



VENTURE CAPITAL IN BANK-BASED AND MARKET-BASED FINANCIAL SYSTEMS: A CROSS-COUNTRY ANALYSIS

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Abstract

Previous research is dominated by the view that venture capital (VC) thrives in market-based systems alone. The paper compares the role of the two systems in VC development using financial markets and financial institutions as proxies. The paper analyses a unique dataset of 31 economies over the period 2005-2017 employing two-step system generalized method of moments (GMM) estimation technique. The paper finds that financial markets, financial institutions, and interaction of financial markets and financial institutions exert a strong and positive effect on VC fundraising. This means there is complementarity between financial markets and financial institutions to explain VC fundraising. The findings emphasize that development of financial institutions are equally important for VC markets as they reduce market frictions through networking and intermediation skills.

Key words: Venture capital. Private equity. Financial markets. Financial institutions. Formal institutions.

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INTRODUCTION

Borrowing from mainstream “bank-based versus market-based” literature in financial economics and corporate finance, studies on venture capital (VC) have taken the argument that a market-based system supports VC markets as market-based system offers an opportunity to

venture capitalists (VCs) to exit from investments through an initial public offerings (IPO). The most cited article in VC literature supporting market-based system in comparison to the bank-based system is that of Black and Gilson (1998). They contend that US has the most vibrant VC market because a market-based system¹ guarantees an implicit contract over control to the entrepreneur – that is, the successful entrepreneur of the firm will take back control of the firm upon exit through an initial public offering (IPO). They maintain that bank-based system does not promise to hand over control of the portfolio firm back to the entrepreneur which is the primary reason for weak VC markets in Germany and Japan compared to the US.

Later studies in the mainstream economics and corporate finance did not confirm the assertion that market-based systems are necessarily more efficient for economic development than bank-based systems. Instead, they find co-evolution between banks and equity markets. For instance, Song and Thakor (2010) show that banks achieve securitization through high quality credit screening that results in higher investor participation and capital market development which in turn facilitate banks to secure cheaper equity capital to meet the domestic risk-sensitive capital needs. These later research in corporate finance shows that there is complementarity between bank-based and market-based systems (Levine, 2005), the VC research is still not updated and the relationship between bank-based system and VC has been neglected. Also in emerging contexts, market-based system and bank-based system contribute to economic growth with the later one showing stronger input in India (Sahoo, 2014) and market-based financial structure increasing financial risk in China (Liu *et al.*, 2022). Though a study shows that bank-based system causes more systematic risk compared to market based financial system (Bats and Houben, 2020). Some suggested that market-based system play better role in reducing income inequality in advanced countries while bank-based system play the same role in developing countries (Moradi, Mirzaeenejad and Geraeenejad, 2016). Similarly, a study shows that bank credit is essential to the determinataion of money supply in Japan (Wang, 2022).

Up to our surprise, we could found only one study examining the effect of bank credit on VC fundraising which shows that credit provided by banking sector bears a significant positive effect on VC fundraising in developed countries but negative impact in the context of emerging markets but the study fails to present sound reasons for this disparity (Oberli, 2014). Studies have examined the relationship between banks and VC from other dimensions particularly from the angle of banks as important source of VC finance and challenges involving in bank financing VC companies (Fiet and Fraser, 1994; Hellmann, 1997). However, these studies are descriptive in nature, lack rigor and take a narrow view of a role of banks. We consider banks not only as important source of capital for VC firms, but also that intermediation and networking skills to cope with agency risks of moral hazard and adverse selection are abundant in an environment with developed financial institutions that leads to a VC culture.

Opposite to the bank-based vs stock market based view, we believe that a country may own stronger banking institutions (compared to its stock markets) yet having a vibrant VC market and that this relationship might be dependent on the development of stock markets. We need to know the place of financial institutions in the stock markets and VC equation. The current paper will investigate whether financial institutions (proxy for bank-based system) *complement* financial markets (proxy for market-based systems) to wield a positive influence on VC or conversely,

¹ A system is considered bank-based when funding to the non-bank private sector from banks exceed funding from the capital markets and vice versa (Osoro and Osano, 2014).

there is a *substitution* effect at play. We take VC fundraising to measure the development of VC. The paper investigates the effects of financial markets and financial institutions as proxies for a bank-market based systems and based system. Moreover, it examines how these two variables interact with each other to explain VC fundraising.

The paper is structured as follows: Section 2 presents theoretical framework and hypotheses. Research design is shown in Section 3 and empirical results in Section 4. Finally, the paper discusses the results considering existing explanations and presents conclusion.

LITERATURE REVIEW AND HYPOTHESES

If the perfect markets hypothesis of Modigliani and Miller's (1958) and hypothetical world without information and transaction costs of Arrow and Debreu's (1954)² are assumed to be true, there would be no need of financial systems. But markets have frictions and information asymmetries that impose additional costs upon financial actors. Financial systems are created to reduce transaction costs (Gazdar and Cherif, 2015; Naeem and Li, 2019), facilitate information and capital flows, and ensure corporate governance, (Levine, 2005). Moreover, developed financial system reduce costs of financing (Rajan and Zingales, 1998), reduces overinvestment inefficiencies in firms (Stein, 2003) and facilitate domestic investment channels that promotes economic growth (Xu, 2000). Since VC involves information asymmetry, strong financial system is expected to have a positive effect on VC fundraising as a development financial system mitigates agency risks. We divide the overall financial development in to two parts: financial markets depth and financial institutions depth. We believe that both financial markets depth and financial institutions depth play role to tackle the market frictions.

Studies show that initial public offerings (IPOs) positively determine VC fundraising (Bygrave and Timmons, 1992; Gompers and Lerner, 1998; Jeng and Wells, 2000). IPOs offer an opportunity to a venture capitalist (VCs) to get back investment and to entrepreneur the retake control of the portfolio firm (Black and Gilson, 1998). Different proxies have been used to represent development of stock markets such as market capitalization, number of stocks traded (Schertler, 2003), stocks turnover (Bonini and Alkan, 2012), and VC divestments (Balboa and Pellón, 2003) to represent stock markets. Stock markets play role in VC development as it offers an exit route from VC investments. At the same time, financial markets serve other purposes. It enhances flows of information, gives protection of investors, and mitigate agency risks through transparency and efficient monitoring mechanisms (Wurgler, 2000; Naeem and Li, 2019). Moreover, financial markets improve the reputation of VC finance (Barber and Yasuda, 2017).

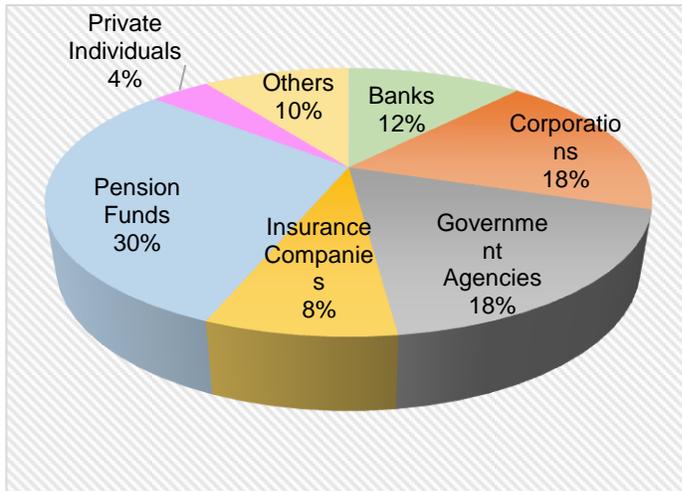
Development of financial institutions also influence VC research. In 1979, when the US Department of Labor clarified the ERISA's 'prudent man' rule, allowing pension funds for investment in VC, it gave enormous boost the VC industry in the US (Bygrave and Timmons, 1992; Gompers, 1994; Gompers and Lerner, 1998, 2004; Kenney, Han and Tanaka, 2002). Private pension funds positively influence VC fundraising as demonstrated in cross country analyses (Gompers and Lerner, 1998; Jeng and Wells, 2000). Bank credit is also used as proxy for financial institutions development. Domestic credit by banks have a significant and positive effect on VC fundraising in developed markets while negative impact in developing countries (Oberli, 2014).

² Also read McKenzie (1959).

Extant literature also highlights that development of financial institutions also mitigate agency problems through efficient monitoring of clients (Hoshi, Kashyap and Scharfstein, 1990; Beck and Levine, 2004). Financial institutions can efficiently monitor managers due to diversification (Diamond, 1984; Williamson, 1986). Moreover, financial institutions are a significant source of VC funds in Asia and Europe (See Figure 1 and Figure 2) and, therefore, greater emphasis should have been placed on the role of financial institutions in VC fundraising. Like other financial investments, it is expected that development of both financial markets and financial institutions reduces agency problems in VC deals that cause more VC fundraising.

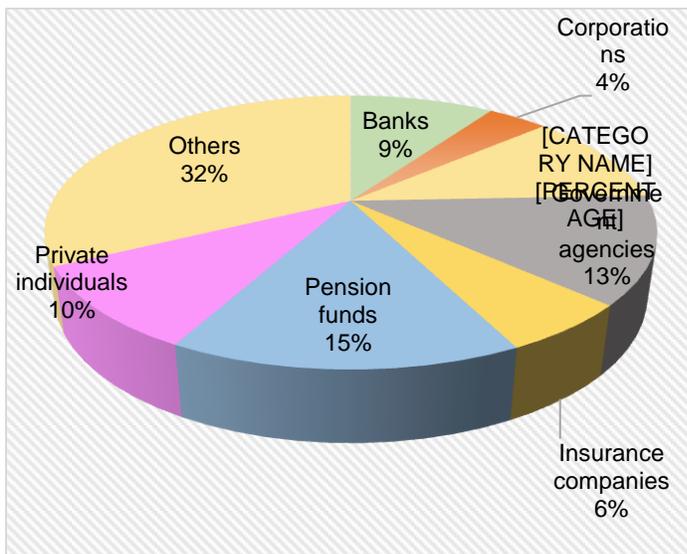
H-1 Depth of both financial markets and financial institutions exert a significant positive effect on VC fundraising.

Figure 1: Sources of VC fundraising in Asia (2010)



Source: AVCJ

Figure 2: Sources of VC fundraising in Europe in 2010



Source: Eurostat

There is a perspective in the law and finance literature that market-dominated systems prosper in common law countries because of the ability of its courts to enforce contracts that give protection to creditors and shareholders. On the other hand, due to the weak protection of property rights, civil law countries allow banks to enforce contracts that give rise to bank-dominated systems (Ergungor, 2004; Megginson, 2004). This debate in the legal origin literature has led to research on the role of market-based systems versus bank-based systems. While much of the debate on bank-based versus market-based literature is outdated, there are areas where debate is still going on such as Gerschenkron hypothesis and that there is still a need for further studies particularly for financing firms such as VC (García-Ruiz and Vasta, 2021). Various recent studies have shown effects of banks-bases system and markets-based systems on various dimensions of economy. For instance, study shows that bank-based system leads to faster capital growth particularly in countries where banks have closer connections to non-financial firms (Rioja and Valev, 2011) and that as an economy moves from bank-based toward market-based, the housing prices experiences an increase (Choi and Park, 2018).

This market vs. bank perspective maneuvered research on VC. For example, Black and Gilson (1998) argue that US has the most vibrant VC market because a market-based system guarantees the implicit contract over control that a successful entrepreneur will take back control of the firm upon exit through an IPO. They contend that bank-based system does not promise to hand over control of the portfolio firm back to the entrepreneur which is the primary reason for weak VC markets in Germany and Japan. While in the mainstream economics and corporate finance literature, there are studies showing that bank-based system is more efficient than market-based. For instance, a study shows that bank-based system experience more per capita income, more investment, less income-inequality, and broad-based industrialization (Chakraborty and Ray, 2006).

Nevertheless, some research show that, growth is less dependent on whether a country is bank-based or market-based as they complement each other and ‘countries with better functioning banks, markets grow faster’ (Levine, 2005). Qian and Yeung (2015) demonstrate that inefficiency of banks adversely affects the degree to which equity markets can discipline market actors. The current study embraces the market-and-bank view as opposed to market-vs-bank perspective taking support from the literature that demonstrate complementarity (Lee, 2012). Previously studies have not investigated association between financial markets and financial institutions for VC markets in context of bank-based vs stock-market based systems despite having calls from recent work for more studies in this regard (García-Ruiz and Vasta, 2021). The current study fills that gap by investigating an interaction between financial institutions (as will be defined later, they include banks credit, insurance companies’ assets, pension funds’ assets, mutual funds’ assets and so forth) and financial markets (access, depth, and efficiency of stock markets).

Further, we conjecture that reliance of VC market on financial markets grows as financial institutions get stronger and vice versa. While Black and Gilson (1998) suggest that a bank-based system should piggy-back on the market-based system, we argue that strength of both systems is essential for VC to prosper. A positive interaction is expected because financial markets reduce agency costs (Chakraborty and Ray, 2006) where financial markets offer a vibrant exit mechanism through an IPO (Black and Gilson, 1998). Therefore, we hypothesize as follows:

H-2: Financial markets and financial institutions complement each other to determine VC fundraising. Development of one strengthens the effect of another on VC fundraising.

DATA AND RESEARCH DESIGN

The dataset comprises 31 developed and developing countries in Asia and Europe covering the 2005-17 period. The 12 Asian countries include Hong Kong, Indonesia, South Korea, Thailand, China (PRC), Singapore, India, Japan, Malaysia, Australia, New Zealand, and Vietnam. The 19 European countries include Austria, Netherlands, Norway, Poland, Portugal, Sweden, Switzerland, France, Germany, Hungary, Ireland, Italy, Belgium, Denmark, Czech Republic, Spain, Finland, Luxembourg, and the UK.

1.1 Dependent variable

VC fundraising as % of GDP is the dependent variable in this study. VC and private equity are two closely related concepts. Strictly, in the US VC involves only seed, start-up, and expansion investments whereas private equity includes VC, buyouts, consolidations, and turnarounds. Outside the US, the concept of VC and private equity converge, and VC is usually referred to what is called private equity in US context (Jeng and Wells, 2000). In Europe, many VC firms offer equity investments would be called private equity financing in the US (Black and Gilson, 1998). The concept gets further complicated in Japan where venture capitalists (VCs) extend loans based on interest rather than equity alone. In this paper, consistent with Wright, Pruthi and Lockett, 2005), the current study take the broader definition of VC, which covers seed, start-up, later stage, expansion, growth, replacement, and buyouts which is synonymous to private equity. We choose the broader definition because the present paper cites both VC and private equity literature – or in other words literature of VC in both narrower sense and broader sense. From academic point of view, the literature on VC in narrower sense is mixed with private equity. See Appendix 1 for description and data source of the dependent variable.

1.2 Independent variables

1.2.1 Financial Markets

The present paper employs the IMF world financial development index. IMF has introduced a more comprehensive index that considers several dimensions of financial development (Svirydzenka, 2016). It categorizes the financial development of a country in to two financial markets and financial institutions which are further divided on the basis of depth, access, and efficiency. Such classification is quite useful to understand the financial system of a country and to relate it to the VC fundraising. No previous research has taken the comprehensive financial development index into consideration. We will use the term “financial institutions” as a proxy of financial institutions and use the “financial institutions depth” that includes banks, pension funds, insurance companies, and so forth. On the other hand, for “financial markets”, we will use “financial markets depth” that represents securities markets factors such as stock market capitalization to GDP, stocks traded to GDP, and numerous government and corporate debt securities. Detailed definitions and data sources can be seen in Appendix 1.

1.2.2 Control Variables

We use control variable based on previous literature. Studies show that taxation (Gompers and Lerner, 1998; Schertler, 2003), labor market rigidities (Bonini and Alkan, 2012), and interest rates (Gompers and Lerner, 1998) negatively influence VC fundraising. On the other hand, mergers and acquisitions (Félix, Pires and Gulamhussen, 2013), economic growth (Félix et al., 2013) and research and development expenditure (Cherif and Gazdar, 2011; Romain and Pottelsberghe, 2004) positively affect VC. Further, social networks (Milosevic, 2018) reputation of general partners (Barber and Yasuda, 2017) and quality of fund management (Balboa and Pellón, 2003) also influence VC. In the current study, the GDP growth, GDP per capita, taxation, foreign direct investment outflows, patents have been used as control variables.

FDI outflows is also expected to capture the overall investment, entrepreneurial, institutional, and fiscal environment that push investors to cross borders instead of making an investment in local markets. One may expect a strong negative sign of FDI outflows; however, it is not unexpected that it displays a positive sign as VC fundraising may already have taken benefit of the local capital market saturation before capital cross border. GDP growth has been added as a control variable to capture the business cycle effect. Tax burden with expected negative sign and patents with expected positive sign have been added because of their relevance to the fundraising activity. GDP growth is expected to have a positive effect on VC fundraising.

1.3 Descriptive statistics

The summary statistics are presented in Table 1 with maximum of 403 observations and minimum of 388 observations, the variation is due to missing values. Table 2 shows matrix of correlations among variables. The variables of interest, namely, financial markets and financial institutions show high correlation with the dependent variable. Moreover, financial institutions and financial markets are also highly correlated with each other which indicates that both elements of a financial system may demonstrate complementarity when it comes to their effect on VC fundraising.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
VC Fundraising _{t-1}	396	.599	1.591	-5.091	4.503
GDP growth	403	.935	.848	-3.669	3.225
GDP per capita	403	11.908	2.172	9.573	17.784
Tax burden	403	4.155	.232	3.487	4.539
FDI outflows	403	1.232	1.349	-2.353	4.986
Patents	388	-.347	2.8	-6.283	5.698
Property rights (Heritage)	403	4.218	.45	2.303	4.576
Financial institutions	403	-.542	.498	-2.243	0
Financial markets	403	-.55	.568	-3.746	-.005
Socioeconomic development	390	2.093	.211	1.386	2.398

Table 2: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) VC Fundraising _{t-1}	1.000								
(2) GDP growth	0.156	1.000							
(3) GDP per capita	-0.066	0.182	1.000						
(4) Tax burden	0.027	0.381	0.243	1.000					
(5) FDI outflows	0.268	-0.100	-0.206	-0.086	1.000				
(6) Patents	0.344	-0.066	0.027	-0.006	0.174	1.000			
(7) Property rights (Heritage)	0.117	-0.378	-0.393	-0.330	0.503	0.455	1.000		
(8) Financial institutions	0.393	-0.291	-0.427	-0.337	0.460	0.599	0.684	1.000	
(9) Financial markets	0.451	-0.225	-0.420	-0.316	0.367	0.475	0.553	0.817	1.000
(10) Socioeconomic development	0.232	-0.151	-0.325	-0.266	0.481	0.673	0.663	0.724	0.549

1.4 Econometric model

Similar to Aizenman and Kendall (2008), the present study uses autoregressive model to examine the impact of financial markets and financial institutions on VC fundraising. The autoregressive or lagged-dependent variable model (LDV) is used when a process has memory and past matters to the present (Keele and Kelly, 2006). We believe that evolution of VC development demonstrates the signs of path-dependency (Manigart, 1994; Black and Gilson, 1999). This in addition to the fact previous findings that success in previous funding help fund managers get more funding i.e. reputational capital (Barber and Yasuda, 2017). Kolmakov, Polyakova and Shalaev (2015) also indicate the presence of delayed effects in VC/PE. Thus, using LDV panel data model, the article considers the following econometric model:

$$FR_{i,t} = \alpha + \beta_1 FR_{i,t-1} + \beta_2 FM_{i,t} + \beta_3 FI_{i,t} + \delta Z_{i,t} + \varepsilon_{i,t} \quad \text{Model I}$$

where $FR_{i,t}$ is the VC fundraising in country i at year t and $FR_{i,t-1}$ is the first lag of VC fundraising, $FM_{i,t}$ represents financial markets whereas $FI_{i,t}$ symbolizes the financial institutions. Moreover, $Z_{i,t}$ characterizes control variables. Symbol α_i represents the individual country

effects ($i = 1,2,3, \dots \dots$ signify lags) while $\varepsilon_{i,t}$ signifies the error term. β_1 measures the autoregressive coefficients, β_2 captures the effect of financial markets, whereas β_3 computes the elasticity of financial institutions. Finally, symbol δ is the vector of control variables. β_1 , β_2 and β_3 are expected to be positive and statistically significant.

To test hypothesis 2, we improves the model as follows:

$$FR_{i,t} = \alpha + \beta_1 FR_{i,t-1} + \beta_2 FM_{i,t} + \beta_3 FI_{i,t} + \beta_4 (FM_{i,t} \times FI_{i,t}) + \delta Z_{i,t} + \varepsilon_{i,t} \quad \text{Model II}$$

where $FM_{i,t} \times FI_{i,t}$ represents interaction term financial markets \times financial institutions and β_4 measures the slope of the interaction term.

1.5 Diagnostic Tests and model specification

The data does not suffer from serial correlation but White/Koenker nR2 test and Modified Wald test for group wise heteroskedasticity in fixed effect regression model suggests there is high level of heteroscedasticity. Moreover, venture capital and PE are endogenously related to GDP growth (Ning, Wang and Yu, 2015; Khan *et al.*, 2021). In presence of endogeneity and heteroscedasticity GMM is considered one of the best technique (Baum, Schaffer and Stillman, 2002). Thus, we will use dynamic penal data two-step efficient system GMM in this paper.

Apart from GDP growth, the VC fundraising has been included as internal instrument whereas all the other regressors including year fixed effect have been listed as external instruments. Moreover, socioeconomic conditions variable has been listed in external instruments in all the models. All the statistics including Hansen and Sargan statistics are satisfactory that justify our treatment of instruments. The AR2 values in column 4-6 indicate that the autocorrelation problem does not exist at 10% level of significance which is acceptable. In all the models in the GMM regressions, Windmeijer (2005) finite sample corrected standard errors have been reported in parentheses in the two-step GMM estimation results and employ “forward orthogonal deviations” (Arellano and Bover, 1995) that subtract the mean of all future available observations of a variable instead of first differencing. Time dummies have been included in all the models as regressors to maintain the correlation across individuals in the idiosyncratic disturbances as assumed by the autocorrelation test and robust estimates of the coefficient standard errors (Roodman, 2009). The p-values reported for AR(1) and AR(2) represent first and second order autocorrelated disturbances, respectively, in the first differences equations. To avoid instrument proliferation, the instrument matrix has been collapsed.

RESULTS

The autoregressive coefficients in columns 1 and 2 of Table 3 are statistically significant and positive suggesting an agglomeration effect i.e., the previous fundraising generates additional fundraising, and that the industry is still growing. Coefficients for overall financial markets are statistically significant and economically large. A one percentage point increase in financial

markets increase fundraising by 0.934 percentage points. The effect of financial institutions on fundraising is also statistically significant at 1% level. The coefficient estimate implies that one percentage point increase in financial institutions leads to an increase of 1.723 percentage points in fundraising. This supports H-1 that financial markets and financial institutions exert significant and positive effect on VC fundraising.

To test H-2, we introduce an interaction term financial markets \times financial institutions in Column 3. The strong and positive sign of the interaction term shows that these two facets of financial development accelerate each other's impact on fundraising. A one percentage point increase in financial markets depth and financial institutions depth together lead to 1.312 percentage point increase in VC fundraising. The interaction effect has been visualized in Figure 3. The dark blue line (with diamond shape) represents the lowest level of financial institutions (lowest development of 2.25) whereas the maroon color line (with circle shape) depicts the highest of financial institutions. Horizontal line displays the level of financial markets that ranges from low value of -3.75 to a high value of 0. In presence of deep finance markets (left side), the effect of financial institutions on fundraising is also pronounced and vice versa.

Table 3: Effect of financial development (financial market and financial institutions) on VC fundraising

	Dependent variable is VC fundraising % GDP		
	Two-step system GMM		
	(1)	(2)	(3)
VC Fundraising _{t-1}	0.175** (0.067)	0.153** (0.059)	0.182*** (0.061)
GDO growth	0.260 (0.276)	0.264 (0.228)	0.249 (0.212)
GDP per capita	-0.061 (0.056)	-0.017 (0.070)	-0.099 (0.065)
Tax burden	0.296 (0.727)	0.506 (0.754)	0.203 (0.809)
FDI outflows	0.278*** (0.095)	0.239** (0.090)	0.221** (0.098)
Patents	0.101* (0.057)	0.066 (0.051)	0.097 (0.064)
Property rights	-0.835** (0.371)	-1.194*** (0.329)	-1.110*** (0.333)
Financial markets	0.934*** (0.254)	--	1.551*** (0.434)
Financial institutions	--	1.723*** (0.472)	1.917** (0.747)
Financial markets × Financial institutions	--	--	1.312*** (0.465)
Year fixed effects	Yes	Yes	Yes
#Observations	340	340	340
#Countries	30	30	30
#Instruments	27.000	27.000	29.000
AR1 p-value	0.004	0.005	0.005
AR2 p-value	0.832	0.893	0.989
Sargan p-value	0.251	0.066	0.134
Hansen p-value	0.547	0.578	0.644

Notes: This table shows the results of regressing financial development index and two sub-indices on VC fundraising over the period 2005-2017 using two-step System GMM approach. *, **, and *** display the significance levels of 10%, 5%, and 1%, respectively. Constants are not reported.

Figure 3: Interaction plots (dependent variable is VC fundraising as % GDP)

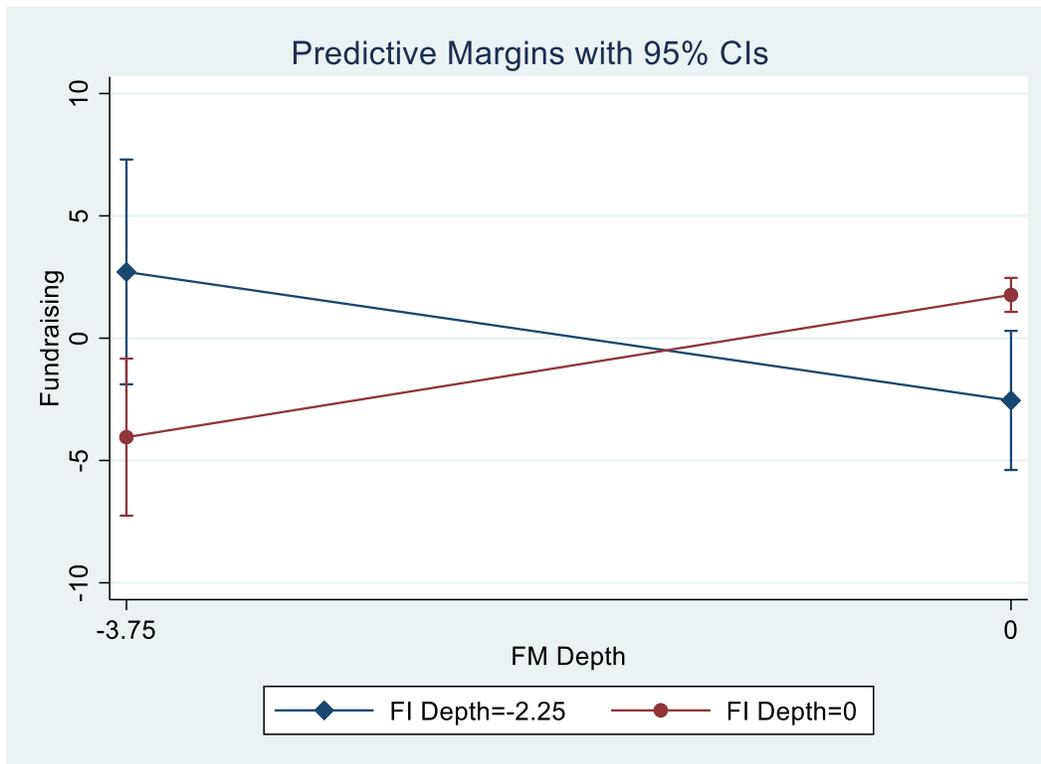


Table 4: Robustness using additional control variables and alternative estimation techniques

	Dependent variable is VC fundraising % GDP		
	Two-step		
	system GMM	Pooled OLS	IV 2sls
	(1)	(2)	(3)
VC Fundraising _{t-1}	0.182*** (0.061)	0.496*** (0.072)	0.640*** (0.145)
GDO growth	0.249 (0.212)	0.213** (0.092)	-1.764 (1.696)
GDP per capita	-0.099 (0.065)	-0.036 (0.033)	-0.159 (0.099)
Tax burden	0.203 (0.809)	0.089 (0.325)	1.630 (1.492)
FDI outflows	0.221** (0.098)	0.159*** (0.059)	0.170* (0.091)
Patents	0.097 (0.064)	0.062 (0.038)	0.152 (0.100)
Property rights	-1.11*** (0.333)	-0.491** (0.236)	-1.691 (1.062)
Financial markets	1.551*** (0.434)	1.127*** (0.372)	1.619** (0.682)
Financial institutions	1.917** (0.747)	0.747* (0.386)	0.708 (0.520)
Financial markets × Financial institutions	1.312*** (0.465)	0.709** (0.348)	1.465** (0.724)
Constant	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
#Observations	340	352	340
#Countries	30	--	--
#Instruments	29.000	--	--
AR1 p-value	0.005	--	--
AR2 p-value	0.989	--	--
Sargan p-value	0.134	--	--
Hansen p-value	0.644	--	--
R Squared	--	0.5671	--
Wald chi2	--	18.35***	182.81***

GDP growth has been instrumented with socio-economic development in the instrumental variable 2sls models reported in Columns 3 and 6. *, **, and *** display the significance levels of at 10%, 5%, and 1%, respectively. Constants are not reported.

In Table 4 the key interaction employed in Column 3 of Table 3 is tested whether it is robust to alternative estimation techniques. Since the rho is zero after random effects estimation which indicates that the panel-level variance component is unimportant, and the panel estimator is not different from the pooled estimator, we chose pooled OLS and IV 2sls estimations for robustness (StataCorp, 2013). Column 1 reports the results of two-step efficient system GMM, Column 2 displays the results of pooled OLS while Column 3 shows the results of instrumental variable random effects. The results of interaction between financial markets depth and financial institutions remain significant in Columns 1 to Column 3 after employing alternative estimation methods particularly pooled OLS and IV 2sls.

CONCLUSION

The paper uses dynamic two-step system GMM to tackle the issues of endogeneity and heteroskedasticity. The results are robust to using variety of estimation techniques. We develop two hypotheses. It was hypothesized that financial markets and financial institutions wield a significant positive effect on VC fundraising and that financial markets and financial institutions positively interact to explain VC fundraising. The study confirms that countries experience more VC fundraising in presence of strong financial institutions as they have the capacity to monitor clients well (Hoshi, Kashyap and Scharfstein, 1990; Beck and Levine, 2004; Chakraborty and Ray, 2006) When applied to the VC market, financial intermediation appears as a significant determinant of VC fundraising. In presence of strong culture of financial intermediation, there is lesser agency risk between investors and fund managers and between fund managers and portfolio firms. Widespread intermediation skills also means large number of fund managers, intensive fund management practices, and more syndicated investments.

Considering the debate in the law and finance literature whether there is *complementarity* between market-based and bank-based systems, the results challenges the work of Black and Gilson (1998) who associated VC with market-based system alone. We find complementarity between market-based and bank-based system that supports work of Lee (2012), Beck and Levine (2004), Levine (2005) and Qian and Yeung (2015) in corporate finance. The paper suggests important recommendations for policy makers to develop their VC markets. In addition to financial markets, financial institutions are also very important for VC and private equity markets. Financial institutions promote intermediation skills to cope to agency problems in VC private equity markets that leads to more fundraising.

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Appendix 1: Variables descriptions and data sources.

Variable	Description	Source
VC fundraising as % of GDP	VC fundraising consists of all stages of fundraising such as venture capital, expansion, growth capital, mezzanine, generalist, and buyouts funds.	Data source for Asian countries is Asian Venture Capital Journal while source of European data is Eurostat.
Financial development index	The index was introduced in 2016 by Svirydzenka (2016). The index has been divided into two sub-indices financial markets index and financial institutions index. Both sub-indices have been further sub-divided in three categories each. There are six indicators at the third level which are: financial market (FM) efficiency, FM depth, FM access, Financial Institutions (FI) efficiency, FI depth and FI access. FM efficiency represents stock market turnover ratio (stocks traded to capitalization). FM depth is defined in new row of the table. FM access proxies the percent of market capitalization outside of top 10 largest companies as well as total number of issuers of debt. FI efficiency covers net interest margin, lending-deposits spread, non-interest income to total income, overhead costs to total assets, return on assets, and return on equity. FI Depth has been defined below in the table. Finally, the FI access is used as proxy for bank branches per 100,000 adults and ATMs per 100,000 adults IMF Financial Access Survey (Svirydzenka, 2016; Data Source: IMF).	IMF
Financial markets depth	FM depth measures stock market capitalization to GDP, stocks traded to GDP, international debt securities of government to GDP, BIS debt securities database, total debt securities of financial corporations to GDP, dealogic corporate debt database, total debt securities of nonfinancial corporations to GDP, and dealogic corporate debt database.	IMF
Financial institutions depth ³	<i>FI Depth</i> represents the overall activity undertaken by financial institutions namely private-sector credit to GDP, pension fund assets to GDP, mutual fund assets to GDP, and insurance premiums, life and non-life to GDP.	IMF
Economic freedom index	It covers four dimensions of institutions i.e., rule of law, government size, regulatory efficiency, and market openness.	Heritage Foundation
Property rights (Heritage)	It measures the extent to which property rights are clearly defined and protected by law. High scores mean high institutional quality.	Heritage Foundation
Property rights (Frazer) index	It measures the extent to which property rights are clearly defined and protected by law. High scores mean high institutional quality.	Frazer Institute
Tax burden	Tax burden is a composite measure that reflects marginal tax rates on both personal and corporate income and the overall level of taxation (including direct and indirect taxes imposed	Heritage Foundation

³ Financial institutions efficiency covers net interest margin, lending-deposits spread, non-interest income to total income, overhead costs to total assets, return on assets, and return on equity. Financial institutions depth represents the overall activity undertaken by financial institutions namely private-sector credit to GDP, pension fund assets to GDP, mutual fund assets to GDP, and insurance premiums, life and non-life to GDP. Finally, Financial institutions access is used as a proxy for bank branches per 100,000 adults and ATMs per 100,000 adults (IMF Financial Access Survey).

	by all levels of government) as a percentage of gross domestic product (GDP). Highest score means favorable taxation regime and vice versa	
Rule of law	It captures the perceptions of the extent to which agents have confidence in the rules of society, quality of contract enforcement, property rights, the police, and the courts. High scores mean high institutional quality.	World Governance Indicators of the World Bank
GDP growth	It is the annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars.	World Development Indicators, World Bank
GDP per capita	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current local currency.	World Development Indicators, World Bank
Foreign direct investment (FDI) outflows as % of GDP	Net outflows of investment from the reporting economy to the rest of the world.	World Development Indicators, World Bank
Patents (residents)	Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office.	World Development Indicators, World Banks
Socioeconomic development	This is an assessment of the socioeconomic pressures at work in society that could constrain government action or fuel social dissatisfaction. The risk rating assigned is the sum of three subcomponents, each with a maximum score of four points and a minimum score of 0 points. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. The subcomponents are: <ul style="list-style-type: none"> • Unemployment • Consumer Confidence • Poverty 	ICRG