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Sustainable financial system and capital investment: a novel perspective of US economy

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ABSTRACT

Nonetheless, the risk factors such as economic risk, political risk, and financial risk have their respective pros and cons in various economic and financial investigations. Yet, the influence of these risk factors on sustainable venture capital is hardly studied in the existing literature. In this sense, the present research tends to investigate the influence of these risks on sustainable venture capital while considering the role of human capital in the US economy. This study uses novel time series approaches using quarterly data from 2006Q1 to 2020Q4. The estimated results validated each variable's stationarity and cointegration between the study variables. The asymmetric data distribution leads to the employment of a novel method of moment quantile regression, which illustrates the positive association between economic risk, political risk, human capital, and sustainable venture capital. On the contrary, financial risk is found adversely affecting the sustainable venture capital in the country. The robustness of the model is examined by employing the bootstrap quantile regression. This study suggests minimizing economic, political, and financial risks and increasing investment in human capital to encourage sustainable venture capital.

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1. Introduction

Startups or new businesses are categorized as high-growth and high-return providers. They are the definitive drivers of economic growth because they increase production activities, innovational advancements, and job creation (Yuan et al., 2022). Since emerging entrepreneurs and businesses have limited access to financial institutions. Hence, venture capitalists play a crucial role in establishing those risky but high-return startups (Kim & Lee, 2022). Venture capital firms provide capital access and, in turn, get an equity position in those nascent businesses (Hmaitane et al., 2019; Pradhan et al., 2018). Besides, they are equally important for global sustainable development. In retrospect, a huge amount of capital and funds are practicing sustainable

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expansion due to increased environmental awareness among investors (Xu et al., 2022; Zheng et al., 2023). Hence, venture capital is ideally imperative as a sustainable investment concerning its promising characteristics. They are well-suited to sustainable projects with a long lock secure investment period providing technological innovation required for sustainability (Ferrat et al., 2021; Ielasi et al., 2018). Further, venture capital provides information asymmetry and uncertainty as they come with constant monitoring for investor protection mechanisms (Lin, 2022). In addition, it can contribute to accomplishing Sustainable development goals by the year 2030 (Keefe et al., 2017). Attributable to the report on 'Global Sustainable Investment Alliance (GSIA), the global sustainable investment rose to 3.5\$trillion, which is a 55% increase from the year 2016 (Berger, 2022; Gao et al., 2021; Lin, 2022).

In the existing body of knowledge on venture capital, quite a few studies have signified the importance of venture capital as it is noteworthy in promoting sustainable economic development (Festel & Rammer, 2015; Fried & Hisrich, 1988; Lin, 2022). Certain scholars and academics analyzed the performance of venture capital investments during the financial crisis of 2008 and its effects onwards since the crisis led to the failure of many businesses and firms (J. H. Block et al., 2010; J. Block & Sandner, 2009). Whereas concerning conventional investments, the role of different types of risks has been explicitly discussed in numerous studies (Busse & Hefeker, 2007; Ghadge et al., 2021; Oudat & Ali, 2021). Yet, the impact of economic, political, and financial risks on venture capital investments is analyzed in the United States. The study is motivated since the United States has nearly 1000 active Venture Capitalist firms. Besides, the major VC firm (Intel Capital) generates revenue of almost 30\$billion with a 28.5% investment-to-exit ratio (Keyvani & Flynn, 2022). For that reason, the authors are motivated to scrutinize the impact of certain factors on venture capital investment in the USA, as it was overlooked in the previous studies. The results would provide novel policy implications regarding risk capital management for favorable business purposes.

According to the research requirements, the study aims to accomplish the following objectives. The study's first objective is to examine the impact of economic, political, and financial risk on venture capital investments in quarterly data of the US economy. The second objective is to assess the impact of economic growth and human capital on venture capital funding in the pre and post-pandemic period. To achieve these objectives, the study utilizes variables such as Venture Capital (VC) as the dependent variable, while Economic Risk (ERI), Financial Risk (FRI), Political Risk (PRI), Gross Domestic Product (GDP), or economic growth, and Human Capital (HCI) as explanatory factors employing novel econometric analysis of seasonal unit root analysis and Quantile regressions for the first time for examining the nexus in the United States in the observed literature.

The study is significant in two-fold ways. First, initially, every business faces several challenges, and venture capital investments are resourceful in spreading the fiascos. They are imperative for expansion because they encourage innovation that is momentous for a sustainable environment besides providing higher profitable revenues. Devoting a small percentage of the potential investor's portfolio to risky businesses could be fruitful in providing high returns. Therefore, the risk assessment

before investing is substantial, and the present research is significant in examining the different risks of venture capital investments. Second, venture capital investments are economic growth and development drivers. For that reason, helping nascent businesses and enterprises in establishing is imperative because it provides additional resources, business expertise to make appropriate decisions, and fast connections in the industrial community that are essential for future growth. Therefore, the present study assesses the determinants of venture capital investments in the pre and post covid era. Additionally, the scrutiny of venture capital investments and their significance in business finance motivated the researchers to explore the determinants using modern econometric analysis. Besides, important implications are withdrawn from the empirical estimations of the study that the reduction in economic, political, and financial risk could help investors and industrialists to enhance investment levels.

Based on the critical literature review, the study contributes to the literature in three-fold succeeding ways. First, the study is a pioneer in examining the influence of economic, financial, and political risk on venture capital investments. Presently no prior study tends to scrutinize the risk-capital association simultaneously. Besides, no study has analyzed all three risks in determining venture capital investments. In addition, the study contributes to the literature on examining Sustainable Financial Systems and Capital Investments, which is novel. Therefore, the present study scrutinizes the nexus between risks and venture capital investments. Second, the study pragmatically contributes to the empirical literature by utilizing the role of human capital, economic growth, economic risk, political risk, and financial risk in sustainable venture capital investments employing innovative econometric techniques as a new input in practical literature. Third, the study uses an updated data period from 2006Q1-2020Q4 in the case of the United States, and quarterly data is employed for the assessment of the nexus mentioned above as a meaningful empirical contribution as new input to the literature. After obtaining the empirical results, this study suggests the reduction of risks, including financial, economic, and political risks, as these are the critical hurdles in the path of decreased venture capital. Besides, the results also lead to the implications of increased investment in human capital, which plays a substantial role in the development of the economy's financial sector.

The remaining manuscript is organized in the following ways. [Section 2](#) explains the aspects and associations between study variables besides stating relevant empirical studies for clarification. The data, model, and research methodology are elaborated in [Section 3](#) of the manuscript. Results and their interpretations are documented in [Section 4](#), respectively. Finally, the concluding remarks and policy implications are mentioned in [Section 5](#) of the study.

2. Literature review

The extant literature on Venture capital does not have concrete findings on the determinants of Venture Capital investments. Even though mere knowledge of empirical studies on Venture Capital funding and explanatory factors, the subsequent impression on the topic might elaborate on the variable's aspects. Nevertheless, later some

shreds of empirical evidence on variables under consideration are revealed in the sub-section of this section.

2.1. Venture capital: Its theoretical relevance and significance

Venture capital is a type of financing or equity provided to encourage small businesses, emerging entrepreneurs, or start-up firms that are predicted to attain possible lasting growth. It is a sub-segment of private equity developed after the Second World War in the United States, referred to as a financial intermediary between investors and businesspersons. Usually, potential investors, investment banks, and other financial institutions provide venture capital to those high-risk and high-return expecting firms or businesses. It can be provided in monetary form or technical/managerial expertise (Najmi, 2019). For a successful capitalist economy, entrepreneurship and innovation are imperative kernels. New businesses are risky and highly cost-intensive. However, external venture capital may spread the hazard of failure besides generating returns. An entrepreneur faces a certain level of cash limitations during the initial firm's life. Therefore, venture capitalists provide funds till the business gives profitable returns. Attributable to the theoretical research findings, (Amit et al., 1998) state that Venture Capital is efficient and prominent in those businesses where informational concerns are imperative. For instance, biotechnology, computer software, industrial energy, and financial services, etc., as they are highly risky but are convenient to monitor by financial institutions. Therefore, Venture Capital provides capital access as the chief source of capital besides filling the gap between traditional capital and innovation funds (Huffman & Bognanno, 2018). Further, it is an evolutionary approach and an innovative source of economic development (Breuer & Pinkwart, 2018; Kuzmina & Konovalova, 2022). Supplementary, a few authors have scrutinized the determinants of Venture capital such as Initial Public Offering, economic growth, market capitalization, and the list. Regarding the previous statement, (Bonini & Alkan, 2014) inspected the crucial determinants of venture capital that substantially influence the capital financing process. The study demonstrated that certain macroeconomic and political factors tend to impact venture capital funding significantly in the number of considered countries. Similarly, in another research, (Najmi, 2019) assessed the VC determinants in G7 economies. The study findings depicted that interest rate, market capital, unemployment, and capital return significantly affect venture capital.

2.2. Nexus amid economic, political, financial risk, and venture capital

The financial crisis in an economy adversely influences investment potential. For that reason, Wang (2019) scrutinized that the financial crisis in 2008 generated unpleasant economic risks and uncertainties that impacted venture capital investments unfavorably. In the renowned book 'Venture Capital Refined,' (Klonowski, 2022) discussed the significant influence of political and economic risk impact on venture capital investments signifying these risks as imperative aspects in determining venture capital. In the available literature, economic, political, and financial risk has a substantial

impact on investment funding (Salehnia et al., 2019). In the context of economic risk uncertainty, (Huang et al., 2022) assessed that increasing economic policy risk slows venture capital investments in the economy, indicating a negative association between economic uncertainty and venture capital decisions in China. Another innovative research in China, (Yang, 2022) examined the impact of financial risk on venture capital or private equity funds. The findings demonstrated that venture capital worsens financial risk indicating a negative association between the variables suggesting that increased financial risk decreases the venture capital investment. Further, during the covid pandemic, a positive association is observed between investments in venture capital and financial risk. However, sustainable venture capitalists could aid in limiting financial risks in the firm/country because they substantially mitigate or divide risks. (Bocken, 2015). (Wu et al., 2022) evaluated that high exposure to political risk negatively impacts the capital structures in an economy. (Bonini & Alkan, 2014) examined the connection between political risk and venture capital investment. The study employed 12 components of political factors. The overall panel results showed that political factors, including corruption, positively influence venture capital investment intensity funding in panel data economies, indicating political risk is a significant determinant of Venture capital.

2.3. Nexus between GDP, human capital, and venture capital

Economic growth substantially affects venture capital investments. (Kolmakov et al., 2015) observed a significant relationship between economic growth and venture capital funds in the case of United States and Russia. However, the effect of Venture Capital investments in the USA and Russia on economic growth is higher than conventional investments. In the case of European countries, (Pradhan et al., 2018) assessed the noteworthy association between venture capital and economic growth (GDP) from 1989 to 2015. The findings depicted a significant causal association between the said variables. Another time, (Pradhan et al., 2019) inspected the association between economic growth and venture capital (early, late, and overall VC stage) in 25 European economies. The empirical findings demonstrated a significant correlation between early, late, and overall venture capital investment and European economic growth. However, again, (Pradhan et al., 2020) investigated the relationship between venture capital, innovation, and economic growth in European economies from 1986 to 2016. The empirical findings from panel data detected a significant association between venture capital and economic growth. The general findings demonstrate that venture capital stimulates economic growth in European economies.

Lastly, human capital is an important determinant in new venture capital. That is, (Sevilir, 2010) discovered a significant association between human capital and venture capital for new startups. (Canavati et al., 2021) analyzed the structural association between human capital and new venture capital (ideas). The study indicates that specific human capital substantially influences generating venture capital notions. (Adomako et al., 2022) examined the relationship between human capital and new venture capital, demonstrating a significant association between human capital and capital growth. (Xu, 2019) explored the association between human capital and new

venture capital. The findings from regression analysis depicted a substantial influence of human capital on new venture capital relationships.

2.4. Literature summary and gap

Venture Capital is efficient and prominent in business, where informational concerns are imperative. In academics, it is an important topic for researchers in promoting sustainable economic development (Festel & Rammer, 2015; Fried & Hisrich, 1988; Lin, 2022). Several factors impact venture capital investments, though the extant literature on Venture capital does not have concrete findings on the determinants of Venture Capital investments. A few pointed out some relevant factors that influence venture capital. As in the available literature, the influence of political and economic risk significantly impacts venture capital investments, implying these are imperative aspects in determining venture capital (Klonowski, 2022). Further, political factors, including corruption, positively influence venture capital investment intensity funding. Other major elements, such as economic and human capital, are also found to be substantial in making investment decisions (Bonini & Alkan, 2014; Pradhan et al., 2019; Wu et al., 2022; Xu, 2019). However, the present study is a pioneer in examining the influence of all three risks, such as economic, financial, and political risk, on venture capital investments. Since presently, no prior study tends to scrutinize the risk-capital association simultaneously. Besides, the present research empirically assesses the determinants of venture capital investments in the pre and post covid era. Therefore, the study aims to scrutinize imperative factors in venture capital investments in the case of the United States.

3. Data and methods

3.1. Variables and model specification

Following the study's objective and the literature above, this study venture capital (VCQ) in a million US\$ as the primary dependent variable. Since the key objective of this study is to explore the influence of risks on VCQ: therefore, this study uses three variables economic risk index (ERIQ), political risk index (PRIQ), and financial risk index (FRIQ). In addition, this study also examines the role of the human capital index (HCIQ) in the sustainability of VCQ. The "Q" in each variable indicates quarter as this study is dealing with the quarterly data from 2006Q1 to 2020Q4. Data for these variables are extracted from several sources, which are given in Table 1.

Following the studies of (Canavati et al., 2021; Wu et al., 2022), this research developed the following study model:

$$VCQ_t = \beta_0 + \alpha_1 FRIQ_t + \alpha_2 ERIQ_t + \alpha_3 PRIQ_t + \alpha_4 HCIQ_t + \varepsilon_t \quad (1)$$

The above model illustrates that VCQ is the function of FRI, ERI, PRI, and HCI. Where the intercept is captured by β , and the slopes are captured by α 's. Furthermore, "t" in the subscript demonstrates time series, while ε represents the random error term of the model.

Table 1. Variables specifications and data source.

Variable	Specification	Data Source
VCQ	A private equity investor that, in return for equity ownership, offers funds to firms with great potential growth.	https://stats.oecd.org/
ERIQ	The risk refers to an investment undertaken in a foreign nation resulting from shifts in business circumstances or the negative impact of macroeconomic variables.	https://www.prsgroup.com/
PRIQ	Political risk is the possibility that an investment's profits may decline due to political instability or volatility in a nation.	
FRIQ	Risk of financial loss associated with an investment or business endeavor.	
HCIQ	People's investment in an accumulation of skills, knowledge, and health across their lifetimes enables them to achieve their potential as contributing society members.	Penn world table 10.0

Source: the authors.

3.2. Estimation strategy

Since the present study deals with time series data, it is essential to utilize appropriate time series approaches. In this respect, the present research employs pre-diagnostic approaches, including normality tests and unit root estimators. The estimated results of the unit root estimator asserted the stationarity of all variables, which allows the study to examine the long-run equilibrium relationship between the study variables. Besides, this study found that all the variables follow the non-linear distribution. In this sense, the study uses the novel non-parametric approach—the method of moment quantile regression. This estimator efficiently examines asymmetric distribution along with the specific estimate of scale and location. Further, this study also tests the robustness of the study model by using the non-linear approach based on the irregular data distribution, i.e., the bootstrap quantile regression. The methodology is explained further in detail in the under-discussion section.

This research provided qualitative information for each variable included in the empirical estimation. To describe the data, descriptive statistics, which often comprises the mean, median, minimum, and maximum (the latter two are known as the range of time series), and the standard deviation (which indicates how far observations deviate from the mean) are essential. In additional specifications, this study investigates skewness and Kurtosis, two indications of data normality. Both two normalcy indices have respective critical values of 1 and 3. If the computed values are greater than or below these critical bounds, then the data are not normally dispersed. Further, the (Jarque & Bera, 1987) statistical tool, which may be phrased as follows, is used to assess the data normality in this research.

$$JB = \frac{N}{6} \left(S^2 + \frac{(K - 3)^2}{4} \right) \quad (2)$$

In the above expression, the number of observations (N), skewness (S), and excess Kurtosis (K) are displayed. This test suggests that the normal distribution of data is the null assumption.

Dickey and Fuller (1979) proposed the augmented Dickey-Fuller (ADF) test for determining if time series variables have a unit root. This inquiry utilizes an ADF

(Augmented Dickey-Fuller) statistic with a negative value. Whenever the confidence level is minimal, the unit root hypothesis is aggressively rejected. As seen below, the ADF test is equivalent to the basic Dickey-Fuller test.

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \dots + \delta_\rho \Delta y_{t-\rho-1} + \varepsilon_t \quad (3)$$

In Equation (3), α represents constant, β is a time trend parameter, and ρ is the lag order of the auto-regressive process. The constraints $\alpha = 0$ and $\beta = 0$ replicate a stochastic process, while the constraint $\beta = 0$ emulates a stochastic process with drift. Consequently, the procedure under study has three primary versions. The ADF concept becomes auto-regressive when lags of ρ order are included. This necessitates the lag length order to be determined during the test duration. One way involves examining the t-values of coefficients beginning with the utmost order. For this test, choosing the Bayesian or Akaike information criteria are essential. The test of unit root is then compared to the null hypothesis ($\gamma = 0$) with the alternate explanation ($\gamma < 0$), which is written as follows:

$$DF_\tau = \frac{\hat{\gamma}}{SE(\hat{\gamma})} \quad (4)$$

After acquiring the statistical information, they could be contrasted to the ADF critical bounds (DF_τ) to reject or accept the null assumption. Since this study deals with quarterly data, there is a possibility of a seasonality issue. In this sense, the present research also employed the seasonal unit root test, where the study follows the traditional methodology of HEGY, proposed by (Hylleberg et al., 1990). The empirical results of this test will provide evidence regarding the presence or absence of a unit root while simplifying the quarterly data and allowing for the issue of seasonality.

After verifying stationary properties, this analysis examines the variables' long-run relationship among the variables. We utilized the combined cointegration test of Bayer-Hanck. This test comprises (Banerjee et al., 1998; Boswijk, 1994; Engle & Granger, 1987; Johansen, 1991), individual cointegration tests. When these tests are employed individually, the accuracy and consistency of the cointegration assessments may be confused (Shahbaz et al., 2018). The present research used Bayer and Hanck's combined cointegration specifications to optimize cointegration analysis and eliminate unclear estimates. Using Fisher's F-statistics, the test integrates all (four specified) cointegrating procedures and yields exact results (Shahbaz et al., 2018). It also requires a certain integrating sequence, i.e., I(1). The null assumption of this test states that cointegration between the variables does not exist. The following is Fisher's formula for Bayer-Hanck cointegration:

$$EG - J = -2[\ln(P_{EG}) + \ln(P_J)] \quad (5)$$

$$EG - J - Ba - Bo = -2[\ln(P_{EG}) + \ln(P_J) + \ln(P_{Ba}) + \ln(P_{Bo})] \quad (6)$$

Where Eq. (6) discloses the probable stats for Engle and Granger (1987) [P_{EG}], Johansen's (1991) [P_J], Banerjee et al.,(1998) [P_{Ba}], and Boswijk's (1994) [P_{Bo}].

Since the analyzed variables exhibited stationary properties, one of the requirements for calculating long-run elasticity, and also exhibited long-run connectedness, the long-run elasticity may be estimated. As a result, the current study considers the non-linear distribution of data, requiring the employment of the Method of Moment Quantile Regression (MMQR) approach. Firstly, (Koenker & Bassett, 1978) introduced the quantile regression approach for estimating the mean dependence and conditional variability to reduce nonlinearity problems. Based on this technique, (Machado & Silva, 2019) created the MMQR method for analyzing the distribution of quantile estimations (Sarkodie & Strezov, 2019). Following is the complex expression for the dependent location-scale variance $[Q_y(\tau|R)]$:

$$Y_{it} = \alpha_i + \beta R_{it} + (\gamma_i + \rho \dot{Z}_{it}) \mu_{it}, \quad (7)$$

In Equation (7), the probable expression $[p(\gamma_i + \rho \dot{Z}_{it} > 0)]$ is identical to one, whereas α , β , γ , and ρ indicate the values chosen for forecasting by this research. The subscript i denotes the fixed effect represented by the indices α_i and γ_i which is constrained to the values $i = 1, 2, \dots, n$. Therefore, the characteristic component of R , expressed by Z , is the k -vector, whereas the variation is marked by the vector " γ ."

$$Z_1 = Z_1(R), \quad \gamma = 1, 2, \dots, k, \quad (8)$$

R_{it} is autonomous and symmetrically disseminated for the total fixed i and t (time), which is itself perpendicular to both t and i (Machado & Silva, 2019). Therefore, both the outside characteristics and reserves are steady. Based on the rationale presented above, the research model, Eq. (1), can be rewritten as follows:

$$Q_y(\tau R_{it}) = (\alpha_i + \gamma_i q(\tau)) + \beta R_{it} + \rho \dot{Z}_{it} q(\tau), \quad (9)$$

In the recent research model, the set of explanatory variables, which consists of ERIQ, PRIQ, FRIQ, and HCIQ, has been augmented and is now described by R_{it} , with the natural logarithm used to articulate them as percentages. In addition, R_{it} indicates the quantile scattering of the predictor variable, as evidenced by Y_{it} and supposed to be VCQ in the current research, likewise dependent on the quantile location. Additionally, the equation $-\alpha_i(\tau) \equiv \alpha_i + \gamma_i q(\tau)$ displays the scalar component that produces the fixed impact of τ quantiles on i . Such quantiles do not affect the regression intercept either. Because of the structural independence of the variables, a multitude of outcomes is vulnerable to alteration. Where $q(\tau)$ represents the τ -th quantile sample, whose values are $Q^{0.25}$, $Q^{0.50}$, $Q^{0.75}$, and $Q^{0.90}$. Consequently, the quantile equation implemented in this investigation is as follows:

$$\min_q \sum_i \sum_t \theta_\tau (R_{it} - (\gamma_i + \rho \dot{Z}_{it}) q) \quad (10)$$

Where $\theta_\tau(A) = (\tau - 1) AI\{A \leq 0\} + TAI\{A > 0\}$ represents the testing function.

Even though the MMQR method delivers quantitative estimates at a certain scale and region, the quantile values are being shown. However, the present research

focuses exclusively on evaluating the model's robustness. This research used the non-parametric estimator for panel data, namely Bootstrap Quantile Regression (BSQR). BSQR is an interstitial method for analyzing confidence intervals and significance tests. This approach overcomes the asymptotically normal sample distribution limitation by quantizing the dataset to draw statistical conclusions (Efron & Tibshirani, 1994). In particular, the BSQR employs mathematical restrictions to analyze the real sample distribution of the evaluation technique, which offers favorable estimate processes and shows approximation evidence (Efron & Tibshirani, 1994). For the robust analysis, this study uses the highest quantile, i.e., $Q^{0.90}$, for the empirical examination.

4. Results and discussion

This study aims to determine the factors influencing venture capital in the US between 2006 and 2020. Before estimating the long-run coefficients, the present research imposes some diagnostic tests for the properties of the time series variables. Specifically, this study analyzes the descriptive statistics for each of the study variables—provided in Table 2. The computational results reveal that the time series' mean, median, and range (minimum and maximum) values are positive. The positive values indicate the progressiveness of all variables. With the enhancement in ERIQ, FRIQ, PRIQ, and HCIQ, the VCQ also improves over time. Since the maximal and minimal observation values exhibit substantial differences, this research examines the volatility of each variable under consideration via evaluation of the standard deviation (Lobato et al., 2021). From the results, this study noted that all the variables exhibit volatility because the observational values differ significantly from the mean value. Among these variables, VCQ is found to be the highly volatile variable, followed by ERIQ, PRIQ, FRIQ, and HCIQ. After the general representation of the descriptive statistics, this study also provided the normality statistics in the table under discussion. Concerning the latter, this study uses two measures, i.e., skewness and Kurtosis, where both these measures provide different statistics than their critical values. Although these measures provide valid results, this study counts the normality issue more extensively. In this sense, the current study applied the (Jarque & Bera, 1987) test for normality, which allows both the excess Kurtosis and skewness and keep their respective value as zero. The zero value reflects the null prediction of the tests, stating that the variable is normally distributed. Since the variables indicate significant

Table 2. Descriptive and normality stats.

	ERIQ	FRIQ	HCIQ	PRIQ	VCQ
Mean	37.62716	33.12253	3.708278	82.31728	66275.05
Median	38.47685	32.83984	3.717548	83.19987	45935.70
Maximum	39.75000	36.81120	3.739045	84.67405	145905.4
Minimum	31.04167	30.63411	3.636805	77.23177	23830.36
Std. Dev.	2.194270	1.474210	0.029986	2.175972	37950.90
Skewness	-1.793447	0.775833	-0.953025	-0.802598	0.784974
Kurtosis	5.850641	3.487114	2.696360	2.575816	2.285232
Jarque-Bera	52.47988	6.612371	9.313054	6.891465	7.439076
Probability	0.000000	0.036656	0.009499	0.031881	0.024245
Observations	60	60	60	60	60

Source: the authors.

probability values, the null hypothesis will be rejected for all the variables. As a result, it is concluded that ERIQ, FRIQ, PRIQ, HCIQ, and VCQ follow asymmetrical distribution, which must be dealt with the suitable long-run estimator.

After computing the descriptive statistics, this study examines the presence of the unit root in each variable by applying the ADF unit root estimator. The results are provided in Table 3 after estimation. From the results, this study observed that the variables, including ERIQ, FRIQ, HCIQ, PROQ, and VCQ, are insignificant at level—failed to reject the null proposition and concludes that all the variables hold unit root. In this regard, this research applied the ADF test on the first differenced data, which validates the stationarity of all variables based on the statistically significant estimates at 1% and 5% levels. Since this study deals with quarterly data, therefore, this study also employed the seasonal unit root test by following the traditional HEGY techniques. The results asserted that only ERIQ and HCIQ are insignificant at π_1 , which validates the non-stationarity of these variables at the quarter, while significant at π_2 , π_3 , and π_4 . Besides, the rest of the variables, i.e., FRIQ, PRIQ, and VCQ, are statistically significant at 10%, 5%, and 1% levels, rejecting the null hypothesis and concluding that the variables are stationary at quarterly, bi-annual, and annual data.

After verifying the stationarity of the variables, it is essential to analyze the long-run connection between the study variables. Since this study noted a unique integrating order, i.e., $I(1)$, which leads to the application of the combined cointegration test, in this context, the present research uses the Bayer-Hanck combined cointegration test, which simultaneously considers the cointegration tests of (Banerjee et al., 1998; Boswijk, 1994; Engle & Granger, 1987; Johansen, 1991). Despite using these tests separately, the Bayer-Hanck combined cointegration specification offers more effective estimates (Shahbaz et al., 2018). The estimated results are presented in Table 4. From the results, the study found that the empirical estimates of (Boswijk, 1994; Johansen, 1991) are statistically significant. Also, the combined test of EG-J and EG-J-Ba-Bo reveals statistically significant statistics at a 5% level. Therefore, the null hypothesis of no cointegration between the variables could be rejected, and it is concluded that ERIQ, FRIQ, PRIQ, HCIQ, and VCQ are cointegrated in the long-run.

Table 3. Unit root test.

ADF Unit Root Test			
Variable	I(0)	I(1)	Level of Integration
ERIQ	-2.487754	-7.428302***	I(1)
FRIQ	-2.932855	-2.028794**	I(1)
HCIQ	-1.932019	-4.578217***	I(1)
PRIQ	-2.348882	-3.526785**	I(1)
VCQ	-1.690239	-4.935990***	I(1)

Seasonal Unit Root Test by following the traditional HEGY method at the periodicity of four seasons.				
	π_1	π_2	π_3	π_4
ERIQ	-1.458169	19.16200**	-4.377489***	19.16154**
FRIQ	-4.636949***	7.068191*	-1.942618**	6.662143**
HCIQ	-1.932019	45.20065***	-6.195685***	40.04231***
PRIQ	-4.680280***	49.62837***	-6.278740***	55.93939***
VCQ	-3.021823*	27.49112**	-3.136355***	24.46369***

Note: π_1 = Frequency zero, π_2 = Frequency $2\pi/4$ and $6\pi/4$, π_3 = Frequency π , π_4 = All seasonal frequencies. Asterisks *, **, *** denote the significance of 10%, 5%, and 1% levels.

Source: the authors.

Table 4. Cointegration tests.

Bayer-Hanck Combined Cointegration (2013)			
Engle-Granger (EG)	Johansen (J)	Banerjee (Ba)	Boswijk (Bo)
-1.8471	294.8454***	-1.8581	289.5668***
	EG-J 55.346605**		EG-J-Ba-Bo 111.19471**

Note: Asterisks *, **, *** denote significance of 10%, 5% and 1% levels.

Source: the authors.

Table 5. Quantile regression estimates—MMQR.

Variable	Location	Scale	Quantiles			
			Q _{0.25}	Q _{0.50}	Q _{0.75}	Q _{0.90}
ERIQ	0.042*** [0.007]	0.000 [0.003]	0.042*** [0.007]	0.042*** [0.007]	0.042*** [0.009]	0.042*** [0.010]
PRIQ	0.022** [0.009]	0.005 [0.004]	0.018** [0.009]	0.021** [0.008]	0.027*** [0.010]	0.029** [0.011]
FRIQ	-0.035*** [0.009]	-0.008* [0.004]	-0.029*** [0.009]	-0.033*** [0.009]	-0.043*** [0.011]	-0.047*** [0.012]
HCIQ	5.284*** [0.648]	0.473 [0.314]	4.918*** [0.651]	5.168*** [0.648]	5.804*** [0.795]	6.002*** [0.873]
Constant	-17.057*** [1.690]	-1.823** [0.817]	-15.647*** [1.712]	-16.612*** [1.720]	-19.064*** [2.077]	-19.826*** [2.263]

Note: The dependent variable is VCQ. Asterisks *, **, *** denote significance of 10%, 5% and 1% levels.

Source: the authors.

Once the Bayer-Hanck combined cointegration test validate the long-run association between the variables, therefore, this study tends to investigate the influence of each regressor on venture capital of the US economy. Nonetheless, there are several econometric approaches, which could provide efficient results, still these specifications are limited in terms of tackling the normality issue of the variables. From the estimates of the (Jarque & Bera, 1987) normality statistics, it is observed that all the variables hold non-normal distribution. Accordingly, the present research uses the most appropriate estimation methodology, i.e., the novel MMQR approach, which offers estimation at a specific location and scale. Results concerning this approach are provided in Table 5. The results explain that economic risk (ERIQ), political risk (PRIQ), and human capital (HCIQ) positively and significantly enhances the venture capital in the US economy. At the same time, an increase in financial risk (FRI) leads to the reduction of venture capital in the US business sector. More specifically, a one percent increase in the ERIQ and PRIQ increases the VCQ by 0.042% and 0.018-0.029%, respectively. These results are statistically significant at 1% and 5% across the quantiles, where the influence magnitude increases from the lower to the upper quantile. Nonetheless, the higher level of political and economic risks substantially reduces venture capital in developing economies, which is validated in the studies of (Huang et al., 2022; Klonowski, 2022). Also, the higher level of exposure to political and economic risk adversely affects the venture capital structure (Wu et al., 2022). Yet, this study found the positive influence of both these variables on venture capital, which is possible due to the higher developmental status of the US economy, indicating that both the political and economic risks are at the lower level, due to which the venture capital is found increasing. This study's empirical findings are in line with the empirical evidence of (Bonini & Alkan, 2014). However, the present findings contradict the studies

of (Huang et al., 2022; Salehnia et al., 2019; Wang, 2019; Yang, 2022), which favors the adverse influence of these variables in the VCQ. Similarly, an increase of one percent in the FRIQ significantly reduces venture capital by 0.029-0.047% at a 1% significance level. Instabilities in the financial market, stock price movement, interest rates, currencies, etc., significantly enhance investment volatility by postponing the investors, capitalists, and industrialists due to higher risk and their future benefits. An increase in such financial risk, whether in a developed or developing economy, substantially reduces the level of capital investment and venture capital in the region. The empirical results of this study are consistent with the existing studies of (Wang, 2019; Yang, 2022). Lastly, the MMQR results reveal that human capital (HCIQ) is a significant factor of venture capital in the US economy. Human capital enables economic expansion. When human capital improves in various fields such as research, management, and education, it enhances innovation, equality, participation rate, social well-being, and productivity, all contributing to enhancing various economic, industrial, and financial activities (Dorfleitner & Grebler, 2022; Hmaitane et al., 2019). As a result, venture capital also tends to increase as investors and capitalists are found investments more attractive due to stable and higher financial returns. Such positive association is also evident in the earlier studies in consistency with the present study, such as (Adomako et al., 2022; Canavati et al., 2021; Sevilir, 2010). All the results are highly statistically significant, which could also be validated by the significant estimates of each variable's location and scale specifications. Besides, the coefficient values at specific quantiles for each variable are also depicted in the graphical form in Figure 1 (Table 5).

After obtaining the empirics via the MMQR approach, this stud tested the model's robustness. In this sense, the present research considers the non-parametric approach

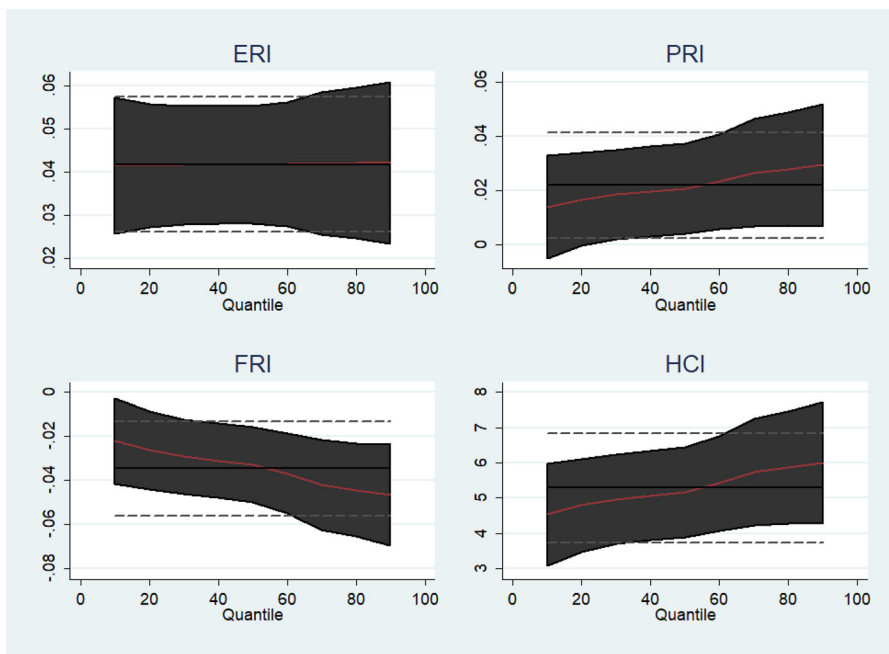


Figure 1. MMQR graphical representation of coefficients.

Source: the authors.

Table 6. Robustness test – BSQR ($Q_{0,90}$).

Variable	Coeff.	Std. Err	T	P> t	95% Conf. Interval	
ERIQ	0.044***	0.004	10.11	0.000	0.034925	0.052184
PRIQ	0.019***	0.005	3.54	0.001	0.008255	0.029862
FRIQ	-0.038***	0.006	-6.43	0.000	-0.04968	-0.02606
HCIQ	6.745***	0.425	15.87	0.000	5.892735	7.596328
Constant	-22.087***	1.113	-19.84	0.000	-24.3177	-19.8553

Note: The dependent variable is VCQ. Asterisks *, **, *** denote significance of 10%, 5% and 1% levels.

Source: the authors.

to tackle the asymmetry issue of the data. Specifically, the BSQR approach is employed at the highest (0,90) quantile, and the estimated results are displayed in Table 6. The estimated results asserted that both the ERIQ and PRIQ are positively associated with venture capital in the US. On the other hand, the FRIQ is adversely affecting venture capital in the US economy. Besides, the estimated results revealed that HCIQ is an important factor of venture capital in the region. All these results are highly statistically significant at a one percent level and consistent with the empirical estimates of the MMQR. Although the magnitude values vary more than that of the MMQR results, the influence of each variable remains the same, which validates the finding of the previous estimator.

5. Conclusion and policy implications

There is uncertainty in several sectors of the country concerning developed and developing nations. Among others, economic, political, and financial risks are the key indicators of economic and financial progress. In this sense, the present research investigates the influence of these risks on venture capital in the US economy. Also, this study considers the role of human capital throughout the period from 2006Q1 to 2020Q4. Using various time series approaches, this study validates the stationarity of all the variables. Also, the cointegration association between the variables is found valid, which allows the present study to examine the influence of each explanatory variable on venture capital. Since the (Jarque & Bera, 1987) normality test validates the asymmetrical data distribution, this research employed the novel MMQR technique, which is more powerful than the linear regression approaches and provides estimates at a specific scale and location for each quantile. The estimated results asserted that economic and political risks positively affect US venture capital. The primary reason behind this positive impact is that the US has already achieved a higher developmental stage, which has already tackled the issues of economic risk and political risk. Therefore, the impact of these variables favors the increase of venture capital. On the other hand, financial risk adversely affects the venture capital throughout the selected period. Since venture capital requires a suitable financial system, higher financial risk disturbs the flow of income circulation and investment, adversely affecting the venture capital. On the contrary, human capital positively affects venture capital, as a higher level of HCI indicates a higher level of education, skills, and knowledge, which leads to better utilization of finances and hence improves the level of venture capital.

Based on the empirical estimates, this study suggests policies that could help the US economy to enhance venture capital. Specifically, this study suggests a further reduction of economic, political, and financial risk, which could help investors and industrialists enhance investment. It is well known that the higher uncertainty level could adversely affect the investment and leads to reduction, temporary and sometimes permanent postponement of investment due to uncertain future outcomes. Therefore, stabilizing such risks will help the US economy increase the investment and venture capital level. Among these three risks, the US economy is suggested to pay appropriate attention to minimizing financial risk, which is the key factor of venture capital. In addition, this study suggests an increase in investment in the human capital, which could enhance the education level, knowledge, and skill level. It encourages the general public and industrialists to invest and efficiently promote venture capital in the country.

Although this study is a substantial contribution to the existing literature, the present research is still limited in a few directions recommended to future researchers and scholars. Specifically, this study only focuses on the empirical examination of the US, which can be extended for other time series and panel estimations, including both emerging and developed economies. Further, this study is limited in terms of analyzing other economic and financial instruments, such as economic growth, financial development, and financial inclusion, among others. Therefore, future researchers are directed to explore the influence of these variables on venture capital. Moreover, the time period of the study can also be increased by scholars in the future for the comprehensive analysis of the problem.

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