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# Retirement re-engineered with DeFi

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**In-depth series**
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# Financial Independence, Retire Early model formulated with 0% interest loans

The importance of financial education, and by extension, the goal to reach financial independence, has become a hot topic in the past decade. Financial Independence, Retire Early, also known as FIRE, has slowly grown into a formidable group of frugal consumers who aim to be able to sustain themselves by selling a small percentage of their investment portfolio every year. But Decentralised Finance interest-free loans might completely change the formula and build generational wealth after the fact. Copper runs through hundreds of paths for successful retirement should equities and structured products make their way onto the blockchain. Preliminary findings increase success exponentially.

In our last In-Depth, Copper discussed the potential of perpetually free lending against crypto, and possibly down the line, securities (read here). In a follow-up to the piece that generated a great deal of interest, our research team is putting pen to excel to establish a use-case that might change lives sooner than most realise possible.

The Financial Independence, Retire Early (FIRE) movement stipulates that if an investor can amass a portfolio, mainly consisting of index funds and bonds, and live off a 4% annual withdrawal, they would be able to retire. The portfolio may eventually go to zero as withdrawals are adjusted for inflation every year. The lower the annual withdrawal rate, the higher chance of success in the long-term.

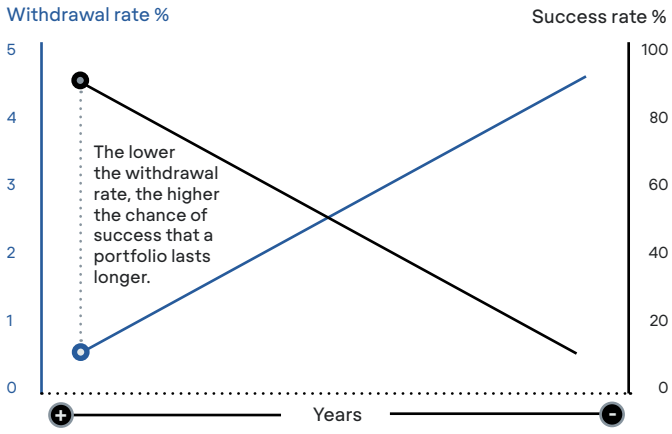
Just as an example, if an investor had $1mn in investments, they would be able to sell 4% every year - $40,000 - and live off that sum. If someone had $500k, they would need to keep their expenses below $20,000. The movement has given a lot of people food for thought in the right direction in living within their means and giving people financial peace.

The topic in fact has garnered so much attention that even Vanguard last year decided to do its own study on the topic as the 4% rule remains hotly debated (read here).

## New Calculations

There are quite a few sticking points to the model. Firstly, the 4% 'Safe Withdrawal Rate' (SWR), is based on historical returns of the stock market. The overall idea is that the S&P500, for example, would return an average of 10% per year in the long-

**The very basic maths behind FIRE**




term. Vanguard highlighted some problems in the model. The time horizon of 30 years isn't actually retiring early and the back-testing would have to see the results over a 50-year period; the main study for FIRE discounted fees and withdrawals would increase every year due to inflation. All these are factors that can derail the success of a portfolio holding up in the long-term. Of course, the FIRE community is well aware of these points and regularly discuss possible paths to success.

To its credit, Vanguard came out with a few suggestions that would increase the rate of success by using a flexible spending model rather than inflation-adjusted withdrawals, as well as diversifying into the international market rather than maintaining a US bias. Add to that a small decrease from the 4% rule to a 3.5% withdrawal and the success of an investors gone FIRE would increase.

## Retire ~~with~~ through debt?

We highlighted an article in our last report from the Wall Street Journal that showed that the wealthy are more than willing to pay 4-5% annual interest against their portfolio rather than selling their stocks. The article titled "Buy, Borrow, and Die" showcased a very different mindset to those looking to retire early who keep their expenses low, and have little to no debt.

And certainly, for such a lifestyle, by living off an investment portfolio on sale the mathematical dynamics wouldn't be able to sustain any sort of heavy long-term debt. Markets are volatile and there are risks involved.

Any reader of our research knows how measured we are in our takes. Which is why for us to say that Decentralised Finance (DeFi) might be on the cusp of reformulating FIRE calculations should be taken with some consideration.

## Never Sell.

Lenders consider multiple factors when creating products and their interest rates. What are the Fed rates? How creditworthy is the person? What rates are the competition charging? After all, banks are large operations that have large costs to cover. Even with Fed rates being so low, traditional outfits are still charging a pretty penny to borrow against securities (see table below).

**TD Ameritrade Securities Based Lending interest rates**

| Credit line amount | Base rate p.a. |
|---|---|
| $100,000 - $249,999 | SOFR + 4.10% |
| $250,000 - $499,999 | SOFR + 3.10% |
| $500,000 - $999,999 | SOFR + 2.60% |
| $1,000,000 - $2,999,999 | SOFR + 2.25% |
| $3,000,000 and above | SOFR + 1.60% |

DeFi, however, doesn't have any real large overhead. It's code. A website that links into the blockchain and wallets. Which is why protocols such as Liquity on Ethereum, and Hedge on Solana can give up to 90% Loan-to-Value against cryptocurrencies at 0% interest rate, forever, with only a small charge of 0.5% on the total value of the loan upon origination.

Importantly, the fee gets added to the debt, and not reduced from the net take. Also noteworthy is that while these protocols have tokens, they are not required to partake in the offering. Which is why Copper will not evaluate the token economics or valuations of protocols as that is beside the point – we're assessing how to utilize current investments, not necessarily make new ones.

In the 80's with nominal interest rates on mortgages as high as almost 19%, the idea of a 0% lifelong interest rate would have been science fiction. But this offer is live against either Ethereum or Solana as collateral.

For the majority of the world, this isn't going to cut the mustard with volatility being so high. And forget about FIRE on crypto collateral. But what happens when the S&P500 index such as State Street's SPY, or Invesco's Nasdaq 100 tracker, the QQQ, make their way onto the blockchain and into these protocols as collateral? The tokenization process has actually already been done via the FTX exchange (although dividend payments aren't clear, neither are transfers). But half the equation is there.

## Getting kicked while you're down

Warren Buffet is clearly not a fan of crypto. And one of the key architects and voices of the FIRE movement, Peter Adeney, is also no fan of crypto, placing the asset class in the rankings of gamblers. But both are champions of compounding interest. Which is why gradually selling part of an investment portfolio, even just 4% a year, can make a devastating difference in accumulated wealth (albeit the goal of FIRE is to be financially independent, not rich.)

We have to ask: why not be on FIRE and have growing wealth?

While the long-term shows an average 10% return annually on the S&P500 (a figure that will forever be disputed higher or lower), the reality is that markets aren't linear. Stock markets have a lower frequency of going into the negative, but when they do, the deep sell-offs would make withdrawals at lows painful for portfolios.

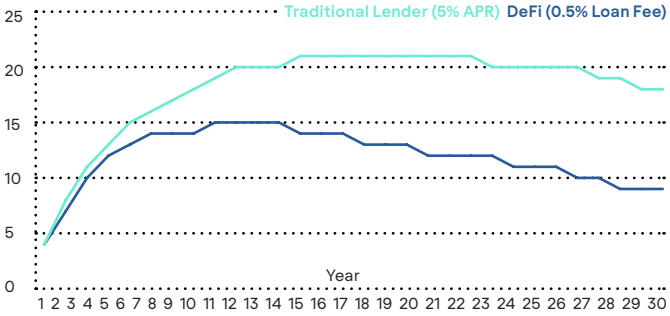
Four cycles in the stock market have been particularly draining on accounts – 1929, 1940, 1973 and 2000. These cycles saw multiple negative years and which is why we start our analysis looking at these periods by borrowing against assets rather than selling.

## Beware of averages

Followers of the FIRE model would sell a portion of their investments to cover their costs. The transaction is pure and simple holding only the risk of returns. But when borrowing, there is a minimum balance that must be maintained before either getting a margin call or being liquidated.

Under traditional Securities-Based Lending, banks typically give credit lines between 50-70% of the investment portfolio. With DeFi, Loan-to-Value (LTV) can be as high as 90%. But the linear assumption of a 10% annual return gives a false sense of security (see chart). Under this assumption, LTV would never come close to margin call thresholds. But in reality, margin calls would be triggered multiple times across the retirement lifecycle if borrowing from a traditional lender as we will show.

**Based on averages: Loan-to-Value (%) at 10% growth & 4% borrow**



Assumptions • Annual S&P500 returns include dividends reinvested • 0.03% Fee • 5% Interest rate from TradFi on Securities-based lending • Inflation-adjusted withdrawals • Intra-day lows not assessed • $1mn starting portfolio • Taxes on sale of equities not accounted (FIRE)

## 1929 - 1958

The 'Great Crash' of 1929 was the only time that the US stock market saw four consecutive years in the red. Investor portfolios dropped by nearly 65% over the course of the Great Depression. It took four more years for investors to see the same value only to be hit by another down cycle. All in all, it took 15 whole years before coming back to parity and moving up.

Under this stress scenario, the FIRE model would hold up for almost 60 years at a 3.5% withdrawal rate before hitting zero, proving just how powerful the idea is. A 4% withdrawal rate will shrink that to only 24 years. But the end result for both scenarios is a zero balance and seeing funds dwindle during retirement.

Under a borrowing model, things change dramatically. Investors would see their net balances shrink in the early years, but would ultimately retire on a wealthy nest egg in 30 years as no stocks had been sold (see chart). But this would only work under the DeFi model of borrowing at no interest. The interest charged on the lending against stocks in the traditional sense would hit margin calls more often than not. Under DeFi, it would be smooth sailing (see charts).

## 1940 - 1969

Despite kicking off the first two years of the 1940's in the negative, the two decades following proved to be the largest growth periods in the stock market's history. This makes all models work very efficiently, albeit certainly not representative of the future.

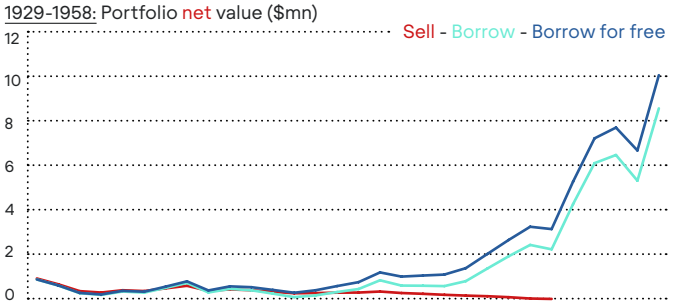
Having said that, Copper tested the numbers to find out what would be the maximum withdrawal rate that would have been successful and the results are mind-boggling.

For FIRE investors who would be selling their equity, a 6.2% withdrawal rate would have seen them hold on for 50 years - over a 50% increase from the current rule for safe withdrawals.

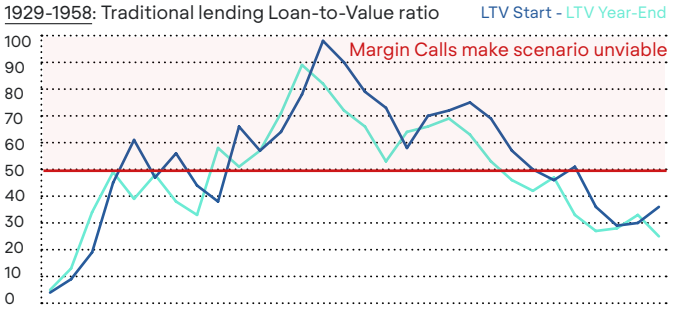
Under the traditional lending scenario, a 6% annual borrow rate would have no margin calls and would result in a 2400% net balance at the end of a 30-year period. DeFi would more than double the borrow rate to a massive 14% and an even larger net balance (see charts).

Of course, there is zero chance of anyone knowing this which is why we're aiming to find the annual Safe Withdrawal Rate (SWR) under a DeFi borrowing scenario across the historical data.

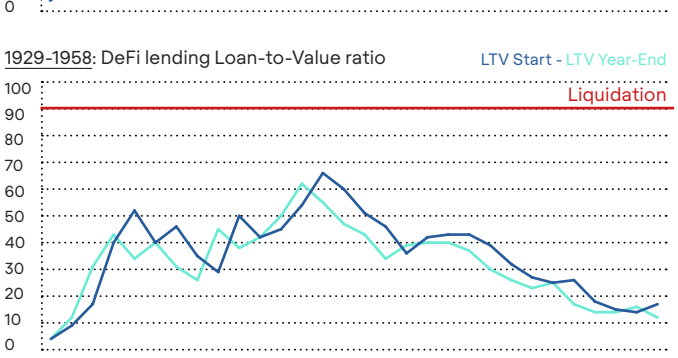
1929-1958: Portfolio net value ($mn)



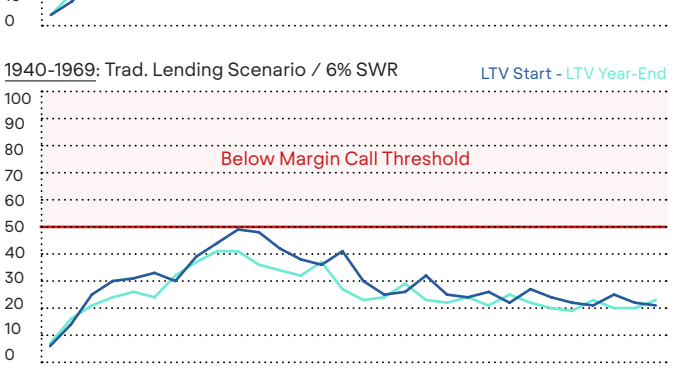

1929-1958: Traditional lending Loan-to-Value ratio



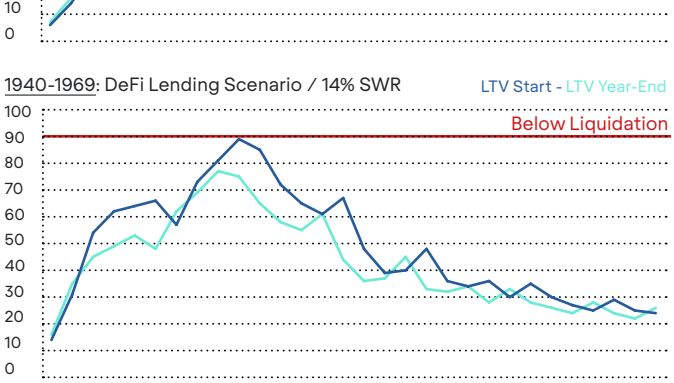

1929-1958: DeFi lending Loan-to-Value ratio




1940-1969: Trad. Lending Scenario / 6% SWR




1940-1969: DeFi Lending Scenario / 14% SWR



## 1973-2002

A stock market Pandora's box showed that this period was fairly painful for investors, having started and ended on multiple negative years.

FIRE investors would have only been safe by selling 3.5% of their portfolio to maintain their retirement well after their 'Golden Years'.

On the upper-side of the DeFi borrowing scenario, the peak withdrawal rate would have been 9.5%. And under a traditional lending scenario, the SWR that would result in no margin calls would have been closer to 4.1% and a net portfolio after paying off the debt at 14× not adjusted for inflation at the end of a 30-year period.

Importantly, the debt difference between the two borrowing models would be double as the interest rate compounds versus the DeFi fee on simply initiating the loan (see chart). In fact, the interest on the debt is almost as much as the withdrawals over the 30-year period, with net take adjusted for yearly inflation as with all our examples.

## 2000-2021

While the period since the Dot-com bubble burst hasn't yet closed the 30-year mark, it would be remiss to not assess the time that stock markets also saw the 'Great Financial Crisis' come about shortly after.

Again, FIRE would still hold up in the long run at a 3.5% withdrawal rate. Past that becomes prickly territory with the remaining portfolio balance just under what was started with (see chart).

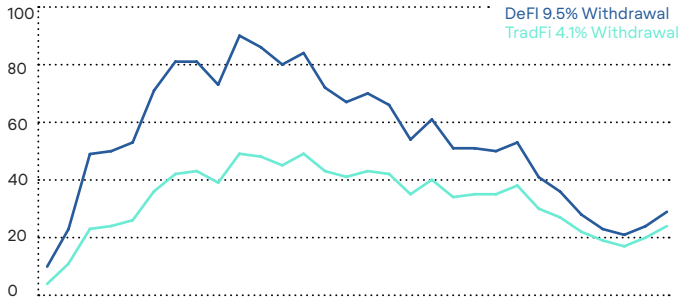
Under a DeFi borrowing model, the safe borrow rate indeed also plummets from what we've seen previously to 5.5%. But the worst would be borrowing from a financial institution which would have seen a mere 2.35% safe borrow rate before being margin called.

## Cherry picking is nice, but...

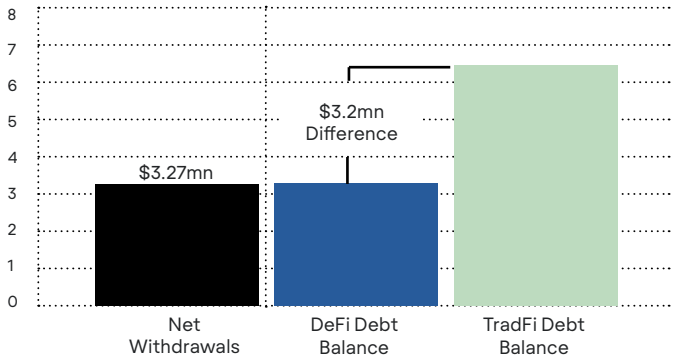
Up until this point we've looked at some of the worst cycles in stock market history. While these examples have certainly illustrated very important data points, the reality is that a safe borrow rate needs to be established across all years.

So far, we've seen that under a DeFi borrowing model, the safest withdrawal rate has ranged between 5.4-14%. By no means a small difference to the current rule of thumb. But it's also important to note that growth of the investment portfolio is sustained.

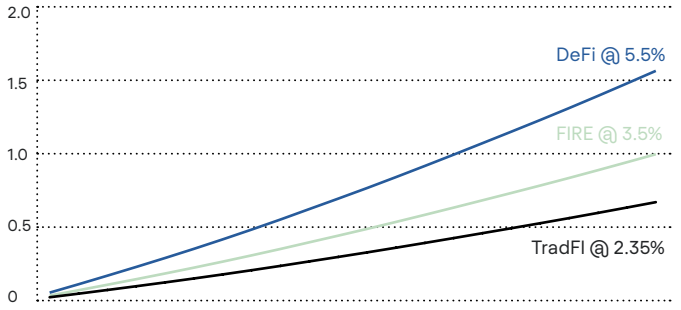
1973-2002: Safe Loan-to-Value Ratio **for period**



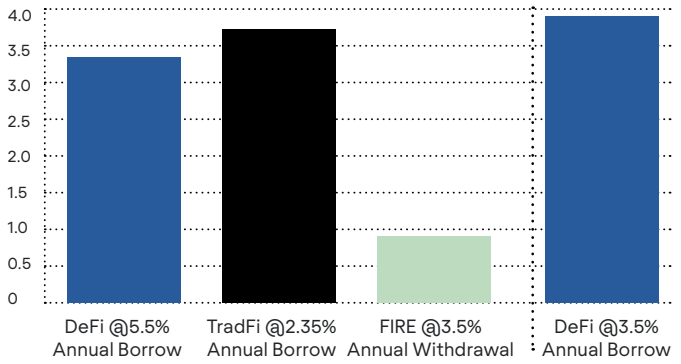

1973-2002: Debt Balance ($mn) - 4.1% Annual Borrow Rate




2020-2021: Cumulative Withdrawals ($mn)




2020-2021: Portfolio **Net** Balance ($mn)




As a reminder, we are simply using historical data to assess what would happen under similar circumstances to the FIRE model. Things might not get that bad. Then again they might. The exercise aims to find a successful ratio based on history which holds no guarantee of the future.

## Back-testing for 30 years

Seeing as the goal of using 0% interest loans to borrow against equities would end with a growing portfolio, Copper looked at 30-year periods starting from 1929 up until 1991.

As we showed earlier, during the 'Great Depression' this model would allow a 5.4% safe annual borrow rate (ABR). However, excluding this period, the minimum across the span of 60 years of stock market returns would actually be 7.3% ABR.

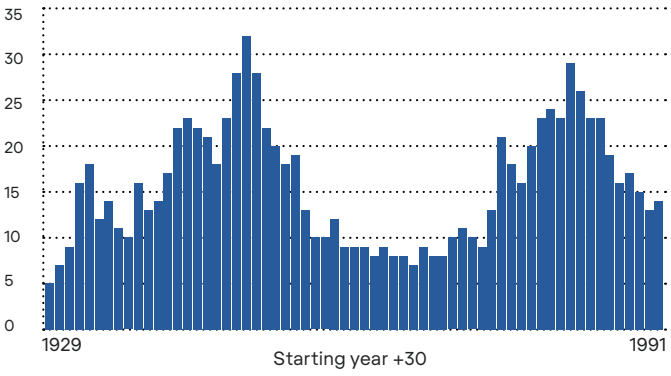
In essence, this means that investors would be able to access almost all the future estimated 10% return of the S&P500 *today*.

Having said that, we tested the returns and ABR right to the edge of maintaining a 90% LTV to avoid liquidation or the need to pay off part of the outstanding debt.

On the maximum side, if an investor began their retirement in 1949, they would have been able to safely withdraw a whopping 32.3% every year. This comes on the back of stock markets returning an average of over 25% between 1949 and 1955. The net portfolio balance would be over 700% (unadjusted for inflation).

Clearly, there is no way of knowing such things. ABR results are very cyclical (see chart below). Between 1978-1985, the safe borrow rate would have been north of 20%. But between 1959 and 1970, this would have been under half that.

DeFI Annual Borrowing Rate to avoid liquidation over 30-years (%)




As we noted earlier, investors who could have begun this strategy in 2000, had it existed as an option, would have seen a maximum ABR of 5.5%, below the 30-year data minimum we see above, akin to the 1929 crash.

Which brings us to a very important point: getting off at the right foot before taking out loans against equity is of key importance. Should stock markets go into the red, careful adjustments would need to be considered (see addendum p8).

**What the annual borrow rate would be depending on start year**
**Note: To maintain healthy ABR, withdrawals would be much less.**

| Starting Year until +30 years | Annual Borrow Rate | Net ROI | Annualized Net Return | Years-to-LTV Peak (90%) |
|---|---|---|---|---|
| 1929 | 5.40% | 856% | 7.80% | 14 |
| 1930 | 6.50% | 1069% | 8.50% | 13 |
| 1931 | 9.20% | 1429% | 9.50% | 12 |
| 1932 | 16.40% | 3406% | 12.60% | 11 |
| 1933 | 17.80% | 3223% | 12.40% | 10 |
| 1934 | 12.10% | 2600% | 11.60% | 9 |
| 1935 | 14.20% | 3101% | 12.20% | 8 |
| 1936 | 11.20% | 2318% | 11.20% | 7 |
| 1937 | 9.60% | 1413% | 9.50% | 13 |
| 1938 | 16.40% | 2893% | 12.00% | 12 |
| 1939 | 13.20% | 2438% | 11.40% | 11 |
| 1940 | 14.10% | 2098% | 10.80% | 10 |
| 1941 | 17.10% | 2366% | 11.30% | 9 |
| 1942 | 22.30% | 3104% | 12.30% | 8 |
| 1943 | 22.70% | 3116% | 12.30% | 7 |
| 1944 | 21.50% | 1798% | 10.30% | 7 |
| 1945 | 20.80% | 673% | 7.10% | 6 |
| 1946 | 17.70% | 827% | 7.70% | 9 |
| 1947 | 22.80% | 1251% | 9.10% | 8 |
| 1948 | 27.50% | 844% | 7.80% | 7 |
| 1949 | 32.30% | 703% | 7.20% | 6 |
| 1950 | 28.10% | 816% | 7.70% | 26 |
| 1951 | 22.20% | 1058% | 8.50% | 25 |
| 1952 | 19.90% | 677% | 7.10% | 24 |
| 1953 | 17.80% | 791% | 7.60% | 23 |
| 1954 | 18.80% | 1113% | 8.70% | 22 |
| 1955 | 12.80% | 726% | 7.30% | 21 |
| 1956 | 10.10% | 836% | 7.70% | 20 |
| 1957 | 10.00% | 990% | 8.30% | 19 |
| 1958 | 12.10% | 1155% | 8.80% | 18 |
| 1959 | 9.10% | 950% | 8.20% | 17 |
| 1960 | 8.60% | 1239% | 9.00% | 16 |
| 1961 | 9.20% | 1114% | 8.70% | 15 |
| 1962 | 7.70% | 1241% | 9.00% | 14 |
| 1963 | 9.10% | 1454% | 9.60% | 13 |
| 1964 | 8.00% | 1282% | 9.10% | 12 |
| 1965 | 7.50% | 1042% | 8.50% | 11 |
| 1966 | 7.30% | 1420% | 9.50% | 10 |
| 1967 | 9.20% | 2026% | 10.70% | 9 |
| 1968 | 8.10% | 2316% | 11.20% | 12 |
| 1969 | 8.10% | 2798% | 11.90% | 11 |
| 1970 | 9.90% | 3806% | 13.00% | 13 |
| 1971 | 10.60% | 3168% | 12.30% | 12 |

Continued next page

As such, the 4% rule used by FIRE can still apply under a DeFi borrowing model promising a great deal of margin of safety against liquidation or margin calls.

The key difference would be in being able to maintain the benefit of the compounding growth that makes the stock market such a lucrative financial avenue. At least historically.

Highlighted in the aforementioned WSJ article, is the tax benefit of not selling stocks too. This would make a huge difference in the net take between the FIRE model of selling stocks versus borrowing against them.

There are also other strategies that could be considered when in a positive position. For example, selling stocks only when the stock market is up over a few years rather than increasing the debt, would increase the success rate while locking in some profits. And plenty of strategies will develop through this vibrant community of conscientious spenders and diligent investors.

## Greed? No need...

The goal of FIRE is in the title itself. And to be able to maintain financial independence, chasing riches is certainly not the main idea. However, with the opportunity to borrow at 0%, the model under DeFi will prove to leave investors with a much larger chance of success **and** generational wealth.

## Stuck transaction

While we did state this earlier, tokenized stocks and structured products have yet to make it onto the blockchain as far as transactions are concerned. But most of the formula for what has been discussed in this report has actually been done.

As things stand, the world is indeed 'DeFi-FIRE-ready' to take advantage of these new developing strategies for retirement and financial independence.

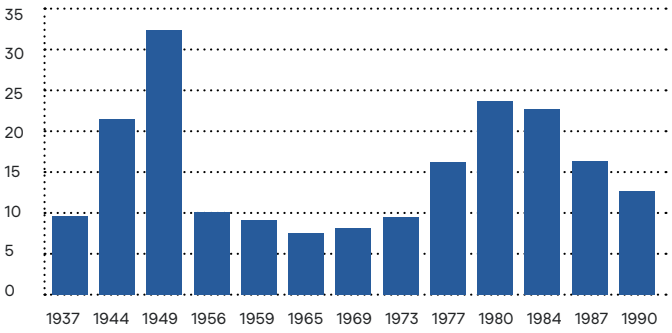
Global exchange, FTX, has already tokenized plenty of stocks, products and even the S&P 500 (SPY) on the Solana blockchain. And Hedge, also built on Solana, has the 0% interest protocol live.

Hedge would have to accept the assets as collateral, which would be a no brainer.  But what has not happened yet is the ability to move these tokenized stocks from FTX to any protocol.

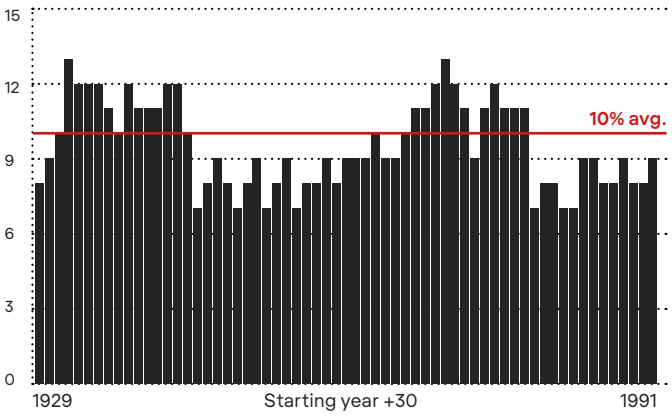
How about it, Sam?

| Starting Year until +30 years | Annual Borrow Rate | Net ROI | Annualized Net Return | Years-to-LTV Peak (90%) |
|---|---|---|---|---|
| 1972 | 10.20% | 2257% | 11.10% | 11 |
| 1973 | 9.40% | 1220% | 9.00% | 10 |
| 1974 | 12.60% | 2036% | 10.70% | 9 |
| 1975 | 20.70% | 3091% | 12.20% | 8 |
| 1976 | 17.70% | 2265% | 11.10% | 10 |
| 1977 | 16.20% | 2157% | 10.90% | 9 |
| 1978 | 20.20% | 2379% | 11.30% | 8 |
| 1979 | 22.50% | 713% | 7.20% | 7 |
| 1980 | 23.60% | 901% | 8.00% | 6 |
| 1981 | 22.60% | 767% | 7.50% | 8 |
| 1982 | 28.70% | 692% | 7.10% | 10 |
| 1983 | 26.30% | 753% | 7.40% | 27 |
| 1984 | 22.70% | 1108% | 8.70% | 26 |
| 1985 | 22.90% | 1278% | 9.10% | 25 |
| 1986 | 18.50% | 925% | 8.10% | 24 |
| 1987 | 16.30% | 918% | 8.00% | 23 |
| 1988 | 16.60% | 1198% | 8.90% | 22 |
| 1989 | 15.30% | 895% | 8.00% | 21 |
| 1990 | 12.60% | 1033% | 8.40% | 20 |
| 1991 | 14.20% | 1359% | 9.30% | 19 |

ABR following two years of consecutive stock market gains (%)




Annualized returns using DeFi borrowing model & maximum ABR (%)



# Addendum: New Rules for DeFi FIRE

The reality is that our findings don't practically change the 4% rule. With a range of 5-32% in safe borrowing against equities, all we've really proven is that the safe Annual Borrow Rate is the lowest point at 5%. The higher numbers in the range are purely speculative and dangerous without considering other factors.

But a 25% increase in net take is not a small amount by any means. Add to that the benefit of a growing portfolio and the chance of success that investments hold up in the long run increases.

There is then a great deal of merit in the potential model, however it requires fine-tuning as the 5% safe borrow rate found teeters on the edge of a margin call or liquidation at least twice against the historical data using that rate. All said however, retirement should be healthy and not focused on LTV.

The 4% rule has been broken down by many people. Retirement that requires a longer period, over 30-years, would need to be adjusted down to 3.5%. This point has been reiterated by the FIRE community and a suggested watch is Ben Felix on the topic.

## The 4%+4 Rule

As previously mentioned getting off on the right foot can drastically change the safe borrow rate. But there is pretty much little chance of anyone knowing what will happen in the stock market and so investors will have to adjust their withdrawals depending on how much of a return they make early on when they begin taking out loans against equity.

On average, the stock market cycles show a recovery at just under 4 years. Which gives us another data point to explore.

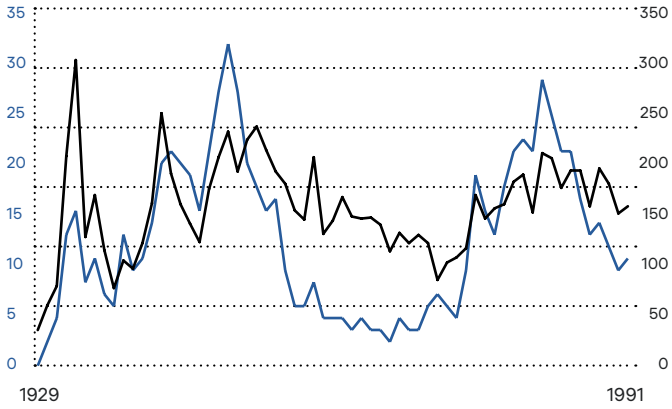
We find significant trend correlation of the back-tested ABR with the value of the portfolio after 4-years (see chart 1). Importantly, we also find that the ABR trends upwards depending on the portfolio value after the fourth year (see chart 2).

Investors starting at a 4% ABR, followed by a 1% increase every four years and up to a 7% ABR will find healthy margin to avoid liquidation or margin calls (see table).

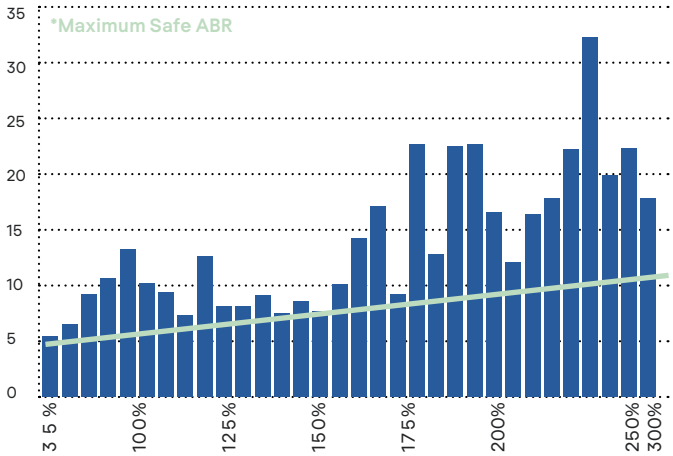
This is one strategy that the numbers back. But we're sure that many other ideas are likely to spruce up with such financial tools at everyone's disposal.

Copper will certainly be revisiting this topic. And we're certainly open to ideas and comments. Ping us at research@copper.co

1: ABR vs Portfolio value after 4-years (%)




2: Minimum* ABR depending on value of portfolio **after 4-years** (%)




Borrowing starting at 4% and increasing by 1% every four years up to 7%

| Year | LTV-Peak | Net ROI | Annualized |
|---|---|---|---|
| 1929 | 86.80% | 823% | 7.70% |
| 1930 | 71.30% | 1071% | 8.50% |
| 1940 | 31.40% | 2515% | 11.50% |
| 1950 | 19.90% | 1792% | 10.30% |
| 1960 | 58.80% | 1364% | 9.40% |
| 1970 | 49.10% | 4072% | 13.20% |
| 1980 | 20.30% | 1931% | 10.60% |
| 1990 | 42.50% | 1319% | 9.20% |
| 1991 | 37.10% | 1708% | 10.10% |
| 2000-21 | 77% | 218% | 3.90% |

**Financial Independence, Retire Early Resources**

- Reddit (See sidebar for links)
- Mr Money Mustache
- The shockingly simple maths behind early retirement
- Fire Calculator

CYBER ESSENTIALS CERTIFIED PLUS

2013 ISO 27001 REGISTERED

Certified by QMS - Cert No: 351152020

SWISS BLOCKCHAIN FEDERATION

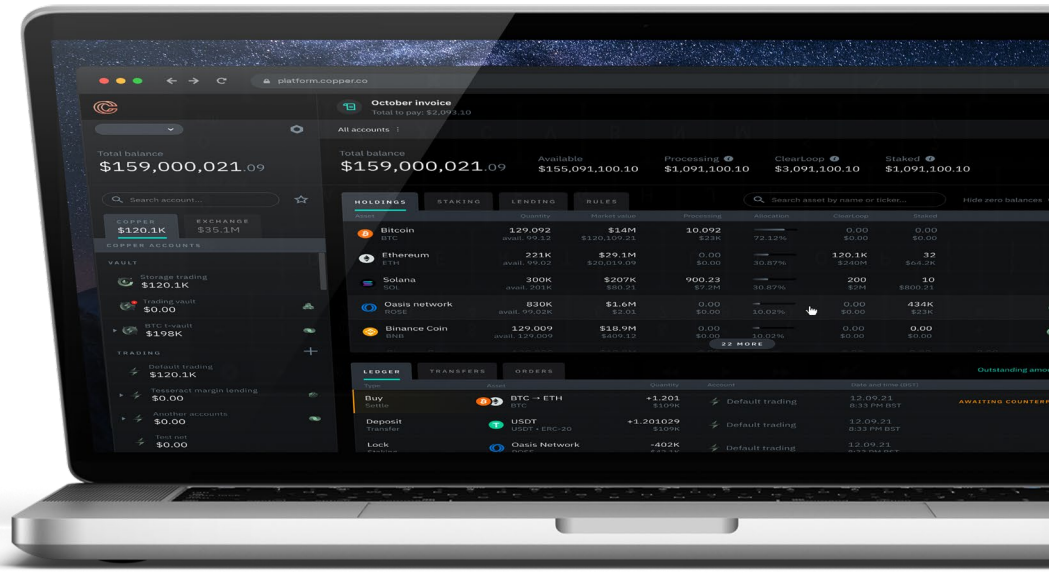
AIMA

OMFIF

ISDA

STATE STREET

GLOBAL PARTNER

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