The Signal and The Noise: Hype in the Age of the Great Stagnation

Abstract

Regular consumers of financial news may have the impression that the hyping of start-ups with bad fundamentals has become increasingly common in recent times. But have start-up founders and investors really become more prone to following hypes, or is this just another popular economic myth? Using Crunchbase data, I attempt to answer this question with a panel regression of growth volatility of start-ups founded or funding rounds raised in the United States against an index of years. Growth volatility was chosen as the variable as interest since hypes are characterised by sharp peaks and crashes in behaviour, which is captured by the concept of volatility.

Controlling for the federal funds rate and industry fixed effects, I find that there is an effect of 0.0007 on growth volatility of start-ups founded per added year between 1960 and 2023, for a total effect of 0.0441 between the start and end years (median of medians for each industry: 0.0357), and an effect of 0.0033 on growth volatility of funding rounds raised per added year between 1960 and 2023, for total effect of 0.207 (median of medians: 0.0469). A more conservative estimate of effect size for a restricted time period with more reliable data finds a per year effect of 0.0004 on growth volatility of start-ups founded and 0.0027 on growth volatility of funding rounds raised.

1. Introduction

1.1 Background

> "At what price would I have refused to pay? $50? $70? While the cutoff is unclear, $34 wasn't enough. I glumly handed over my credit card, and got even glummer when we discovered that the flavor was mediocre, too. My ice cream was none too sweet, and according to my son and daughter, the bobas tasted 'funny.' ... Most people would blame the free market for the bad result. I, in contrast, blame myself. ... **For all their wonder, free markets aren't wonderful enough to protect people from lack of common sense. If consumers place orders without checking prices, then cough up whatever vendors ask after the fact, the outcome will be poor.**" (Caplan, 2024)[1]

In 2019, WeWork raised $1 billion from Softbank, raising its equity valuation to $47 billion. In 2023, WeWork declared bankruptcy, reducing its equity valuation to $0. WeWork founder Adam Neumann walked away with $1.7 billion in stock sales and non-recourse loans (Levine, 2024)[2]. Start-up unicorns Uber, Lyft, WeWork, Pinterest, and Snapchat have consistently failed to be profitable, with Uber's cumulative losses approaching $25 billion. In other cases, as in Theranos, Luckin Coffee, and Wirecard, start-ups commited outright fraud (Funk, 2021)[3].

The fundamental truth of economics is that resources are scarce. Thus the fundamental job of economic actors - firms, investors, consumers, regulators - is to *usefully* allocate those scarce resources. When hype substitutes judgement of profit, potential, and loss, billions of dollars and millions of labour-hours (...)[4] are not invested into the scientific, technological, and organisational advances that make societies grow (Cohen & DeLong, 2016)[5].

Hypes, by themselves, are not inherently negative. Hypes occur whenever technological innovation, regulatory changes, or other discontinuities create new possibilities in a field, drawing entrepreneurs and investors to enter the field (Shumpeter, 1934)[6]. They are therefore a natural part of technological development, driving the funding of innovation and the building of communities of practice (Guice, 1999)[7]. But when the underlying promise of a hype is false, or even when the promise is true but too early to be realised, hypes can direct resources towards confident fraudsters away from more qualified founders (...)[8], and disappointment can damage the development of a nascent field (Hendler, 2008)[9][10].

If there has been a rise in fundamentally unsound hypes, we might speculate on their causes. We might, for example, attribute the increase in hypes to changes in the strategies chosen by start-up founders and investors, particularly in the tech industry.

Prioritising risky growth over guaranteed profits, rather than a careless oversight, is/was the explicit strategy of start-up founders and investors. In an essay titled "Startup = Growth", major Silicon Valley venture capitalist Paul Graham[11] wrote: "Growing too slowly is particularly dangerous in a business with network effects, which the best startups usually have to some degree." (Graham, 2012)[12]. As of (...). This strategy is not without merit. As of 2021, Microsoft, Apple, Amazon, Netflix, Alphabet, and Meta represented more than 25 percent of the S&P's total market capitalisation (Funk, 2021)[3], and all six firms benefit greatly from network effects.

There is also a related potential cause of unsound hype in the incentives of venture capital funds. Venture capital funds collect percentage fees on assets under management (AUM), in addition to profit incentives (Mauboussin & Callahan, 2020)[13]. Further, as a venture capital fund's AUM rises, returns may be expected to fall, since the needs of a start-up to expand do not necessarily scale with the needs of a venture capital fund to invest (Graham, 2005)[14] Large venture capital funds may therefore be incentivised to raise more capital over improving allocation of existing capital (Harrison, 2022)[15]. Venture capital funds are also incentivised to discourage funding rounds at a lower valuation than previous rounds, since lower valuations result in a write-down of AUM (Levine, 2023)[16].

Bad strategy is the most optimistic potential cause of the increase in hypes, since markets should self-correct by reducing the willingness of start-up founders to found and investors to fund unprofitable start-ups. There is some evidence of a correction in the start-up sector, with reports of multiple well-funded and highly-valuated start-ups failing in 2023 (Griffith, 2023)[17]. The tech industry has also experienced large layoffs, totalling 160k in 2022 and 260k in 2023 (Layoffs.fyi, 2024)[18].

The less optimistic potential cause is structural: More money, chasing less (good) investments. In the U.S., state and local government pension funds have an estimated $4.5 trillion AUM (Mauboussin & Callahan, 2020)[13], compared to the U.S. nominal GDP of $25 trillion in 2023 (CEIC, 2024)[19]. University endowments have a further $600 billion AUM. As U.S. 30-year Treasury bond yields declined from 15% in 1981 to a low of 1.2% in 2020, institutional investors increased returns by re-allocating assets into riskier investments like buyout and venture funds, with state and local government pension funds increasing asset allocation in "alternative assets" from 7% in 1990 to 29% in 2019 (Mauboussin & Callahan, 2020)[13]. Pension funds, in particular, (...). Similarly, Softbank could not have invested into Uber and WeWork at a premium without $60 billion of investment by of Saudi Arabia's and Abu Dhabi's sovereign wealth funds (Jones, 2022)[20].

As the supply of funds for investment grew faster, the supply of good investments grew slower. Cowen (2011)[21] describes a decline in yearly total factor productivity growth from 2-3% per year from 1919 to

1948, to less than 1% per year since 1973[22], which Cowen attributes to a decline in real innovation. Bloom et. al (2020)[23] describes a decline in research productivity in the same period[24]. At the same time, large firms shifted their R&D investment away from fundamental "Research" and towards commercial "Development", outsourcing research to universities and start-ups (Pisano, 2010)[25].

While this shift theoretically combines the advantage of large corporations in commercialisation and small start-ups in innovation (Arora & Gambardella, 1994)[26], Pisano (2010)[25] describes the challenges facing science-based start-ups. Science-based start-ups, such as in biotechnology, require large investments >$1 billion over long time periods >10 years, with uncertain payoff schedules. Venture capital funds, meanwhile, are structured for liquidity events within 5-10 years (Harrison, 2022)[15]**, and manage risk by limiting investments in individual start-ups. Meanwhile, universities are regularly criticised by researchers for bureaucratic and risk-averse funding mechanisms (Guzey, 2019)[27]. The University of Pennsylvania famously demoted Katalin Karikó, one of the principle researchers behind mRNA technology, from tenure track after she failed to receive grant funding for the technology (Garde, 2010)[28].

For the purposes of this paper, I will not attempt to determine whether strategic or structural causes are more relevant, or how persistent they are. Very smart people in the public and private sector are aware of these issues and have made efforts to address them. Moderna raised $40 million from venture capital funds in 2012 before any drugs had reached human trials, and raised more then $2 billion before going public in 2018, even before the COVID-19 pandemic (Garde, 2010)[28] More recently, Stanford, UC-Berkeley and UC-San Francisco jointly launched the Arc Institute with $650 million in funding, with plans to give 10 to 15 core investigators eight years of funding to pursue research without external pressure to commercialise or obtain grant funding (Mast, 2022)[29].

It is sufficient for me to state that in so far as structural imbalances between the supply and demand of capital persist or worsen, it is likely fundamentally unsound hype will return. The most recent correction in the tech industry occured in 2022/2023, after the U.S. Federal Reserve hiked the effective federal funds rate to control inflation, from about 4.33% in 2022 and 5.33% in 2023 (Smith, 2023)[30]. With the easing of inflation from a peak of 9.1% in 2022 to 3.1% in 2024 (Trading Economics, 2024)[31], there will be increased political pressure to lower the federal funds rate (Dennis, 2023)[32], which will remove the proximate restraint on hype. An aging population (...)[33] with a longer lifespan (...)[34] and fewer children (...)[35] will simultaneously increase investable funds as older adults accumulate more wealth (...)[36], put more pressure on pension systems to find higher returns (Mauboussin & Callahan, 2020)[13], and potentially shrink the pool of "good" investments as population aging reduces productivity growth (Maestas et. al, 2016)[37]**.

1.2 Contributions to the Literature

The contributions of this paper are: (1) To bring together a conceptual framework of hype from disparate threads of research, which will be covered in this section, and (2) To establish a factual baseline that there has been an increase in hype from 1960-2023, which will be covered in the Results section. In the Background section I have described some background factors which (...), but to bring together a conceptual framework of hype, I must first define what hypes are.

What are hypes? Though the words "bubble" and "hype" are often conflated, I follow the definition of a bubble as a deviation of asset prices from fundamentals, and define hype more broadly as over-indexing or "herd" behaviour, where individual agents act in a highly correlated way because they are following the same signal. This results in sharp peaks and crashes as supposedly individual actors all move in the same

direction at once (...)[38]. This definition of hype is agnostic as to whether the triggering signal is a good measure of fundamentals.

I draw this distinction between bubbles and hypes because I will not attempt to control for fundamentals in my subsequent analysis. This is because the data I use includes a wide range of industries, and would require much more careful analysis of heterogenous fundamentals before the fundamentals can be properly considered. My justification for not doing fundamentals analysis are as follows.

First, I believe it is reasonable to assume that any trend in hype found across a wide range of industries would be independent of industry-specific fundamentals. If we further establish that there has not been an a matching trend in returns on investment over time, it is reasonable to claim that any trend in hype is at least somewhat suspect from a fundamentals perspective. Given that venture capital funds' returns on investment have been decreasing over time, with the public market equivalent returns for venture capital funds, adjusted for size, sector, and leverage averaging to 1.1 (Mauboussin & Callahan, 2020)[13], we might find an increase in hype not well-justified.

Second, hype, or exuberance, has been studied as an explosive autoregressive process without reference to fundamentals in other contexts, such as exchange rates (Yang & Oxley, 2017)[39] and stock prices (Phillips et. al. 2011)[40].

Third, regardless of whether hypes are well-justified, understanding the dynamics and changes in dynamics of hype is empirically useful. If hype has indeed been "speeding up", one possible outcome is that the start-up ecosystem becomes more unstable, as money lurches from one industry to another, *even if each industry being funded is more deserving than the last*. In complex systems, relative rates of change can matter as much as rates of change. Stock market bubbles can be described (...)[].

Fourth, economic actors care about describing and understanding the behaviour of hypes. Gartner - one of the leading consulting firms on technological strategy with an revenue of $5.1 billion as of 2023 - uses its hype cycle model to advise the R&D decisions of large companies[Scrutinising Gartner's Hype Cycle Approach, 2010].

There is a deeper literature on scientific research/technological innovation and the growth rates and funding thereof.

The literature is deeper for venture capital funding, which is (...)

The final paper I wish to discuss is [A Tale of Two Crises, 2023]. (...)

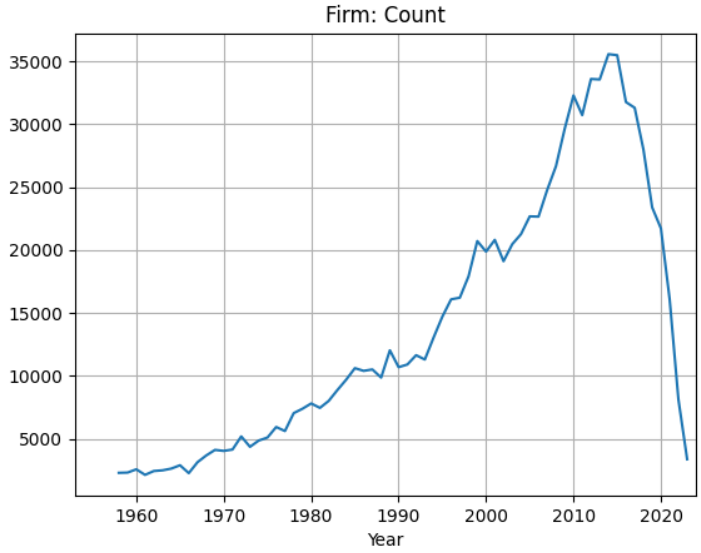
(...)

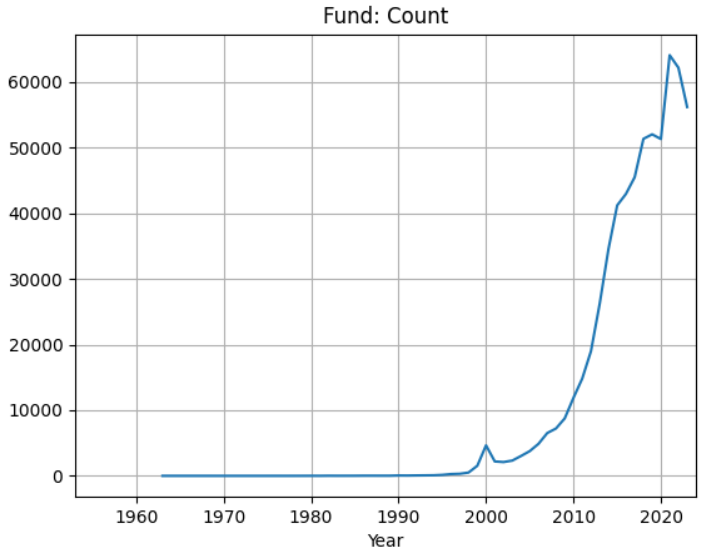
Data and Methodology

Firm and funding data was obtained from Crunchbase. Federal funds rate data was sourced from CEIC. The firm dataset includes all 1.2 million US firms available from Crunchbase, filtered to only include for-profit companies founded between 1960 and 2023 (inclusive), reducing the data set to (...) firms. Where the founding date was not available from Crunchbase, I supplemented the data with the date of domain registration from WHOIS, a public protocol to access domain registration details. The funding data set includes all 620k funding rounds available from Crunchbase, filtered to only include funding rounds between 1960 and 2023, reducing the dataset to (...) funding rounds. Since we only start to have >100

funding rounds a year in 1994, I will also perform the regression only including years 1994-2023 as a robustness check.

The start year of 1960 was chosen as the earliest 'round' year where macroeconomic data was available. The end year was chosen to exclude 2024, which is an incomplete year. Some consideration was given as to whether to include the COVID-19 period from 2019-2023, which resulted in a collapse of firm founding independently of hype dynamics. I ultimately chose to include it as funding rounds increased throughout this period, and many of the perceived excesses of start-up hype happened during this period, including Peloton, Zoom, (...)[]. As a robustness check, I will also perform the regression excluding 2019-2023.





The classification of industries and "industry groups" (Groups of related industries, e.g. Biotechnology and Genetics are in the same industry group) was also obtained from Crunchbase. Crunchbase's classification allows for and even encourages the inclusion of a firm into multiple industries and industry groups. I do not control for this, so it's possible that any observed change over time is the result of changes in labelling over time. A possible future approach is to use The Refinitiv Business Classification instead, which assigns only one industry per company based on factors such as main source of revenue[A Tale of Two Crises, 2023]. To avoid potential issues of sparse data for specific industries, I will use industry group as the grouping variable, as we have 49 industry groups compared to (...) industries. As a robustness check, I will also perform the regression with industry as the grouping variable.

(...)

Panel regression was done on both firm and funding data using a calculated variable $\beta_{i,t}$ as the variable of interest. $\beta_{i,t}$ was calculated as the multiple of the previous growth rate $g_{ig, t-1}$ in terms of *firms founded* or *funding rounds announced* in an industry group in a year to get the current growth rate $g_{ig, t}$: $g_{ig, t} = \beta_{ig, t} g_{ig, t-1}$. $\beta_{i,t}$ represents the responsiveness of firm founders or investors to the potential of an industry group, represented by its growth rate in the previous period. This construction was necessary to model the responsiveness as a potentially changeable variable, rather than an average over time. High positive $\beta_{ig, t}$s represent strong "trend-following" in either positive or negative growth, while high negative $\beta_{ig, t}$s represent strong corrections. Since a sharp peak and a sharp crash are both symptoms of hype, but a sharp peak followed by sharp crash will result in an average $\beta_{ig, t}$ of 0, I will use the absolute value of $\beta_{ig, t}$ instead. As a robustness check, I will also perform the regression using raw values.

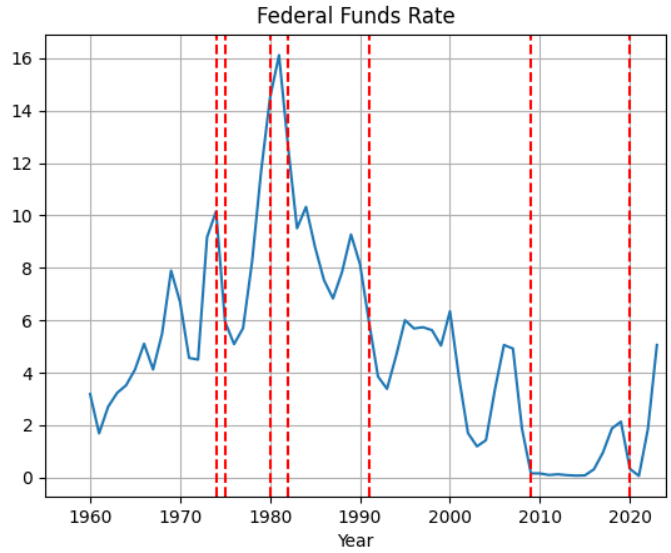
This is the final form of the panel regression: $$\beta_{i,t} = c + \alpha_{i} + \gamma t + \delta r_t + \epsilon_{i, t}$$ The growth volatility \beta_{i,t} of an industry in each year will be regressed, a time variable t and a federal funds rate variable r_t as a control, with a constant c and an industry fixed effect α_{i} also specified. Year is normalised to be the year a firm is founded or a funding round announced minus the start year. This allows the coefficient of year to be interpretable as the effect of each additional year from the start year on the response parameter. I use industry fixed effects instead of coefficients of each industry since the growth volatity of each industry differs significantly between industries, so the difference in effect of an industry from a reference industry will not be interpretable.

Results and Interpretation

Table 1 and Table 2 are the results of the panel regressions on growth volatility $\beta_{i,t}$ of firms founded and funding rounds announced respectively. Note that the year coefficients are larger than they initially seem. A year coefficient of 0.0033, as in Table 2, will be multiplied by the 63 year difference between the start and end years. This gives a total effect of 0.207 in the last period compared to the first period. For reference, some of the industries with the highest median growth volatility for funding rounds announced are Ethereum at 0.288, Bitcoin at 0.253, and Cannabis at 0.175, with a median of medians of 0.0469.

For firms founded, the industries with the highest median growth volatility are Advertising at 0.101, Dental at 0.0979, and Publishing at 0.0956, with a median of medians of 0.0357.

The federal funds rate coefficients are small for both firms founded and funding rounds announced, and removing the federal funds rate control from the regressions do not significantly alter the results. This finding is slightly strange since we might expect the federal funds rate to affect money supply and therefore willingness to invest. This result seems more reasonable when we plot the federal funds rate against time. There was a clear change in interest rate regime between the period 1960-1980, where interest rates were consistently increasing, and the period 1980-2023, where interest rates were consistently decreasing.



If no or few industries have such strong trends in growth volatility, the correlation of the federal funds rate to growth volatility will be weak. Therefore the small federal funds rate coefficients suggest that the internal dynamics of each industry matter more to growth volatility than macroeconomic factors like federal funds rates.

The R^2 of the regressions are relatively small, though I would argue still large enough to be empirically meaningful, at 0.085 for firms founded and 0.113 for funding rounds announced.

Table 1: Firms Founded (1960-2023)

```
==============================================================================
====
            Parameter  Std. Err.     T-stat    P-value    Lower CI
Upper CI
------------------------------------------------------------------------------
----
const          0.0280     0.0014     19.977     0.0000      0.0253
0.0308
year_norm      0.0007  3.377e-05     19.846     0.0000      0.0006
0.0007
fed_rate      -0.0001  9.237e-05    -1.1982     0.2308     -0.0003
7.037e-05
==============================================================================
====
R-squared:                        0.0850
```

The year coefficient is 0.0007 at p < 0.05, for a total effect of 0.0441 between 1960 and 2023. We find an increase in volatility in firms founded in this period, though not as strongly as funding rounds announced.

Table 2: Funding Rounds Announced (1960-2023)

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==============================================================================
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```

```
             Parameter  Std. Err.     T-stat    P-value    Lower CI
Upper CI
------------------------------------------------------------------------------
----
const         -0.1050     0.0076    -13.905     0.0000     -0.1198
-0.0902
year_norm      0.0033     0.0001     23.704     0.0000      0.0030
0.0036
fed_rate       0.0008     0.0003     2.7866     0.0053      0.0002
0.0014
==============================================================================
====
R-squared:                        0.1137
```

The year coefficient is 0.0033 at $p < 0.05$, for a total effect of 0.207 between 1960 and 2023. We find an increase in volatility in funding rounds announced in this period.

Robustness Checks

Restricted Period (Excluding 2019-2023)

Table 3: Firms Founded (1960-2018)

```
==============================================================================
====
             Parameter  Std. Err.     T-stat    P-value    Lower CI
Upper CI
------------------------------------------------------------------------------
----
const          0.0264     0.0014     19.335     0.0000      0.0237
0.0290
year_norm      0.0007   3.47e-05     21.007     0.0000      0.0007
0.0008
fed_rate   -6.578e-05  9.178e-05    -0.7167     0.4735     -0.0002
0.0001
==============================================================================
====
R-squared:                        0.0946
```

The year coefficient is 0.0007 at $p < 0.05$, for a total effect of 0.406 between 1960 and 2018. We find an increase in volatility in firms founded in this period.

Table 4: Funding Rounds Announced (1960-2018), Grouped by Industry

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==============================================================================
====
             Parameter  Std. Err.     T-stat    P-value    Lower CI
Upper CI
------------------------------------------------------------------------------
```

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----
const         -0.0546     0.0087    -6.2649     0.0000     -0.0716
-0.0375
year_norm      0.0025     0.0002     14.504     0.0000      0.0021
0.0028
fed_rate      -0.0030     0.0003    -9.9727     0.0000     -0.0036
-0.0024
==============================================================================
====
R-squared:                          0.0819
```

The year coefficient is 0.0025 at $p < 0.05$, for a total effect of 0.145 between 1960 and 2018. We find an increase in volatility in funding rounds announced in this period.

Restricted Period (Only Including 1994-2023)

Table 5: Firms Founded (1994-2023)

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==============================================================================
====
            Parameter  Std. Err.     T-stat    P-value    Lower CI
Upper CI
------------------------------------------------------------------------------
----
const          0.0529     0.0021     24.617     0.0000      0.0487
0.0571
year_norm      0.0004     0.0001     4.1199     0.0000      0.0002
0.0007
fed_rate      -0.0007     0.0003    -2.5711     0.0101     -0.0012
-0.0002
==============================================================================
====
R-squared:                          0.0121
```

The year coefficient is 0.0004 at $p < 0.05$, for a total effect of 0.0116 between 1994 and 2023. We find an increase in volatility in firms founded in this period.

Table 6: Funding Rounds Announced (1994-2023), Grouped by Industry

```
==============================================================================
====
            Parameter  Std. Err.     T-stat    P-value    Lower CI
Upper CI
------------------------------------------------------------------------------
----
const          0.0167     0.0037     4.4672     0.0000      0.0094
0.0241
year_norm      0.0027     0.0002     13.551     0.0000      0.0023
0.0031
```

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fed_rate       0.0023     0.0003     6.5702     0.0000      0.0016
0.0029
==============================================================================
====
R-squared:                          0.0648
```

The year coefficient is 0.0027 at $p < 0.05$, for a total effect of 0.0783 between 1994 and 2023. We find an increase in volatility in funding rounds announced in this period.

For both firms founded and funding rounds, the year coefficient and the R^2, which suggests that a large part of the effect found in previous regressions came from years between 1960 and 1993, where less data was available and estimates are probably less reliable. I would therefore conclude the results of the restricted regressions between 1994-2023 are closest to the true effects. Since the median of medians do not change significantly between the non-restricted and the restricted regressions, we may conclude that there is still a relatively strong time effect.

Limitations

The limitations of the data and methodology chosen are as follows:

- Crunchbase's labelling of industries is done by the firms themselves, for the purpose of being easily searchable. This biases the labels towards more trendy industries. Multiple labels are also allowed, resulting in the double counting of industries. We might imagine a hypothetical trend-following startup labelling itself an AI *and* a Bitcoin startup for extra hype points. These possible biases were not corrected for in the analysis. A future study might use a different source of labelling, such as The Refinitiv Business Classification.
- The analysis almost certainly aggregates very different firms together in the same industry. A future study might do a deeper analysis of smaller, more specific groupings to avoid potential confounders.
- Counts of firms founded and funding rounds announced were used instead of sums of firm estimated revenue or money raised in funding rounds, as not all firms and founding rounds have monetary data. This may distort results if there are differences in trends between the counts and sums e.g. the number of funding rounds have increased, while the total money raised remained the same. A future study might use sums instead.
- Volatility was used as a measure of hype. This means we can't conclude that hype leads to volatility from this study, or we would be assuming our own conclusion. An alternative measure for hype might be the tendency of firms founded/funding rounds announced to follow leading investors, news events, IPOs, or other indicators. A future study might then correlate both measures.
- It might also be interesting to study whether those indicators have gotten more or less accurate over time.
- The analysis aggregates different classes of investors together. A potential future research question might be to ask if there are differences in hype response between e.g. venture capitalists and government investors. (Retroactive, successful firms)

Conclusion

(...)

Appendix

Appendix 1: Firms Founded (1960-2023), Grouped by Industry Group

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==============================================================================
====
            Parameter  Std. Err.     T-stat    P-value    Lower CI
Upper CI
------------------------------------------------------------------------------
----
const          0.0830     0.0082     10.114     0.0000      0.0669
0.0991
year_norm   8.698e-05     0.0002     0.3732     0.7090     -0.0004
0.0005
fed_rate       0.0007     0.0004     1.9116     0.0560  -1.821e-05
0.0014
==============================================================================
====
R-squared:                         0.0011
```

The year coefficient is close to 0. We do not find any increase in volatility in firms founded between 1960 and 2023 when firms are grouped by industry group.

Appendix 2: Funding Rounds Announced (1960-2023), Grouped by Industry Group

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==============================================================================
====
            Parameter  Std. Err.     T-stat    P-value    Lower CI
Upper CI
------------------------------------------------------------------------------
----
const          0.1258     0.0285     4.4111     0.0000      0.0699
0.1818
year_norm      0.0006     0.0005     1.1092     0.2675     -0.0005
0.0016
fed_rate      -0.0076     0.0014    -5.4448     0.0000     -0.0103
-0.0048
==============================================================================
====
squared:                         0.0254
```

The year coefficient is 0.0006 at p > 0.05. We do not find any increase in volatility in funding rounds announced between 1960 and 2023 when funding rounds are grouped by industry group.

References

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[] Funk, J. (2021). American Affairs Journal. The Crisis of Venture Capital: Fixing America's Broken Start-up System

[] Cohen, S. S. & DeLong, J. B. (2016). Concrete Economics: The Hamilton Approach to Economic Growth and Policy.

[] Schumpeter, J. (1934). Theory of Economic Development. As an aside, I found Schumpeter's quote about entrepreneurship quite brilliant: "The conditions under which entrepreneurs may appear - neglecting the general economic and social conditions of the competitive economy - ... may be briefly and incompletely formulated as the existence of new possibilities more advantageous from the private economic standpoint - a condition which must always be fulfilled; the limited accessibility of these possibilities because of the personal qualifications and external circumstances which are necessary; and an economic situation which allows tolerably reliable calculation. **Why entrepreneurs appear under those conditions is ... the fact that anyone seizes a gain when it is immediately before his eyes**"

[] Guice, J. (1999) Designing the future: the culture of new trends in science and technology. Research Policy, 28(1):81-98

[] Hendler, J. (2008). Avoiding Another AI Winter. IEEE Intelligent Systems. 23:2-4

[] Graham, P. (2012). Startup = Growth. https://paulgraham.com/growth.html. Graham distinguishes between start-ups and "service businesses": "Let's start with a distinction that should be obvious but is often overlooked: not every newly founded company is a startup. Millions of companies are started every year in the US. Only a tiny fraction are startups. Most are service businesses — restaurants, barbershops, plumbers, and so on. These are not startups, except in a few unusual cases. A barbershop isn't designed to grow fast. Whereas a search engine, for example, is."

[] I should note, however, that all six firms except for Meta were founded before 2000, and all six firms except for Amazon achieved profitability in 5-6 years. Meta, then Facebook, was founded in 2004. Amazon achieved profitability in 10 years. *Uber* was founded in *2009*. (Funk, 2021)[] The dominance of the "Big Tech" is not only in profits; (...)

[] Mauboussin, M. J. & Callahan, D. (2020). Public to Private Equity in the United States: A Long-Term Look. Morgan Stanley

[] Graham, P. (2005). A Unified Theory of VC Suckage. https://paulgraham.com/venturecapital.html. Quote: "The huge investments themselves are something founders would dislike, if they realized how damaging they can be. VCs don't invest $x million because that's the amount you need, but because that's the amount the structure of their business requires them to invest. ... Google survived enormous VC funding because it could legitimately absorb large amounts of money. They had to buy a lot of servers and a lot of bandwidth to crawl the whole Web. Less fortunate startups just end up hiring armies of people to sit around having meetings."

[14] Harrison, K. (2022). The Blackstone of Innovation. Investing 101 Substack. https://investing1012dot0.substack.com/p/the-blackstone-of-innovation

[] Levine, M. (2023). Private Markets Don't Like to Go Down. Bloomberg Opinion. https://www.bloomberg.com/opinion/articles/2023-01-04/private-markets-don-t-like-to-go-down

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[] Layoffs.fyi. (2024). https://layoffs.fyi/. I should note that Microsoft, Apple, Amazon, Netflix, Alphabet, and Meta contributed only 70k of those 420k layoffs, and have still grown headcounts significantly since COVID-19. (Francis & Pipe, 2024). This continues a trend of "Big Tech" dominating the healthy parts of the tech industry (...).

[] Francis, T. & Pipe A. (2024). Tech Layoffs Keep Coming. Why Is Head Count Barely Budging?. The Wall Street Journal. https://www.wsj.com/economy/jobs/tech-layoffs-keep-coming-why-is-head-count-barely-budging-760a314b

[] United States Nominal GDP. (2024). CEIC. https://www.ceicdata.com/en/indicator/united-states/nominal-gdp

[] Jones, R. (2022). SoftBank Vision Fund Drew Big Persian Gulf Investors. Their Bets Are Floundering. https://www.wsj.com/articles/softbank-vision-fund-drew-big-persian-gulf-investors-their-bets-are-floundering-11660500235

[20] Cowen, T. (2011). The Great Stagnation: How America Ate All the Low-Hanging Fruit of Modern History, Got Sick, and Will (Eventually) Feel Better. I should note that I used a newer paper of Cowen's as my main reference: Cowen, T. & Southwood, B. (2019). Is the Rate of Scientific Progress Slowing Down?. GMU Working Paper in Economics. 21-13

[21] Cowen also describes a brief increase to 2% per year in the mid-1990s to early 2000s, which corresponds to the time period Amazon, Netflix, Alphabet, and Meta were founded.

[22] Bloom, Nicholas, Charles I. Jones, John Van Reenen, and Michael Webb. 2020. "Are Ideas Getting Harder to Find?" American Economic Review, 110 (4): 1104-44.

[25] Pisano, Gary. (2010). The Evolution of Science-Based Business: Innovating How We Innovate. Industrial and Corporate Change. 19. 465-482. 10.2139/ssrn.1545806. Quote: "Throughout much of the 20th century, a number of large US enterprises, including DuPont, Corning, Dow, General Electric, Westinghouse, Xerox, Kodak, IBM, and of course AT&T, created corporate research laboratories capable of pursuing leading edge science. A small number of Nobel Prize winners in Chemistry and in Physics even came from industrial laboratories. ... Increasingly competitive markets, combined with a shift in corporate governance principles that placed greater emphasis on maximizing sort-term shareholder returns, lead to the shuttering or curtailing of corporate research laboratories, including those at Xerox, Kodak, IBM, and GE. And even DuPont, by the 1980s, was asking its research laboratories to focus more on the commercial needs of the existing businesses."

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required. By contrast, innovation developed on the basis of abstract knowledge is easier to replicate in different contexts, allowing for the division of innovative labour.

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[] With the benefit of hindsight, I will note that AlphaGo's victory over Lee Sedol in Go and the public release of ChatGPT 3.5, happened in 2016 and 2022 respectively. Both events are generally considered milestones in AI development [The Mystery of Go, 1965], and both AIs used forms of neural networks

(...)

[What Happens After A Hype, 2010] describes a framework of hype that distinguished between media activities, as well as different types of expectation: project-specific expectations, general technological expectations, and broader social framing such as ethical debates. It describes hype around stationary fuel cells in Germany, finding that while there was hype and disappointment of media attention and general expectations, positive social framing of fuel cell technology limited the negative effect of disappointment on innovative activities. [Comparing Technological Hype Cycles, 2013] expands on this framework and describes differences in hype dynamics of three technologies: voice over internet protocol (VoIP), gene therapy, and high temperature superconductivity, finding that (...).