The Effect of Monetary Policy on US Venture Capital Investment

ECON 101: Economic Policy Seminar

Business Sector

Ali Taoube, Ava Bochner, Lance Allan, Senan Khawaja

Executive Summary

The relationship between monetary policy and venture capital (VC) investment has profound implications for economic growth, particularly in the context of early-stage startups. This policy brief explores the dynamic interplay between interest rates, macroeconomic factors, and government policy on venture capital investments in the U.S. economy. The analysis utilizes data from 1980 to 2023, examining how different monetary policies influence VC funding especially during critical economic periods such as the COVID-19 pandemic.

Our study finds that low interest rates foster a conducive environment for VC investments by reducing the cost of borrowing and encouraging investors to diversify their portfolios into venture capital. This environment facilitates significant capital raising by VC firms, which in turn supports new businesses and job creation, contributing to overall economic growth. On the other hand, an extended period of zero-interest rates, like the one experienced during the early 2020s, can lead to unsustainable investments practices, resulting in overvaluations and subsequent market corrections that may harm the VC ecosystem and broader economic stability. Our analysis reveals that low interest rates are beneficial for venture capital, while zero-interest rate environments pose risks. Based on these insights, we recommend that the Federal Reserve avoid zero-interest rate policies, and instead maintain low but positive interest rates to strike a balance between encouraging venture capital investments and financial stability.

Introduction

2020 to 2022 was a time of extreme flooding for the start-up ecosystem, as showcased in the graph below, the amount of investment entering start-ups more than doubled from 2019 to 2021 going from 73 billion to well over 150 billion by 2021 and nearly 175 billion by 2022. This

was brought about by the zero-interest rate environment as well as quantitative easing policy rate measures implemented by the federal reserve. Due to this many companies were given funding with less scrutiny than previous industry standard, in light of this a significant amount of the investments made from 2020-22 under performed leading to venture capital firms struggling to invest in 2023 and now in 2024, and a much greater degree of scrutiny. Considering this investment in 2023 fell to its lowest level since 2015.

VC Capital Raised and 10 Year Treasury Yield Over Time
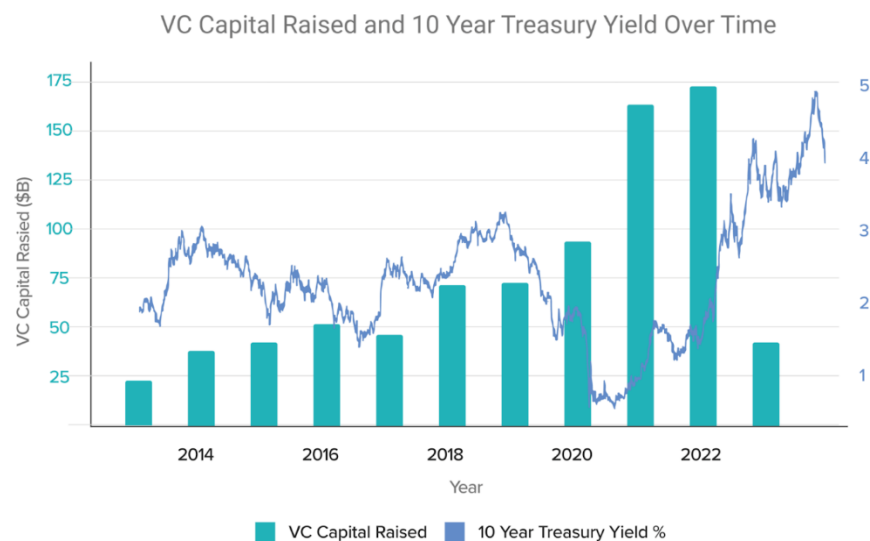
[Figure 1.0 Carta 2023]

This leads to the question, why did these VC investments rise and fall so dramatically? This is the first question that we will delve into and explore the relationship between monetary policy and venture capital investment.

Capital is still flowing to the earliest startups
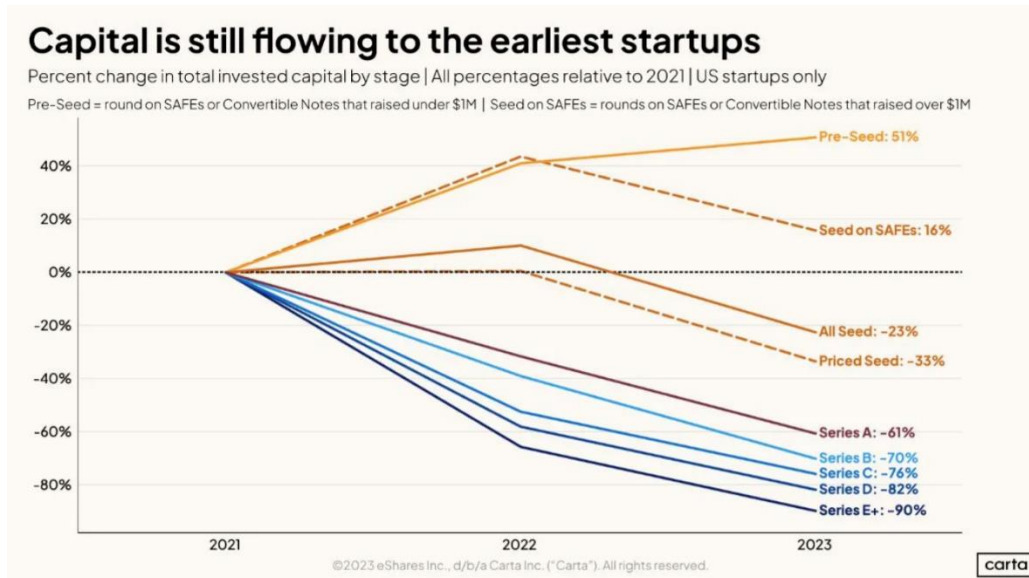
[Figure 1.1 Carta Dec 2023]

The second question we explored in this paper is the one being told by the graph above. Despite the fall in overall venture capital investment as evident by figure 1.0, we see in figure 1.1 there is a clear rise in venture capital in the earliest form of startups, the Pre-seed and Seed on SAFE investments. This is an interesting phenomenon that we sought to explore further in this paper.

Literature Review

Theme 1: Impact of Interest Rates on Venture Capital Investment

1. Monetary Policy and Innovation (Yueran Ma, Kasper Zimmerman; July 2023)
   a. This paper examines the impact of monetary policy on innovation activities. The authors find that when there is a tightening of monetary policy by 100 basis points, there are significant declines in innovation-related spending and activities. Specifically, research and development (R&D) spending drops by about 1 to 3 percent, venture capital investment

decreases by about 25 percent, and patenting in crucial technologies as well as overall patent-based innovation indices fall by up to 9 percent over the following few years. These declines suggest that higher interest rates can deter investment in innovation due to less favorable financial conditions and reduced overall economic demand. Additionally, the study suggests that these effects on innovation might have long-term implications for the economy's productive capacity, potentially leading to a 1 percent reduction in output after five years. This highlights the broader economic consequences of monetary policy decisions beyond their immediate effects on inflation and economic stability.

2. Monetary policy and venture capital markets (Bellavitis et al.)

    a. This study shows that the level of GDP and the number of companies in the national stock market is positively correlated with VC firms' fundraising activities. In addition, it finds that money supply is strongly correlated with VC fundraising. Variables including self-employment, unemployment rates, and VC demand show significant correlation with VC activities. Increased interest rates also led to more VC fundraising: when interest rates were 0%, fundraising was $145M. When interest rates were 2.27%, fundraising increased to $164M, a 12% increase. A one standard deviation increase above the interest rate mean led to a 20% increase in VC funding to $197M. There is also a fading effect with prolonged periods of negative rates, where the impact on fundraising activity diminishes over time. The

finding that VC funds fundraising is positively impacted by interest rates

highlights the importance of understanding the different aspects of the VC market

and how each is impacted by interest rates. By understanding how interest rates

impact the supply of limited partners, policy makers can understand how

monetary policy, and extreme monetary policy, can impact the supply of venture

funds. It is important for policy makers to understand that higher interest rates

may increase venture funds as a result of increased fundraising.

3. Interest Rates, Venture Capital, and Financial Stability (HJ Allen; March 2024)

   a. Allen's article investigates the interplay between interest rates, VC, and financial

   stability. The article argues that the prolonged period of accommodative monetary

   policy from 2009 to 2021, which aimed to mitigate the effects of the Global

   Financial Crisis and the COVID-19 pandemic, inadvertently fueled a bubble in

   the venture capital industry, which in turn led to a surge in the cryptocurrency

   market and contributed to instability at Silicon Valley Bank, favored by many

   venture capitalists. Allen argues for proactive financial regulation to prevent these

   crises that necessitate accommodative monetary policies and to mitigate the risks

   these policies can introduce. She suggests increased monitoring of the VC

   industry by financial stability regulators, emphasizing that the industry's potential

   to create asset bubbles poses significant future financial stability risks. The article

   also advocates for stronger enforcement of securities laws to address the current

   crypto bubble and proposes structural separation between cryptocurrency and

   traditional financial systems.

Overall, we can see that interest rates play a crucial role in influencing venture capital investment. Ma and Zimmerman (2023) reveal that tightening monetary policy by raising interest rates significantly drops VC investments by reducing innovation-related activities. Higher interest rates makes borrowing more expensive, which deters investments in riskier ventures. Bellavitis et al. further support this by showing that while higher interest rates can increase VC fundraising, prolonged periods of negative rates eventually diminish fundraising activity. This highlights the complex relationship between interest rates and VC supply, suggesting that monetary policy impacts the availability of funds. Allen (2024) contributes to this discussion by speaking to the financial stability risks posed by low interest rates, as the prolonged accommodative policies post 2009 contributed to asset bubbles in the VC industry and broader financial institutions.

Theme 2: Macroeconomic factors influencing Venture Capital

1. The Driving Forces of Venture Capital Investment (Yixi Ning et. al; 22 June, 2014)

    a. This paper finds that there is a robust positive relationship between periods of economic growth, measured by higher GDP and industrial production, and increased VC activity, both in terms of total investment and the number of deals. The performance of stock indices like NASDAQ and Russell 2000 significantly influences VC investments, suggesting that strong public market performance can buoy VC activities. In addition, VC investments contract significantly during economic crises, but there is often a quick rebound in certain sectors, indicating sector-specific resilience and strategic adjustments by venture capitalists. From a monetary policy perspective, the paper indicates that it is very important to entrepreneurship that the FOMC sets interest rates that achieve a soft landing for

the US economy. US VC investments are highly correlated with how the greater economy is performing, so any hints of recession could have a positive feedback loop where VC firms lower their risk profile and stunt innovation. We also see that high interest rates discourage VC investments as the incentive to invest is lower with safe treasury yields being high. However, the main priority is to prioritize the stability of financial markets and the greater economy.

2. Venture Capital Booms and Start-up financing (Janeway et. al)

    a. The paper explores the dynamics of venture capital financing and its role in fostering innovation and economic growth. The paper discusses how VC investment is not merely reactive to the broader financial market conditions, but often precedes and fuels macroeconomic shifts. Large inflows into the VC asset class, particularly notable in the last few decades, are shown to be both a cause and effect of macroeconomic fluctuations. This cyclical relationship indicates that VC investments are an integral part of the broader economic environment, influencing and being influenced by global financial trends. The paper emphasizes that these VC booms are not only significant in terms of temporal investment investment patterns but also play a critical role in shaping the geographical and industry-specific landscape of innovation. For instance, substantial portions of VC funds have been historically concentrated in industries such as information and communication technologies and biotechnology. This is partly attributed to macroeconomic policies and government interventions that have steered capital towards these high-growth areas. The authors also highlight the impact of macroeconomic policies on the distribution and flow of venture

capital, where regulatory changes and economic policies influence the risk capital available for startups, thereby affecting the overall innovation trajectory of the economy. This interplay between government policy and venture capital is crucial, with implications for both the emergence of new industries and the expansion of established ones.

3. Short and Long-Term Interactions Between Venture Capital Returns and the Macroeconomy: Evidence for the United States (Füss, Schwizer; 2012).

    a. This study by Füss and Schweizer investigates the influence of macroeconomic and financial variables on the performance of venture capital in the United States using a vector error correction model (VECM). Their findings reveal that the value of VC investments is positively related to short-term interest rates, which highlights the importance of industrial production as a short-term influence on VC performance and demonstrating that VC returns Granger cause Nasdaq performance, indicating a bidirectional relationship. The analysis utilizes various macroeconomic variables to understand their long term equilibrium relationships and short term dynamics. Their results suggest that understanding these interactions is crucial for venture capitalists in making strategic investment decisions and for policymakers in creating supportive environments for VC investments.

Venture Capital investment is significantly influenced by broader macroeconomic factors. Ning et al. (2014) identifies a strong positive relationship between economic growth (measured by GDP and industrial production) and increased VC activity. Strong stock market performance is also a strong indicator for increased VC investments. Janeway et al. extends this

understanding by showing that VC investment both influences and is influenced by macroeconomic cycles. Füss and Schweizer (2012) further show this dynamic by demonstrating that short-term interest rates and industrial production significantly impact VC performance, finding that VC returns can predict future Nasdaq performance, which again signals as to how interconnected these industries are and how integral VC performance is in affecting the other industries. These studies underscore the importance of stable and positive macroeconomic conditions in supporting a vibrant VC market.

Theme 3: Government Policy and Technological Innovation

1. Analyzing the Federal Reserve's impact policies on tech innovation: Examining how Fed's monetary policies influence investment in tech-driven industries, shaping United States Innovations (Korker et. al; 2024)

    a. This study investigates the impact of Federal Reserve policies on investments in technology driven industries in the United States, focusing on how interest rates and money supply influence technological advancements. The paper utilized time series data from the World Bank and the US Bureau of Economic Analysis spanning 2000 to 2022, using Ordinary Least Squares (OLS) regression analysis. The paper found that there is a significant positive relationship between lending rates and technology innovation. This indicates that lower borrowing costs stimulate R&D spending and attract venture capital. Variations in the money supply, influenced by Fed policies also show a positive correlation with technological advancements. The authors conclude that policymakers need to balance immediate economic needs with long-term innovation incentives.

Companies in technology-driven sectors should align their strategies with

expected effects of monetary policies to foster continuous technological progress.

2. Venture Capital Investment Cycles: The Impact of Public Markets (Gompers et. al; 2008)

   a. This study investigates how fluctuations in public market signals influence

   venture capital investing. The authors analyze data from 1975 to 1998, finding

   that the most experienced VC firms significantly increase their investments when

   public market signals, including higher valuations and IPO activity, indicate

   favorable conditions. This reaction is found to be less pronounced at less

   experienced firms. Despite the increased investment rates during favorable market

   conditions, the success rates of these investments do not decline substantially,

   indicating that there is a rational response to the market conditions, rather than an

   overreaction. These findings also highlight the importance of industry-specific

   experience and networks in driving successful investment decisions.

Government policies are found to have a profound impact on technological innovation

and VC investments. Korker et al. (2024) investigates the influence of Federal Reserve policies

on tech-driven industries, finding that lower interest rates and increased money supply stimulate

R&D spending and attract VC funding. This suggests that accommodative monetary policies can

foster technological advancements by making capital more accessible. Gompers at al. (2008)

adds that public market signals, such as high valuations and active IPO markets, encourage

experienced VC firms to increase their investments. Overall, these studies find that both

monetary policy and market conditions shape the landscape of VC investment in technology

sectors, emphasizing the need for a policy environment that supports continuous technological

progress by aligning with market signals.

Data

We acquired data on total U.S. venture capital investment by combining datasets from two sources: the PricewaterhouseCoopers (PwC) August 2003 MoneyTree Survey and the NVCA 2024 Yearbook. Both sources documented yearly venture capital investment activity. Our combined dataset included the annual total venture capital investment in the U.S. spanning from 1980 to 2023. Additionally, we obtained data specifically on pre-seed and seed funding from the years 2015 to 2023 from the NVCA 2024 Yearbook.

We also collected data on monthly Federal Funds Rates (FFR), Unemployment Rates, Current Business Activity, and Manufacturing Purchasing Managers Index (PMI). We sourced FFR and Unemployment Rate data from the Federal Reserve Bank of St. Louis (FRED). We obtained Current Business Activity Diffusion Index data from the Federal Reserve Bank of Philadelphia Business Outlook Survey. Lastly, we extracted Manufacturing PMI data from the Institute for Supply Management (ISM). We computed yearly averages from 1980 to 2023 for each dataset to use in our analysis.

Methodology

1. <u>Regression Analysis</u>

The main underlying assumption is that the Federal Reserve Bank changes the Federal Funds Rate based on factors such as inflation, unemployment, and output while business indicators respond to interest rates. More specifically, macroeconomic theory suggests that rising interest rates cause the investment portion of GDP to fall, leading business indicators to falter during periods of high interest rates like the United States is currently experiencing. Therefore,

the Federal Reserve does not directly target business indicators when changing interest rates, but it will still indirectly have an impact.

In our analysis, we will use the current activity diffusion index from the *Federal Reserve Bank of Philadelphia* Business Outlook Survey as our business indicator. The Business Outlook Survey collects information from a sample of businesses about their current trends of business activities, using primary factors such as prices, employment, and revenue. This information is quantified into a diffusion index that is calculated as the percentage of businesses reporting an increase in activity minus the percentage reporting a decrease. A positive diffusion index suggests growth in the business sector while a negative diffusion index suggests a weakening business sector, a reflection of what's going on in the macroeconomy. The diffusion index is a good measure of current activity and offers insights into unemployment rates and investment activity, highlighting incentives to create new businesses such as startups.

We consider the following equation:

$$(1) \quad business_t = \alpha_b + \beta i_t + v_t$$

where $business_t$ is the current activity diffusion index during period t, α_t is the intercept term, i_t is the Fed Funds Rate, and v_t is the error term. We also consider the following equation which regresses venture capital investment on current activity diffusion index and the Fed Funds Rate:

$$(2) \quad vc_t = \alpha_{vc} + \gamma business_t + \theta i_t + \varepsilon_t$$

where vc_t is the venture capital raised in the United States during period t, α_{vc} is the intercept term, i_t is the Fed Funds Rate, and ε_t is the error term. We are interested in measuring θ which estimates the correlation between monetary policy and the amount of venture capital investments across the United States in an entire year.

However, a collinearity problem exists if we run the equation (2) since there exists a linear relation between $business_t$ and i_t. To see this, we plug equation (1) into equation (2):

$$(3) \quad vc_t = \alpha_{vc} + \gamma\alpha_b + (\gamma\beta + \theta)i_t + \gamma v_t + \varepsilon_t$$

If we regress vc_t on only i_t, we risk omitted variable bias since business conditions are also a key factor in determining when venture capital will be invested. Both problems violate underlying OLS assumptions and will produce inaccurate estimates of θ, our variable of interest.

Instead, we solve the problem by estimating the current activity diffusion index using the Fed Funds Rate, the purchasing managers index (PMI), and the unemployment rate. As a note, PMI is based on surveys of purchasing managers in the manufacturing sector asking about various activity levels, including new orders, production levels, employment, supplier deliveries, and inventories. The PMI is calculated as a diffusion index which ranges from 0 to 100, with values above 50 indicating expansion and values below 50 indicating contraction. The PMI is important to the business sector because it indicates how well the manufacturing industry is doing

$$(4) \quad \widehat{business}_t = \hat{\alpha}_b + \widehat{\beta_1}i_t + \widehat{\beta_2}PMI_t + \widehat{\beta_3}unrate_t$$

We then subtract the predicted current activity diffusion index $\widehat{business}_t$ from the observed current activity diffusion index in period t to calculate $business\_diff_t$ as illustrated below:

$$(5) \quad business\_diff_t = business_t - \widehat{business}_t$$

Finally, we arrive at our final model which regresses venture capital raised in period t on $business\_diff_t$ and i_t.

$$(6) \quad vc_t = \alpha_{vc} + \gamma business\_diff_t + \theta i_t + \varepsilon_t$$

By following this strategy, we aim to get a non-biased estimate of θ free of collinearity problems while also keeping business conditions in the regression and preventing omitted variable bias.

2. Structural Break Analysis

To account for changes in undetermined factors that may have changed venture capital investing trends, we tested our data for structural changes. We used a sequential procedure called the $supF_T(L + 1|L)$ test that first tested the null hypothesis of L structural changes against an alternative hypothesis of L + 1 structural changes, starting with L = 0. Figure 2.1 displays the results of the sequential test.

	supF(1|0)	supF(2|1)	supF(3|2)	supF(4|3)	supF(5|4)
Seq supF	14.558	8.516	2.816	0.509	0.000
10% CV	7.040	8.510	9.410	10.040	10.580
5% CV	8.580	10.130	11.140	11.830	12.250
2.5% CV	10.180	11.860	12.660	13.400	13.890
1% CV	12.290	13.890	14.800	15.280	15.760

Figure 2.1

As shown in figure 2.1, the supF(2|1) test is 8.516 and is smaller than the 5% critical value of 10.13. We therefore concluded that only one significant structural break exists in the data. We found that the structural break occurred in 1998.

Results

We begin by taking the quarterly data from the *National Venture Capital Association (NVCA)* 2024 Report on venture capital raised by pre-seed and seed stage startups in the United

States. We follow the regression modeled in equation (4) to estimate the current activity for each quarter between 2015 Q1 and 2023 Q4.

Table 1:

	Dependent variable:
	Current_Activity
Fed_Funds_Rate	−2.139**
	(1.045)
Unemployment_Rate	−1.387*
	(0.804)
PMI	2.580***
	(0.306)
Constant	−118.685***
	(19.169)
Observations	36
R^2	0.819
Adjusted R^2	0.802
Residual Std. Error	7.035 (df = 32)
F Statistic	48.205*** (df = 3; 32)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 1: Current activity diffusion index regressed on the Federal Funds Rate, unemployment, and PMI for quarterly data from 2015 Q1 to 2023 Q4

From Table 1, we see the coefficients for PMI and the constant are statistically significant at a 99 percent confidence level. The coefficients for the Fed Funds Rate and unemployment rate are also statistically significant at a 95 percent confidence level and 90 percent confidence level respectively. The R^2 value of the model is also high at 0.819, further validating the coefficients from Table 1 being accurate predictors for current activity.

Given these results, we can confidently conclude that the Federal Funds Rate has a negative impact on current activity. For a 1 percent increase in the Federal Funds Rate, the current activity diffusion index falls by 2.139 points. This is consistent with economic theory since rising interest rates decrease the amount of investment activity in an economy, and this effect is captured by the firms reporting to the Business Outlook Survey. We also observe

unemployment rising by 1 percent reduces current activity by 1.387 points since rising unemployment rates serve as a signal for an economy that's struggling and in turn reduce the activity of firms. Lastly, we observe a 1-point rise in the PMI index raises current activity by 2.58 points since PMI is based on new orders and production which directly increases current activity in the business sector.

Using the model from Table 1, we predict current activity using the quarterly data of the Fed Funds Rate, unemployment, and PMI from 2015 Q1 to 2023 Q4. We then calculate the difference between the predicted current activity and observed current activity as in equation (5) and regress venture capital raised by pre-seed and seed startups on the Fed Funds Rate and the business activity difference variable we calculated modeled as in equation (6).

Table 2:

	Dependent variable:
	preSeed_seed
business_diff	−0.057
	(0.035)
interest_rate	0.138
	(0.147)
Constant	2.160***
	(0.309)
Observations	36
R^2	0.099
Adjusted R^2	0.044
Residual Std. Error	1.376 (df = 33)
F Statistic	1.811 (df = 2; 33)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 2: Venture capital raised by pre-seed and seed startups from 2015 Q1 to 2023 Q4 regressed on the Federal Funds Rate and the business activity difference variable

While the constant is statistically significant, the model in Table 2 has statistically insignificant coefficients for the Federal Funds Rate and the business difference variable. However, the coefficient for the Federal Funds Rate is positive, consistent with the trend that

venture capital investment has increased in early-stage startups since the pandemic despite rising interest rates. The coefficient for the business difference variable is negative unlike we'd expect, but with a larger sample size we believe a positive, statistically significant coefficient would come about.

Next, we analyze the impact interest rates have on total annual venture capital investment across all stages of startups to find trends in the venture capital industry as a whole. We utilize annual data from the *NVCA* 2024 Report and *PwC's* 2003 MoneyTree Report on venture capital raised in the United States from 1980 to 2023. We again begin with our model from equation (4) where we regress the current activity diffusion index on the Fed Funds Rate, the unemployment rate, and PMI.

Table 3:

	Dependent variable:
	Current_Activity
Fed_Funds_Rate	0.569*
	(0.290)
Unemployment_Rate	0.707
	(0.614)
PMI	2.653***
	(0.241)
Constant	−137.057***
	(13.806)
Observations	44
R^2	0.763
Adjusted R^2	0.745
Residual Std. Error	6.807 (df = 40)
F Statistic	42.921*** (df = 3; 40)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 3: Current activity diffusion index regressed on the Federal Funds Rate, unemployment, and PMI for annual data from 1980 to 2023

We see over more historical data, that only PMI and the Federal Funds Rate have a statistically significant impact on current activity, while the unemployment rate no longer does. We also observe that while the PMI coefficient estimate is comparatively like the coefficient

from Table 1, the coefficients for the unemployment rate and Federal Funds Rate have become positive. We attribute this change to structural changes that occurred in venture capital investment that impacted current activity which we will explore more in-depth later.

We use the model from Table 3 to construct our business difference variable. We then regress total US venture capital raised on the business difference variable and the Federal Funds Rate.

	Table 4:
	Dependent variable:
	Total_VC_Investments
business_diff	−0.291
	(1.393)
interest_rate	−7.455***
	(2.315)
Constant	80.072***
	(13.636)
Observations	44
R^2	0.202
Adjusted R^2	0.164
Residual Std. Error	59.987 (df = 41)
F Statistic	5.205*** (df = 2; 41)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 4: Venture capital raised by all startups from 1980 to 2023 regressed on the Federal Funds Rate and the business activity difference variable

Based on Table 4, we see that the Federal Funds Rate has a strong negative correlation with total venture capital investment in the United States. The coefficient is statistically significant at a 99 percent confidence level and suggests a 1 percent increase in the Federal Funds Rate decreases venture capital investment by $7.455 billion annually. This coincides with trends we see in later stage startups which typically receive greater installments of venture capital and economic theory that higher interest rates lower investment in the economy. As a

final note, the business difference variable is statistically insignificant and negative which again might change if more data was available to be trained on.

Lastly, we see from the structural break analysis a significant change in venture capital investment after 1998, which coincides with the Dotcom Bubble when investment and equity prices swelled above sustainable levels. For our final model, we incorporate an indicator variable for years after 1998 to incorporate the structural change in venture capital investment in the United States.

Table 5:

	Dependent variable:
	Total_VC_Investments
business_diff	0.421
	(1.325)
interest_rate	−1.088
	(3.206)
After_1998	68.506**
	(25.521)
Constant	13.086
	(28.005)
Observations	44
R^2	0.324
Adjusted R^2	0.274
Residual Std. Error	55.905 (df = 40)
F Statistic	6.397*** (df = 3; 40)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 5: Total venture capital raised by all startups from 1980 to 2023 regressed on the Federal Funds Rate, the business difference variable, and an indicator variable for the structural break in VC investment that occurred after 1998.

After incorporating the structural change, we see only the indicator variable for years after 1998 is statistically significant showing venture capital investments are impacted by structural shifts in the economy. Furthermore, including the indicator variable also improves the predictive power of the model by increasing the R^2 value from 0.202 in Table 4 to 0.324. We also observe the magnitude of the Fed Funds Rate coefficient shrinks to a $1.088 billion decrease in venture capital investment per 1 percent increase in the Fed Funds Rate. The business

difference variable also now has a positive coefficient consistent with the belief that better business conditions increase incentives to invest. While both coefficients match economic theory and coincide with past literature, they are statistically insignificant, likely because of the small dataset we were limited to by financial and time constraints. With this in mind, we believe the coefficients depict an accurate trend in the economy.

Constraints and Limitations

Our study is subject to several limitations. First, due to limited access to data, some of our findings were not statistically significant. A larger sample size could potentially have yielded statistically significant results. Secondly, the venture capital investment data we used in our analysis was yearly. Since FFR, unemployment rates, business activity, and PMI fluctuates throughout the year, a yearly analysis may not have accurately captured how each of these factors impact venture capital investment. Thirdly, venture capital investment increased significantly during the COVID-19 pandemic in 2020. While it is plausible that a structural break occurred during this period, insufficient time has elapsed to comprehensively assess the pandemic's long and short-term effects on venture capital investment. Fourthly, our early stage investments data only included years 2015-2023. Since our total investment model was trained on data from 1980-2023 and the early stage model was only trained on data from 2015-2023, it is difficult to compare the results of the two models. Lastly, potential endogeneity may have influenced the estimation of $\widehat{business}_t$ in Equation 4, consequently biasing the $business\_diff_t$ variable calculated in equation 5 and potentially skewing our results.

Conclusion

In conclusion our analysis comes up with two primary conclusions.

1. Low interest rates are good.

The first of which is that low interest rates are beneficial for the venture capital and new businesses ecosystem. The lower cost of borrowing and of doing business allows venture capital to raise money and make investments more easily. Further, low interest rate environments encourage investors to diversify their investments and put money into the economy in various forms, including venture capital firms. In low interest rate environments VC firms are able to raise significant amounts of capital which they can in turn invest in new businesses which create jobs and help grow the economy.

For companies going through different stages of growth lower interest rates allow them to grow more easily as well and subsequently secure additional capital through either debt or equity financing.

2. Interest rates at zero are dangerous.

When interest rates are too low however, they become dangerous. We can see a breakpoint in our data in 1998, where interest rates decreased significantly and VC investment shot up, another breakpoint in our data was in Q2 2020, i.e the onset of COVID. The ZIRP (Zero interest rate environment) coupled with quantitative easing led to the VC industry more than doubling their investments from 2019 to 2021. This seismic shift was fundamentally unsustainable and led to an increased amount of over-valuation of new businesses (read bloated unicorns), as well funding of many businesses with much less scrutiny than before.

Later on, when interest rates shot back up and the chickens come home to roost (in the form of companies underperforming, lowering their valuations, and going bust), VC's had to come to

terms with their losses which their limited partners (the people who invest in VC's) were extremely unsatisfied with across the industry. This subsequently led to a new break point in 2023, where VC investment has gone back to 2015 levels, and the data for 2024 is not promising in terms of growth.

Thus, we recommend that monetary policy makers should steer clear from ZIRP, as it leads to:

1. Bad practices amongst firms taking investment (they will treat money like it's free!)

2. Under confidence in VC's -> American VC's are at the cutting edge of the world

Moral of the story, too much money spoils VC's and businesses alike, low but non-zero interest rates are important for consistent industry growth but if the interest rates get too low these same stakeholders may begin acting with impunity in detriment to themselves and the economy alike.

Policy Recommendation

In conclusion, our policy proposal is for the Federal Reserve to lower their interest rates to facilitate economic revival in the US. We believe that the Federal Reserve should implement this policy as soon as possible as the US economy has been in a slump post covid with the negative effects reverberating throughout society.

High interest rates cause capital to be drawn outside of the economy, slowing job creation and the ability for businesses to grow and prosper. Thus, it is imperative for interest rates to be lowered at the next Federal Reserve meeting in June.

Works Cited

1. Allen, H. J. (2023). Interest Rates, Venture Capital, and Financial Stability. *Venture Capital, and Financial Stability*.

2. Bellavitis, C., Fisch, C., & Vismara, S. (2022). Monetary policy and venture capital markets. *Review of Corporate Finance*.

3. Füss, R., & Schweizer, D. (2012). Short and long-term interactions between venture capital returns and the macroeconomy: Evidence for the United States. *Review of Quantitative Finance and Accounting, 38*, 391-410.

4. Gompers, P., Kovner, A., Lerner, J., & Scharfstein, D. (2008). Venture capital investment cycles: The impact of public markets. *Journal of Financial Economics, 87*(1), 1-23.

5. Contact, N. P. (2023, July 13). *Venture Capital Dollars invested exceeds $10 billion for fifth consecutive quarter, according to the Moneytree Report - National Venture Capital Association*. NVCA. https://nvca.org/press_releases/venture-capital-dollars-invested-exceeds-10-billion-for-fifth-consecutive-quarter-according-to-the-moneytree-report/#:~:text=About%20the%20PricewaterhouseCoopers/National%20Venture,primary%20activity%20is%20financial%20investing.

6. PricewaterhouseCoopers/Thomson Venture Economics/ National Venture Capital Association MoneyTree Survey Q2 2003 update. PowerPoint Presentation.

7. Maloney, S. (2024, May 14). *NVCA 2024 Yearbook - National Venture Capital Association*. NVCA. https://nvca.org/sdm_downloads/nvca-2024-yearbook/

8. https://www.stlouisfed.org/

9. https://www.ismworld.org/supply-management-news-and-reports/reports/ism-report-on-business/

10. https://blogs.bu.edu/perron/files/2023/01/mbreaks-20230125.pdf

11. Janeway, W. H., Nanda, R., & Rhodes-Kropf, M. (2021). Venture capital booms and start-up financing. *Annual Review of Financial Economics, 13*, 111-127.

12. Korkor, P. M., Okunnuga, I., Fatai, F. O., & Efijemue, P. P. A. O. P. Analyzing the Federal Reserve's impact policies on tech innovation: Examining how Fed's monetary policies influence investment in tech-driven industries, shaping United States innovations.

13. Ma, Y., & Zimmermann, K. (2023). Monetary policy and innovation (No. w31698). *National Bureau of Economic Research*.

14. Yixi, N., & Wang, W. (2014). The driving forces of venture capital investments. *Small Business Economics, 44*(2).