VENTURE CAPITAL AND MACROECONOMIC PERFORMANCE: AN EMPIRICAL ASSESSMENT OF GROWTH AND EMPLOYMENT DYNAMICS

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Abstract
This study investigates the influence of venture capital investments and their proportion relative to gross domestic product on two key macroeconomic variables: gross domestic product growth rate and unemployment rate. By analyzing data from 13 countries over the period 2014 to 2021, the research seeks to clarify the impact of venture capital metrics using a range of statistical techniques, including descriptive statistics, correlation and covariance assessments, panel ordinary least squares, and panel generalized method of moments. The results from the panel ordinary least squares regression indicate that both dependent variables, gross domestic product growth rate and unemployment rate, exhibit limited explanatory power concerning the impact of venture capital metrics. Even after controlling for heteroskedasticity and autocorrelation, and incorporating dynamic specifications and endogeneity adjustments, the results remain largely unchanged. The empirical findings further indicate that gross domestic product growth rates are non-stationary, while unemployment rates are stationary, underscoring the greater importance of structural and policy-driven factors in shaping economic performance. The only notable result from this analysis is the significant persistence of gross domestic product growth rates through their own lagged values, which emphasizes the primacy of historical economic trends over external capital inflows. Overall, the results reveal that venture capital metrics do not have a statistically significant or economically meaningful effect on either gross domestic product growth rate or unemployment rate. These findings challenge the commonly held assumption that venture capital metrics directly influence or enhance key macroeconomic indicators. Consequently, policymakers should view venture capital investments as secondary rather than primary drivers of economic growth and employment, and should instead prioritize comprehensive strategies focused on education, labor market reforms, and institutional development to achieve sustained macroeconomic progress.
Keywords: Venture Capital, Artificial Intelligence, Research and Development, Economic Growth, Employment

INTRODUCTION

Venture capital is a mode of financing available to start-ups and other research and development-centric businesses in their early stage of life cycle (Bygrave & Timmons, 1992; Lerner, 2009). Venture capital can also help run existing businesses by removing the inefficiencies from their operations, adapting to ever-changing technological developments, and responding to emerging ecological trends, enabling them to be more responsive and adaptable to changes in the environment (Davila et al., 2003; Kerr et al., 2014). Venture capital firms provide backing to the firms through the induction of equity and involvement in the management of the businesses (Megginson & Weiss, 1991; Gorman & Sahlman, 1989). Due to this, these vehicles are, by default, helpful to promote innovation and research and development in sectors such as healthcare, energy and technology, especially in their initial phase where the risk is high enough for conventional financial institutions to back away from providing financing due to uncertainty and long gestation periods (Timmons & Spinelli, 2004; Ali & Afzal, 2019; Adjasi & Yu, 2021). Venture capital firms invest in such start-ups with the expectation of high returns by providing funding against equity and a participatory role in business management, thereby aligning their interests with the entrepreneurs (Kaplan & Stromberg, 2001; Gompers & Lerner, 2004). Venture capitals have substantial impact on economic development, particularly in developed countries such as United States and European Union by fueling the rise of tech-based firms, creating ripple effects thereby stimulating gross domestic product growth, innovation and employment (Jeng & Wells, 2000; Bottazzi & Da Rin, 2002; Samila & Sorenson, 2011). However, the impact of venture capital may be influenced and magnified through social networks, disparities in geographies, persistence of sectoral outcomes, and supportive policies (Hochberg et al., 2007; Chen et al., 2010; Dahmani & Makram, 2024).

Venture capitals are often used for funding innovation-led projects in developed economies in sectors where innovation is essential and the potential for exponential growth exists (Kortum & Lerner, 2000). These include healthcare, clean energy, artificial intelligence, deep tech, and robotics (Lerner & Nanda, 2020). However, these institutions are not common in underdeveloped economies due to a lack of research and development activities, underdeveloped financial systems, inadequate intellectual property protections, political and regulatory instability, and insufficient human capital (Bruton et al., 2005; Ahlstrom & Bruton, 2006; Avnimelech & Teubal, 2006). Venture capitals also contribute significantly to labor market dynamics. High-growth startups supported by venture capital funding often become hubs of employment, directly hiring skilled professionals and indirectly stimulating demand across supply chains and supporting services (Mason & Harrison, 2002). Florida & Kenney (1988) observed that areas with dense venture capital activity experience increased job creation and innovation-led regional development. The multiplier effect of venture capital

investments extends to ancillary industries, fostering overall economic vibrancy (Inderst & Mueller, 2004; Zook, 2005). The role of venture capital extends way beyond stimulating funding. These firms also contribute towards managerial expertise, strategic guidance, and networking to the entrepreneurs (Sapienza et al., 1996; Sorenson & Stuart, 2001). As a result, value addition is made by venture capitalists in the form of improved corporate governance, structured decision-making, and fast scalability (Hellmann & Puri, 2002; Baum & Silverman, 2004).

Several macroeconomic indicators impact the success rate of venture capital ecosystems. These include education quality, infrastructure supporting research and development, policies supporting innovation, tax reforms, and legislation, along with the overall business environment (Lerner, 2009; Ali & Rehman, 2015; Khan, 2018; Karhan, 2019; Labeeque & Sanaullah, 2019; Konnov, 2020; Adjusi & Yu, 2021; Das, 2022; Ali & Mohsin, 2023; Xiong, 2024; Audi, 2024). Countries that actively focus on these pre-conditions are in a better position to attract venture capital investments (Guler & Guillén, 2010; Ali, 2015; Kaplan & Lerner, 2016; Ali & Sajid, 2020; Fatima & Zaman, 2020; Abigail, 2023; Radas, 2023; Turan & Can, 2024). Several developing economies, such as India and Israel, are taking steps to provide favorable conditions to attract venture capital investments by improving legal infrastructure, introducing tax incentives, supporting incubators and accelerators, and promoting public-private partnerships (Wilson, 2011; Ahmad, 2018; Roy & Modheswaran, 2020; Muhammad, 2023).

In recent years, scholars and practitioners have highlighted the importance of expanding venture capital's role beyond economic growth to include sustainability and resilience. Venture capital can serve as a key enabler of sustainable development by channeling funds into environmentally and socially responsible businesses (Cumming et al., 2016; Farahmand, 2019; Cohen et al., 2019; Avelino & Cornoel, 2021; Chen, 2022; Sadashiv, 2023). Sectors such as clean technology, sustainable agriculture, green transportation, and renewable energy represent fertile ground for venture capital-backed innovation (Bocken et al., 2014; Safdar & Malik, 2020; Ang, 2022). By aligning investment decisions with Environmental, Social, and Governance principles, venture capital can generate financial returns while addressing global sustainability challenges (Weber & Kratzer, 2013; Kilyachkov & Chaldaeva, 2021; Pacillo, 2022). The globalization of venture capital is also a hot area of focus. Although historically concentrated in North America and Western Europe, venture capital activity is expanding into Asia, Latin America, and parts of Africa (Wright et al., 2005; Bruton et al., 2009). This global spread is facilitated by digital platforms, cross-border investment mechanisms, and a growing pool of globally minded entrepreneurs (Aernoudt, 2005; Safar & Malik, 2020; Ackah, 2023; Dhamani & Makram, 2024). However, local adaptation remains crucial, as regional differences in legal systems, cultural norms, and economic structures affect how venture capitalists operate and assess risk (Lockett et al., 2002). Empirical studies have also been conducted to understand the existing and expected trends in venture capital investments and the concentration of the venture capital industry in developed and developing countries and regions all across the world. Such synthesis integrates findings from cross-country analysis, firm-level research, and regional studies to show the systemic role of venture capital in modern economic and sustainability. Thus, the main focus of the researcher was to assess the impact of the venture capital industry on the economic development of a country by assessing the relationship between macroeconomic factors with the number of venture capital firms operating across multiple years in developed and developing economies.

LITERATURE REVIEW

Numerous studies in empirical and theoretical literature examine the role of venture capital in fostering innovation, economic growth, job creation, and overall economic prosperity across developed and developing economies around the world. Berlin (1998) explored the non-financial contribution of venture capital that includes governance, mentorship, and network building. Based on this, the study showed that venture capital played an extremely important role in shaping the strategic direction of startups and helping them to enter into new markets, pivot business models, and attract follow-on investments ethically. In another research, Jeong et al. (2020) examined how venture capital investments influence startups by analyzing performance and sustainable growth. This research focused on factors such as absorptive capacity, involving a firm's ability to assimilate, acquire, and apply external knowledge, as well as venture capital reputation, with the prestige and track record of venture capitalists. von Rosen (2021) analyzed, in detail, the macroeconomic effects of venture capital investments. Furthermore, the study compares, in detail, venture capital penetration in developed vs. emerging countries around the world. The research showed a strong correlation between venture capital activity and gross domestic product growth. However, the author argued that venture capital simulates innovation ecosystems through high-reward ventures and funding of high-risk entities traditionally avoided by conventional banks.

Adleberger (1999) explored German startups between 1990 and 2000. The results of the study showed that the gain in employment growth was 25% faster than non-venture capital peers. The author also noted that venture capital is outperforming angel investors in scaling firms, thus providing significant benefits to venture capital-backed firms. Ferrary & Granovetter (2009) surveyed some Silicon Valley startups. The results of their empirical study showed that 50% of venture capital-funded firms are involved in pursuing disruptive innovator strategies as compared with 20% non-venture capital firms. Furthermore, the involvement of venture capital has improved managerial practices and also enhanced survival rates by 30%. Bertoni et al. (2010) conducted a detailed study of 351 Italian Startups between 1993 and 2003. The results of their study showed that no patent advantage was gained by these startups over non-venture capital peers, suggesting regional ecosystem disparities. Sargon (2018) examined manufacturing firms operating in the United States of America from 1965 to 1992 and found that venture capital-backed firms are producing 3 times more patents per USD

of research and development activities when compared with non-venture capital peers. The authors noted that the commercialization speed of these research and development activities is also high because venture capital minimized time to market for innovation by 40%. Romain & Van Pottelsberghe (2004) performed a detailed analysis of panel data gained from 16 OECD member countries between 1990 and 2021 to compare social returns of venture capital with other businesses and public sector research and development projects. The results of this study indicated higher research and development, absorptive capacity, and job creation of venture capital in comparison with other businesses and public sector research and development projects. Parhankangas (2012) has analyzed the role of venture capital in economic growth and development. The author conducted an empirical study to assess the impact of macroeconomic conditions, changes in technology, and entrepreneurial culture on the demand and supply of venture capital investments by analyzing the data for the years 1999 and 2000 from multiple economies. The author has noted that venture capital investments show a cyclical trend and are also influenced by interest rates.

Warren (2012) reviewed macroeconomic trends in venture capital investments post the Great Recession. The study also included a detailed discussion of the fluctuations in venture capital funding levels, industry focus, and geographic distribution. Moreover, the study also highlighted recovery in venture capital investments post-recession, with key regions like Silicon Valley dominating the industry. Another study presented by Kolamakov et al. (2015) examined the influence of venture capital investments on innovation and economic growth in Russia and the United States of America. Based on the comparative analysis, it was observed that the role of venture capital was significant in stimulating research and development activities, enhancing productivity, and fostering technological innovation in both countries. However, the effectiveness level of venture capital was not the same because of high differences in market maturity, institutional frameworks, and innovation ecosystems. The results showed that the United States of America gained benefits from a mature venture capital market. The study also showed that the emerging venture capital sector in Russia was gradually contributing to economic modernization and innovation capacity building. Kato & Chiloane-Tsoka (2024) showed how venture capital investments can transform early-stage firms in emerging economies. Their research involved performing a comparative study of Kenya and South Africa. The results showed that venture capital funding not only provides critical financial resources but also some strategic guidance, managerial expertise, and market access.

Da Rin et al. (2013) performed a detailed examination of how Venture Capital/Private Equity has influenced different economic indicators such as productivity, employment, innovation, and industrial diversification. From empirical analysis, they have observed that Venture Capital/Private Equity backed firms are contributing more to job creation, particularly in high-skill sectors like biotech and Information Technology. Breuer & Pinkwart (2018) provided a comprehensive review based on the role of venture capital in financing high-growth startups. The results showed that venture capital-backed firms are highly responsible for breakthrough innovation linked with the biotechnology and technology sectors. Sergi & Popkova (2022) presented the role of venture capital in OECD countries. The results of their study showed that traditional venture capital focuses on private commercial interests in industry by sometimes ignoring broader societal benefits. Also, the article advocates for a wider role of venture capital in which investors are collaborating with Corporate Social Responsibility goals by aiming to deliver high societal advantages like digital competitiveness and innovation, and gain high profit rates.

Gornall & Strebulaev (2021) conducted a detailed study about public companies operating in the United States of America between 1970 and 2020 to assess the impact of venture capital investments on these companies. The results of their study showed that venture capital-backed firms gained huge dominance in the market, as these comprised 41% of market capitalization and contributed 62% of research and development spending. Poelhekke & Wache (2023) analyzed venture capital investment flows across different companies operating in the United States of America from 1986 to 2019 in major venture capital hubs like Boston, New York, and Silicon Valley for the resulting implications on the job creation and employment rates. The authors noted that doubling venture capital investments in a country can increase employment rates and payroll wages by 8.3% and 9.8% respectively. The authors also noted that venture capital investment of USD 1 million may create approximately 41 jobs. Baker (2024) has explored how venture capitals fuel global economic growth by gross domestic product expansion, innovation, and entrepreneurship. By analyzing all theoretical frameworks and empirical data, the paper highlights the transformative impact of venture capital by including productivity gains, job creation, and technological advancements.

Tricot (2021), in his study, has analyzed venture capital investment trends in Artificial Intelligence companies from 2012 to 2022, highlighting the growth and concentration of investments in the United States of America and China. The research uses data from private companies and shows a significant increase in venture capital funding directed towards Artificial Intelligence-based startups globally. The study also shows the strategic importance of Artificial Intelligence and the role of venture capital in accelerating innovation and commercialization. According to the research presented by Arnold et al. (2024), venture capital investments in the European Union (averaging at 0.2% of gross domestic product) are significantly lower than venture capital investments in United States of America (averaging at 0.7% of gross domestic product) and are thus restricting growth and innovation. Fernandes & Leonard (2024), in their research, showed that global venture capital funding surged by 24% on a quarter-over-quarter basis in Quarter 4 2024. Due to this, its value reached USD 120 billion, comprising more than 4,000 deals. Generative AI was considered the main driver with high investments in infrastructure, AI models, and development tools, dominating venture capital deal activities. Most of empirical studies have been conducted to understand the positive effects of venture capital on innovation, job creation,

and economic growth. The bulk of evidence from these studies shows that venture capitals spur innovation, encourages productivity gains, and promotes high-growth entrepreneurship. However, the effects on broad macroeconomic development (like GDP or employment) are more mixed and contingent on other institutional and market conditions. Further, the long-term socioeconomic implications of venture capital beyond startup success metrics remain unexplored. Most studies are concentrated in developed economies, leaving a gap in how venture capitals operate in underdeveloped regions with rudimentary financial systems. Some studies have focused on specific sectors, such as AI or biotech; however, cross-sector analyses and their varying impacts are lacking. The impact of culture, institutions, and policy on the effectiveness of venture capital across different countries also warrants a deeper investigation. Furthermore, there is also a lack of longitudinal studies evaluating the sociological extent of sustaining capitalism features of venture capital growth, particularly in the context of societal benefit versus private gain.

THEORETICAL MODEL

The theoretical model has been developed to examine the relationship between the venture capital metrics and key macroeconomic indicators, i.e., economic growth and labor market dynamics (Kortum & Lerner, 2000; Samila & Sorenson, 2011; Sajid & Ali, 2018; Yan & Chen, 2019; Kumar & Kumar, 2020; Zhang, 2020; Audi et al., 2022; Umoh & Effiong, 2024; Mbodj & Laye, 2025). Economic growth is proxied by the annual gross domestic product growth rate, while labor market performance is represented by the unemployment rate. These dependent variables are influenced by the scale and intensity of venture capital investments in the economy. The model uses a multivariate linear regression framework to empirically assess the impact of these venture capital metrics on economic performance over time. Endogenous growth theory focuses on the impacts of technological advances, human capital, and the spillovers associated with knowledge on the economy's growth in the long run (Romer, 1990). This is due to venture capital's critical role in financing productivity, innovation, and entrepreneurship, which drives economic growth (Kortum & Lerner, 2000; Shahid & Ali, 2015). Furthermore, Schumpeter's (1942) creative destruction theory describes the phenomenon of outdated firms and practices being replaced by more productive innovations as a result of entrepreneurial activity. Venture capital investments facilitate this process, resulting in the creation of new jobs and improving labour productivity. Based on the same, a positive relationship between venture capital metrics and gross domestic product growth rates is expected, while a negative trend is anticipated for unemployment rates.

MODEL SPECIFICATION

A multivariate linear regression framework for each of the dependent variables is proposed as follows:

Equation 1: GDP growth model

$$GDPG_t = \alpha_1 + \beta_1 VCI_t + \beta_2 (VCI\_GDP)_t + \gamma_1 X_t + \varepsilon_{1t}$$

Equation 2: Unemployment model

$$UNEMP_t = \alpha_2 + \beta_3 VCI_t + \beta_4 (VCI\_GDP)_t + \gamma_2 X_t + \varepsilon_{2t}$$

Where:

X_t represents a vector of relevant control variables (i.e., inflation, education levels, research and development expenditures, interest rates). α_i are constant terms; β_i are coefficients of interest. ε_{it} are stochastic error terms.

DEPENDENT VARIABLES

Gross Domestic Product Growth Rate (GDPG): The annual percentage change in gross domestic product in an economy, indicating overall economic performance, expressed in terms of percentage.

Unemployment Rate (UNEMP): The proportion of the labor force that is unemployed and actively seeking employment, expressed in terms of percentage.

INDEPENDENT VARIABLES

Venture Capital Investments (VCI): The total value of venture capital investments, measured as absolute value in USD, rounded off to the nearest million.

Venture Capital Investments to Gross Domestic Product ratio (VCI_GDP): The proportion of venture capital investments to gross domestic product, expressed as a percentage, to capture investment intensity adjusted for the size of the economy, expressed in terms of percentage.

SAMPLING

We have selected a sample of data related to 13 countries for assessment and analysis over a period of 8 years from 2014 to 2021 i.e. pre and post COVID era (Australia, Canada, China, France, Germany, India, Israel, Japan, Korea, Republic, Saudi Arabia, United Arab Emirates, United Kingdom, United States). The countries have been selected based on their respective share in the global venture capital market as well as the availability of data. We have also ensured that all the major regions of the world have been covered while selecting the countries for further analysis and hypothesis testing. We have not selected any country from underdeveloped economies as the presence of venture capital industries in these countries is negligible enough to enable us to conclude (Data sources: OECD, Bain & Company, MAGNiTT, Department of Industry, Science and Resources, World Bank Group).

RESULTS AND DISCUSSION

Table 1 displays the descriptive statistics of the variables, the average, the standard deviation, and other key attributes. This analysis provides key statistical insights about the variables, i.e., gross domestic product growth rate, venture capital investments, unemployment rate, and venture capital investments to gross domestic product ratio. Based on the results of

the normality tests, the dependent variables, i.e., gross domestic product growth rate and unemployment rate, are relatively stable.

Table 1: Descriptive Statistics

	GDPG	UNEMP	VCI	VCI_GDP
Mean	0.022224	0.051897	14740.29	0.003295
Median	0.022872	0.048465	2207.12	0.000948
Maximum	0.082563	0.103540	260008.40	0.047556
Minimum	-0.102969	0.016400	20.00	0.000026
Std. Dev.	0.031520	0.019635	35418.98	0.006337
Skewness	-1.017870	0.621418	4.28	4.238231
Kurtosis	5.637326	2.965629	25.49	25.997360
Jarque-Bera	48.098820	6.698564	2509.07	2603.160000
Probablity	0.000000	0.035110	0.00	0.000000
Sum	2.311340	5.397300	1532990.00	0.342712
Sum Sq. Dev.	0.102328	0.039711	1.29E+11	0.004136
Observations	104	104	104	104

Table 2 displays covariance and correlation metrics highlighting relationships between all the variables, i.e., gross domestic product growth rate, venture capital investments, unemployment rate, and venture capital investments to gross domestic product ratio. From the analyses, it has been noted that there is no strong linear relationship present between unemployment rates, gross domestic product growth rate, and the independent variables. Such a weak correlation shows that these variables may be observed more independently in the data. However, there is a moderate link present between the venture capital investments to gross domestic product ratio and venture capital investments, confirming that larger investments will have a corresponding impact on the gross domestic product.

Table 2: Covariance and Correlation Metrics

Variables			
	GDPG	UNEMP	VCI
UNEMP	-1.58E-05		
VCI	-50.01089	28.99118	
VCI_GDP	-5.19E-06	0.00000572	63.72014

Correlation	GDPG	UNEMP	VCI
UNEMP	-0.025822		
VCI	-0.045232	0.042091	
VCI_GDP	-0.026230	0.046387	0.286642

Tables 3 and 4 display the results of the panel ordinary least squares regression test performed to examine the impact of independent variables, i.e., venture capital investments and venture capital investments to gross domestic product ratio, on dependent variables, i.e., gross domestic product growth rate and unemployment rates, by using balanced panel data. (13 cross-sections over 8 years with 104 observations).

Table 3: Panel OLS
Dependent Variable: GDPG

	Coefficient	Std. Error	t-Statistic	Prob.
VCI	-3.66E-08	9.23E-08	-0.396057	0.692900
VCI_GDP	-0.071882	0.516004	-0.139306	0.889500
C	0.023000	0.003624	6.345835	0.000000

Venture capital investments show a negligible coefficient with -3.66E-08 with a high p-value of 0.6929. Hence, it shows no statistically significant effect on gross domestic product growth rate. The venture capital investments to gross domestic product ratio also shows an insignificant coefficient with -0.0719 and a p-value of 0.8895, suggesting the ratio of venture capital investments to gross domestic product does not have a meaningful influence on the gross domestic product growth rate. From the results of the aforementioned test, we have not been able to establish a significant link between the independent variables and gross domestic product growth rate. Further, a poor fit model and autocorrelation suggest alternative specifications such as analysis of fixed or random effects, lagged variables, and nonlinear relationships by including threshold effects or adding other macroeconomic factors that better explain gross domestic product growth rate. The results are also partially in line with the empirical study conducted by Popov and Roosenboom (2013), through analyzed a large panel dataset across European countries to investigate the impact of venture capital on economic growth. The results of the empirical study performed by the above-stated authors found no strong or consistent evidence that venture capital investments significantly impact gross domestic product growth in the short term, aligning with our

findings. However, the study has also identified some long-term positive associations in innovation-driven sectors, suggesting that venture capital may influence economic growth through indirect mechanisms not captured in simple linear models.

Table 4: Panel OLS

Dependent Variable: Unemployment Rate

Variables	Coefficient	Std. Error	t-Statistic	Prob.
VCI	1.74E-08	5.75E-08	0.302517	0.762900
VCI_GDP	0.115863	0.321318	0.360587	0.719200
C	0.051259	0.002257	22.71137	0.000000

Venture capital investments show a negligible coefficient with 1.74E-08 with a high p-value of 0.7629. Hence, it shows no statistically significant effect on the unemployment rate. The venture capital investments to gross domestic product ratio also shows an insignificant coefficient with 0.1157 and a p-value of 0.7192, suggesting the ratio of venture capital investments to gross domestic product does not have a meaningful influence on the gross domestic product growth rate. The constant term, that is 0.0513, its value is highly significant with p p-value less than 0.001, implying that the baseline unemployment rate is approximately 5.13%.

For the unemployment rate, both the independent variables have failed to establish a significant link, as evident from the dataset. Our analysis is also supported by an empirical study performed by Cumming and MacIntosh (2006) who, based on the results from panel ordinary least square models, noted that while venture capital influences firm-level growth, its effects on macroeconomic indicators such as unemployment are often not significant, underscoring the importance of exploring alternative panel data methods for more robust inference.

As a result, there is a need to implement alternative analyses, such as fixed and random effects and the dynamic panel model, to better capture the unemployment rate dynamics. In other words, it may be important for policymakers not to solely depend on venture capital metrics to simulate the unemployment rate without further evidence.

Tables 5 and 6 display the analysis of panel generalized methods of moments. These examine the dynamic relationship present between dependent variables, i.e., gross domestic product growth rate and unemployment rate, with venture capital metrics such as venture capital investments and venture capital investments to gross domestic product ratio by using first-difference transformation and instrumental variables to resolve unobserved heterogeneity and endogeneity.

Table 5: Panel GMM

Dependent Variable: GDPG

Variables	Coefficient	Std. Error	t-Statistic	Prob.
GDPG(-1)	0.510248	0.044144	11.55861	0.0000
VCI	-3.97E-07	4.44E-07	-0.894937	0.3884
VCI_GDP	-2.806813	1.376300	-2.039391	0.0641
Effects Specification				
Cross-section fixed (first differences)				
Mean dependent var	-0.011115	S.D. dependent var		0.027288
S.E. of regression	0.027719	Sum squared resid		0.057626
J-statistic	8.244802	Instrument rank		13
Prob (J-statistic)	0.604939			

Lagged gross domestic product growth rate coefficient of 0.510 and p value less than 0.001 show highly significant results, indicating strong autocorrelation present in gross domestic product growth rate. In other words, if 1% increment is applied independent variables in the prior year, the gross domestic product growth rate will increase by 0.51% approximately, showing a persistent economic momentum. Venture capital investments have shown an insignificant and negligible coefficient with a value of -3.97E-07 and p-value of 0.388, which suggests that there is no short-term impact on the variable on gross domestic product growth rate. Furthermore, the venture capital investments to gross domestic product ratio has also shown a marginally significant coefficient with a negative effect of -2.807 and a p-value of 0.064, indicating that higher venture capital investments to gross domestic product ratio may minimize gross domestic product growth rate. The results have shown that the gross domestic product growth rate is highly persistent and focuses on the role of historical trends. Moreover, venture capital metrics are not showing positive short-term impacts, with the venture capital investments to gross domestic product ratio potentially connected with growth declines. This contradicts conventional wisdom and is suggestive of the fact that time lags may have significant impacts on the results, with the possibility of manifesting over longer horizons.

Samila & Sorenson (2011) employed panel data with dynamic specifications, including lag structures, to examine the causal relationship between venture capital, entrepreneurship, and economic growth. Their findings contrast somewhat with our results, showing that venture capital does have a statistically significant and positive long-term impact on economic growth, but only when accounting for indirect effects such as increased entrepreneurial activity and innovation. Unlike the paragraph's findings, which suggest negative or negligible short-term effects, Samila & Sorenson (2011) have

emphasized the importance of time lags and structural conditions, supporting the conclusion that short-term interpretations of venture capital's impact can be misleading and that dynamic, long-term modeling is necessary.

Table 6: Panel GMM

Dependent Variable: Unemployment Rate

Variables	Coefficient	Std. Error	t-Statistic	Prob.
UNEMP(-1)	0.077296	0.102568	0.753612	0.4656
VCI	-4.08E-10	3.62E-08	-0.011284	0.9912
VCI_GDP	0.200621	0.404281	0.496240	0.6287
Effects Specification				
Cross-section fixed (first differences)				
Mean dependent var	-0.000554	S.D. dependent var		0.009879
S.E. of regression	0.010386	Sum squared resid		0.008090
J-statistic	12.45859	Instrument rank		13
Prob (J-statistic)	0.255536			

Lagged unemployment rate coefficient of 0.077 and p value less than 0.466 show statistically significant results, suggesting that unemployment lacks strong persistence in this specification. Hence, it contracts properly with typical labor market hysteresis patterns. Venture capital investments have shown an insignificant and negligible coefficient with a value of -4.08E-10 and a p-value of 0.991, implying no measurable impact on the unemployment rate. Though the venture capital investments to gross domestic product ratio has shown a positive coefficient with 0.201 and p p-value of 0.629, this is highly insignificant to provide evidence supporting any measurable impact on the unemployment rate. The results show no statistically significant relationship between independent variables, i.e., venture capital investments and venture capital investments to gross domestic product ratio and unemployment rate. The lack of unemployment persistence may show specification limitations with a short time horizon, labor market flexibility in the sample countries, and some measurement issues are also linked with unemployment rate data. Bonini and Alkan (2012) examined global venture capital flows and their macroeconomic effects, including labor market outcomes. Their analysis revealed that while venture capital can support job creation in certain sectors, there is no robust, statistically significant link between aggregate venture capital activity and national unemployment rates, especially in the short term. These findings align with the paragraph's results, which also show no measurable effect of venture capital metrics on unemployment. The study further supports the idea that structural and institutional variables play a larger role in labor market outcomes than venture capital alone, consistent with the paragraph's emphasis on measurement issues and specification limitations.

CONCLUSION

This study examined the effects of changes in venture capital measurements, specifically, venture capital investments and the ratio of venture capital investments to gross domestic product, on key macroeconomic indicators, including gross domestic product growth rates and unemployment rates, for 13 countries over the period from 2014 to 2021. Utilizing a combination of econometric tests, the analysis revealed that changes in both venture capital investments and the venture capital investment to gross domestic product ratio exert limited macroeconomic effects on the dependent variables. The results did not demonstrate any statistically significant impact in the models evaluated. Notably, the negative coefficient values for the venture capital investment to gross domestic product ratio in the generalized method of moments estimation suggested a potential risk of resource misallocation; however, this result lacked robustness. Concerning unemployment, the independent variables remained insignificant across all model specifications, contradicting assertions that venture capital investments directly contribute to reductions in unemployment rates. The findings for the unemployment models further indicated an uncertain serial relationship, thus undermining the core assumptions of ordinary least squares methodology. For gross domestic product growth, the data revealed non-stationarity, necessitating the use of differencing techniques for unemployment rates and confirming the validity of level analysis for the latter. The analysis also identified a divergence between dynamic and static effects, as evidenced by the persistence of gross domestic product growth in dynamic models. The generalized method of moments results indicated strong autocorrelation, underscoring the importance of historical trends among independent variables. Meanwhile, the unemployment rate displayed weak persistence and lacked lagged dependence, suggesting that shocks to unemployment are generally short-lived. Overall, the findings demonstrate that the developmental effects of venture capital investments on macroeconomic performance are neither immediate nor automatic. This underscores the necessity for holistic development strategies that integrate venture capital investments with labor market policies, fiscal stability, and regulatory quality. It is also essential to evaluate the implications for other econometric indicators to avoid overreliance on simplistic narratives regarding the transformative capacity of venture capital.

Policymakers are therefore advised to develop integrated policy frameworks that align venture capital incentives with national economic objectives, such as innovation-led productivity and inclusive employment. Such frameworks could include targeted tax incentives for venture-backed enterprises in high-impact sectors, coupled with regulatory mechanisms that encourage prudent capital deployment. Additionally, the establishment of regional innovation hubs and public-private

co-investment platforms may mitigate risks of resource misallocation by channeling venture capital toward economically and socially strategic activities.

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