Understanding Crypto Fundamentals

Value Investing in Cryptoassets and Management of Underlying Risks

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To you, the readers who take
their financial future into their hands

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About the Author

Thomas Jeegers studied economics and computer science, with master's degrees from the Catholic University of Louvain and Maastricht University and an MBA from INSEAD.

Specialized in financial risk management and blockchain technology, Thomas has worked in finance for the past ten years. In parallel to his work, he completed the advanced financial certifications Chartered Financial Analyst (CFA) and Financial Risk Manager (FRM), as well as multiple blockchain certifications from institutions including INSEAD and Oxford University. He is now also a frequent speaker at events on blockchain and cryptoassets.

About the Technical Reviewer

Yamini Sagar is the founder/CEO of Instarails, a company that provides instant global payment rails. She has over 20 years of experience in tech, blockchain, and payments and has a track record of building innovative products. Yamini has worked at renowned companies like Intercontinental Exchange NYSE, BitPay, and Bakkt. She has been an amateur investor in cryptos since 2018, and her favorite is Bitcoin. When she's not working, Yamini enjoys reading about emerging technologies and sharing her insights on the latest trends.

Disclaimer

This book is not a recommendation to buy cryptoassets but rather a structured analysis of what they are, why they may be appropriate for some investors, and what such investors ought to consider. In this regard, several disclaimers are necessary.

First, I am not a financial advisor. The contents of this book should be regarded as educational, not as financial advice.

Second, cryptoassets are subject to high price volatility and more legal uncertainty than traditional investments. Facing this volatility and uncertainty is not appropriate for all investors.

Third, the cryptoasset space is evolving very rapidly. Every effort was made to provide up-to-date sources at the time of publication. However, it may no longer be the case when you read these lines. I can, therefore, hold no responsibility for outdated information or decisions (financial or otherwise) made based on the material covered in this book.

Any investor, in cryptoassets or otherwise, should assess whether a particular investment fits one's specific needs. They include risk-return characteristics, liquidity, time horizon, tax status, and other unique features. Any investment should be considered as part of the investor's total portfolio, not as an independent investment. Furthermore, one is responsible for doing one's own investment research, especially in regard to understanding the underlying risks. If you do not have the ability or desire to perform such an assessment, refer to a financial advisor who could tailor portfolio recommendations based on your unique needs and characteristics.

Preface

I decided not to invest in cryptoassets—many times. However, recent developments changed my mind.

On a Saturday evening in the autumn of 2012, I sat with friends for a session of our newly-formed think tank in Brussels. It was my turn to bring up a mind-provoking topic. Our group had diverse expertise ranging from engineering to IT and physics. Leveraging my economics background, that day's topic was the revolutionary potential of complementary currencies. Indeed, monetary systems working in parallel to a traditional single-currency model can benefit local communities in countless ways. At the time, I was not even aware of Bitcoin's existence. Still years ahead of cryptoassets becoming mainstream, alternative currencies were an obscure idea that needed to emerge.

This visionary concept would change everything. In the same way steam, electricity, and the Internet triggered the first, second, and third industrial revolutions, reframing society's use of currencies could initiate a fourth industrial revolution.

A couple of months later, I heard about Bitcoin for the first time during an economic conference in Zurich. Yet, despite my unwavering belief in alternative currencies' potential, I considered that this new digital currency was not worth its trading price, $70 apiece.

I then specialized in regulatory risk management and eventually became the local expert on blockchain technology in Germany's third-largest bank. However, given the underlying risks, I still argued in April 2016 that $430 per bitcoin was grossly overpriced. Despite blockchain's promising future, this nascent technology could not be relied upon to replace current ways of working in finance or our monetary system. Yet.

Even after completing an MBA in Singapore in 2018, I doubted investing in cryptoassets was worth the risk. I believed that past returns orders of magnitude above the highest-performing traditional asset class did not justify the lack of fundamentals. Ultimately, Bitcoin and other cryptoassets relied exclusively on trust that a peer-to-peer network would keep working. Too much could go wrong. While Bitcoin was a fascinating use case of technology as a monetary system, its likelihood of failure was exceptionally high.

During 2021's market bull run, Bitcoin and other cryptoassets made the headlines again. Thanks to recent developments in the cryptoasset industry, their adoption skyrocketed. Institutions formerly loudly advocating against cryptocurrencies changed their mind. Many of these institutions started offering cryptoasset services; some even invested considerable amounts in such assets.

Another increase in value ensued. By one order of magnitude. For the seventh time in a decade.

The last few years passed multiple milestones in cryptoasset history. We witnessed El Salvador become the first country to adopt Bitcoin as legal tender, and the financial industry evolved to leverage cryptoassets' potential. It established cryptoassets as an asset class. Regulatory uncertainty dropped, likely making cryptoassets the asset class with the most attractive risk-adjusted expected return.

For a decade, I have been too risk-averse to dare set foot in the crypto arena. However, still highly risk-conscious, I believe it is now time to step in for most investors—even risk-averse ones like me.

And I am not the only one who feels this way.

> *I don't think there is anything more important in my lifetime to work on [than Bitcoin].*
>
> —Jack Dorsey, CEO of Twitter and Block (previously Square)
> June 4, 2021, Bitcoin 2021 Conference

> *Bitcoin is a bank in cyberspace, run by incorruptible software, offering a global, affordable, simple, & secure savings account to billions of people that don't have the option or desire to run their own hedge fund.*
>
> —Michael Saylor, CEO of MicroStrategy
> December 17, 2020, Twitter

> *Paper money is going away. And crypto is a far better way to transfer value than a piece of paper, that's for sure.*
>
> —Elon Musk, CEO of Tesla, SpaceX, and Twitter
> February 19, 2019, interview with ARK Invest

Something like bitcoin is going to be successful, and it's going to enable a whole new way of doing finance.

—Richard Branson, Founder of the Virgin Group
October 21, 2016, Twitter

PayPal had these goals of creating a new currency. We failed at that, and we just created a new payment system. I think Bitcoin has succeeded on the level of a new currency, but the payment system is somewhat lacking.

—Peter Thiel, Co-founder of PayPal,
February 2015, interview with The Buttonwood Gathering

[Bitcoin] is a remarkable cryptographic achievement. The ability to create something which is not duplicable in the digital world has enormous value.

—Eric Schmidt, former CEO of Google,
March 2014, Computer History Museum

Bitcoin is the beginning of something great: a currency without a government, something necessary and imperative.

—Nassim Taleb, *New York Times* best-selling author
March 20, 2013, Ask Me Anything (AMA) on Reddit.com

I think the Internet is going to be one of the major forces for reducing the role of government. The one thing that's missing, but that will soon be developed, is a reliable e-cash, a method whereby on the Internet you can transfer funds from A to B without A knowing B or B knowing A…

—Milton Friedman, Economics Nobel Prize laureate 1999,
interview with the NTU

This book started as my notes on the optimal crypto investment strategy. It uncovers the exceptional potential of cryptoassets and their specific risks. Debunk the myths, set up a meaningful investment portfolio, and get to terms with this volatile new world.

Feedback

I welcome any feedback and suggestions for possible future editions of the book. Please feel free to share any thoughts by emailing me at thomas@thomasjeegers.com.

Introduction

An investment in knowledge pays the best interest.

—Benjamin Franklin

Fundamental analysis is the concept of thoroughly researching an asset's economic value and the drivers for its price. In the case of a stock, it involves understanding the underlying company's business and financial statements. In the case of a commodity, it involves understanding the commodity's inventory and seasonal cycles, government policies, and related markets, as well as the drivers of supply and demand for it. The fundamentals of a stock and the fundamentals of a commodity are therefore wildly different.

Likewise, the fundamentals of cryptoassets are also unique. They involve understanding how digital information can have value, what drives this value, and how the cryptoasset ecosystem impacts it. However, similarly to any tradable asset, the market price of a cryptoasset ultimately boils down to supply and demand.

Fundamental analysis is used for long-term investment. It differs *fundamentally* from technical analysis, which analyses an asset's monthly, weekly, daily, or even intra-daily price patterns to predict short-term moves. In other words, fundamental analysis is the investor's tool, the same way technical analysis is the speculator's tool. Assets subject to fundamental and technical analyses span debt to equity, real estate to derivative products, currencies to traded funds, and any security. Of course, cryptoassets do not escape scrutiny.

However, they differ in the type of asset at hand. In particular, blockchain technology makes Bitcoin the first digital asset that is scarce and cannot be counterfeit. It is achieved by decentralizing the asset, meaning that there is no unique network owner. Through an ingenious combination of multiple technologies, it enables worldwide transfers of value settled in minutes and permanently, without requiring any intermediary. These characteristics make Bitcoin and other cryptoassets the logical next milestones in the development of a global society's monetary and financial system. It is not a revolution but rather an evolution—the natural next step in the history of money and finance. They not only offer monetary digitalization but also, and much more importantly, decentralization.

As this book covers in detail, decentralization makes cryptoassets the base for a strictly superior monetary model compared to paper-based currencies emitted by governmental entities or private banks. Indeed, with sufficient adoption, cryptoassets offer greater value in all three core functions of money: unit of account, store of value, and medium of exchange.

In addition, the consequences of this disruption reach far beyond the monetary system. In an increasingly digital society, sharing digital assets needs fair and transparent rules. It is not only valid for money but also for identity, property titles, music, and art, among many other use cases. As a result, virtually all industries will be impacted, directly or indirectly, by cryptoassets and their underlying technology, blockchain. In particular, Chapter 3 presents multiple ways blockchain technology revolutionizes the world as a driver for the greater good.

This book primarily covers the potential of cryptoassets as part of the next monetary system and as a new asset class for investments. In particular, it analyzes cryptoassets from an economic and financial perspective, following principles of value investing. In other words, the aim is to identify what this new asset class is worth. The book identifies and measures fundamental pillars of cryptoassets to help assess their genuine value. It also balances the picture by highlighting the underlying risks, both financial and non-financial. Specifically, it is structured following critical questions that any investor, experienced or new, should ask before investing. *Why* is this asset class valuable? *What* is this asset class made of? *When* is the right time to invest? *Where* should one invest? *How* should one invest in terms of investment strategy and risk management? And finally, *which* valuation methods exist and are appropriate for cryptoassets? This book does not recommend any particular investment but provides the framework necessary to make more informed cryptoasset investment decisions. It enables an understanding of why they have true economic value and hints at how to measure it. It is the starting point for serious long-term cryptoasset investors rather than the answer for short-term speculators looking for get-rich-quick schemes.

Besides, outstanding cryptoasset resources already exist. This book does not seek to replace but rather complement them with a focus on value investing. Covering technical aspects of cryptoassets and blockchain technology too deeply would divert the focus from this book's purpose. All intricacies behind this technology would barely even fit in a book of their own. Therefore, this book only covers blockchain technology's high-level functioning. In particular, it does not cover the following topics.

- Advanced cryptography and dApps programming. Interested readers and programmers should refer to the in-depth book *Mastering Blockchain* by Imran Bashir [1].
- Non-fungible tokens (NFT). Interested readers should refer to *The NFT Handbook* by Fortnow and Terry [2].
- Cryptoasset taxation. Tax considerations of cryptoassets are wildly different for every country and rapidly evolving. Interested readers can refer to the extensive book *Taxation of Crypto Assets* by Schmidt, Bernstein, Richter, and Zarlenga, second edition (2023), covering tax law for cryptoassets in over 40 countries [3].
- Technical analysis (TA). The book focuses on the long term, not short-term horizons considered in technical analysis. The macro thesis presented here will likely take several years, possibly decades, to play out. Short-horizon crypto traders should refer to books on swing trading (short term) or breakout trading (medium term).

Since Bitcoin is the first cryptoasset and because its market value is roughly half of all cryptoassets' value combined, there is a corresponding focus on this particular asset. Nevertheless, many more cryptoassets followed in Bitcoin's wake, with purposes extending much beyond Bitcoin's original value proposition.

As the author, I feel compelled to highlight that what I do not know about cryptoassets is much broader than what I do know. In particular, while I have superficial experience in these fields, I am neither a programmer nor a professional investor with decades of experience. In addition, the exceptional pace of development of the cryptoasset industry makes it impossible to closely follow all things happening in the cryptoasset space. Nevertheless, I believe this book makes a compelling case for cryptoassets, their rightful place in a balanced investment portfolio, and the risks investors face as of 2023.

Some readers may believe they missed the opportunity. Many teenage cryptomillionaires made the headlines over the last decade. Some early investors and innovators even became billionaires through the early gains of the industry. As this book shows, it is not too late to profit from the innovation, far from it. Actually, it is just the beginning. If a human life represented the development of cryptoassets, it would currently be at the toddler stage. It can barely stand on its own feet, but it still has a lifetime of development ahead. Crises will surely pave its teenage years, but the best is yet to come.

Regardless of one's opinion on cryptoassets, their proof of concept redefines how we think about trust. The technology behind them could become the most transformational innovation for society since the Internet—not big data, artificial intelligence, or self-driving cars but blockchain. What was once in the hands of a powerful few, for better or worse, can now be in everybody's hands—or nobody's hands, depending on how one looks at it.

PART I

Why Consider Crypto Investments?

CHAPTER 1

A Brief History of Money

> *Central banks in their present form would no longer exist; nor would money… The successors to Bill Gates could put the successors to Alan Greenspan out of business.*
>
> —Mervyn King, 1999

The history of cryptoassets, like this book, begins with money. In particular, with the established monetary system. Understanding what makes money and how it has evolved is essential to understand the value proposition of cryptoassets—Bitcoin in particular. Therefore, let us start with the basics by going back several millennia to identify the fundamentals of money. As you will see, they naturally make a case for what is coming next.

What Makes Money?

As human societies emerged millennia ago, the need to exchange value became crucial. Direct trades of value in a barter system, such as individuals exchanging eggs for fruits, had severe limitations. A barter system only works when one individual wants to buy what another wants to sell, while the seller also wants something the buyer has to offer. In addition, goods traded must have similar value. For example, a seller would not want to exchange a house that took months to build for a few eggs. Moreover, even if one could gather enough eggs, the trade would still be unattractive since eggs are perishable and inappropriate for transactions of considerable value. A medium of exchange, a form of money, had to arise to facilitate trade and economic activity.

In all societies, media of exchange would naturally emerge. However, they would not all be equally appropriate. A medium of exchange requires several characteristics to become an optimal form of money. Nothing dictates what should or should not be

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money, but some features make for better forms of money. For example, sound money needs to have value in the eyes of as many potential trade participants as possible to broaden its usability. Also, it should hold its value through time. For instance, it should not be perishable, like the eggs in the previous example. Optimally, it should also be countable and divisible into smaller units to facilitate transactions of little value and transportable to enable users to carry their wealth. Finally, an optimal form of money would have all units worth the same and be indistinguishable from one another, a characteristic known as *fungibility*.

In the fourth century BCE, Aristotle established the following critical characteristics as the base for sound money [4]. In particular, money should be

1. a medium of exchange
2. a unit of account
3. a store of value
4. durable
5. portable
6. divisible
7. fungible

Forms of money used by societies over time only partially fulfilled these characteristics—from seashells to beads, cattle, grain, salt, tobacco, skins, silver, and even gold.

The founder of the Austrian School of Economics,[1] Carl Menger, challenges the popular thinking that a medium of exchange becomes money by authority, for example by law dictated by the state [5]. Instead, he considers money as a special case of other assets (commodities) with a remarkably high degree of "saleability" (*Absatzfähigkeit*). A saleable item is readily marketable at any convenient time without incurring a material

[1] This school of thoughts is a branch of economics focusing on the results of individual actions in line with rational decisions following economics incentives. Its early proponents were Austrians, which gave it its name. Nowadays, it contrasts predominantly to the Keynesian school of thoughts, which promotes extensive government control in all economic matters.

decrease in the selling price. In other words, it represents the degree to which a seller can dispose of the asset at a fair economic price. Menger identifies the following six criteria affecting an asset's saleability.[2]

1. the number of potentially interested buyers
2. their purchasing power
3. the quantity available of the good compared to the total unsupplied quantity that the market wants of it
4. the divisibility of the asset
5. the level of market development and speculation and
6. the legal and regulatory limitations imposed on transacting the asset

The criteria summarized by Aristotle on the one hand and by Menger on the other are critical in understanding why an asset makes a good form of money. By extension, they are crucial to evaluate the potential for such money to become valuable. These lists are also helpful in assessing how a change in any criterion affects the asset's valuation. For example, improving market development or reducing regulatory limitations on transactions would increase the asset's saleability and value.

Rational individuals facing several potential media of exchange will naturally tilt toward the "better" forms of money, that is, those with greater saleability. Even if one does not need the asset, the mere knowledge that others may need it is sufficient to incentivize acquiring it. Indeed, the owner of the better medium of exchange maximizes his ability to purchase goods in the future. Individuals arriving at the marketplace with less saleable assets (e.g., rare antique writings) find themselves at a disadvantage compared to individuals with more saleable assets (e.g., gold coins). The less saleable asset must first be converted to a more saleable asset before the owner can perform any further trade.

[2] Menger also identifies five criteria conditioning the geographical limits to the saleability of an asset and seven criteria conditioning its limits through time. Such spatial and temporal criteria are similarly important in assessing the value of an asset as a medium of exchange, but beyond the scope of this book. The interested reader should refer to the original text [5].

It ensued in every society that better forms of money (i.e., with a higher degree of saleability) tended to be hoarded. At the same time, comparatively inferior forms of money lost attractiveness. One tends to exchange less saleable for more saleable assets because doing so is in one's best interest. Thus, the preceding criteria, not the pressure of a central authority, enabled specific forms of money in a free economy to become the most appropriate medium of exchange. These criteria enabled one particular asset to emerge as the best form of money among all potential candidates.

Precious Metals As Money

In early societies, precious metals were desirable for their utility and beauty. Gold and silver, for example, shone from the Far East to the Western world as ornaments. They were less prone to corrosion (contrary to iron or copper), so they could last generations. In other words, they had high durability. Also, since they carried much value in relatively small weight, they enabled the portability of one's wealth. At the same time, their relative scarcity made the unsupplied quantity that the market demanded proportionally larger than the available quantity. These characteristics positioned them well as assets with a high degree of saleability.

Before metals such as silver or gold became the officially state-backed medium of exchange, individuals already used them as such. Many individuals bought them because of their intrinsic characteristics of durability, portability, divisibility, and especially store of value. It enabled them to transfer value across space and time. This interest, in turn, increased their saleability. Precious metals became money because traders following their self-interest effectively used them, not because an authority imposed them as currency. As metallurgy improved, the malleability and subsequent standardization in shape, quality, and weight of these metals further enhanced their attributes of sound money (namely fungibility and divisibility), which made them even more saleable. They became the de facto money in most of the civilized world. However, it is essential to understand that money is a social construct, not a regulatory one. Regulations and state backing only followed and strengthened this pre-existing social construct.

Storing Value

The concept of saleability introduced by Menger is closely related to that of a store of value. In particular, his first and third criteria[3] are worth investigating further to understand what makes an actual store of value.

Paraphrasing Menger's first criterion, there must be a demand for the good. If the demand for a good is non-existent, it is worthless, regardless of its supply characteristics. For example, if a mediocre artist paints only five paintings over his lifetime, it does not automatically make them valuable. There must be interested buyers for the paintings to have value. In other words, a good store of value has a high demand. With population growth and increasing prosperity in early societies, the demand for shiny metals was growing, especially for gold and silver.

Menger's third criterion of the saleability of an asset relates to relative scarcity, which is measured by the *stock-to-flow ratio*.[4] The *stock* of an asset is the total existing usable quantity of the asset. For example, while unmined gold still exists in difficult-to-reach areas, its *stock* is the quantity of available gold usable by individuals. On the other hand, the asset's *flow* is the quantity that can be added to its stock per unit of time—for example, the number of tons of gold mined in a year.

An asset with a high flow relative to its stock renders the stock of the asset worth little because the stock can increase significantly with time. For example, if the stock of copper in an economy at the beginning of a year is 100, and its yearly flow is 50, then the stock at the end of the year would sum up to 150, assuming no loss, destruction, or corrosion of the stock. A copper holder cannot expect the asset to remain scarce because a substantial proportion, compared to the existing quantity, can rapidly increase the stock. An asset with a high flow compared to its stock quickly loses any scarcity it might have had. By extension, only assets with a small flow compared to their stock (or high stock-to-flow ratio) can be potential stores of value because only such assets remain scarce.

[3] The number of potential interested buyers and the quantity available of the good in relation to the total unsupplied quantity that the market wants of it.

[4] The book *Whither Gold?* from Antal Fekete provides a more in-depth discussion of the relationship between the stock-to-flow ratio and the saleability of an asset [58].

Regarding their stock-to-flow, assets are not equal. Far from it, actually. First, any perishable product (e.g., apples, eggs, nuts), corrodible asset (e.g., iron, copper), or other consumable commodities (e.g., zinc, nickel) have a low stock-to-flow because no stock can accumulate over extended periods. At the same time, the flow represents a substantial portion of the asset's stock. Only durable (non-perishable) assets can apply as potential stores of value. Gold, for example, ranks well as a durable asset because its chemical stability makes it virtually indestructible.

Second, an actual store of value must be an asset whose flow does not vary much with the stock's market price. Economists refer to this characteristic as the price elasticity of supply. For example, if the market value of copper suddenly increased dramatically, many individuals would become copper producers to leverage the opportunity. As a result, the quantity of copper produced would rise accordingly. In other terms, the flow would increase until the asset is no longer scarce and its price drops to its long-term economic level. So, copper production (its flow) depends heavily on its market price. In economic terms, copper is an asset with a high price elasticity of supply. However, this price-to-supply relationship is almost non-existent for gold. History has shown that even when the price of gold increased dramatically, its production remained almost unchanged. In particular, the increase in the global gold stockpile did not exceed 2% in any year since World War II. In 2006, despite a 36% increase in the market price of gold, the annual production decreased in both 2006 and 2007.[5] In other words, gold's supply is not affected much by changes in its market price. Gold has a low price elasticity of supply.

Growing demand and marginally increasing supply made gold the optimal store of value throughout the past few millennia. While silver ranks better than other commodities, it is still second to gold in these characteristics. For this reason, people typically only used silver as a medium of exchange for transactions of small value.

[5] See Chapter 3 of *The Bitcoin Standard* by Saifedean Ammous [56].

From Money to Currency

Money and currency are not the same thing. Money is the natural medium selected by individuals to conduct transactions. On the other hand, governments impose currency on their citizens for these transactions. They can be the same and typically start as such. However, many times in history, governments have let their currency gradually drift away from money. These episodes ended badly, often in disasters of epic proportions. A few examples follow.

Gold and silver established themselves as money for most of the past five millennia. Sound money enabled civilizations to flourish and push the boundaries of humankind's development. Thanks to the coinage of these metals, the great Greek civilization, half a millennium BCE, became the world's most prosperous society and kept expanding. It established a free-market economy with an effective tax system and became the world's first democracy. However, in 431 BCE, Athens entered the Peloponnesian War against Sparta, which lasted almost two decades, much longer than anticipated. As the war went on, funding it became challenging and soon impossible. To ease the problem, Athenian authorities creatively mixed copper with the gold and silver they gathered from taxes to melt new coins. They could increase the number of coins they had on hand and suddenly spend more than their revenue. This creative development became the first currency debasement in history. Gold and silver were no longer traded based on their weight but rather on the historical value of coins. Athens had just created the first government currency. In the few years that followed, citizens progressively realized the trick and stopped accepting these coins as genuine gold or silver. The new currency quickly became worthless, Athens lost the war, and its prosperity ended. What remained of the country became a conquest of the next great civilization, Rome.

The Roman Empire was next in line to reach the heights of the world's dominant civilization. However, after centuries of prosperity, the emperors' greed led Rome to unaffordable wars. Similar to the Greeks, Romans funded wars by debasing their currency. They shrank the size of coins and mixed cheaper metals to produce new ones. The debasement was initially slow and minimal. From the original denarius containing 95% silver under Augustus, only 50% remained under Caracalla two centuries later. However, once the process started, emperors minted more currency at increasing rates, trying to escape price increases. In the middle of the third century CE, the silver content in a denarius dropped to only 0.5% within a couple of decades. The unavoidable

consequence materialized as the Roman Empire sank into hyperinflation. In these two decades, known as the Crisis of the Third Century, prices increased by nearly 1000% (i.e., multiplied by a factor of 10). Troops hired by the emperor would only accept payment in gold for their services, thereby plainly denying the value of the official currency. Toward the end of the century, the situation temporarily stabilized after the assassination of dozens of short-term emperors. However, the process quickly resumed. Under Diocletian in 301, a pound of gold traded for 50,000 denarii. By the year of his death, in 337, it increased to 20 million denarii, corresponding to 40,000% inflation.[6]

Figure 1-1. *Denarius under Augustus (Source: Classical Numismatic Group, Inc.* http://www.cngcoins.com*; Wikimedia, public domain)*

Episodes of hyperinflation are not limited to ancient history. For example, in sixteenth-century England, the Great Debasement under Henry VIII rhymes with the preceding stories of Greece and Rome. To finance wars in France, the English King ordered the reduction of precious metals in coins by replacing them with cheaper metals. As a result, the formerly prestigious English currency quickly disintegrated and disappeared from circulation. The same pattern arises in all cases: unaffordable wars require increasing the currency supply, leading to price increases, ruining the nation, and ending in a collapse of the currency.

[6] *Inflation and the Fall of the Roman Empire*, J. R. Peden, Mises Daily Articles [66].

In the next century, on the European continent, small German states repeated the same mistakes in the Thirty Years War. Under the Holy Roman Empire, only a few princes had the right to mint coins. The Empire was, in theory, under a bimetallic standard, with large gold coins of high value and silver coins for smaller denominations. While coin alteration was punishable by death, enforcing the sentence was difficult. As a result, this period became known as the *clipping and culling times* (*Kipper- und Wipperzeit*), following the recurrent clipping of coin edges and careful selection of the best coins. Little remained due to debasement from the original coins made of valuable metals. Coins progressively lost their valuable content until becoming exclusively copper. As in previous examples, hyperinflation settled, and an economic crisis followed. People stopped accepting coins as payment, and the currency became worthless.[7]

The Ascension of Paper Currency

In eighteenth-century France, this pattern appears again, but with elements of novelty: central banking and paper money. After the death of the French King Louis XIV, the Duke of Orléans Philip II took over the regency of the country until the eleven-year-old successor to the throne, Louis XV, came of age. The duke found the country buried under unimaginable war debt the previous monarch had accumulated. France's tax revenue did not even cover the interest payments on that debt.

The "remedy" came in May 1716, as the French government established a central bank with the power to print paper currency. In a few months of currency printing, France could not only pay interest on its debt but also reimburse that debt entirely. However, as in previous cases, inflating the currency supply inevitably led to rampant prices. By January 1720, prices were increasing at 23% monthly. Rents and real estate prices, for example, had increased 20-fold since the beginning of this money-printing frenzy. In February 1720, banks stopped redeeming paper currency for gold or silver. It became illegal to transact in precious metals, which were confiscated from anyone found in possession of them. When banks reopened in May of that year, gold, silver, and copper ran out as people were desperate to exchange the worthless paper currency for real money. Ultimately, these four years of hysteric money printing drove the country and a large part of Europe into a depression that lasted decades.

[7] *Money and trust: lessons from the 1620s for money in the digital age*, Schnabel and Shin, Bank for International Settlements [72].

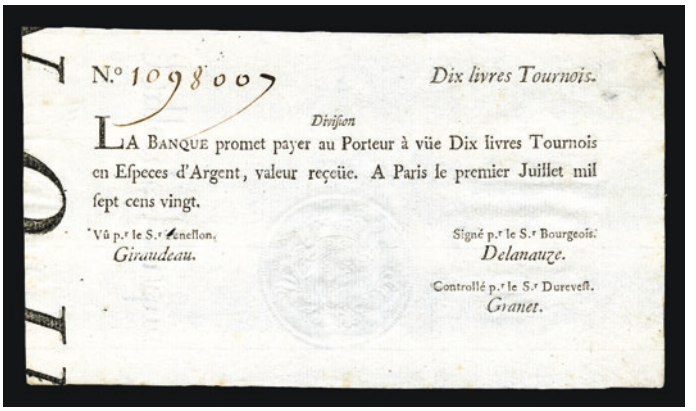

Figure 1-2. *Paper currency note issued by France's Banque Royale in 1720 (Source: National Numismatic Collection at the Smithsonian Institution; Wikimedia, public domain)*

Using paper currency only resumed in France during the Revolutionary Wars toward the end of that century. Similar to its predecessor, the new French paper currency (the assignat) became legal tender. And similar to its predecessor, the currency supplier (the National Assembly) printed increasing amounts of the new currency. Despite critics pointing out that this approach risked the same fate as money-printing earlier in the century, the supply of assignats grew from millions to billions in a few short years. As expected, the new currency lost all of its value less than a decade after its creation.

Figure 1-3. *Assignat of 1792, a short-lived legal tender paper currency in France (Source: Design: Nicolas-Marie Gatteaux - Lettering: Jean-Baptiste Gérard; Wikimedia, public domain)*

Another noteworthy episode of printing frenzy happened under the Weimar Republic in Germany at the beginning of the twentieth century. As in all previous examples, it started with a war. At the outbreak of World War I, Germany abandoned its gold-bound currency, the gold mark, for the paper mark. The republic started to use cheap metals like iron, zinc, and aluminum to mint new coins and increased the number of paper marks 4-fold over the war period.

The devastating impact of excessive currency supply did not materialize until after the war because people were holding on to savings during wartime, avoiding unnecessary spending. In a couple of years after the end of World War I, prices increased more than tenfold, wiping out over 90% of people's savings value.

When war reparation payments to France became due, the printing press accelerated its frenzy. The price of a gold mark increased from 15 marks in 1920 to 100 thousand marks in July 1923, 13 million marks in September, and 1 trillion marks in November of that year. Typical banknotes in circulation grew from 10 marks in 1920 to 100 trillion marks in 1924. October 1923 alone saw prices increase by 29,500%, while printing presses emitted another 500 quadrillion new paper marks daily.[8] As in previous examples, the paper currency lost all of its value, and the nation collapsed and ultimately returned to a gold-backed currency.

Figure 1-4. *Weimar Republic's banknote of 100 trillion marks in 1924*[9] *(Source: National Numismatic Collection, National Museum of American History; Wikimedia, public domain)*

[8] *German Hyperinflation 1922/23*, Amankwah, Goulding, Krausbeck, Mwenda, and Schweigert [67].

[9] The German word *billion* counterintuitively means *trillion* in English, not billion.

Central Banking and Fractional Reserve Banking

On the other side of the Atlantic Ocean, a major financial development happened over the same period. Until the outbreak of World War I, the United States and most of the developed world backed their currency with gold. Since the new supply (the flow) of gold compared to its stock was minimal, there was no inflation. Back-and-forth wealth transfers happened from one country to another as the relative price of goods adjusted, but they summed up to zero. Inflation was virtually non-existent, enabling people to store their wealth. It changed for the United States in 1914 when it created a private bank, the Federal Reserve, a.k.a. the Fed, with the authority to print US currency. The Fed is independent of the US government, has no budget, undergoes no audit, has no supervisor, and is accountable to no one.[10] As the Fed describes itself, it lends to the US government by creating new currency.[11] The "money" lent is new currency created out of thin air. As should be clear by now, no new value arises; printing just dilutes the value of all existing dollars. Also, the Fed does not back any new dollar with real value, such as gold.

This questionable scheme becomes even more contentious when considering the fractional reserve banking system that goes with it. When a commercial bank holds deposits from the public, only a fraction of that amount has to stay in the vault. Instead of holding on to deposits, the bank lends out most of them. In the United States, the Fed sets the reserve requirement. This way, it controls how much currency flows into the economy. Assume a 10% reserve requirement. When Alice deposits $100 at her commercial bank, say ING, the bank can lend out $90 to Bob while it keeps $10 in its vault.[12] Bob buys stuff from Charlie with that money, and Charlie deposits the $90 he just earned into his account at his commercial bank, say Wells Fargo. This bank, in turn, keeps $9 (10%) on hand and lends the remaining $81 out to Dan. Dan buys stuff from Erin, who saves the money at her commercial bank. At this point, Alice has $100 in her bank account, Charlie has $90 in his, and Erin has $81. All of this is happening with the original $100 from Alice. The process does not stop there but continues further. A 10% fractional reserve ratio enables commercial banks to "create" up to nine times that amount of money: the $100 can end up as $1,000 in circulation.

[10] *The Case Against the Fed*, Rothbard [57].

[11] *Putting it Simply*, Federal Reserve Bank of Boston [87].

[12] In practice, the money is not kept physically in a vault but on the bank's financial account at the central bank.