% Wealth Share				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Credit to GDP (%)	-0.039***				-0.059***
	(0.0049)				(0.0065)
Stk. Mkt. Cap. to GDP (%)		0.023***			0.096***
		(0.0042)			(0.0054)
Listed Firms per Million			-0.072***		-0.106***
			(0.0130)		(0.0128)
(Syn. Loan+Corp. Bond)/GDP (%)				-0.318***	-0.431***
				(0.0332)	(0.0806)
Year FE	Y	Y	Y	Y	Y
No. Obs	1598	1131	1202	1093	751
R2	0.04	0.02	0.07	0.02	0.31

This table presents the regression of top 1% wealth share on financial development indicators. The dependent variable is top 1% wealth share. Independent variables are included in percentage terms. Time period is 2000-2018. Year fixed effect is included and standard error is clustered at year level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

B Model Appendix

B.1 Proof

B.1.1 Proof of Proposition 1

For the contract to be incentive compatible, we have the following:

$$Pr(\theta = \theta_{high}|\tilde{\pi} < \pi^*) \leq Pr(\theta = \theta_{high}|\tilde{\pi} > \pi^*)$$

which we could expand to obtain,

$$\begin{aligned} &\frac{Pr(\tilde{\pi} < \pi^*|\theta = \theta_{high})Pr(\theta = \theta_{high})}{Pr(\tilde{\pi} < \pi^*|\theta = \theta_{low})Pr(\theta = \theta_{low}) + Pr(\tilde{\pi} < \pi^*|\theta = \theta_{high})Pr(\theta = \theta_{high})} \\ \leq &\frac{Pr(\tilde{\pi} > \pi^*|\theta = \theta_{high})Pr(\theta = \theta_{high})}{Pr(\tilde{\pi} > \pi^*|\theta = \theta_{low})Pr(\theta = \theta_{low}) + Pr(\tilde{\pi} > \pi^*|\theta = \theta_{high})Pr(\theta = \theta_{high})} \end{aligned}$$

which can be simplified to be,

$$\begin{aligned} Pr(\tilde{\pi} < \pi^*|\theta = \theta_{high})Pr(\tilde{\pi} > \pi^*|\theta = \theta_{low}) &\leq Pr(\tilde{\pi} > \pi^*|\theta = \theta_{high})Pr(\tilde{\pi} < \pi^*|\theta = \theta_{low}) \\ Pr(\tilde{\pi} < \pi^*|\theta = \theta_{high})[1 - Pr(\tilde{\pi} < \pi^*|\theta = \theta_{low})] &\leq [1 - Pr(\tilde{\pi} < \pi^*|\theta = \theta_{high})]Pr(\tilde{\pi} < \pi^*|\theta = \theta_{low}) \end{aligned}$$

Therefore we have

$$Pr(\tilde{\pi} < \pi^*|\theta = \theta_{high}) \leq Pr(\tilde{\pi} < \pi^*|\theta = \theta_{low})$$

which can be written as

$$F_{high}(\pi^*) \leq F_{low}(\pi^*) \quad \square$$

B.1.2 Proof of Proposition 2

Choose π^* to maximize the following:

$$\begin{aligned} \max_{\pi^*} \;\; & u(c) + \beta(1 - \pi_d)\Big\{ Pr(\tilde{\pi} < \pi^*)\mathbb{E}_{\eta'}[V_w(X^Q; \eta')] \\ & + Pr(\tilde{\pi} \geq \pi^*)\left[Pr(\theta = \theta_{low}|\tilde{\pi} \geq \pi^*)\mathbb{E}_{\eta'}[V_w(X^w; \eta')] + Pr(\theta = \theta_{high}|\tilde{\pi} \geq \pi^*)V_e(X^H, z)\right] \Big\} \end{aligned}$$

We can rewrite the problem as following:

$$\max_{\pi^*} \; u(c) + \beta(1-\pi_d)\Bigg\{ \underbrace{Pr(\tilde{\pi} < \pi^* | \theta = \theta_{high}) Pr(\theta = \theta_{high}) \mathbb{E}_{\eta'}[V_w(X^Q;\eta')]}_{\text{false positive}}$$
$$+ \underbrace{Pr(\tilde{\pi} < \pi^* | \theta = \theta_{low}) Pr(\theta = \theta_{low}) \mathbb{E}_{\eta'}[V_w(X^Q;\eta')]}_{\text{true positive}}$$
$$+ \underbrace{Pr(\tilde{\pi} > \pi^* | \theta = \theta_{low}) Pr(\theta = \theta_{low}) \mathbb{E}_{\eta'}[V_w(X^w;\eta')]}_{\text{false negative}}$$
$$+ \underbrace{Pr(\tilde{\pi} > \pi^* | \theta = \theta_{high}) Pr(\theta = \theta_{high}) V_e(X^H, z)}_{\text{true negative}} \Bigg\}$$

which is equivalent to maximizing the following expression:

$$\max_{\pi^*} \; Pr(\theta = \theta_{high}) F_{high}(\pi^*) \mathbb{E}_{\eta'}[V_w(X^Q;\eta')] + Pr(\theta = \theta_{low}) F_{low}(\pi^*) \mathbb{E}_{\eta'}[V_w(X^Q;\eta')]$$
$$+ Pr(\theta = \theta_{low})[1 - F_{low}(\pi^*)] \mathbb{E}_{\eta'}[V_w(X^w;\eta')] + Pr(\theta = \theta_{high})[1 - F_{high}(\pi^*)] V_e(X^H, z)$$

we can obtain the first order condition with respect to π^* as following:

$$Pr(\theta = \theta_{low}) f_{low}(\pi^*) \left\{ \mathbb{E}_{\eta'}[V_w(X^Q;\eta')] - \mathbb{E}_{\eta'}[V_w(X^w;\eta')] - V_{ex}(X^H, z) \right\}$$
$$= Pr(\theta = \theta_{high}) f_{high}(\pi^*) \left\{ V_e(X^H, z) - \mathbb{E}_{\eta'}[V_w(X^Q;\eta')] - V_{ex}(X^H, z) \frac{F_{low}(\pi^*)}{F_{high}(\pi^*)} \right\}$$

therefore, we have:

$$\frac{Pr(\theta = \theta_{high}) \left(V_e(X^H, z) - \mathbb{E}_{\eta'}[V_w(X^Q;\eta')] - V_{ex}(X^H, z) \frac{F_{low}(\pi^*)}{F_{high}(\pi^*)} \right)}{Pr(\theta = \theta_{low}) \left(\mathbb{E}_{\eta'}[V_w(X^Q;\eta')] - \mathbb{E}_{\eta'}[V_w(X^w;\eta')] - V_{ex}(X^H, z) \right)} = \frac{f_{low}(\pi^*)}{f_{high}(\pi^*)} \qquad \square$$

B.2 Model Solution

This appendix section presents the analysis of the choice of violation threshold. The accuracy of the covenant test is analyzed in terms of covenant tightness and excessive lending.

Violation Threshold The cash flow-based debt contract does not only specify the level of debt, but also characterizes the earning-based covenant which requires the choice of the violation threshold. The choice of π^* is a balance of benefit from covenant violation triggered reorganization in the case of low state, and the cost of covenant violation triggered prevention from continuing operation in the case of high state. Figure B1 below plots the optimal π^* for firms of different cash-on-hand and productivity.

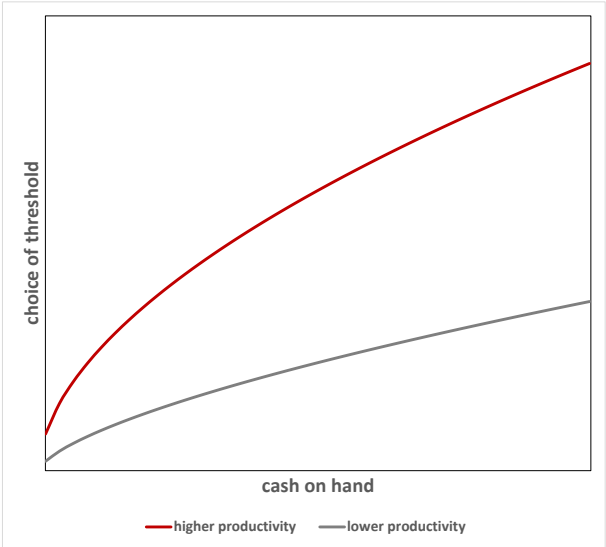


Figure B1: Choice of Violation Threshold π^*

This figure plots the choice of violation threshold π^* for firms of different cash-on-hand and productivity level. The red line plots the violation threshold for firms of higher productivity while the gray line plots for firms with lower productivity.

Covenant Tightness and Excessive Lending The choice of the threshold would affect the firm's covenant tightness. Following Kermani and Ma (2021), I define covenant tightness as the probability of violating the covenant for firms of the higher state. More formally, I define covenant tightness as $Pr(\tilde{\pi} < \pi^* | \theta = \theta_{high})$. Also there is possibility of excess lending where the observation of π is higher than the violation threshold and the firm continues operation even in the bad state. Figure B2 below plots the probability of covenant tightness and excess lending for firms of different productivity levels.

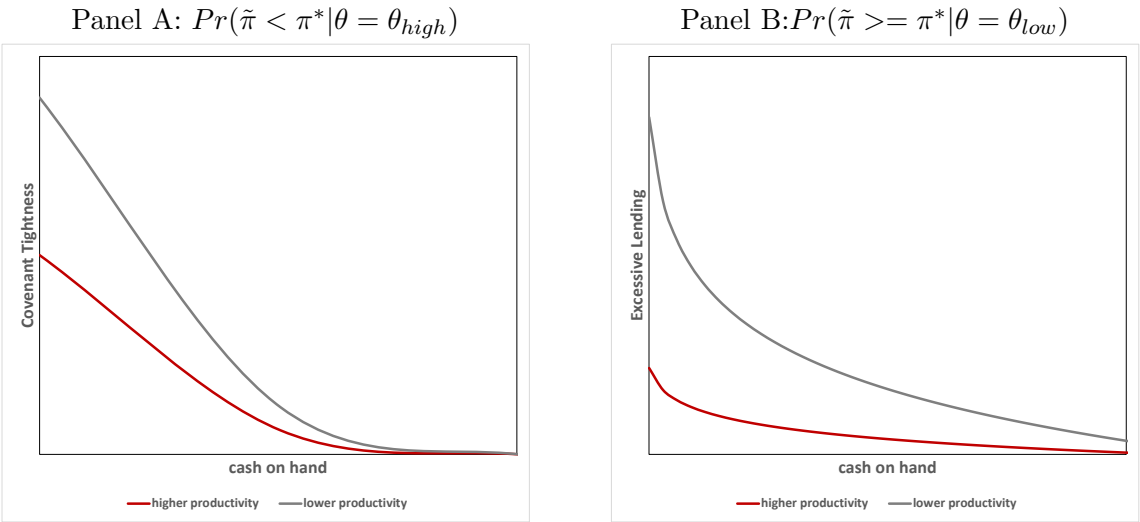


Figure B2: Covenant Tightness and Excessive Lending

This figure plots the probability of covenant violation when the firm is in the good state, and the probability of continuing operation when the firm is in the bad state. Panel A plots the probability of observing π lower than the threshold when the firm is in good state. Panel B plots the probability of firm not violating the covenant when in bad state. The red line plots the probability for firms of higher productivity while the gray line plots for firms with lower productivity.

Figure B2, Panel A plots covenant tightness for firms of different levels of cash-on-hand. As firms have more cash-on-hand, their choice of investment increases. In turn, the gap between the distributions of earning realizations from the two states increases. While the choice of π^* is increasing with the level of investment choice, the choice of π^* is moving further away from the expectation of earnings in the high state, which reduces the probability of covenant violation in the high state.

The distance between the two distributions of earning observations in the low and high state grows larger as investment increases, which allows the choice of π^* such that the distance between the violation threshold and the low state expected revenue and the high state expected revenue both increases. Therefore both type I and type II errors in the covenant detection decreases. Figure B2, Panel B plots the decrease in excess lending when cash-on-hand increases.

C Quantitative Appendix

C.1 Algorithm

C.1.1 Asset-Based Debt Only

The algorithm employs the endogenous grid method introduced by Carroll (2006), and extended by Barillas and Fernández-Villaverde (2007). The setup of the problem faced by firms involves borrowing constraint, which could be occasionally binding. This type of problem is also similar to the setup of Hintermaier and Koeniger (2010). The algorithm first identifies the marginal firm, below the asset of which firms will be constrained, and above the asset of which firms will be unconstrained. Then separately solve for the solution of the constrained and unconstrained firms. Described below is the algorithm for solving the private firm's production problem for the benchmark model where there is only collateral constraint. The firm facing a public firm is similar with only one additional state variable.

The firm solves the following Lagrangian.

$$\begin{aligned}\mathcal{L} =& u(x+b-k') + \beta(1-\pi_d)\Big\{[1-Pr(\theta=\theta_{low})]V_e\left(zk'^{\nu}+(1-\delta)k'-Rb, z\right) \\ &+ Pr(\theta=\theta_{low})\mathbb{E}_{\eta'}\left[V_w\left((1-\delta)k'-Rb+w\eta';\eta'\right)\right]\Big\} + \mu\left(\frac{\lambda_{AB}(1-\delta)k'}{R}-b\right)\end{aligned}$$

This implies the following first order conditions:

$$\begin{aligned}\text{FOC}(k') : u'(c) =& \beta(1-\pi_d)\Big\{[1-Pr(\theta=\theta_{low})]V_{ex}(X')[z\nu k'^{\nu-1}+1-\delta] \\ &+ Pr(\theta=\theta_{low})\mathbb{E}_{\eta'}\left[V_{wx}(X'_w;\eta')\right](1-\delta)\Big\} + \mu\frac{\lambda_{AB}(1-\delta)}{R}\end{aligned} \tag{1}$$

$$\text{FOC}(b) : u'(c) = \beta(1-\pi_d)\Big\{[1-Pr(\theta=\theta_{low})]V_{ex}(X')R + Pr(\theta=\theta_{low})\mathbb{E}_{\eta'}\left[V_{wx}(X'_w;\eta')\right]R\Big\} + \mu \tag{2}$$

1. Initialize the grid $G_{X,z}$ on cash-on-hand (X) and productivity (z). Start with the initial guess of value function $V_e^0(X,z)$. Calculate $V_{ex}^0(X,z)$ for the following iteration.

2. Find the marginal entrepreneur who has the asset at the threshold of being constrained.

For the marginal entrepreneur, the following holds:

$$X' = zk'^{\nu} + (1-\lambda_{AB})(1-\delta)k' \tag{3}$$

$$[1 - Pr(\theta = \theta_{low})]V_{ex}(X')[z\nu k'^{\nu-1} + (1-\delta) - R] = Pr(\theta = \theta_{low})\mathbb{E}_{\eta'}\left[V_{wx}(X'_w;\eta')\right][R - (1-\delta)] \tag{4}$$

For each X', we can find $\bar{k}$ satisfying the budget constraint (3) given that the borrowing constraint is binding. For $\bar{k}$ we can compute the left and right hand side of (4). For the marginal entrepreneur, equation (4) holds. If the left hand side of equation (4) is greater than the right hand side of equation (4) at the respective $\bar{k}$ for entrepreneur X', then the entrepreneur X' is constrained. Otherwise, the entrepreneur is unconstrained. Therefore, given $V_e^n(X,z)$, we can find the marginal entrepreneur and define the constrained and unconstrained area. If for all X' on the grid, left hand side of equation (4) is less than the right hand side, than all grid points are constrained, and vice versa.

3. For the constrained region, given X' we can find the $\bar{k}$ from equation (3). We can find c by eliminating multiplier μ from FOC (1) and (2):

$$u'(c)\left[1 - \frac{\lambda_{AB}(1-\delta)}{R}\right] = \beta(1-\pi_d)\Big\{[1 - Pr(\theta = \theta_{low})]V_{ex}(X')[z\nu k'^{\nu-1} + (1-\delta)(1-\lambda_{AB})] + Pr(\theta = \theta_{low})\mathbb{E}_{\eta'}[V_{wx}(X'_w;\eta')](1-\delta)(1-\lambda_{AB})\Big\}$$

   And we arrive at the endogenous grid X from the budget constraint.

4. For the unconstrained region, first we need to figure out the value of k'. In the unconstrained case, the multiplier $\mu = 0$, equation (4) holds. Under the CRRA utility case, $V_w(X'_w)$ has a closed form solution which we can write as an expression of k'. Also, we have $V_e^n(X,z)$ for the entrepreneur's value function, and the derivative $V_{ex}^n(X,z)$ from the value function. Therefore, we can solve for k' which satisfies equation (4). Given k', we could find c and the respective endogenous grid x.

5. Calculate the value function on the endogenous grid X obtained from step 3 and 4 by the following:

$$V_e(Xend,z) = \frac{cend^{(1-\sigma)}}{1-\sigma} + \beta(1-\pi_d)\left\{[1 - Pr(\theta = \theta_{low})]V_e^n(X',z) + Pr(\theta = \theta_{low})\mathbb{E}_{\eta'}[V_w(X'_w;\eta')]\right\}$$

   for the initial grid $G_{X,z}$, if $X_i \in [Xend_k, Xend_{k+1}]$ for $k = 1, 2, ..., NX-1$, interpolate $V_e(Xend,z)$ to obtain the value function X_i.

If $X_i < Xend(1)$, obtain $V_e(X_i, z)$ from the following:

$$V_e(X_i, z) = \frac{[X_i + bend(1) - kend(1)]^{(1-\sigma)}}{1-\sigma} + \beta(1-\pi_d)\left\{[1 - Pr(\theta = \theta_{low})]V_e^n(X_1, z) + Pr(\theta = \theta_{low})\mathbb{E}_{\eta'}[V_w(X'_{w1}; \eta')\right\}$$

If $X_i < Xend(NX)$, obtain $V_e(X_i, z)$ from the following:

$$V_e(X_i, z) = \frac{[X_i + bend(NX) - kend(NX)]^{(1-\sigma)}}{1-\sigma} + \beta(1-\pi_d)\left\{[1 - Pr(\theta = \theta_{low})]V_e^n(X_{NX}, z) + Pr(\theta = \theta_{low})\mathbb{E}_{\eta'}[V_w(X'_{wNX}; \eta')\right\}$$

Now we have obtained the updated value function $V_e^{n+1}(X, z)$ on the initially defined grid $G_{X,z}$. Find the distance between $V_e^{n+1}(X, z)$ and $V_e^n(X, z)$, and iterate until convergence.

6. Now we have obtained the value function on grid $G_{X,z}$, and the policy functions which would give the next period's resources on grid $G_{X,z}$, we would interpolate the value function to obtain the policy function on $G_{X,z}$ given that the grid points represent today's resources.

C.1.2 Cash Flow-Based Debt Only

This section describes the application of the endogenous grid method to the setup where the firm has access to cash flow-based debt only. The debt limit of cash flow-based debt depends on the going concern value of the firm, which is approximated by a multiple of firm's operational earnings. The earning-based covenant specifies the threshold below which firm's control right shifts. The algorithm first identifies the threshold below which the firm is constrained. The algorithm then separately solve for the solution of the firms in the different regions. The optimal threshold of covenant is solved together with the optimal allocations.

The firm solves the following Lagrangian.

$$
\begin{aligned}
\mathcal{L} =& u(x+b-k') + \beta(1-\pi_d)\Big\{ Pr(\theta=\theta_{high})F_{high}(\pi^*)\mathbb{E}_{\eta'}\left[V_w\left(\lambda_{CF} z k'^{\nu} + (1-\delta)k' - Rb + w\eta'; \eta'\right)\right] \\
&+ Pr(\theta=\theta_{high})[1-F_{high}(\pi^*)]V_e\left(zk'^{\nu} + (1-\delta)k' - \frac{Rb}{Pr(\theta=\theta_{high}|\tilde{\pi}\geq\pi^*)}, z\right) \\
&+ Pr(\theta=\theta_{low})F_{low}(\pi^*)\mathbb{E}_{\eta'}\left[V_w\left(\lambda_{CF} z k'^{\nu} + (1-\delta)k' - Rb + w\eta'; \eta'\right)\right] \\
&+ Pr(\theta=\theta_{low})[1-F_{low}(\pi^*)]\mathbb{E}_{\eta'}\left[V_w\left((1-\delta)k' + w\eta'; \eta'\right)\right]\Big\} + \mu\left(\frac{\lambda_{CF} z k'^{\nu}}{R} - b_{CF}\right)
\end{aligned}
$$

This implies the following first order conditions:

$$
\begin{aligned}
\text{FOC}(k') : u'(c) =& \beta(1-\pi_d)\Big\{ Pr(\theta=\theta_{high})F_{high}(\pi^*)\mathbb{E}_{\eta'}\left[V_{wx}\left(X^Q;\eta'\right)\right]\left[\lambda_{CF} z\nu k'^{\nu-1} + (1-\delta)\right] \\
&+ Pr(\theta=\theta_{high})f_{high}(\pi^*)\nu\theta_{high} z k'^{\nu-1}\mathbb{E}_{\eta'}\left[V_w\left(X^Q;\eta'\right)\right] \\
&+ Pr(\theta=\theta_{high})[1-F_{high}(\pi^*)]V_{ex}(X^H,z)[z\nu k'^{\nu-1} + (1-\delta)] \\
&- Pr(\theta=\theta_{high})f_{high}(\pi^*)\nu\theta_{high} z k'^{\nu-1}V_e(X^H,z) \\
&+ Pr(\theta=\theta_{low})F_{low}(\pi^*)\mathbb{E}_{\eta'}\left[V_{wx}\left(X^Q;\eta'\right)\right]\left[\lambda_{CF} z\nu k'^{\nu-1} + (1-\delta)\right] \\
&+ Pr(\theta=\theta_{low})f_{low}(\pi^*)\nu\theta_{low} z k'^{\nu-1}\mathbb{E}_{\eta'}\left[V_w\left(X^Q;\eta'\right)\right] \\
&+ Pr(\theta=\theta_{low})[1-F_{low}(\pi^*)]\left[V_{wx}\left(X^w;\eta'\right)\right](1-\delta) \\
&- Pr(\theta=\theta_{low})f_{low}(\pi^*)\nu\theta_{low} z k'^{\nu-1}\left[V_w\left(X^w;\eta'\right)\right]\Big\} + \mu\frac{\nu\lambda_{CF} z k'^{\nu-1}}{R}
\end{aligned} \tag{5}
$$

$$
\begin{aligned}
\text{FOC}(b) : u'(c) =& \beta(1-\pi_d)\Big\{ Pr(\theta=\theta_{high})F_{high}(\pi^*)\mathbb{E}_{\eta'}\left[V_{wx}\left(X^Q;\eta'\right)\right]R \\
&+ Pr(\theta=\theta_{high})[1-F_{high}(\pi^*)]V_{ex}(X^H,z)\frac{R}{Pr(\theta=\theta_{high}|\tilde{\pi}\geq\pi^*)} \\
&+ Pr(\theta=\theta_{low})F_{low}(\pi^*)\mathbb{E}_{\eta'}\left[V_{wx}\left(X^Q;\eta'\right)\right]R\Big\} + \mu
\end{aligned} \tag{6}
$$

$$\text{FOC}(\pi^*): \frac{f_{low}(\pi^*)}{f_{high}(\pi^*)} = \frac{Pr(\theta = \theta_{high})\left(V_e(X^H, z) - \mathbb{E}_{\eta'}[V_w(X^Q; \eta')] - V_{ex}(X^H, z)\frac{F_{low}(\pi^*)}{F_{high}(\pi^*)}\right)}{Pr(\theta = \theta_{low})\left(\mathbb{E}_{\eta'}[V_w(X^Q; \eta')] - \mathbb{E}_{\eta'}[V_w(X^w; \eta')] - V_{ex}(X^H, z)\right)} \tag{7}$$

1. Initialize the grid $G_{X,z}$ on cash-on-hand (X) and productivity (z). Start with the initial guess of value function $V_e^0(X, z)$. Calculate $V_{ex}^0(X, z)$ for the following iteration.

2. Find the marginal entrepreneur who has the asset at the threshold of being constrained. For the marginal entrepreneur, the borrowing constraint is binding and $\mu = 0$. For each X', we can find $\bar{k}$ and the corresponding π^* satisfying the budget constraint and equation (7). For $\bar{k}$ we can compute right hand side of first order condition (5) and (6) by applying $\mu = 0$. For the marginal entrepreneur, the right hand side of equation (5) and (6) equals when $\mu = 0$. If the right hand side of equation (5) is greater than the right hand side of equation (6) at the respective $\bar{k}$ for entrepreneur X', then the entrepreneur X' is constrained. Otherwise, the entrepreneur is unconstrained. Therefore, given $V_e^n(X, z)$, we can find the marginal entrepreneur and define the constrained and unconstrained area. If for all X' on the grid, right hand side of equation (5) is less than the right hand side of equation (6), than all grid points are constrained, and vice versa.

3. For the constrained region, given X' we can find the $\bar{k}$ and corresponding π^* together from the budget constraint and equation (7). We can find c by eliminating multiplier μ from first order conditions (5) and (6). And we can back out the endogenous grid X from the budget constraint.

4. For the unconstrained region, first we need to figure out the value of k'. In the unconstrained case, the multiplier $\mu = 0$. Under the CRRA utility case, $V_w(X^{w\prime})$ has a closed form solution which we can write as an expression of k'. Also, we have $V_e^n(X, z)$ for the entrepreneur's value function, and the derivative $V_{ex}^n(X, z)$ from the value function. Therefore, we can solve for k' and the corresponding π^* from equating the right hand side of FOC (5) and (6) and using the FOC (7) related to π^*. Given k', we could find c and the respective endogenous grid X.

5. Calculate the value function on the endogenous grid X obtained from step 3 and 4 by

the following:

$$
\begin{aligned}
V(Xend, z) =& \frac{cend^{(1-\sigma)}}{1-\sigma} + \beta(1-\pi_d)\Big\{ Pr(\theta = \theta_{high}) F_{high}(\pi^*) \mathbb{E}_{\eta'} \left[V_w \left(X'_Q; \eta' \right) \right] \\
&+ Pr(\theta = \theta_{high})[1 - F_{high}(\pi^*)] V_e \left(X'_H, z \right) \\
&+ Pr(\theta = \theta_{low}) F_{low}(\pi^*) \mathbb{E}_{\eta'} \left[V_w \left(X'_Q; \eta' \right) \right] \\
&+ Pr(\theta = \theta_{low})[1 - F_{low}(\pi^*)] \mathbb{E}_{\eta'} \left[V_w \left(X'_w; \eta' \right) \right] \Big\}
\end{aligned}
$$

for the initial grid $G_{X,z}$, if $X_i \in [Xend_k, Xend_{k+1}]$ for $k = 1, 2, ..., NX - 1$, interpolate $V(Xend, z)$ to obtain the value function on X_i.

If $X_i < Xend(1)$, obtain $V(X_i, z)$ from the following:

$$
\begin{aligned}
V(X_i, z) =& \frac{[X_i + bend(1) - kend(1)]^{(1-\sigma)}}{1-\sigma} \\
&+ \beta(1-\pi_d)\Big\{ Pr(\theta = \theta_{high}) F_{high}(\pi^*) \mathbb{E}_{\eta'} \left[V_w \left(X'_{Q1}; \eta' \right) \right] \\
&+ Pr(\theta = \theta_{high})[1 - F_{high}(\pi^*)] V_e \left(X'_{H1}, z \right) + Pr(\theta = \theta_{low}) F_{low}(\pi^*) \mathbb{E}_{\eta'} \left[V_w \left(X'_{Q1}; \eta' \right) \right] \\
&+ Pr(\theta = \theta_{low})[1 - F_{low}(\pi^*)] \mathbb{E}_{\eta'} \left[V_w \left(X'_{w1}; \eta' \right) \right] \Big\}
\end{aligned}
$$

If $X_i > Xend(NX)$, obtain $V(X_i, z)$ from the following:

$$
\begin{aligned}
V(X_i, z) =& \frac{[X_i + bend(NX) - kend(NX)]^{(1-\sigma)}}{1-\sigma} \\
&+ \beta(1-\pi_d)\Big\{ Pr(\theta = \theta_{high}) F_{high}(\pi^*) \mathbb{E}_{\eta'} \left[V_w \left(X'_{QNX}; \eta' \right) \right] \\
&+ Pr(\theta = \theta_{high})[1 - F_{high}(\pi^*)] V_e \left(X'_{HNX}, z \right) + Pr(\theta = \theta_{low}) F_{low}(\pi^*) \mathbb{E}_{\eta'} \left[V_w \left(X'_{QNX}; \eta' \right) \right] \\
&+ Pr(\theta = \theta_{low})[1 - F_{low}(\pi^*)] \mathbb{E}_{\eta'} \left[V_w \left(X'_{wNX}; \eta' \right) \right] \Big\}
\end{aligned}
$$

Now we have obtained the updated value function $V_e^{n+1}(X, z)$ on the initially defined grid $G_{X,z}$. Find the distance between $V_e^{n+1}(X, z)$ and $V_e^n(X, z)$, and iterate until convergence.

6. Now we have obtained the value function on grid $G_{X,z}$, and the policy functions which would give the next period's resources on grid $G_{X,z}$, we would interpolate the value function to obtain the policy function on $G_{X,z}$ given that the grid points represent today's resources.

C.2 Calibration

Table C1: Parameters Same Across Countries

Parameter	Value	Description
(a) Parameters related to workers		
π_d	0.02	death probability*
σ	2	risk aversion
χ	0.5	parent wealth inheritance*
ρ_θ	0.9	persistence of worker productivity
σ_θ	0.65	std.dev. of worker productivity
(b) Parameters related to firms		
R	1.02	risk-free rate
δ	0.06	depreciation
$Pr(\theta = \theta_{low})$	0.05	exit probability*
θ_{low}	0.2	mean of earnings*
θ_{high}	1	normalized
σ_π	5	std.dev. of earnings*
β	0.98	discount rate
ν	0.9	return to scale
α	0.33	capital share
(c) Parameters regarding type distribution		
S_w	0.92	share of workers*
z_1/z_2	15	Productivity of type 2 firms
z_1/z_3	50	Productivity of type 3 firms

This table shows the parameter values that are kept constant across countries. The values closely follows Peter (2021). Panel (a) presents parameters related to the worker's productivity distribution and agent preference. Panel (b) presents parameters related to the firm's production and investment. Panel (c) presents parameters governing the distribution of worker and entrepreneur productivity types. * indicates the parameter is calculated to match moments from data.

Table C2: Calibration List of Countries (Below Median Credit to GDP ratio)

Country	**CredittoGDP**	**StktoGDP**	**Region**	**Income**
Low credit to GDP ratio, low stock market capitalization to GDP ratio				
Argentina	12.4	13.7	Latin America & Caribbean	Upper middle income
Bangladesh	36.2	20.4	South Asia	Lower middle income
Bulgaria	69.0	16.6	Europe & Central Asia	Upper middle income
Costa Rica	47.7	4.8	Latin America & Caribbean	Upper middle income
Croatia	66.8	42.5	Europe & Central Asia	High income
Ghana	15.7	9.3	Sub-Saharan Africa	Lower middle income
Hungary	59.9	23.0	Europe & Central Asia	High income
Indonesia	27.7	39.8	East Asia & Pacific	Lower middle income
Kenya	25.0	29.6	Sub-Saharan Africa	Lower middle income
Lebanon	72.0	36.3	Middle East & North Africa	Upper middle income
Mexico	22.7	39.1	Latin America & Caribbean	Upper middle income
Nigeria	19.6	11.0	Sub-Saharan Africa	Lower middle income
Oman	46.7	46.4	Middle East & North Africa	High income
Pakistan	22.7	19.0	South Asia	Lower middle income
Philippines	27.9	49.0	East Asia & Pacific	Lower middle income
Poland	47.0	34.3	Europe & Central Asia	High income
Romania	37.0	7.5	Europe & Central Asia	Upper middle income
Sri Lanka	25.7	22.7	South Asia	Lower middle income
Turkey	37.1	35.7	Europe & Central Asia	Upper middle income
Low credit to GDP ratio, high stock market capitalization to GDP ratio				
Bahrain	71.4	70.9	Middle East & North Africa	High income
Belgium	58.7	54.0	Europe & Central Asia	High income
Brazil	47.5	80.2	Latin America & Caribbean	Upper middle income
Colombia	30.1	60.5	Latin America & Caribbean	Upper middle income
India	48.1	101.9	South Asia	Lower middle income
Israel	66.9	91.0	Middle East & North Africa	High income
Peru	30.0	59.3	Latin America & Caribbean	Upper middle income
Russian Federation	45.3	62.3	Europe & Central Asia	Upper middle income
Saudi Arabia	45.6	74.3	Middle East & North Africa	High income

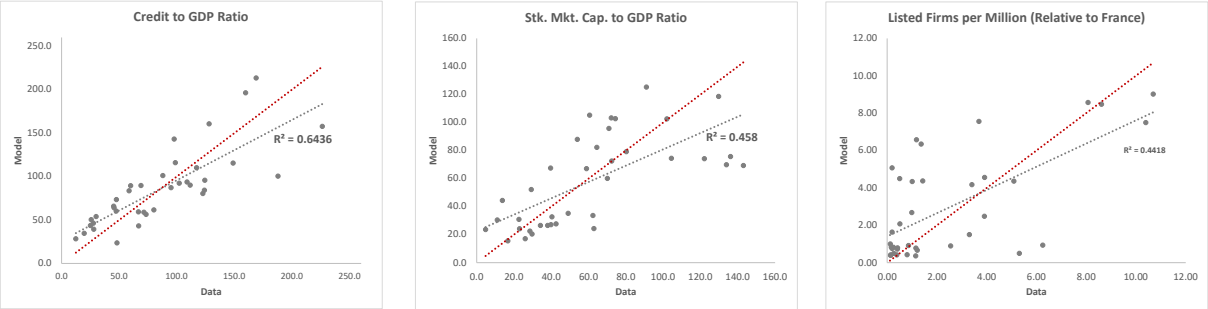
This table presents the list of countries which are included in the calibration exercise. This list includes countries with below median levels of credit to GDP ratio. The sample is constructed using countries which has non-missing information on credit to GDP ratio, stock market capitalization to GDP ratio, and number of public firms per million from World Bank's Global Financial Development Database for the year 2009. The second column presents country's credit to GDP ratio, and the third column presents stock market capitalization to GDP ratio. Information is gather from World Bank for the year 2009.

Table C3: Calibration List of Countries (Above Median Credit to GDP ratio)

Country	**CredittoGDP**	**StktoGDP**	**Region**	**Income**
High credit to GDP ratio, low stock market capitalization to GDP ratio				
Austria	97.7	28.5	Europe & Central Asia	High income
Cyprus	226.4	39.6	Europe & Central Asia	High income
Germany	98.8	38.0	Europe & Central Asia	High income
Greece	88.0	34.1	Europe & Central Asia	High income
Ireland	169.0	26.0	Europe & Central Asia	High income
Italy	87.6	29.9	Europe & Central Asia	High income
Malta	122.1	46.9	Middle East & North Africa	High income
New Zealand	149.0	29.3	East Asia & Pacific	High income
Portugal	159.9	40.3	Europe & Central Asia	High income
Slovenia	83.1	24.1	Europe & Central Asia	High income
High credit to GDP ratio, high stock market capitalization to GDP ratio				
Australia	122.6	136.0	East Asia & Pacific	High income
Canada	124.1	122.0	North America	High income
Chile	102.2	133.8	Latin America & Caribbean	High income
China	124.4	70.0	East Asia & Pacific	Upper middle income
France	95.1	72.3	Europe & Central Asia	High income
Japan	167.8	63.2	East Asia & Pacific	High income
Jordan	73.3	129.7	Middle East & North Africa	Upper middle income
Malaysia	111.6	143.0	East Asia & Pacific	Upper middle income
Mauritius	80.1	72.1	Sub-Saharan Africa	Upper middle income
Netherlands	117.2	64.4	Europe & Central Asia	High income
Norway	128.1	58.8	Europe & Central Asia	High income
Singapore	96.9	247.9	East Asia & Pacific	High income
Spain	174.0	96.6	Europe & Central Asia	High income
Switzerland	154.1	190.7	Europe & Central Asia	High income
Thailand	109.0	62.8	East Asia & Pacific	Upper middle income
United Arab Emirates	87.6	54.5	Middle East & North Africa	High income
United Kingdom	192.5	115.9	Europe & Central Asia	High income
United States	187.9	104.3	North America	High income

This table presents the list of countries which are included in the calibration exercise. This list includes countries with above median levels of credit to GDP ratio. The sample is constructed using countries which has non-missing information on credit to GDP ratio, stock market capitalization to GDP ratio, and number of public firms per million from World Bank's Global Financial Development Database for the year 2009. The second column presents country's credit to GDP ratio, and the third column presents stock market capitalization to GDP ratio. Information is gather from World Bank for the year 2009.

Figure C1: Model Fit (Targeted Moments)



This figure plots model fit for targeted moments in the list of countries included in the calibration exercise under cash flow-based debt. Left figure plots the fit of credit to GDP ratio. Middle figure plots the fit of stock market capitalization to GDP ratio. Right figure plots the fit of listed firms per million relative to France. The dotted grey line is the regression line of the scatter plot. The red line is the 45 degree line.

Table C4: Model Fit (Untargeted Moments)

	(1) GDP	(2) GDP	(3) GDP	(4) Wealth 10	(5) Wealth 10	(6) Wealth 10
Panel A: Data						
CredittoGDP	0.51***			-0.07***		
	[0.32, 0.69]			[-0.11, -0.02]		
StktoGDP		0.13			0.02	
		[-0.22, 0.47]			[-0.05, 0.09]	
ListedFirmsperMil			4.79***			-1.34***
			[0.52, 9.06]			[-2.19, -0.47]
No. Obs.	51	51	51	51	51	51
R^2	0.37	0.01	0.08	0.14	0.01	0.15
Panel B: Model						
CredittoGDP	0.44***			-0.02		
	[0.24, 0.64]			[-0.04, 0.00]		
StktoGDP		0.26			-0.04***	
		[-0.06, 0.58]			[-0.07, -0.02]	
ListedFirmsperMil			4.78***			-0.54***
			[1.26, 8.29]			[-0.85, -0.24]
No. Obs.	51	51	51	51	51	51
R^2	0.33	0.04	0.15	0.03	0.19	0.23

This table presents the model fit for untargeted moments under cash flow-based debt. The relationship between financial development and aggregate outcome is evaluated in data and model. The first three columns present the regression results using GDP per capita relative to France. The last three columns use top 10 percent wealth share as the dependent variable. The upper panel shows the regression results from data and the lower panel shows the regression results from model. 95% confidence interval is presented in the parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.