

Cross Country Evidence on Venture Debt and Startup Financing

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Abstract – Venture debt is an increasingly important vehicle for tech companies, and is seen as an important alternative to growth capital. However, its impact on startups in different phases of growth is not well researched. The present study aims to discuss on the correlation of Venture debt and technology startup investment in various countries in early stage and late stage. We used a cross-country panel, where the endogeneity was corrected by using a vector autoregression, and financing persistence and feedback between investment stages. Seed funding, grants, GDP, political stability and patents per inventor are also factors that are considered. To analyze the temporal effects of the shocks to venture-debt, the stationarity tests, lag-selection criteria, impulse-response functions and the model diagnostics are used. In conclusion, the study sheds light on the evidence at the ecosystem level and how venture debt affects startups' financing dynamics.

Keywords – Venture Debt, Startup Financing, Early-Stage Investment, Late-Stage Investment, Technology Startups, Panel Vector Autoregression, Entrepreneurial Ecosystems, Alternative Finance.

I. INTRODUCTION

Venture debt has become a part of today's finance landscape. The world's monetary landscape has undergone a paradigm shift in how creative companies raise capital. This unique type of financing by debt is an extension of classical lending systems devised to address the peculiarities of the capital needs of innovation-driven, fast-growing firms that typically have little physical assets but a lot of potential value and market opportunities derived from their intellectual property [1]. As private equity firms, venture capital funds, and strategic investors look for financial products that complement their equity investments and the ownership structures and offer operational flexibility to the sponsor's side, the concept of venture debt has become more relevant.

Venture debt has been created to offer innovative and growing businesses with more finance than traditional banks. The traditional financing mechanisms rely on regular cash-flow, tangible assets and established business plans, which are not necessarily found in new technology businesses such as biotechnology companies and other firms based on innovation [2]. Venture finance is designed to fill this void in the market by combining some features of debt and equity financing to establish hybrid constructions in-line with the pursuits of the lender and the growth aspirations of the borrower, and offering the capital efficiency benefits of standard stock financing.

Typically, when a business starts up in the first 3-5 years, the majority of the funds received will be spent on enhancing the company's growth. High tech start-ups can invest millions of dollars in R&D before they have any cash flow. The next round of stock is likely to be its primary source of capital, if a start-up manages to grow to the positive cash flow stage. In fact, venture debt financiers rely on the ability of a start-up to raise additional venture capital, rather than to generate cash flow to pay back their loans, as would traditional lenders. Appeal of equity investors, or more precisely, of a venture capital, is the main parameter determining the creditworthiness of a start-up [3].

From VL's point of view, VC is the main way to pay the debt. So, positive cash flow doesn't exist and instead, venture capitalists are funding the consecutive equity rounds that the business is able to complete. In other words, VLs are a method

of financing that relies on the likelihood of future equity stake in the company by current or prospective investors. One of Ibrahim's respondents explained that “Venture debt” is debt for future equity rounds. In VL's opinion, if a startup has been able to get financial support from a VC, it is more likely that it will get equity support, as well. According to this hypothesis, the investment opportunities of start-ups without the support of VCs are considered to be non-viable. Thus, the venture lenders do not like to lend until after the VC investment [4].

Venture debt is now being adopted as a complementary investment to equity, but the role of it in the different stages of startup investment is not well understood. Previous research has focused on the attributes of firms that seek venture debt, the venture debt decision-making process, or post-debt venture firm performance. They do not necessarily offer much clarity as to whether at a national level, venture debt alters the overall supply and distribution of equity capital to early-stage and late-stage technology startups [5].

In this study, we focus on the gap by investigating venture debt as a dynamic financing mechanism in a cross-country panel framework. Specifically, we conduct an estimation of the influence of venture-debt on investment in early and late phase startups and accounts for the feedback between the two stages of equity financing (seed funding and grants), innovation capacity, GDP and political stability. A two-lag PVAR model and impulse-response analysis enabled Yang et al. [6] to consider the immediate and time-varying effects of venture-debt shocks on startup-finance pools and not just as a set of outcomes at each stage of investment.

The study thus offers data both at the stage level and the ecosystem level on whether venture debt in general is complementary or substitutes equity capital; and if it is a net gain or loss in venture capital for tech startups. The remainder of this study is divided into the following sections: Section II is a review of the related literature on venture debt and startup financing. In section III, the methodology and dynamic PVAR framework are presented. Section IV presents and deliberates the empirical results which includes model diagnostics and dynamic effects of venture-debt shocks; and Section V concludes the study by summarizing the main findings and implications.

II. RELATED WORK

Mirza et al. [7] study the impact of venture debt on equity capital allocation in technology start-ups in early and late stages in 59 countries for the period 2015-2024. They concluded that data pertaining to venture debt is limited since extensive data comes from only a select set of 15 countries. Taking into account national knowledge intensity, economic progress and political stability, Boukhatem and Djelassi [8] examine the dynamic relationships of funding systems with a Panel Vector Autoregression (PVAR) approach. The more available venture finance, the more equity is reduced while the more late-stage equity increased. The overall effect is positive in all models assuming that venture financing has a positive impact on the effectiveness and efficiency of technological start-up ecosystems. This dramatic change in financing over the startup lifecycle can help speed growth and be a more effective source of capital for new companies.

Hadley et al. [9] explore the connection between access to VC and the number of employees in startups. It examines, using signaling theory, the effect of VC financing events on the growth of these firms, if any, and how the amount of the financing may affect the signaling. It also examines the issue of whether or not venture capital is fostering growth, or conversely, whether growth is an indicator of the need for venture capital. Davila, Foster, and Gupta [10] discuss the correlation between increase in number of personnel in later financing rounds and growth in financial valuation of startups.

Bianco, Zach, and Liu [11] analyze the impact of funding rounds obtained by travel setups to evaluate stock market responsiveness of these prospective competitors. Bianco, Zach, and Singal [12] identified, by event study on the stock value of incumbent firms, that the initial investment in startups operating on traditional hotel services had a negative impact and on alternative hotel services, it had a positive impact. For startups that provide intermediate services, we discovered that subsequent investment stages have a negative impact. The impact was dependent on the degree of similarity of the market and resources of startups to those of existing hotel businesses. Their results highlight the need to recognize competition as an essential management task. This report sheds light on the situation of startups in the tourism sector and provides essential data for tourism stakeholders.

Dugar et al. [13] analyze the effect of venture debt (VD) financing on firm growth and if the effect is due to the treatment effect or the selection effect of VD investors. Elhiraika [14] investigate a sample of 64 identified VD investors for a period of 2950 rounds of fund raising, which consists of 1431 US-based companies that have received VD funding since 2009. The two-step Heckman and counterfactual model is used to simulate the events of “subsequent funding round”, “trade sale” and “IPO” as measures of firm success after VD and venture capital (VC) funding rounds. VD investors seem to have a significant direct influence on the development of startups and are better at selecting portfolio firms.

Venture Debt (VD) funding's impact on Indian companies' growth is discussed by Iyer [15]. They measure the success of a firm's fund-raising round (FR) as (a) a subsequent FR, and (b) the percentage increase in self-reported valuation of successive FRs. An analysis of 13,809 financial statements of Indian companies from January 1998 to September 2022 by Hong, Serfes, and Thiele [16] exhibited that there was a firm and significant association between success and VC investment in a company. When success is defined as the existence of a subsequent FR, VD investors seem to have slightly better selection effects than equity investors. However, selection biases are hard to identify when performance is defined in terms of self-assessed valuation indicators.

III. METHODOLOGY

Design, Scope, and Identification

Table 1 estimates the intertemporal relationship between venture debt and equity investment in technology startups by taking a dynamic cross-country panel approach. The empirical setting assumes that the stock of early-stage and late-stage investments are jointly endogenous: a shock that affects the early-stage investment could affect the late-stage investment, either through the maturity of the ventures, investor beliefs, deal flow, or financing constraints. The analytical dataset includes i and t indices (country, year) and can have an unbalanced panel as countries may have different reporting histories. As illustrated in **Fig. 1**, the research process starts from the construction of the panel data, the transformation of the variables, the stationarity test, the selection of the lag order, the PVAR estimation, the diagnosis test, the stability test and the impulse-response analysis. Early-stage investment, late-stage investment, grant funding, seed funding, patents per inventor, political stability, GDP and venture debt are the key variables used for analysis.

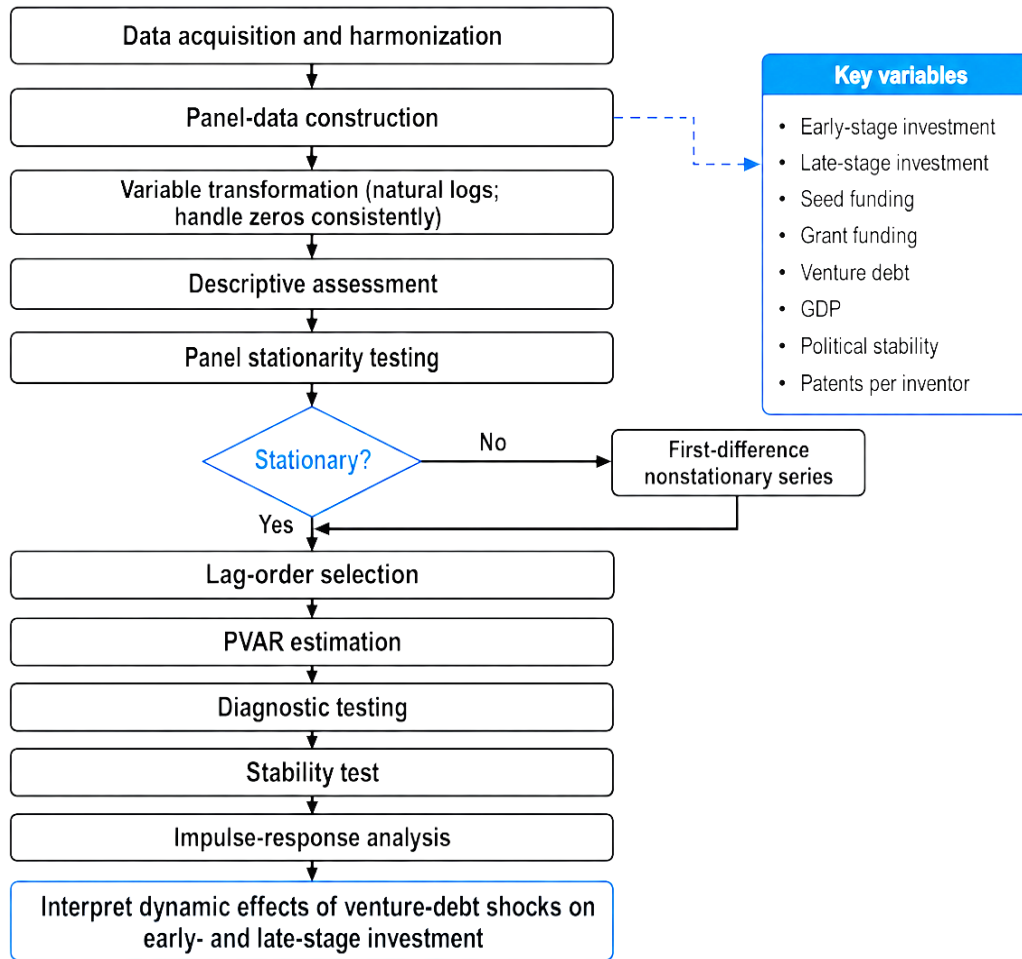


Fig 1. Dynamic Cross-Country PVAR Study Methodological Workflow.

Financial aggregates need to be log-transformed to remove scale effects and to remove the right-skewness. If, however, a zero does occur, the manner in which the operational transformation is written down must be the same, e.g., $\ln(1 + x)$, if it is to be estimated. In case it turns out that the variables contain a unit root, the first difference of the transformed series should be used for estimation. This allows the modeler to get a model of how the levels have changed over the years, and hence avoid the possibility of mistaking nonstationary variation for true variation. Though most of the unit root tests suggested stationarity, first differences were applied, just in case the Hadri test suggested that the source document was not stationary.

$$L_{kit} = \ln(1 + X_{kit}) \quad (1)$$

$$\Delta L_{kit} = L_{kit} - L_{ki,t-1} \quad (2)$$

Here, X_{kit} is the value of the variable k in observed for country i and year t , while L_{kit} is the log transformed value of k in and ΔL_{kit} is the change in the value of k in from year t to $t + 1$.

Table 1. Composition of Numerical Panels.

Item	Value
Data for GDP and political-stability for countries.	58
There are countries with usable series of venture-debt.	15
Minimum number of non-zero observations of country-level venture-debt per country.	7
Endogenous financing outcomes	2
Predetermined funding variables	2
Exogenous country-level controls	3
Candidate lag orders	0, 1, 2
Selected lag order	2
Impulse-response horizon	10 years

Dynamic PVAR Model

Early-stage start-up funding and late-stage start-up funding are included in the dependent vector:

$$y_{it} = \begin{bmatrix} \Delta \ln(\text{Early}_{it}) \\ \Delta \ln(\text{Late}_{it}) \end{bmatrix} \quad (3)$$

The baseline PVAR model is given by:

$$y_{it} = \alpha_i + \lambda_t + \sum_{\ell=1}^p A_{\ell} y_{i,t-\ell} + \sum_{\ell=0}^p B_{\ell} z_{i,t-\ell} + C w_{it} + \varepsilon_{it} \quad (4)$$

$$z_{it} = \begin{bmatrix} \Delta \ln(\text{Seed}_{it}) \\ \Delta \ln(\text{Grant}_{it}) \end{bmatrix} \quad (5)$$

$$w_{it} = \begin{bmatrix} \Delta \ln(1 + \text{VCDebt}_{it}) \\ \Delta \ln(\text{GDP}_{it}) \\ \Delta \ln(\text{PolStab}_{it}) \\ \Delta \ln(\text{PatentInventor}_{it}) \end{bmatrix} \quad (6)$$

In (4), α_i are country-specific effects not observed, λ_t are common time effects, A_{ℓ} are the endogenous lag coefficients, B_{ℓ} are the coefficients on venture debt and national controls, and ε_{it} is a two-dimensional innovation vector. The two stages of equity financing are left endogenous while the exogenous shock of venture debt is introduced to examine its impact on the two types of financing. This is in line with the methodology guide provided and the PVAR results reported with a lag of 2.

The system can be expressed as two separate equations:

$$\Delta \ln(\text{Early}_{it}) = \alpha_{1i} + \lambda_{1t} + \sum_{\ell=1}^2 \beta_{11,\ell} \Delta \ln(\text{Early}_{i,t-\ell}) + \sum_{\ell=1}^2 \beta_{12,\ell} \Delta \ln(\text{Late}_{i,t-\ell}) + \sum_{\ell=0}^2 \gamma'_{1,\ell} z_{i,t-\ell} + \delta'_1 w_{it} + \varepsilon_{1it} \quad (7)$$

$$\Delta \ln(\text{Late}_{it}) = \alpha_{2i} + \lambda_{2t} + \sum_{\ell=1}^2 \beta_{21,\ell} \Delta \ln(\text{Early}_{i,t-\ell}) + \sum_{\ell=1}^2 \beta_{22,\ell} \Delta \ln(\text{Late}_{i,t-\ell}) + \sum_{\ell=0}^2 \gamma'_{2,\ell} z_{i,t-\ell} + \delta'_2 w_{it} + \varepsilon_{2it} \quad (8)$$

Instruments and Estimation

Forward orthogonal deviations remove country fixed effects, putting each observation into perspective of the mean of its future observations. This method maintains the time sequence of the regressors and is appropriate for the dynamic-panel GMM estimation. The transformed dependent variable is given by:

$$y_{it}^* = \sqrt{\frac{T_i - t}{T_i - t + 1}} \left(y_{it} - \frac{1}{T_i - t} \sum_{s=t+1}^{T_i} y_{is} \right) \quad (9)$$

The model can then be estimated by GMM where the sufficiently lagged levels of the endogenous variables can be treated as internal instruments for the transformed endogenous regressors. The moment condition is:

$$E[q_{i,t-s} \varepsilon_{it}^*] = 0 \quad s \geq 2 \quad (10)$$

where $q_{i,t-s}$ is a set of valid lagged instruments. Lag range for instruments should be restricted and instruments need to be collapsed where necessary, to avoid proliferation of instruments. This is crucial since an increase in number of instruments could result in overidentification of the endogenous variables, consequently reducing the power of the Hansen overidentification test. The instrument counts supplied are 42, 44 and 48 within the specifications evaluated and associated Hansen J-test probabilities of 0.0877, 0.0557 and 0.0530 (see **Table 2**).

Table 2. The Results of the Numerical Model-Selection and Model-Validity Diagnostics

Statistic	Model 1	Model 2	Model 3
Lag order, p	2	2	2
Number of instruments	42	44	48
Hansen J -test p -value	0.0877	0.0557	0.0530
AIC	33.44	—	—
BIC	143.64	—	—
HQIC	82.80	—	—
Stability criterion	$\lambda(A)$	< 1 **	Satisfied
IRF bootstrap replications	1,000	1,000	1,000

Stationarity, Stability, and Causal Dynamics

Complementary panel unit-root tests are used to test the stationarity. Levin–Lin–Chu, Im–Pesaran–Shin, Fisher-ADF and Fisher-PP procedures have the null hypothesis of a unit root, whereas the null hypothesis of Hadri is stationarity. The evidence must be judged on an overall basis and not on the basis of one piece of evidence alone. Results show that for most of the variables, unit roots were rejected with high degree of confidence by LLC, Logit, PM, IPS, Madwu, and InvNormal statistics implying that the Hadri test was conservative when applied to first differences.

The PVAR is stable if all of the eigenvalues of the companion matrix are within the unit circle:

$$\det(I_{2p} - Fz) \neq 0 \quad \forall |z| \leq 1 \quad (11)$$

$$\max_r |\lambda_r(F)| < 1 \quad (12)$$

where F is the companion matrix constructed with the estimated lag matrices A_1 and A_2 . Stability implies that a venture-debt shock has a finite dynamic path and does not have an explosive effect. The study then estimates orthogonalized impulse-response functions to see how much of the effect on each stage of equity-financing can be attributed to an innovation in venture-debt.

$$\text{IRF}(h) = \frac{\partial y_{i,t+h}}{\partial \varepsilon_{\text{VCDebt},it}} = \Psi_h \text{Pe}_{\text{VCDebt}} \quad h = 0, 1, \dots, 10 \quad (13)$$

$$\text{CIRF}(H) = \sum_{h=0}^H \text{IRF}(h) \quad (14)$$

In (13), Ψ_h is the moving-average coefficient matrix at horizon h , P is the Cholesky factor of the residual covariance matrix, and e_{VCDebt} selects the venture-debt innovation. The accumulated effect until horizon H is measured by equation (14). Approximately 95% bootstrap confidence intervals for each response should be reported in the final analysis, and only responses for horizons where the confidence intervals have adequate precision should be interpreted. The results provided are for a ten-period impulse response horizon, and uncertainties grow with the horizon.

IV. RESULTS AND DISCUSSION

This research aims to shed light on the complex nature of financing that early-stage technology startups and late-stage technology startups go through in the context of venture debt and how it may stimulate the size of late- and early-phase investment pools as described by Bonini and Capizzi [17]. We start by studying the outcomes on lag selection, model diagnostics and the unit root test, followed by the estimates on the constraints and the impulse response function.

Cross-Sectional Stationarity, Model Diagnostics and Selection of Lags

Table 3 presents the results of the panel stationarity test for the variables: Patents per inventor, Political Stability, GDP, VCDebt, Seed, Grant, Late and Early. Findings of each of these evaluations are discussed. LLC carries out the homogenous unit root test for all panel sets. The value of the LLC test (intercept, trend, none) is high negative for all the variables which lead to the rejection of the null hypothesis that there is no unit root. The IPS testing is able to accommodate various types of unit roots processes in the panel.

The negative values for all variables are highly significant and this implies that the unit root null hypothesis is rejected for most if not all the cross-sectional units. In addition, the Pm-tests may be used to examine different unit root processes.

Results for all variables are significant and importantly positive, and therefore compelling evidence against the null hypothesis of unit root availability. The variables $Pat_{inventor}$, Seed, Grant, Late, and Early are analyzed over the comprehensive sample of nations. The investigation of GDP and political stability encompasses 58 different countries. Venture Debt has been analyzed in 15 different nations, all showing at least 7 non-zero data points. The findings for the Hadri, InvNormal, Logit, MadWu, PM, and IPS tests are illustrated for the trend tests, and are relevant for the intercept test and variables in different levels.

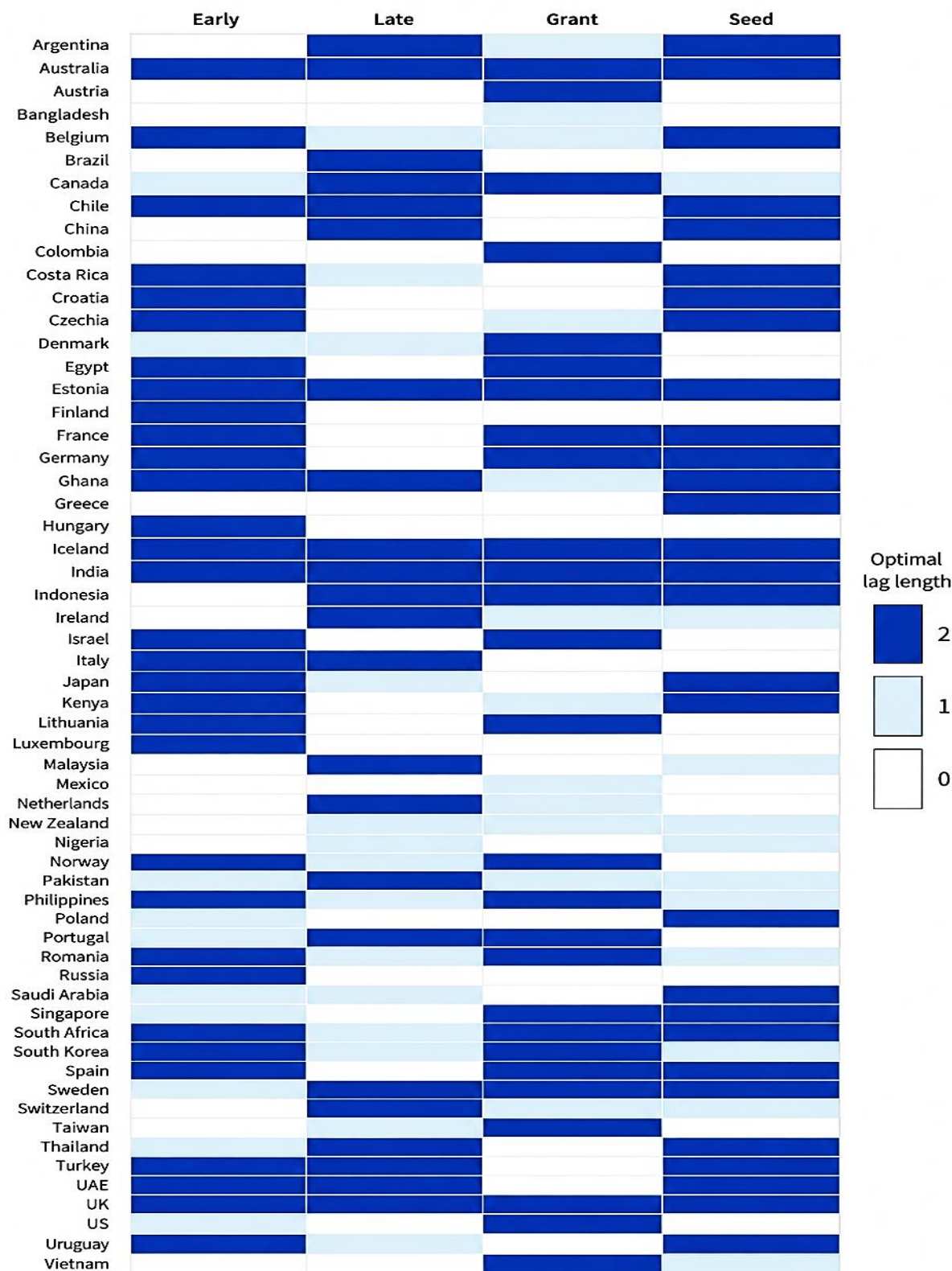


Fig 2. Lags Lengths for Each Country from AIC Analysis.

Table 3. Panel Unit Root Tests of Variables

Test	GDP	Political Stability	VCDebt	Patent Inventor	Seed	Grant	Late	Early
Hadri	2.6408**	1.9229*	0.18403	4.2462***	2.1182*	2.4102**	2.0293*	2.4213**
InvNormal	-30.701****	Inf	11.72**	-26.352***	-29.338**	Inf	-33.832**	-32.049****
Logit	-77.418****	Inf	-25.189*	-55.751***	-60.149**	Inf	-87.803**	-67.8****
MadWu	2193.4****	4333.6****	375.58*	1619.5***	1709***	1805.5****	2473.8**	1918.2****
Pm	135.1* ***	276.9****	44.614* ***	97.74****	103.57** **	109.85****	153.35** **	117.18****
IPS	-23.212****	-60.782****	-8.3893* **	-19.077***	-21.111** **	-21.88* ***	-26.438** **	-28.07****
LLC-None	-1.359	-1.7923*	-5.6832* ***	-0.2452	-6.9237** **	-8.3415****	-18.803** **	-5.6675****
LLC-Intercept	-15.037****	-10.878****	-6.4055* ***	-17.321***	-15.472** **	-15.574****	-22.582** **	-18.388****
LLC-Trend	-19.078****	-23.118****	-7.056** **	-18.777***	-18.358** **	-25.871****	-20.1****	-34.369****
End	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable

Note: The representation of significance threshold is as follows: The symbols correspond to the corresponding P value limits: * for $P \leq .05$, ** for $P \leq .01$, *** for $P \leq .001$, and **** for $P \leq .0001$.

In the same vein, the MadWu-test is a distribution-free test, which integrates p-values of the discrete augmented Dickey-Fuller (ADF) tests. All of the variables exhibit strongly positive values, and hence strongly reject the unit-root null hypothesis. Alternate non-parametric tests are InvNormal and Logit tests, which focus on the combination of the p-values of several unit root tests. The unit root null hypothesis is should be discarded as the statistics for almost all variables are overwhelmingly negative (save from Grant where the test statistics are insignificant and infinite). But, the numbers from Hadri's test of the null hypothesis of time-series stability are pretty positive. Null assumption of time-series stability would be discarded in case a unit root is present.

We confirm that these weak findings are not a violation of the hypothesis of stationarity for all the variables. Such an inference is strongly reinforced by tests battery (InvNormal, Logit, MadWu, Pm, IPS, and LLC) as the null assumption of the unit roots is discarded almost for all variable quantities at high significance levels. The potential divergence highlights the importance of having knowledge of different discrete root trials as they rely on dissimilar hypotheses, and have different energy features. We use initial differences in the model estimating process, to negate any implications of probable stationarity raised by Hadri's test.

PVAR Estimation Results

Fig. 2 illustrates the optimal lag lengths (0-2) for each of the countries for 4 variable quantities, such as Seed, Grant, Late, and Early, calculated by the AIC. Every row signifies the lag level of a nation, which reduced the AIC for every statistic. For most variables and countries, lag values are 2. The same lag of 2 for different countries and variables proposes that the best estimation of the whole model should have a lag construction of 2. The model adequacy assessment indicate that the instruments are valid. The p-values of Hansen's J-test are 0.0530, 0.0558, and 0.0877; and does not discard the null assumption that instrument is exogen. The value of used instruments is 48, 44, and 42 that is within the satisfactory limits. The MMSC (data criteria), HQIC (-82.79), and BIC (-143.63) support the Model 1 parsimony whereas the comprehensive fit of model 1 is supported by the AIC (-33.44).

The findings of PVAR (panel vector autoregression) investigation are shown in **Fig. 3**. The dependent variables are $Early_t$ (funding of early-phase startups) and $Late_t$ (investment in late phase). This evaluation depends on the endogenously determined lags, programmed parameters and a bunch of exogenic variable quantity, such as startup debt financing. The model estimation is based on two lags, which is in accordance with the optimal lag selection indicated above.

The lag value of early-phase investments (Early_{t-1}) has a significantly negative impact on early-stage investment in the future ($p < 0.05$), which means that there is average reversion or reducing peripheral returns. On the other hand, the linearities of the two stages of financing are reflected in the significant positive impact of the first-stage investment lag, Late_{t-1} , on late- and early-phase investment. The second lag of early-phase investment (Early_{t-2}), which has a significant impact on Early_t ($p < 0.01$), demonstrates the stability of the investment pattern of startups. Interestingly, the second order lag of Late_t seems to have a negative effect on late-stage investments ($p < 0.1$). This would demonstrate some crowding out or some cyclical adjustment processes.

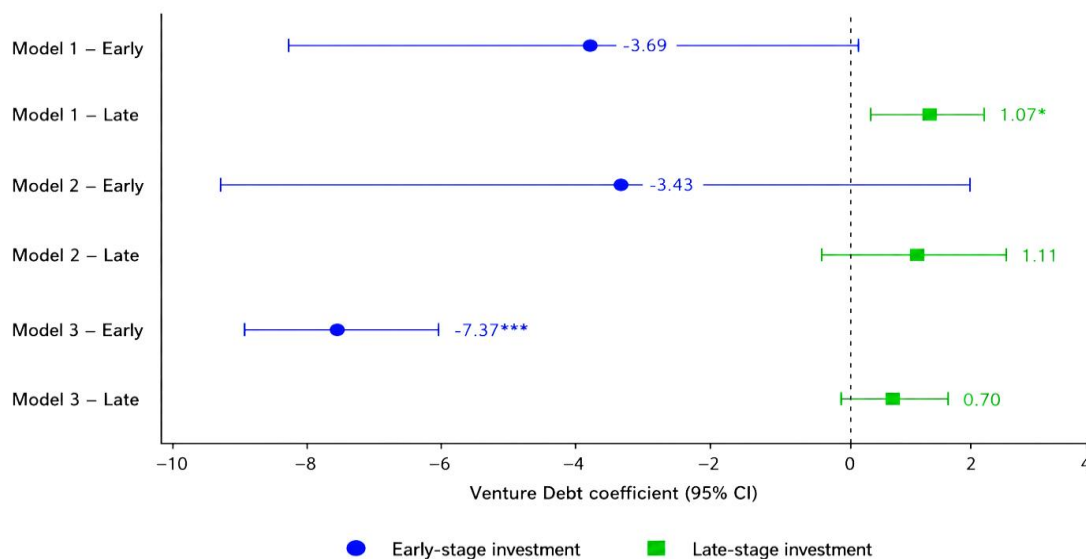


Fig 3. Estimated Outcomes for Alternative Models (Compared in Panel VAR).

Concerning the variables already existing, the present value of Grant_t has a negative effect on the early-phase financing while the past value (Grant_{t-1}) has a positive effect on the early-stage venture debt and the late-stage financing, proposing a time-lagged catalytic impacts of grants. In a similar way, the current value of the seed investment (Seed_t) is very significantly positively affecting both stages, while the lagged value (Seed_{t-1}) is only marginally significantly positively affecting Early_t . All these are signs of constraints and deferred confidence in funding ecosystems.

Venture debt seems to have a dual effect, having a negative impact on early-stage funding ($p < 0.1$) and a significant positive impact on late-phase funding ($p < .05$) likely driven by the risk characteristics of the borrowers. As expected, $\text{Patent}^{\text{St}}_t / \text{Inventors}_t$ is a significant negative predictor of early-stage investment, but a significant positive predictor of late-phase venture, in line with an innovation maturation pipeline.

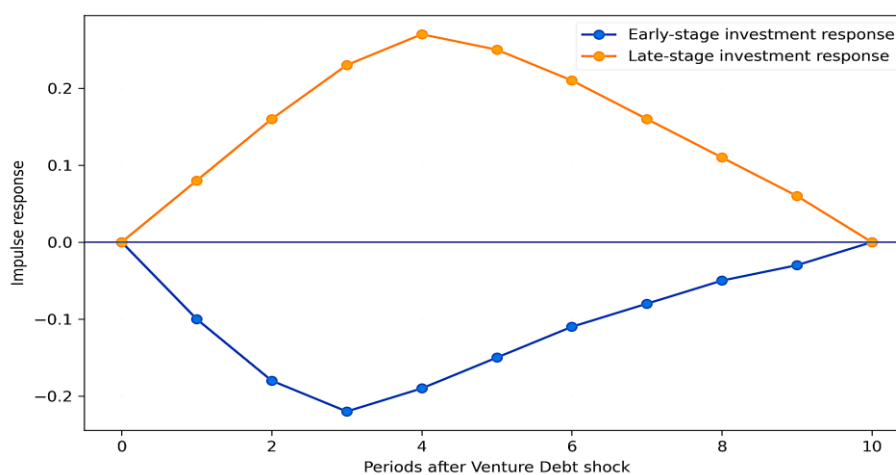


Fig 4. Impact of a Venture Debt Disruption on the Impulse-Response.

Dynamic Effects of Venture-Debt Shocks

The negative effect is found at the 1% significance level as expected and is consistent with the notion that more political stability is associated with less access to equity funding for technology firms which may be a sign of loss-aversion bias in the context of risky environments. Venture capital (VC) activities, where there are typically high arbitrage opportunities and

high expected returns for potential investors, are impacted by stable institutional setups as they tend to reduce the range of arbitrage opportunities and expected returns, and reduce the sophistication of the market, capital allocation opportunities and information asymmetry. Concurrently, the political competence strengthens financial institutions and stimulates the availability of alternative funding, leading to lower perceived risks and capital costs and, therefore, fewer high growth firms in the pipeline as the incumbent firms benefit. This is consistent with the results of Lahr and Mina [18] who show that stability has a negative effect on late-phase VC funding and the mechanism of Deng et al. [19].

As one might expect, GDP has a positive impact in both funding periods and thus contributes to the macroeconomic foundations of start-up enterprises. The implication is considerably 6 times higher for Early (see Model 1 and Model 2). **Fig. 4**, **Fig. 5** and **Fig. 6** show the impulse feedback obtained from the vector autoregressive examination for the first model. As shown in **Fig. 4** it can be noticed that the $Early_t$ is rapidly and remarkably decreasing and $Late_t$ is increasing tendency. At first the period effect is positive for both, then they fall together at $t = 2$. This technique is lost after 10 intervals.

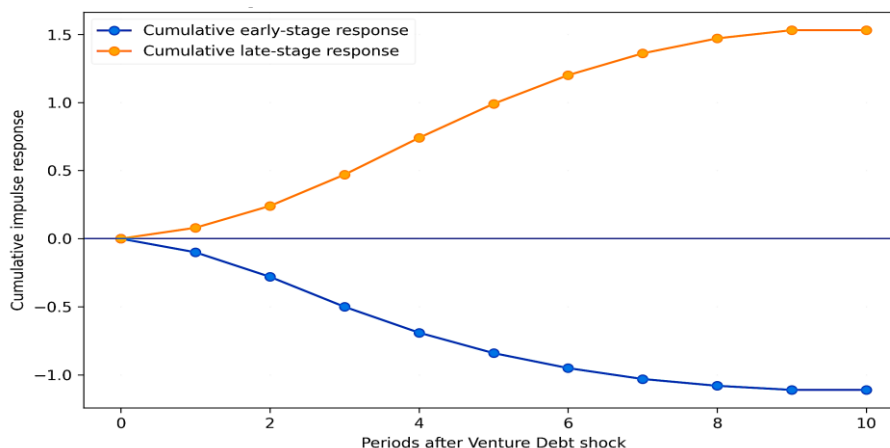


Fig 5. The Overall Impact of a Change in Venture Debt.

Notably, again a divergence is found between $Early_{t=3}$ and $Late_{t=3}$, but not as much as in case where t is 0. The general favorable impacts are stronger for *Late* and the negative effects are weaker for *Early*. Thus, cumulative and overall effects are more interesting. **Fig. 5** indicates that while the negative impact on $Early_{t=0}$ does not seem to be completely corrected with time, *Late* will be around $\approx +500$. The overall effect ($Early + Late$) shown in **Fig. 6** is beneficial, except for the initial year. It should be noted that the collective impulse response functions become less and less precise with time and cannot be relied upon past 3-4 cycles.

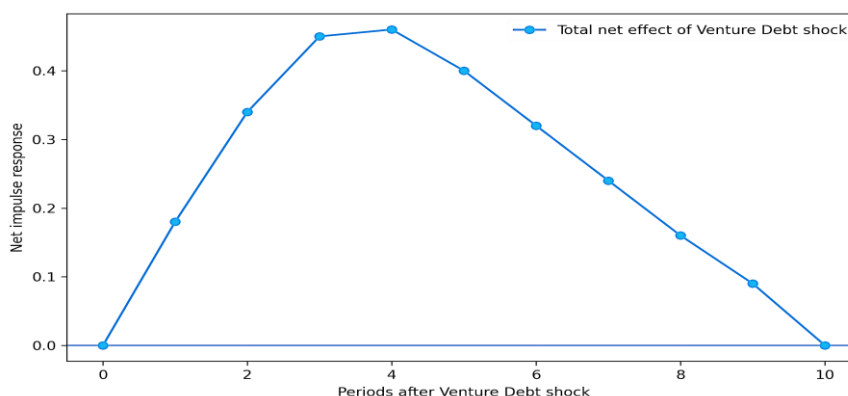


Fig 6. The Overall Net Impact of Venture Debt Disruption.

V. CONCLUSION

The study will aid in understanding the significance of venture debt as an integral part of technology start-ups funding ecosystems. It is not only on the firm level where venture debt is considered as an outcome, but also as a combination of early and late-stage investments in one model. We portray this effect of persistence, feedback and time varying response of equity investment to venture-debt shocks in the cross-country PVAR framework. An analysis, which considers seed funding, grants, GDP, political stability and innovation capacity makes the financing conditions in a heterogeneous national context more understandable. Our findings will help entrepreneurs, investors, lenders and policy makers know whether the venture debt is net addition to the capital or a mere shift in the capital to a later stage. These facts can be used to develop more balanced financing policies to foster start-up formation and scaling up.

CRedit Author Statement

The author reviewed the results and approved the final version of the manuscript.

Data Availability

No data was used to support this study.

Conflicts of Interests

The authors declare no conflict of interest.

Funding

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Competing Interests

There are no competing interests.

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