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UNIVERSITY OF CALIFORNIA,  
IRVINE

Essays on Money and Financial Institutions in the History of Economic Thought, USA  
History, and Theory

DISSERTATION

submitted in partial satisfaction of the requirements  
for the degree of

DOCTOR OF PHILOSOPHY

in Economics

by

Alejandro Toyofusa Komai

Dissertation Committee:  
Gary Richardson, Guillaume Rocheteau, Co-Chairs  
Dan Bogart

2015



# DEDICATION

To my brother, Ricardo Kiyohiro Komai

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# ABSTRACT OF THE DISSERTATION

Essays on Money and Financial Institutions in the History of Economic Thought, USA  
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By

Alejandro Toyofusa Komai

Doctor of Philosophy in Economics

University of California, Irvine, 2015

Gary Richardson, Guillaume Rocheteau, Co-Chairs

I study the institution of money. I provide a history of the real bills doctrine in its various forms through debates with the quantity theory of money. I provide a brief history of financial regulation in the USA. I use a monetary history of the USA to motivate a search and matching model of transition from commodity money to fiat. I provide a theoretical underpinning to the fact that monetary history is a history of commodity money. I extend my model to consider convertible money, oligarchy, two currencies, money and credit, and Aztec money.

# Chapter 1

## Introduction

Money is weird. I have been trying to understand money for about four years now. In January 2011 I started taking Joseph Ostroy's History of Economic Thought class. The course had a few themes: Adam Smith is more right than we thought; the duties of the sovereign is the ultimate question in economics; fair compensation is all about the marginal product. At the time I was teaching assistant to Michael Sproul, one of the last remaining advocates of the backing theory of money. Through Mike and Joe I was introduced to the debates between real bills doctrine, which holds money has value because there are assets backing it, and the quantity theory of money, which holds that the value of money is inversely proportional to the quantity in circulation. Why do intrinsically worthless pieces of paper have value? My first pass at answering this question was an examination of the history of economic thought.

The history of thought is rich with monetary and banking debates. In fact, let me be clear right now: it is easy to model money without banks but it is very difficult to divorce the history of money from the history of the financial system. I focused on the recurring debates between the quantity theory of money and the real bills doctrine. Ostensibly, this

disagreement was first documented between David Hume and Adam Smith. In 1742 David Hume published an essay, *On Money*, in which he defined the quantity theory: the value of money is inversely proportional to the quantity of money good in circulation. Money created by the bank is going to have the same effect as a new silver mine. Adam Smith (1776) accepts that bank notes can serve as money even without 100% reserves [84, p. 241]. However, the question of banks over-issuing notes is resolved in the real bills doctrine by excess money flowing into foreign markets or returning to banks. In this way, paper money can only substitute for commodity money; it cannot be over-issued. Real bills claim that paper money created by banks will not change prices; quantity theory claims the form of money does not matter, only the quantity in circulation matters for changes in prices.

The Bullionist Controversy revisited this debate in 1810. During the Napoleonic Wars, the Bank of England suspended convertibility in 1797. Napoleon then defeated Spain and Portugal, European ports closed to British trade, and a speculative boom accompanied the opening of ports in South America. The Bullion Committee was charged with determining whether there was an over-issue of notes due to the suspension of convertibility. In Chapter 5 I spend some time considering what it means to model a suspension of convertibility as what happened with the Bank of England in this time. David Ricardo led the bullionist — quantity theory — side of the debate. Charles Bosanquet led the anti-bullionist — real bills — side. Had the Bank of England over-issued notes during the suspension? Ricardo advocated the return to convertibility to allow for the end of over-issue. Bosanquet argued that new currency is only ever issued in exchange for sufficient security. Ricardo won the debate and partial convertibility resumed in 1817, with the entirety of the Restriction Act being repealed in 1823.

From the 1820s to 1844, the quantity theory struggle with real bills continued with debate over the regulation of the Bank of England. The Currency School represented the latest incarnation of the quantity theory and was advocated by McCulloch and Lord Overstone.

The Banking School represented real bills and was led by Tooke and Fullarton. The Currency School believed the Bank of England's responsibility as a central bank was to maintain appropriate reserves. The Banking School believed banks achieve the social optimum for currency issue by making good loans — no restrictions needed, the invisible hand once again providing the best of all possible worlds. To be clear, this is another debate about the over-issue of bank notes. This time the debate was resolved by the 1844 Bank Charter Act, which gave the Bank of England monopoly over note issue and required 100% gold reserves. Again, the real bills doctrine lost the debate to quantity theory.

Studying these debates left me with more questions than answers. I had pursued a history of thought answer to the question, “What are the duties of the sovereign?” The contemporary economic equivalent to this question is, “What is the socially optimal rule for money creation?” Real bills offered a Smithian invisible hand guiding self-interested parties to the social optimum. Quantity theory protested. The key difference in their views seemed to stem from how money actually obtains value. But just how relevant was that in today's economy? Debates over the values of a bank note could be completely different from debates over the value of a Federal Reserve note that cannot be converted to its underlying assets. I needed to take history up to the present.

Around this time I started working with Gary Richardson on a brief history of financial regulation in the USA. This history covered everything from the Constitution up to Dodd-Frank. USA financial regulatory history is a patchwork. The pattern is: crisis, debate, reform. Reform is driven by the political process. The Constitution is a microcosm of how various, often geographically determined, interests engender broad compromises. The USA rarely overhauls its regulatory framework. The key thing is the system is not efficient. For example, consider the Federal Reserve System. The Federal Reserve started as a response to the Panic of 1907. J. P. Morgan, a citizen with no elected authority, bailed out the financial system on his own. This did not sit well with the country. A committee was formed

to determine how the nation might provide for a common defense against economic panic. Then, instead of creating one central bank imbued with sufficient authority to act as a lender of last resort, the federal government created twelve geographically distinct central banks with independent policy making power and limited ability to lend in times of crisis. Had the Federal Reserve System of 1913 been in place during the Panic of 1907, it is doubtful it would have prevented the panic. It was not until after the New Deal that the Federal Reserve was reformed to serve as it was originally intended.

What would be a better system? In my opinion, after researching the history of regulation in the USA, the alphabet soup of regulatory agencies is ineffective. If there are to be regulations, there ought to be two regulatory bodies, each also monitoring the other. I use an analogy from software development. Take two web browsers: Internet Explorer and Mozilla Firefox. Internet Explorer is said to have millions of lines of code. Whenever Microsoft wants to update Internet Explorer, they just add more code until it does what it needs to do. The code is so large and overwhelming it is said to have “security [from attacks] by obscurity,” meaning anyone seeking to exploit the code will have too many lines of code to read through to actually find the exploit they are looking for. Mozilla Firefox on the other hand is open source. Anyone can read the code. Any exploits in the code are quickly found and receive immediate attention. The code in its entirety seeks to be streamlined and readable, so that anyone may challenge the code itself. The philosophy behind Mozilla Firefox, and most open source code, is security through rigorous programming. Transparency is what keeps Mozilla Firefox competitive and secure. The USA regulatory system is Internet Explorer. It is convoluted. It is messy. There are overlapping agencies with unclear mandates. Two agencies with the exact same mandate, but each also auditing the other, could achieve efficient regulation. How close or far the USA will be from efficient regulation is still a matter of speculation, as rules stemming from Dodd-Frank are still awaiting implementation.

The monetary history of the USA starts with intrinsically valued money, adopts convertible



paper money, flirts with unconvertible paper money, attempts a gold standard, then moves to fiat. Originally the USA was bimetallic, but at any point in time was either de facto gold or de facto silver standard. What mattered was the intrinsic value of the dollar. It's important to note that though the Constitution did grant Congress the authority to create a national currency, it did not exercise this power until the Civil War. However, as early as the War of 1812, the USA issued interest-bearing Treasury notes cut to the same size and shape as bank notes, which circulated as currency for a brief period. I use this notion of an interest-bearing note in my model of the seigniorage-maximizing sovereign, the only difference being my sovereign issues perpetuities. In the 1960s the USA adopted tokens for small change, meaning the face value of the coins was greater than the intrinsic value. Nickel and copper were adopted for this token currency instead of silver.

Studying USA monetary history taught me about the differences in key terms like “receivable,” meaning acceptable as payment for taxes, and “legal tender,” meaning acceptable to clear all debts public and private. These can be seen as different forms of commodity money, in that there is an intrinsic value to money which can be used to pay taxes or clear debts. Other forms of commodity money in USA history include convertible paper money and literal commodity money in the form of silver or gold.

The USA has several episodes where convertibility was suspended, like in 1814. Perhaps reflecting the debates in England, in the wake of the Ricardo-Bosanquet bullionist debates, Congress sought a return to convertibility in 1817. The value of money (in gold) dropped relative to the official price of gold until resumption. The Greenback period starting in the Civil War tells a similar story. USA history seems to confirm quantity theory predictions when we're only looking at the price level of the underlying commodity backing the currency. But is that sufficient? Why does money have value?

The USA finally transitioned to fiat in the 1970s. To be more precise, that meant Federal Reserve notes circulate, but could not be redeemed for some underlying asset, nor do they

pay a dividend, nor are they intrinsically valued. Federal Reserve notes are still liabilities on the Federal Reserve's balance sheet, but they don't act like demand deposits. Federal Reserve notes are legal tender and receivable. I use the search and matching model framework to understand this transition. I came to the search and matching literature through work with Guillaume Rocheteau. I have been convinced of the utility of modeling explicitly money's medium of exchange function through the study of search and matching models.

In my model money has value greater than its fundamentals because it performs a function as a medium of exchange. Agents with heterogeneous preferences and technologies use money to overcome the commitment problem in a world where credit cannot be sustained. The amount of money in the world is determined by a self-interested sovereign. This sovereign creates perpetuities which pay a dividend every period forever. The perpetuities are then sold in the first period in exchange for goods, of which the sovereign wants to maximize their consumption. Ideally, a sovereign will set the dividend payment on the perpetuities at zero and extract seigniorage from the production of money at no cost. However, I find that in some cases agents will not be willing to hold intrinsically worthless pieces of paper to be used as a medium of exchange. Sometimes fiat is not feasible. The sovereign can still make positive seigniorage in this case because they can sell the asset above the intrinsic value because it will have an additional liquidity value. The key variables in my model for determining whether agents will be willing to hold fiat money are the thickness of the markets, competitiveness of those markets, and patience of the agents. As agents grow more patient, as markets grow thicker and more competitive, then the sovereign is more likely to be able to offer intrinsically worthless pieces of paper as the medium of exchange. Similarly, the amount of commodity chosen for the money decreases comparatively in environments of greater agent patience and market thickness.

Historically, money did not resemble a perpetuity at all times. I used the benchmark sovereign maximizing-seigniorage model to push the framework further. I modeled con-

vertible money. I found that as agents grew more patient and markets thickened, the ease with which money can be converted decreased, which matched the long-run trend in the USA of a gradual degradation of the ease of convertibility. I changed the sovereign to an oligarchy of agents and proved that the choices of the oligarchy approach the social optimum the more inclusive the oligarchy grew to be. This is due to the gains for the oligarchy being less about seigniorage — a once-and-for-all gain at the creation of money — and more about the gains from trading as much as possible in each successive period thanks to sufficient money being produced. I extended the model to include two currencies, a reflection of the bimetallic history of the USA. In order to model the medieval transition out of credit and into money, I modeled the village and the faire; in the village credit is possible because everyone knows everyone, but in the faire you only deal with strangers, so money is required. As the faire comes to dominate agents' trading lives, money grows in significance and credit diminishes. Finally, I look at the particulars of Aztec money, which was freely “minted” by any individual by preserving the seeds from the cacao tree. I show that the Aztec government controlled the growth rate of money indirectly through a direct control of prices.

I suppose after four years of studying money, I have grown to find it stranger than when I originally began examining its forms and functions. On the one hand, theory happily classifies money as a rational bubble that improves our welfare. On the other hand, we have a long history of money having some aspect of commodity-ness, whether in the form of an actual intrinsically valued commodity like silver or gold, or as a way to clear debts, or to pay taxes, or, if the real bills doctrine is right, even existing as a liability in a balance sheet with sufficient assets backing it. In a final defense of a form of real bills, I do have this to offer: within the context of my search and matching model, were the sovereign to over-issue money, two things would happen. Firstly, given sufficient money, agents will be able to maximize their gains from trade; they will not be constrained by a low amount of money in the economy. Secondly, seigniorage will collapse to zero, as the liquidity premium of the assets also vanishes. Real bills doctrine failed to recognize the inherently political nature of

a seemingly theoretical issue and dwelt on the duties of the sovereign when it should have considered the sovereign's self-interest.

## Chapter 2

# Quantity Theory Versus Real Bills

## Doctrine: Three Debates

### 2.1 Introduction

The quantity theory of money is the orthodox view of money in economics. It is strange that the doctrine has survived five centuries to rise to dominance. In all likelihood, the original statements of the quantity theory were drawn from the observation of the Price Revolution in Spain following the colonization of the New World. The connection between precious metal mines coming on-line and the price levels rising in Spain suggest an obvious hypothesis: that the quantity of money is inversely proportional to its value. The quantity theory underwent few refinements over the centuries and it is David Hume's eighteenth century pronouncement of the theory that is given the highest authority. But one who must be considered a higher authority on matters economic, Adam Smith, friend and correspondent with Hume, famously pronounced a competing theory of money known as the real bills doctrine in his book, *The Wealth of Nations*.

These two theories take different approaches to how money works and the state's proper role in money and banking. To the quantity theorist, bank notes affect prices as much as newly extracted silver from Mexico. The real bills theorist, on the other hand, draws a distinction, noting that bank notes are only ever issued in exchanged for assets of equal backing. Each may admit a role for a central bank, but whereas the quantity theory concerns itself with an over-issue of notes leading to inflation, the real bills doctrine points to channels which may prevent over-issue. Not until Walter Bagehot does the question of bank runs and the role of the central bank — touched upon by Smith — come to the fore.

Despite its prominent exponent, real bills doctrine lost the big debates in British banking history. Under the banner of bullionism and led by David Ricardo, the quantity theory triumphed over real bills anti-bullionism. Reasserted by Thomas Tooke and the Banking School in the 1820s, real bills essentially lost under the passage of the Bank Charter Act of 1844, which instituted Currency School — quantity theory — policy recommendations. The current form of real bills has been refined through these historical debates, but the core tenet, that notes will trade at value proportional to the assets backing them held by the bank which issued them, has not changed. Similarly, the debate has barely changed from its classical roots.

## **2.2 The Debates**

### **2.2.1 Quantity Theory Versus Real Bills Doctrine**

Though the original exponents of the quantity theory can be traced back to Copernicus and others in the early sixteenth century, David Hume has come to be known as the first enunciator of modern quantity theory [6]. Hume's statement of the quantity theory eclipsed previous versions and attained the status of authority in future generations of quantity

theorists: “It seems a maxim almost self-evident, that the prices of every thing depend on the proportion between commodities and money, and that any considerable alteration on either has the same effect, either of heightening or lowering the price” [37, p. 4]. In illustrating the means by which an importation of gold or silver can increase the price level, Hume conscientiously traces the impact: starting from having no effect at all, sitting in the coffers of merchants, to flowing to the laborers employed with the newly acquired money — originally with no change to the price of labor, then gradually rising as labor becomes more scarce — and finally to the market for final goods as artisans seek to purchase more products with their greater wages. Essentially he describes price stickiness. Hume concludes, “It is easy to trace the money in its progress through the whole commonwealth; where we shall find, that it must first quicken the diligence of every individual, before it encrease the price of labor” [37, p. 3]. An interesting result of this model is that though the quantity of money itself is irrelevant, “[t]he good policy of the magistrate consists only in keeping it, if possible still encreasing; because by that means, he keeps alive a spirit of industry in the nation, and encreases the stock of labour, in which consists all real power and riches” — or in other words, the stickiness of prices leads to inflation being productive and deflation being destructive [37, p. 3].

In his essay, “Of Money,” he lays out the advantages of a central bank and a 100% reserve requirement.

“If the public provide not a bank, private bankers will take advantage of this circumstance [...] And therefore it is better, it may be thought, that a public company should enjoy the benefit of that paper-credit, which always will have place in every opulent kingdom. But to endeavor artificially to encrease such a credit, can never be the interest of any trading nation; but must lay them under disadvantages, by encreasing money beyond its natural proportion to labour and commodities, and thereby heightening their price to the merchant

and manufacturer. And in this view, it must be allowed, that no bank could be more advantageous, than one as locked up all the money it received, and never augmented the circulating coin, as is usual, by returning part of its treasure into commerce. A public bank, by this expedient, might cut off much of the dealings of private bankers and money-jobbers; and though the state bore the charge of salaries to the directors and tellers of this bank (for, according to the preceding supposition, it would have no profit from its dealings), the national advantage, resulting from the low price of labour and the destruction of paper-credit, would be a sufficient compensation.” —David Hume [37, p. 2]

Here David Hume advocates a central (public) bank that limits the creation of credit to prevent the excessive creation of money, which would lead to inflation in his model. Building on this point he concludes a 100% reserve central bank, though requiring funding from the state, would be optimal for society in that it would not lead to higher prices. This passage clarifies the quantity theory position that paper money issued by banks is as much a contributor to the fluctuations in price as a newly discovered silver mine in the Americas. Real bills doctrine directly opposes this position, most famously enunciated by Adam Smith in *The Wealth of Nations*.

Compared to future advocates of real bills, Adam Smith sounds like a wayward quantity theorist. Consider this passage: “A particular banker lends among his customers his own promissory notes, to the extent, we shall suppose, of a hundred thousand pounds. [...] Though he has generally in circulation, therefore, notes to the extent of a hundred thousand pounds, twenty thousand pounds in gold and silver may, frequently, be a sufficient provision for answering occasional demands. By this operation, therefore, twenty thousand pounds in gold and silver perform all the functions which a hundred thousand could otherwise have performed” [84, p. 241]. If banker’s notes serve the same function as gold and silver, then bankers can be seen as creating money. This is exactly in line with the quantity theory.



Smith expands on the example and rather than reaching the conclusion that quantity theory provides — that prices shall rise according to the increase in money — he concludes that, “[t]he goods to be bought and sold being precisely the same as before, the same quantity of money will be sufficient for buying and selling them” [84, p. 242]. What happens to the “overflow” money? For one, money in the form accepted by foreign markets — notably not banker’s notes — can be spent in foreign markets [84, p. 242]. If such a demand for money is absent, the money will return to the bank.

Adam Smith is not content to let abstraction sit unsupported. He gives a history of Scotland and its transition to union with the rest of Great Britain, the point of which being, “[b]ut though the circulating gold and silver of Scotland have suffered so great a diminution during this period, its real riches and prosperity do not appear to have suffered any” [84, p. 247]. Hume’s specification of the quantity theory would predict deflation and ensuing hardships due to what we would call price stickiness — and this history flies in the face of that. Rather than suffering, Scotland prospered.

The distinctions between real bills and quantity theory are further clarified by Adam Smith. “The whole paper money of every kind which can easily circulate in any country never can exceed the value of the gold and silver, of which it supplies the place, or which (the commerce being supposed the same) would circulate there, if there was no paper money” [84, p. 249]. This distinction between paper and metal money is key. To a quantity theorist, regardless of a money’s origin, it serves the same function and affects the price level equally. Real bills insists that money created by banks will not change prices. Paper money is just a substitute for gold and silver. Future theorists would point to this as advice against printing more notes when the central bank was losing gold, the central tenet of Currency Theory [36, p. 42]. The irony in this being that Smith’s views actually lay the foundation for Banking Theory: that banks should provide money to “supply the needs of trade,” and in so doing would avoid over-issue of notes [36, p. 43]. Adam Smith explicitly addresses the debate: “The increase of

paper money, it has been said, by augmenting the quantity, and consequently diminishing the value of the whole currency, necessarily augments the money price of commodities. But as the quantity of gold and silver, which is taken from the currency, is always equal to the quantity of paper which is added to it, paper money does not necessarily increase the quantity of the whole currency.” [84, p. 263]. Smith lays down the real bills position that currency issued by banks will only be done in amounts equal to assets taken on by that bank, and thus should have no effect on prices. In real bills, banks do not create money in the same way the quantity theory proposes.

Bank runs are incorporated into the model. “Should the circulating paper at any time exceed that sum, as the excess could neither be sent abroad nor be employed in the circulation of the country, it must immediately return upon the banks to be exchanged for gold and silver. [...] There would immediately, therefore, be a run upon the banks to the whole extent of this superfluous paper, and, if they shewed any difficulty or backwardness in payment, to a much greater extent; the alarm, which this would occasion, necessarily increasing the run” [84, p. 249-50]. Importantly, this model of a bank run is spurred not by a shift in confidence, as will become the standard issue of concern, but by decisions made by individuals without regard for their strategic interactions with others. Contrast this with a panic, which arises when the bank cannot pay — and then we are in a standard model where it is optimal to withdraw funds because you expect everyone else to be withdrawing. Smith, however, is silent on the question of whether the state should have any role during such a panic.

Specifically regarding money and banks, Smith has little to say about the duties of the state. To Adam Smith, use of notes are a matter of natural rights, and restrictions on such free exchange are, “a manifest violation of that natural liberty which it is the proper business of law, not to infringe, but to support” [84, p. 263]. This is not an unlimited support of note-issue. “But those exertions of the natural liberty of a few individuals, which might endanger the security of the whole society, are, and ought to be, restrained by the laws of

all governments; of the most free, as well as of the most despotical” [84, p. 263]. This hardly can be considered a clear sign that Smith would support lender of last resort policy, but it certainly cannot be used to argue he would oppose it.

### **2.2.2 Bullionists Versus Anti-Bullionists**

The Bullionist Controversy was a debate over policy of the Bank of England in 1810. Bullionists were headed by David Ricardo and the conclusions of the Bullion Committee were a reflection of the views he expounded in his tract, *The High Price of Bullion* [55, p. PE-65]. The only anti-bullionist whom Ricardo addressed was Charles Bosanquet, and by the end of the debate Ricardo was considered the winner.

A timeline of events leading up to the controversy will provide context for the debate. By the end of the eighteenth century, the Bank of England had nearly a monopoly on note-issue, following the restriction that notes were not allowed to be issued by banks with more than six directors. This led to country banks with five directors continuing to issue notes. In 1797, the Restriction Act suspended convertibility of Bank of England notes [55, p. PE-65]. The prime minister, during military conflicts of the period, pushed through legislation to legalize loans to the government from the Bank of England without a cap on the size of the loans. This prime minister exercised restraint when using this power, but then he passed away. “The closing of European ports to British commerce and the opening up of South American ports (following the defeat of Portugal and Spain by France) fuelled a speculative boom in 1809, leading to a greatly increased paper currency issue. As a response to this development, the Bullion Committee was appointed in February 1810 to deliberate whether the notes had been issued in excess and to suggest a framework for regulation of the issues. The main conclusions of the Bullion Report were “that at the time there was an excessive paper currency, of which the most unequivocal symptom was the very high price of gold

bullion and... the very depressed state of the foreign exchanges. That the excess was to be attributed to the removal of all control on the issues of the Bank of England by the suspension of cash payment... The only true and proper remedy... was... a resumption of cash payments” [Macleod 1855: vol 2]. The report was presented to parliament on May 6, 1811 but was rejected by an overwhelming majority” [55, p. PE-66].

Nachane and Hatekar summarize the crux of the debate between the bullionists and the anti-bullionists: “The bullionists asserted that a circulation in excess of what, under similar conditions, could have been maintained under a metallic standard, was tantamount to an overissue of currency. Further, as the main indicator of excess issue, they proposed the existence of a premium on bullion over paper currency. [...] Since the bullionists also subscribed, in the main, to Hume’s quantity theory, they held that a relative rise of prices in England *vis-a-vis* those abroad and a fall in the sterling exchanges were additional evidence of depreciation. [...] The main thrust of [the anti-bullionists] argument was the denial of a premium on bullion as a proof of excess currency. [...] A far more important argument adduced by the anti-bullionists, was that under inconvertibility, the state of the exchanges and the premium on bullion would be governed solely by the balance of payments and that, in a period of heavy military remittances or grain imports, the exchanges could fall substantially without necessarily implying an excess issue” [55, p. PE-67-8]. In this context, we can examine the debate through David Ricardo’s *The High Price of Bullion* and *Reply to Mr. Bosanquet* and draw the connections between this debate and the disagreement between Hume and Smith.

David Ricardo begins *The High Price of Bullion* with a restatement of the quantity theory’s view of the essential equality between paper and metallic money. He begins by hypothesizing the effect of a new mine on the money supply and price level, and says, “[i]f instead of a mine being discovered in any country, a bank were established, such as the Bank of England, with the power of issuing its notes for a circulating medium; after a large amount had been issued either by way of loan to merchants, or by advances to government, thereby adding

considerably to the sum of the currency, the same effect would follow as in the case of the mine. The circulating medium would be lowered in value, and goods would experience a proportionate rise. The equilibrium between that and other nations would only be restored by the exportation of part of the coin” [70, p. 5]. This statement by Ricardo sums neatly two key points of the Bullionist position: firstly, that notes issued by the Bank of England have the same effect on the price level as silver extracted from a mine, and secondly, that the exchange of bullion between nations can be used as an indicator of this. Ricardo continues by arguing against trade restrictions on bullion. “The exportation of the specie may at all times be safely left to the discretion of individuals; it will not be exported more than any other commodity, unless its exportation should be advantageous to the country. If it be advantageous to export it, no laws can effectually prevent its exportation. Happily in this case, as well as in most others in commerce where there is free competition, the interests of the individual and that of the community are never at variance” [70, p. 6]. This is interesting because Ricardo is arguing that private and social interests are aligned when it comes to the exportation of bullion. If it is not the individuals exporting the bullion who are causing an over-abundance of paper, wherefore the mismatch? “Parliament, by restricting the Bank from paying in specie, have enabled the conductors of that concern to increase or decrease at pleasure the quantity and amount of their notes, and the previously existing checks against an over-issue having been thereby removed, those conductors have acquired the power of increasing or decreasing the value of the paper currency” [70, p. 14-5]. For Ricardo and the bullionists, the fluctuations in prices were completely due to over-issue of bank notes from the Bank of England during the period of suspended convertibility. The channel through which an over-issue of notes would return to the bank in exchange for bullion, a channel Smith explicitly mentions in *The Wealth of Nations*, had been closed, and this was identified as a cause for believing an over-issue of bank notes had occurred [84, p. 249-50]. “The only legitimate security which the public can possess against the indiscretion of the Bank is to oblige them to pay their notes on demand in specie; and this can only be effected by

diminishing the amount of bank-notes in circulation till the nominal price of gold be lowered to the mint price” [70, p. 26]. Ricardo concludes that the mechanism by which the Bank of England is forced to restrict note-issue is convertibility and the suspension of convertibility has allowed the Bank to circulate more money than otherwise it could. He advocates the return to convertibility, which according to quantity theory should decrease the over-issue of notes and lead to lowered prices without an exodus of bullion.

The main objector to Ricardo and the Bullion Committee’s conclusions was Charles Bosanquet. Ricardo’s reply to Bosanquet’s objections effectively ended the bullionist controversy and validated the bullionist position until Thomas Tooke and the Banking School revived the anti-bullionist position during the debates between the Currency and Banking Schools. Ricardo addressed six main objections from Bosanquet in his reply, most importantly, Bosanquet’s objection to the assertion, “[t]hat the paper currency is now excessive, and depreciated in comparison with gold, and that the high price of Bullion and low rates of exchange are the consequence as well as the sign of such depreciation” [71, p. 86]. This is the real bills objection to the quantity theory’s interpretation of events. Ricardo addresses Bosanquet’s objection to the assertion, “[t]hat the Bank, during the restriction, possesses exclusively the power of limiting the circulation of Bank notes” by arguing, “[t]he plea that no more is issued than the wants of commerce require is of no weight; because the sum required for such purpose cannot be defined. Commerce is insatiable in its demands, and the same portion of it may employ 10 millions or 100 millions of circulating medium; the quantity depends wholly on its value” [71, p. 114]. Ricardo is making two points here. He both argues that the demand of borrowers for loans at a given rate, is insatiable, and the quantity demanded of borrowers for loans depends on the purchasing power of the medium of exchange. The Ricardian model of the money market can be interpreted as a perfectly inelastic supply of money, which is composed of metallic and paper money, and unit elastic demand for money. In this way you can see doubling the supply of money (which doubles the quantity supplied) halves the price, or purchasing power, or money. It is interesting to note that if you change

this model slightly to include a monopolist issuer of money, the monopolist maximizes its profits by issuing any quantity of notes up to the quantity at which supply is vertical.

Ricardo steps aside and allows a generous quotation of Bosanquet arguing that the analogy of the Bank of England to a mine is inappropriate because, “[...] the principle on which the Bank issues its notes is that of a loan. Every note is issued at the requisition of some party, who becomes indebted to the Bank for its amount, and gives security to return this note, or another of equal value at a fixed and not remote period; paying an interest proportioned to the time allowed” [71, p. 115]. This is the real bills doctrine. According to real bills, bank note issue should have no effect on the price level if all notes are issued in exchange for sufficient security. Ricardo replies with a restatement of the quantity theory. So the two doctrines remained at loggerheads, though Ricardo persuaded many of the superiority of the quantity theory. In the 1820s the debate would be revived under new names.

### **2.2.3 Currency School Versus Banking School**

As mentioned in the discussion of the origins of the modern debate between quantity theory and real bills, Adam Smith can lay claim to providing both the principles by which the Currency School and the Banking School were established. In one part due to the ambiguity of his diction and in another to the effect of changing interpretation over time, Smith’s real bills doctrine provided the Currency School with the principle that banks should begin to restrict note issue when losing gold - the central bank in particular. Smith’s statement of an automatic mechanism by which notes return to banks when over-issued can be seen as the establishment of the Banking Principle [36, p. 42-3]. To put it clearly: the Currency School holds that the central bank must be cautious in its note issue, whereas the Banking School holds that sufficient backing and reserves on the parts of all banks leads to an automatic arrival at the social optimum. In the scope of our discussion, the Currency School can be

seen as a restatement of the quantity theory and the Banking School as a restatement of real bills.

In 1817 Bank of England “commenced partial redemption at the old par value. [...] [O]n July 2, 1823, an act was passed revoking the earlier Restriction Act” [55, p. PE-66]. The subsequent decades, through the 1850s, saw regular booms and crises. The Act of 1826 led to the “reorganising of country credit by abolishing the monopoly of the Bank of England in the provinces, and encouraging the establishment of joint-stock banks of issue. This was followed by the Act of 1833, which made the Bank notes legal tender and exempted the Bank of England from the purview of usury laws, so that the rate of discount need no longer be confined to a ceiling of 5 per cent” [55, p. PE67]. From the 1820s through the Bank Charter Act of 1844, the Currency School and Banking School debated the proper role of the central bank. A separate movement, the Free Banking School, argued vehemently against the establishment of a central bank at all, the one principle on which the Currency and Banking Schools agreed.

Two main Currency School advocates were McCulloch and Loyd (later dubbed Lord Overstone); the Banking School was led by Tooke and Fullarton [81]. Hatekar and Nachane quote Andreades’s distinction between the Banking and Currency Schools: ““According to the Banking Principle the business of the Bank was to extend its transactions as much as possible, provided of course, that these were sound in character, without any feeling that it had a special function to perform of greater importance than all its other functions and to which those must, of necessity, be sacrificed. The Currency Principle embodied a totally different view of the position of the Bank of England. The primary function of the Bank was not the transaction of business, but maintenance of a sufficient reserve on behalf of the nation to enable the latter to meet its liabilities with other countries” [Andreades 1909:273]” [55, p. PE-67].

Loyd argued that an automatic mechanism would regulate the relation between metallic



currency in circulation and the price level, but that a central bank needed to be pro-active to avoid under- and over-issue of notes. This, according to the Currency School, warranted regulation of note-issue [81]. Among other things, Tooke's *State of the Currency* addressed the question of whether a criterion might be identified to guide a central bank's issue of bank-notes. "The result of the preceding reasoning upon the regulation of a paper circulation, even with a considerable amount of bullion and coin in the country to meet emergencies, seems to be [...] the bank-directors have no sufficiently accurate criterion by which they can regulate their issues, so as constantly to preserve the paper circulation at the level which a gold circulation would preserve, with respect to the currency of the rest of the world" [98, p. 99-100]. Here Tooke has argued that the exchanges can't be used as a criterion for regulating the creation or destruction of paper currency. In fact, the use of the criterion of exchanges will lead to greater fluctuations in interest rates than would warrant the operation. Fullarton is explicit: "As a general principle, indeed, I am quite free to admit, that the increase or decrease of a circulation of bank-notes, from whatever cause it may proceed, ought to correspond with the increase or decrease which a currency of metallic coin would exhibit under the same circumstances. But I go further than this: I contend, that there not only ought to be such correspondence, but that there always is [...]" [24, p. 27].

This seems to contradict the anti-bullionist stance on the connection between convertibility and proper levels of note-issue. Anna Schwartz explains that the Banking School rested on three principles, and the principle which altered traditional real bills was known as the law of reflux. This specified a new channel through which notes returned to banks in circumstances of over-issue, even when convertibility is suspended. According to the law of reflux, excess notes immediately return to banks to repay outstanding loans [81]. The reasoning is excess notes are redeemable at the banks at the same unit of account, even if over-issued and insufficiently backed by bank assets. To borrowers these notes will be worth more because the purchasing power of the notes will be diminished on the market, but to the borrower these notes will be recognized at par when taken to their bank of issue for credit to their loan

accounts. The other tenets of the Banking School are for banks to restrict holdings to real bills and for demand to determine the level of note-issue. Oddly, the non-difference between real and fictitious bills had been pointed out by Thornton decades prior [97, p. 42-4]. That demand should determine note-issue was a traditional real bills idea and can be understood as a critique of the quantity theory's assertion of a perfectly inelastic supply curve.

The debate remained unsettled, but the Bank Charter Act of 1844 was an undisputed victory for the Currency School. The Bank of England, under the act, was given monopoly over note-issue and was required to have a 100% gold reserve backing any new note issue [81].

## **2.3 Conclusion: Duties of the Sovereign**

That two theories which focus on questions of value should survive the marginal revolution unscathed is surprising to say the least. To this day the quantity theory asserts a perfectly inelastic supply of money which can be shifted according to the issue of loans from banks. Since it is the supply curve entirely that is controlled by the banks, it is in the central bankers' hands not to over- or under- issue notes, or in contemporary terms, to target the level of inflation. Real bills, in its current form as the backing theory of money, can be interpreted as a perfectly elastic supply of money, where the price of issuing new money is set to the fixed unit of account. If demand is downward sloping, then the historical arguments in favor of allowing demand to determine the quantity of money, is rationalized. Unit elastic demand rationalizes quantity theory's prediction that doubling the supply of money should halve the purchasing power of each unit. Broken down in these terms, the debate becomes a question of the elasticity of the supply of money.

Under the quantity theory, the supply of money is chosen by the central bank, and thus rules are required to avoid over- and under- issue of notes. This is why the quantity theory

is amenable to 100% reserve requirements. The backing theory, on the other hand, supports fractional reserve banking, so long as adequately backed assets are held by the bank.

In a side note, this study of debates in British banking history has revealed to me this: the story of evolving institutions learning from past mistakes does not apply to the Bank of England. Different generations may face similar problems, but rules adopted to deal with them are forgotten or distorted into rules of thumb which rely on context-specific assumptions. From this lesson it is easy to identify with the Currency School's goal of codifying banking principles. But the relevant question then becomes which principles best reflect the reality of the situation, and which are the unexamined remnants of an ancient theory? After studying the debates between quantity theory and real bills, Thomas Kuhn's theory of scientific revolutions seems heartachingly accurate.

# Chapter 3

## A History of Financial Regulation in the USA from the Beginning until Today: 1789 to 2011

### 3.1 Introduction

In the USA today, the system of financial regulation is complex and fragmented. Responsibility to regulate the financial services industry is split between about a dozen federal agencies, hundreds of state agencies, and numerous industry-sponsored self-governing associations. Regulatory jurisdictions often overlap, so that most financial firms report to multiple regulators; but gaps exist in the supervisory structure, so that some firms report to few, and at times, no regulator. The overlapping jumble of standards, laws, and federal, state, and private jurisdictions can confuse even the most sophisticated student of the system. At times, it can be unclear exactly who regulates whom, what rules apply in which instances, and where to turn for a resolution of these questions. This confusion occasionally

inhibits innovation in the financial services industry and investments in some sectors of the economy. At other times, this confusion enables firms and investors to fly under the radar and profit from regulatory arbitrage. Whether this confusion promotes economic growth or causes economic instability is an open question.

How this confusion arose can be explained. The history of financial regulation is long but well documented. Responsibility for overseeing the financial services industry evolved in the United States during the last two centuries. Debate about how to regulate financial activity began at the Constitutional Convention in 1787 and continued unabated for two centuries. The political debate dictated the structure of the financial system; scholars have long noted this fact. An example comes from Jacob Viner's address at the American Economic Association's annual meeting in 1936. Viner argued that America's fragmented financial system,

“[...] has deep roots in our history, in our regional diversities, and local loyalties. Its persistence is due to the support it derives from state jealousy of encroachments on state autonomy, from agrarian and small-town jealousy of the metropolitan areas, and from the nation-wide fear of undue concentration of financial power in the great metropolitan centers, and especially fear of Wall Street domination” [101].

This chapter summarizes that history. Section 3.2 briefly describes the foundations of the financial system in the eighteenth and nineteenth centuries. The story begins with the United States Constitution, which establishes the parameters of the debate. Section 3.3 examines the response of the system to financial crisis in the early decades of the twentieth century, focusing on the creation of the Federal Reserve System. Section 3.4 examines the reform of the system in response to the financial crises of the Great Depression of the 1930s. Sections 3.5 and 3.6 discuss the creation of the modern financial system from the 1940s through the 1990s. Section 3.7 discusses attempts to plug leaks that arose in the modern financial system

during the first decade of the twenty-first century.

To illuminate the information in our narrative, three tables appear at the end of our essay. Table 3.1 lists the government agencies that oversee financial markets today (or oversaw financial activity in the past). The columns of the table indicate the legislation that authorized the agency (and major revisions), the purpose of the agency, and (some of) its major data collections. Table 3.2 lists the principal non-governmental organizations that set standards for financial markets. Table 3.3 lists the principal laws that influenced the regulation of financial markets over the last 200 years, with a focus on legislation since the founding of the Federal Reserve System in 1913. Of course, in constructing these tables, choices had to be made, because publishing complete lists would be prohibitive. In this regard, the authors decided to exclude information about hundreds of state agencies and thousands of state laws and to exclude references to the 12 Federal Reserve District banks.<sup>1</sup>

To illustrate the story that we tell, we reproduce as Figures 3.1 and 3.2 a figure previously published in January 2009 by the General Accounting Office of the United States [96]. This figure is the useful depiction of the history of the system. The figure begins in the 1860s, at the time of the US Civil War. But the complexity of financial regulation in the USA begins before that date. Understanding why requires a discussion of the founding of our nation.

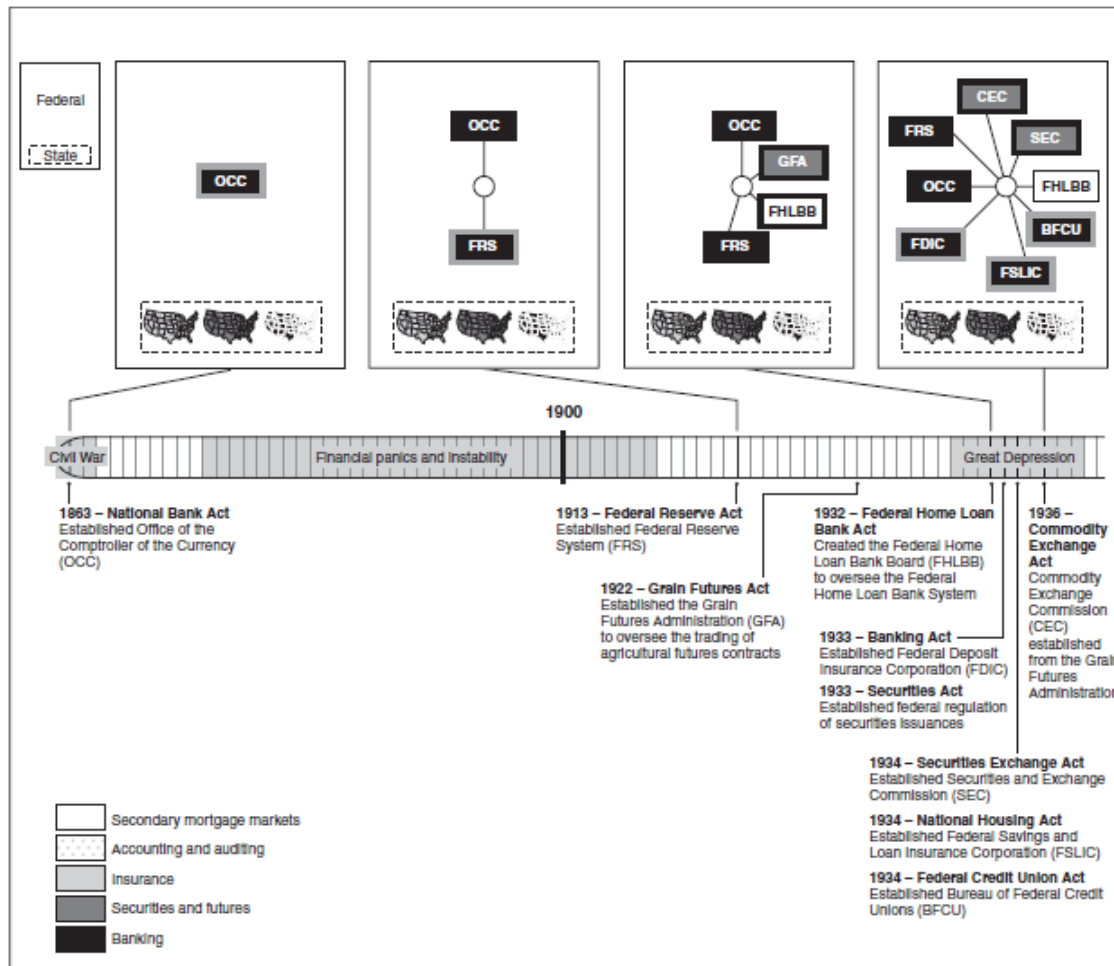
## **3.2 Constitutional Foundations of our Financial System**

At the Constitutional Convention in 1787, delegates debated how to regulate financial activity. Some delegates advocated the creation of a national currency and a national bank.

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<sup>1</sup>The authors would be interested to hear readers' thoughts about our decisions, particularly what information should have been excluded and what information should have been added in its place.

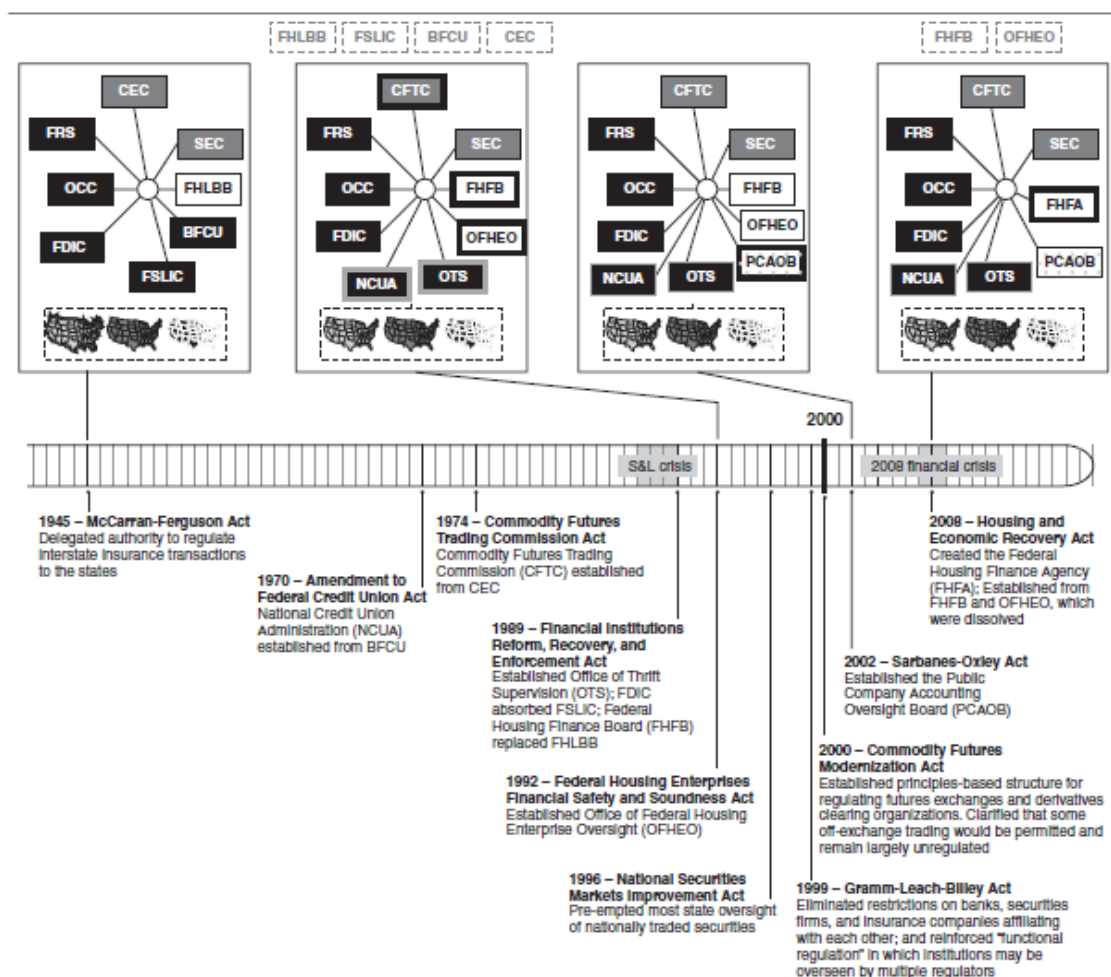
Figure 3.1: Graphical representation of evolution of financial regulation in the USA, through Great Depression



Others opposed those proposals, arguing that the regulation of financial activity should be left to state governments. Bitter divisions engendered broad compromises. These appear in the portion of the constitution that delineates powers of the federal legislature. Article 1, Section 8 provides Congress with powers to

- Borrow money on the credit of the USA
- Coin money, regulate the value thereof, and of foreign coin

Figure 3.2: Graphical representation of evolution of financial regulation in the USA, Great Depression through today



- Regulate commerce with foreign nations and among the several states
- Establish uniform laws on the subject of bankruptcies throughout the USA.

In 1791, Congress chartered the First Bank of the United States to handle the financial needs of the federal government and the credit and coinage of the nation. In 1811, the charter expired, and by one vote, Congress defeated the bill reauthorizing the institution. In 1816, Congress chartered the Second Bank of the United States, whose charter expired in 1836.



These charters expired because politicians disagreed about the federal government's role in the regulation of the financial system. Politicians from northern industrial states favored federal – centralized – rather than state government. Politicians from southern and western states feared financial conglomerates and favored regulating financial activity through state legislatures. Their opposition prevented the establishment of a central bank, a uniform fiat currency, or uniform nationwide regulations for financial institutions [12, 34, 54, 77].

State governments filled these gaps. State courts enforced financial contracts. States chartered corporations that provided financial services, particularly banks, and regulated their behavior. The profitability of these charters created problems with political corruption, which were mitigated when states adopted general incorporation and free banking laws, enabling anyone meeting specific criteria to obtain a charter and open a bank. By the mid-1830s, financiers had little difficulty chartering banks. Banks opened in large numbers. Each bank issued its own currency, which traded at an exchange rate that reflected the bank's reputation and risk of default. State governments left bank regulation to market forces. About half of all banks failed. Most failures occurred within a few years of the opening of an institution. Average longevity for financial firms appears to have been about 5 years. Because of these characteristics, financial historians refer to this era, from the expiration of the Second Bank of the United States to the Civil War, as one of wildcat banking [16, 75].

The Civil War provided an opportunity to reform the financial system, because southern politicians who opposed federal regulation of financial markets withdrew from Congress. In their absence, Congress passed the National Currency Act (ch. 58, 12 Stat. 665; February 25, 1863) establishing a national currency printed by the US Treasury and issued by commercial banks [23, 35, 108]. A bank could issue notes in proportion to the value of the capital that the bank deposited with the Treasury. To discourage the circulation of privately printed currencies, the Act taxed currencies of all other types, effectively forcing them out of circulation. One year later, Congress passed the National Banking Act (ch. 106, 13 Stat. 99;

June 3, 1864), which established a system for issuing federal charters to commercial banks and authorized the Office of the Comptroller of Currency to supervise those banks. The Comptroller's annual reports created a systematic national data collection covering a large swath of the banking industry. The act established a pyramid structure of reserves cities which shaped the financial landscape of the USA during the decades that followed.

The second panel of Figure 3.1 depicts the regulatory landscape after the passage of the National Banking and Currency Acts. The Office of the Comptroller of Currency (OCC) appears as the sole federal regulator of financial activity. The governments of the 36 states regulated financial activities within their borders, typically under a Superintendent of Banks or similar agency regulating commercial banks, trust companies, and building and loan corporations. Many states also possessed (or soon established) an agency that regulated insurance companies.

### **3.3 Responses to Financial Panics, 1890 to 1930**

In the decades between the Civil War and World War I, financial panics occurred frequently, including major panics in 1873, 1893, and 1907 [38, 39]. After these panics, legislators (both federal and state) debated reforming financial regulation. The panics of the 1890s contributed to the passage of the Bankruptcy Act of 1898 (1 July 1898, ch. 541, 30 Stat. 544). The act established federal-court procedures for court-supervised liquidation of corporations unable to pay creditors, but left the liquidation of commercial banks in the hands of state bank supervisors and the Office of the Comptroller of Currency.

The panic of 1907 inspired further reform. An attempt to corner the market on the stock of the United Copper Company failed, and the banks that had lent money to the speculators sustained substantial losses. Depositor runs on these institutions spread rapidly to associated

banks and trust companies, culminating in the collapse of the Knickerbocker Trust Company, New York City's third-largest trust institution. In turn, Knickerbocker's failure provoked a nationwide run on bank deposits [86]. In the absence of a central bank, the famous financier J. P. Morgan interceded by convincing New York's bankers to pledge funds to shore up depositories beset by the cash crunch. One year later, Congress established a commission, chaired by Senator Nelson Aldrich, to investigate the crisis and propose solutions. The commission studied financial systems in numerous nations. Its exhaustive report inspired the creation of the Federal Reserve System. The environment was ripe for this proposal thanks to the findings of the Pujo Commission, which publicly uncovered the connections between influential Wall Street financiers and major industries in the USA [91].

The Federal Reserve continued the compromise between advocates of local and national regulation. The system consists of twelve district banks, each of which originally acted as the central bank for a region of the nation, with a board of directors located in Washington, DC, which coordinated (but did not control) the activities of the system. Federal Reserve district banks possessed authority to conduct monetary policy – including discount lending and open market operations – at its own discretion under rules different from today. Then, Federal Reserve banks could only purchase (or loan money on the security of) what is now known as short-term commercial paper. Federal Reserve banks did no deal in overnight loans among private banks (federal funds) or US government securities, which are the principal monetary policy levers today [73, 9].

District banks also supervised the commercial banks that joined the system. The Federal Reserve Act required all nationally chartered banks to join the system, putting them under a dual system (Fed and OCC) of regulation and examination. State chartered banks could also join, if they fulfilled all federal regulations — such as levels of required reserves and restrictions on risky investments — which tended to be stricter than those imposed by state statutes [49, 50].

The third panel in Figure 3.1 depicts the regulatory landscape after the creation of the Federal Reserve in 1913. State governments continued to be the principal regulators of financial activity. State courts enforced most financial contracts. State legislators chartered most financial corporations. State regulators supervised roughly two out of three commercial banks and all other financial institutions, including insurance companies, trust companies, mutual savings banks, credit unions, mortgage originators, and building and loan societies [107, 110]. Some states even dabbled in state-run deposit insurance programs [10].

An array of private entities also supervised financial intermediation. Clearing houses operated in nearly one hundred cities. Banks that belonged to clearing houses had to obey their rules regarding reserves, risk, and regular inspections. State banking associations and the American Banking Association imposed codes of conduct on the behavior of members. Financial conglomerates – some of which began to form bank holding companies – began to purchase shares of stock in large numbers of banks and place directors on the banks’ boards. Rating agencies (e.g., Moody’s) and business information providers (e.g., Rand McNally) began to collect and disseminate balance sheet information from most banks operating in the USA. Stock exchanges operated in dozens of cities; some, such as New York, possessed several. Exchanges regulated transactions in equity, bond, and futures markets, ensuring that those who bought and sold in those venues fulfilled the terms of their contracts.<sup>2</sup>

The fourth panel of Figure 3.1 depicts further changes in the regulatory landscape during the 1910s and 1920s. On September 21, 1922, Congress passed the Grain Futures Act (ch. 369, 42 Stat. 998, 7 U.S.C. 1), which established the Grain Futures Administration (GFA). The GFA supervised trading of commodities futures contracts. The City of Chicago challenged the constitutionality of this act, which was upheld by the Supreme Court in *Board of Trade of City of Chicago v. Olsen*, 262 US 1 (1923). The Supreme Court had ruled against an earlier version of the act (the Futures Trading Act of 1921) in *Hill v. Wallace*, 259 U.S. 44 (1922).

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<sup>2</sup>One of the contemporary descriptions of the US financial system appears in Rand McNally Bankers Directory, which was published biannually, in January and July, beginning in the 1890s.

These court cases illuminate the political tension generated by the federal government's increasing attempts to regulate – and at times shape – the financial markets.

The government's broadest intervention at the time may have been in agricultural credit. In 1916, Congress passed the Federal Farm Loan Act. This act established a Federal Farm Loan Board to supervise twelve Federal Intermediate Credit Banks. These banks extended short-term, seasonal loans to farms, ranches, and companies that processed agricultural products. Funds for these loans came from bonds with similar maturities sold on securities markets in major cities. The Farm Loan Act also established Federal Land Banks and National Farm Loan Associations. These organizations raised funds for farm mortgages by selling mortgage-backed bonds in cities with sizeable securities markets. Capital for the land banks and intermediate credit banks came from the US Treasury and from farmers who were the customers, who were required to purchase stock in the corporations [85].

The federal government's intervention into farm lending coincided with the rapid expansion of agricultural production in the Great Plains and western states. This expansion led to the creation of new banks, businesses, and even towns that served as conduits for farm commodities. The expansion continued throughout World War I and for several years afterward, until climatic shocks (particularly droughts) reduced crop yields and international competition (particularly from European farms put back into production after the war) lowered crop prices. The ensuing contraction of farm incomes impeded the repayment of agricultural loans, contributing to the failure of thousands of small banks that operated in farm communities [2].

While the US Congress debated a wide array of financial reforms during the 1920s, the most important legislation was the McFadden Act of 1927 [64]. The act's provisions fell into three groups. First, the act extended the life of the Federal Reserve System. The act extended indefinitely the original twenty-year charters of Federal Reserve Banks. Second, the McFadden Act revised national banking laws to conform with legal rulings, administrative

decisions, and current business practices.<sup>3</sup> Third, the McFadden Act expanded national banks' authority to operate branches. Before the act, national banks could not operate branch facilities except in a few special circumstances. After the act, national banks could operate branches in the same city as their headquarters to the same extent as state-chartered banks under state law, but could not branch outside their home city or across state lines. While the McFadden Act had broad effects, it is remembered primarily for its impact on branch banking, which persisted for nearly seventy years, until modified by the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 [67].

### 3.4 Policy Responses to the Great Depression

Thousands of banks failed during the contraction beginning in 1929 and continuing until March 1933 [72, 73]. While the Federal Government made a few attempts to address the financial calamity during the years of 1930-1932, their efforts proved to be too little and too late. In early 1933, the public lost faith in banks in general. Depositors fled from the financial system, forcing twenty-eight states to close all financial institutions and eventually forcing the president to declare a national banking holiday, which shut down all financial institutions for seven business days before gradually resuscitating the financial system. In response to this disaster, the federal government changed the structure of financial regulation [25, 109].

On 22 January 1932, Congress passed an act (c. 8, 47 Stat. 5) chartering the Reconstruction Finance Corporation (RFC) and authorized the RFC to extend loans to all financial institutions in the USA, including state-chartered banks lacking links to the Federal Reserve, and

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<sup>3</sup>Some of these changes appeared merely technical, such as allowing subordinate officers to sign reports to the Comptroller of Currency, rather than only the president or cashier (CEO and CFO) of the bank. Others provided firm legal footing for services increasingly offered by national banks, such investment departments which marketed bonds and similar securities and trust departments which served as custodians for customers' financial assets.

to accept as collateral an array of assets, as long as the RFC's leaders deemed the loans to be 'amply' secured. The RFC's mandate emphasized loaning funds to solvent but illiquid institutions, whose assets appeared to have sufficient long-term value to pay all obligations, but which in the short run could not be sold at a price high enough to repay current creditors. The RFC also loaned funds to the receivers of banks in liquidation, which enabled receivers to repay depositors as soon as possible, and repay the RFC in the future, when assets could be sold at higher prices. The RFC also loaned funds to Federal Land Banks, which financed farm mortgages, and Federal Intermediate Credit Banks, which financed seasonal agricultural lending. The RFC also advanced funds to railroads, which indirectly aided banks, since numerous banks possessed portfolios of railroad bonds, which declined in value as rail traffic declined during the depression, and to insurance companies, which also aided banks, since banks often purchased insurance on the values of their bond portfolios.

The Reconstruction Finance Corporation was a quasi-public corporation, staffed by professionals recruited outside of the civil service system, but owned by the federal government, which appointed the corporation's executive officers and board of directors. The RFC's initial capital came from \$500 million in stock sold to the U.S. Treasury. The RFC raised an additional \$1.5 billion by selling bonds to the Treasury, which the Treasury in turn sold to the public. In the years that followed, the RFC borrowed \$51.3 billion from the Treasury and \$3.1 billion directly from the public. All of the RFC's obligations were guaranteed by the federal government [41]. On 21 July 1932, an amendment authorized the RFC to loan funds to states and localities for self-liquidating public relief projects, such as the construction of utilities and bridges, whose construction costs would be repaid by user charges and tolls. The amendment also authorized the RFC to loan funds to states and localities to provide relief for the unemployed, when those loans could be repaid by future tax receipts.<sup>4</sup>

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<sup>4</sup>To accomplish its goals, the RFC established several subsidiary and allied corporations. These include the Metals Reserve Company, the Defense Plant Corporation (DPC), Defense Homes Corporation (DHC), War Damage Corporation (WDC), Rubber Reserve Company (RRC), Electric Home and Farm Authority (EHFA), Lafayette Building Corporation (LBC), Federal Facilities Corporation (FFC). Many of these agencies played important roles in financing economic expansion during World War II. In 1953, Congress passed an act

On 27 February 1932, Congress passed the Banking Act of 1932.<sup>5</sup> The Banking Act of 1932 expanded the Federal Reserve's lending powers, allowing Federal Reserve district banks to loan funds to member banks on the security of a broad range of assets equivalent to the assets accepted by the RFC. Loans secured by collateral previously ineligible for rediscount had to be approved by a minimum of five members of the Federal Reserve Board and had to pay a rate at least one percent above the prevailing discount rate. Federal Reserve districts could also loan funds to individuals, firms, and corporations, under restrictions mentioned above, and with the added stipulation that the borrowers prove that they had applied for but could not obtain credit from commercial banks in their own communities.

Congress passed the Emergency Banking Relief Act on 9 March 1933, in the week following Franklin Roosevelt's inauguration, in the midst of the national banking holiday, to facilitate reopening the nation's banks. Herbert Hoover's subordinates in the Department of Treasury and the Reconstruction Finance Corporation wrote the Act, which sat on Herbert Hoover's desk for many months to be used as a last resort in dire circumstances. Hoover never implemented the plan, although the economic crisis deepened during the months after his electoral defeat. During the interregnum, currency and gold fled from the USA. Bank runs swept the nation. Governors of more than twenty states declared financial holidays. Franklin Roosevelt implemented the disaster plan immediately after his inauguration. The Emergency Banking Relief Act clarified the Federal Government's authority to act during a national financial emergency under legal authority created by the Trading with the Enemy Act which Congress passed during World War I.

The Emergency Banking Act contained five titles. Title I authorized the President to declare

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that disbanded the RFC, transferring most of its functions to the Treasury Department effective June 1954, to wind down its affairs. Treasury completed that task in 1954. Vestiges of the RFC survive in the federal bureaucracy today. Successor agencies include the National Science Foundation, General Services Administration, and the Office of Defense Lending.

<sup>5</sup>Senator Carter Glass and Representative Henry Steagall coauthored the legislation, which was initially called the Glass-Steagall Act, until that label became the universal appellation for the act that Senator Glass and Representative Steagall cosponsored in the summer of 1933.



an emergency, during which he could control the national finances and foreign exchange of the USA, prohibit the hoarding and export of gold, and dictate which banks would reopen, merge, or remain closed. Title II authorized the Comptroller of the Currency to seize and operate any bank in the USA. The Comptroller used this authority to appoint conservators for banks deemed unfit to resume operations but with the potential to recover. Conservators ‘froze’ existing deposits, allowing depositors access to funds according to a schedule determined by recoveries on assets, and segregated new deposits into separate accounts. Conservators strove to reopen, reorganize, or merge banks under their supervision. Title III authorized national banks to issue preferred stock. Preferred stock paid dividends not exceeding six percent per year and did not subject holders to double liability [46, 32]. The Reconstruction Finance Corporation could purchase preferred stock, and during the years that followed, did so in large quantities. Title IV expanded powers of the Federal Reserve. Federal Reserve banks were authorized to use as collateral for Federal Reserve notes all direct obligations of the United States government (in the past they could only use gold and government bonds issued prior to World War I). Fed banks could also use as collateral all notes, drafts, bills of exchange, and bankers’ acceptances acquired during the banking emergency. Fed banks could issue notes summing to 100 percent of the value of their United States government obligations and ninety percent of the estimated value of all other collateral. Fed banks also received expanded lending powers. Fed banks could make loans to member banks under “exceptional and exigent circumstances” whenever the loan was secured to the satisfaction of the Federal Reserve Bank. This provision expanded powers granted to Federal Reserve banks by the Banking Act of 1932. Title V of the Act contained three sections. Section 1 allowed Federal Reserve banks to convert debt instruments of the US federal government into currency at par value and to convert any circulating liability of a commercial bank (e.g., check, draft, or banker’s acceptance) into cash at ninety percent of its apparent value. Section 2 authorized Federal Reserve banks to make unsecured loans to member banks at a rate at least one percent above the discount rate. Section 3 authorized Federal Reserve banks

to loan funds to any individual or corporation for ninety days if the loan was secured by US government securities. On March 24, 1933, an amendment expanded these powers, enabling Federal Reserve banks to loan funds directly to non-member banks and trust companies for the duration of the existing emergency.

On June 16, 1933, the Banking Act of 1933 (Pub.L. 73-66, 48 Stat. 162) became law [22]. Congress had considered progenitors of the legislation during preceding years. The final act merged in conference the two bills introduced by Carter Glass in the Senate and Henry Steagall in the House. Congress approved the act on June 13 and the President signed it on June 16. The final bill contains most of the provisions proposed by Senator Glass, with the exception of branch banking, which Steagall opposed, and the addition of deposit insurance, which Steagall advocated.

The Glass-Steagall Act contained several provisions which shaped the financial landscape in the USA during the next decades. First, the act established nationwide deposit insurance replacing the temporary insurance fund established by the Emergency Banking Act. This provision created the Federal Deposit Insurance Corporation (FDIC), under the management of a board of directors appointed by the President. The corporation's capital came from the US Treasury, Federal Reserve District Banks, and banks that joined the insurance system. All banks that belonged to the Federal Reserve had to join the deposit insurance system. Non-member banks could join the system by subscribing to stock in the association. Those that joined had to meet the requirements for Federal Reserve membership by July 1, 1936. This provision, in effect, induced all FDIC-insured banks to join the Federal Reserve System. Carter Glass – the legislative proponent of this provision – had intended this to happen. He hoped to induce all state-chartered banks to join the Federal Reserve and rationalize the dual banking system [22, p. 70-71]. All insured banks could be charged assessments, if the stock of the corporation proved insufficient to cover required insurance payouts. The FDIC insured the all deposits up to \$10,000 and of larger deposits, 100 percent of the first \$10,000;

seventy-five percent of the next \$40,000; and fifty percent of any deposit over \$50,000.

Second, the act separated commercial from investment banking. The act required commercial banks to sell their securities affiliates within one year and restricted their bond departments to the purchase and sale of securities on the order of and for the account of customers. Underwriting investment securities was prohibited. Interlocking directorates between commercial banks and securities companies was also forbidden. Firms engaged in selling securities were prohibited from taking deposits one year after the enactment of the law (i.e., after June 16, 1934). The use of bank credit for the purchase of securities and speculation in securities markets was restricted. The Federal Reserve received powers to prevent member banks from extending loans for investment in securities markets.

These provisions were motivated, in part, by Congressional investigations of the causes of the Wall Street Crash of 1929 and the collapse of the commercial banking system from the fall of 1930 through the winter of 1933. These hearings came to be known by the name of the chief counsel, Ferdinand Pecora, hired to pursue the investigations and write the final report. Pecora personally interviewed an array of high profile witnesses, including some of the most influential financiers in the USA. His efforts illuminated abusive practices and conflicts of interest on the part of banks, bank holding companies, and their financial affiliates. The worst abuses included the underwriting of unsound securities to pay off defaulted bank loans, insider trading, and fraudulent manipulation of securities prices. These revelations garnered widespread media attention. The ensuing public outcry galvanized support for banking reforms during the 1930s [61, 62].

Third, the Banking Act of 1933 imposed stricter regulations on financial institutions. Some of these regulations sought to reduce conflicts of interest among officers and directors. For example, the act prohibited officers and directors of member banks from borrowing from their own institutions and required them to report all borrowing from all other organizations. The act also prohibited officers and directors of member banks from associating with corporations

that loaned funds on the security of stocks and bonds. Officers and directors of federally insured banks also had to conform to these regulations.

Other regulations sought to alter conditions that engendered bank failures, particularly among small banks. One example is an increase in minimum capital requirements. Another example was the prohibition of payments on demand deposits, which legislators expected would reduce the cost of funds for commercial banks and encourage depositors to place more of their funds in time deposits (i.e., savings accounts and certificates of deposit), providing commercial banks with a stable source of funds that was less subject to panics and runs. Additional examples were the restriction upon the use of bank credit for speculation, authorization of state-wide branch banking, federal supervision of group banking, modification of double liability, and increased authority of bank examiners.

Another restriction was the prohibition of private banking. Private bankers were individuals (or partnerships) that accepted demand deposits. The act required private bankers, after one year, to surrender either their deposit business or their dealing in investment securities. If they elected to conduct a deposit business, the law required them to submit to periodic examination by the Comptroller of the Currency.

Two years later, the Banking Act of 1935 contained two key sections. Title I modified the deposit insurance system so that the FDIC insured the first \$5,000 of all deposits and nothing over that amount. The FDIC collected an annual assessment of one-twelfth of one percent of all deposits in insured banks with no provision for collecting “special assessments” to cover periodic losses. Insured state chartered banks with deposits over \$1,000,000 were still required to join the Federal Reserve System, but the deadline for doing so was pushed from 1936 back to 1942. Banks with deposits less than \$1,000,000 were no longer required to join the Fed. Those that had joined were given the option to depart, but only fifty of the roughly 7,500 banks that joined the system chose to leave it.

While Title I made minor modifications to the FDIC, Title II made major changes to the structure of the Federal Reserve System. These changes centralized control of supply of money and credit in the hands of the Federal Reserve Board of Governors (the “Board”). Title II gave the Board the power to approve governors and vice-governors of the twelve district banks. The Board also received the authority to set discount rates and establish lending policies. The act provided that “subject to such regulations as to maturity and other matters as the Federal Reserve Board may prescribe,” a Federal Reserve Bank might discount any commercial, agricultural, or industrial paper for member banks, and might make advances to member banks secured by “any sound asset.” The act also permitted the Federal Reserve to purchase securities issued or guaranteed by the US government.

The new Board dominated a new Federal Reserve Open Market Committee (FOMC), consisting of the seven members of the Board, the President of the Federal Reserve Bank of New York (FRB-NY), and the presidents of four other Federal Reserve districts on a rotating basis. Title II gave the FOMC the authority to establish policies pertaining to the purchase of securities in the open market. The decisions of the FOMC became binding on Federal Reserve banks, which in the past, need to participate in programs of open-market purchases and sales recommended by the Federal Reserve Board. Other Depression-era legislation dealt with deposit-taking institutions other than banks, such as savings and loans and credit unions. These organizations differed in the types of deposits that they accepted and the types of assets that they held. Commercial banks accepted deposits payable upon demand and provided customers with the opportunity to circulate those liabilities by writing checks. Commercial banks invested the preponderance of their short-term liabilities in short-term commercial loans, providing credit (often seasonal) to manufacturers, wholesalers, retailers, and farmers. Savings and Loans accepted only savings deposits and invested the bulk of these long-term liabilities in long-term investments like home mortgages. Credit Unions did not accept deposits. Instead, members of credit unions (and related entities such as mutual savings banks and building and loan societies) held stock in a non-profit credit cooperative.

The cooperative typically treated the shares of stock like savings accounts, allowing members to buy and sell shares just like individuals deposited and withdrew funds from commercial banks. In 1934, Congress passed the National Housing Act, which established the Federal Savings and Loan Insurance Corporation (FSLIC), which insured deposits in savings and loans (S&Ls) and regulated the S&L industry. Congress also passed the Federal Credit Union Act, which established the Bureau of Federal Credit Unions to insure and regulate member-owned credit cooperatives [106].

The federal government's intervention into mortgage markets expanded in 1932, when the Congress passed the Federal Home Loan Bank Act. The act created the Federal Home Loan Bank Board to oversee twelve government-backed banks with the authority to purchase mortgage loans issued by originators – primarily building and loan and savings and loan organizations – operating within their jurisdiction [66]. In 1938, the federal government intervened in mortgage markets expanded again, when Congress amended the National Housing Act to create the Federal National Mortgage Association (FNMA), colloquially known as Fannie Mae. Fannie Mae operated as a government sponsored entity whose mission was to purchase home loans originated by commercial banks and mortgage brokers, create a liquid secondary mortgage market, reduce the cost of home ownership, and encourage middle-class home ownership. Fannie Mae principally purchased mortgages insured by the Federal Housing Administration (FHA). For thirty years, Fannie Mae was the preponderant purchaser of mortgages, exercising a virtual monopoly over the secondary mortgage market [19].

Another series of acts regulated stock exchanges and securities markets. In 1933, Congress passed the Securities Act, which established federal regulation of securities issues. In 1934, Congress passed the Securities Exchange Act which established the Securities and Exchange Commission (SEC) to regulate the issuance, purchase, and sale of securities, particularly equities and debt instruments. The act required all public companies to submit periodic financial statements under penalty of perjury. In 1936, Congress passed the Commodity

Exchange Act (ch. 545, 49 Stat. 1491, enacted June 15, 1936) which required all commodities futures and options to be traded on organized exchanges. To regulate those exchanges, the legislation established the Commodity Exchange Commission (CEC). This organization absorbed and assumed the legal authority of the Grain Futures Administration (GFA), which had been established in 1922. For an overview of this legislative history, see Stassen (1982) [87].

### **3.5 Constructing the Modern Financial System, 1940 to 1980**

Financial markets operated calmly from the 1940s through the 1980s. Institutions created in the wake of the New Deal held significant sway over the financial world and regulatory practices during this period.

One of the hallmarks of the SEC's oversight of securities markets was the preference for industry self-regulation. While the SEC has the authority to create accounting standards for publicly traded companies, it often defers to private accounting standards boards such as the Financial Accounting Standards Board (FASB) and its predecessors [53]. The most prominent example of this tradition is the FASB, which sets the Generally Accepted Accounting Principles (GAAP) for the industry. In 1972, the American Institute of Certified Public Accountants (AICPA) issued a report calling for an end to the Accounting Principles Board (APB) and the creation of a fully-independent FASB [82].<sup>6</sup>

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<sup>6</sup>Whereas the members of the APB were part-time, unpaid members who worked for firms as accountants, members of the FASB are paid to work full-time devising standards. This set of distinctions is the intended source of independence, though Meyer concludes from his examination of APB Opinions that the APB was not systematically influenced by the connections between members and their "external constituencies" [51]. Seidler points out that members may be influenced on an industry and national level rather than an individual and company level, and that this influence would not be broken when transitioning to the FASB [82].

The Financial Accounting Standards Board sets the Generally Accepted Accounting Principles in the USA. A five-tiered hierarchy of rulings and opinions make up GAAP:

**A.** Category A, the highest category

**A.1.** FASB-issued statements

**A.1.a)** Statements of Financial Accounting Standards (SFAS)

**A.1.b)** Financial Accounting Standards Board Interpretations (FINs)

**A.2.** APB-issued statements

**A.2.a)** Accounting Principles Board Opinions

**A.3.** AICPA Committee on Accounting Procedure (CAP) statements (APB's predecessor)

**A.3.a)** Accounting Research Bulletins (ARBs)

**B.** Category B

**B.1.** FASB Technical Bulletins (FTB)

**B.1.a)** Created by FASB staff, rather than the actual board

**B.2.** AICPA Industry Audit and Accounting Guides

**B.2.a)** Created by committees and task forces in AICPA

**B.3.** AICPA Statements of Positions (SOPs)

**B.3.a)** Created by AICPA Accounting Standards Executive Committee (AcSEC)

**C.** Category C

**C.1.** Consensus positions of FASB's Emerging Issues Task Force (EITF)<sup>7</sup>

**C.2.** AcSEC practice bulletins

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<sup>7</sup>The EITF is designed to provide more timely opinions than SFAS [53].



## D. Category D

**D.1.** AICPA Accounting Interpretations (AINs)

**D.2.** FASB Staff Implementation Guides

**D.3.** “[P]ractices that are widely recognized and prevalent either generally or in the industry” [53, 58]

## E. Category E

**E.1.** Catchall encompassing all other written sources of accounting authority [53, 58]

The Norwalk Agreement with the International Accounting Standards Board (IASB) marked a shift in FASB goals. Issued September 18, 2002 [20], the Norwalk Agreement made the alignment of US GAAP with international standards a priority for the FASB.

From the 1940s through the 1980s, practices of the FDIC influenced bank behavior. Banks insured by the FDIC must submit a Report of Condition and Income, also known as a Call Report, each quarter. The FDIC is responsible for maintaining and correcting these data, as well as making them available for the public. This responsibility is set down in the Federal Deposit Insurance Act of 1950. The bank’s Call Report must follow Federal Financial Institutions Examination Council (FFIEC) and FASB rules, as enforced by the FDIC. The FFIEC was created by the Financial Institutions Regulatory and Interest Rate Control Act of 1978 [88] and is tasked with creating uniform principles and standards across the several financial regulatory bodies such as the Fed, the OCC, and the FDIC. These data, from “insured national and state nonmember commercial banks and state-chartered savings banks,” are the principal source of information on the banking system available to the public and are often used by regulators as a measure of the system [93].

When a bank fails, the FDIC has a few standard procedures for resolution. Typically, the FDIC will either perform a deposit payoff, a purchase and assumption (P&A), or open bank

assistance.<sup>8</sup> There are two types of deposit payoff. In a straight deposit payoff, the FDIC pays the insured depositors up to the limit. In an insured deposit transfer, “insured deposits and secured liabilities of a failed bank or thrift are transferred to a healthy institution, and service to insured depositors is uninterrupted” [93]. The main alternative is a purchase and assumption. A P&A resembles an assisted merger in that a failed financial institution is absorbed by a healthy one (James 1991). The FDIC auctions a package of assets from the failed institution and replaces them on the balance sheets with “good” assets [29]. To determine which method it will employ in failure resolution, the FDIC estimates the cost of covering uninsured depositors of the failed institution, plus FDIC administrative costs of executing a payoff and liquidation and sees if it can find bidders among healthy institutions willing to cover those costs to absorb the failed institution. P&A is typically preferred, mainly because payoff and liquidation leads to a loss of going-concern value (Buck 1984). The Dodd-Frank Act will change resolution requirements – in particular through the the introduction of orderly liquidation authority (OLA) for systemically important financial institutions — but these rules are still being implemented.

In 1974, Congress amended the Commodities Exchange Act and created the Commodity Futures Trading Commission (CFTC). The CFTC succeeded the Commodity Exchange Commission, as seen in the second panel of Figure 3.2. The CFTC consists of five commissioners appointed by the President and confirmed by the Senate. The CFTC has the “authority to regulate futures trading in all goods, articles, services, rights, and interests traded for future delivery” [4]. To that end it has power injunction, giving it authority to pursue its own matters. The CFTC is also granted power to take special action in emergencies to maintain order [4]. The proximate cause of the creation of the CFTC was the leap in prices in 1973 attributed to the action of speculators [4]. In order to ease passage of the CFTC Act, some issues were left for the Commission to decide. Among these issues were the regulation of option trading in previously unregulated futures commodities, time-stamping, and regulation

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<sup>8</sup>Open bank assistance has not been used since 1992 after the implementation of least cost analysis [93].

of whether to permit futures commission merchants (FCMs) to dual trade — “trading for their own accounts as well as for the accounts of their customers” [4].

Other new regulations and regulatory agencies were created in the 1970s. The Employment Retirement Income Security Act (ERISA) was passed to protect retirees. ERISA also created the Pension Benefit Guaranty Corporation (PBGC), “to encourage the continuation and maintenance of private-sector defined benefit pension plans, provide timely and uninterrupted payment of pension benefits, and keep pension insurance premiums at a minimum” [94]. The PBGC acts to implement data collection and disclosure requirements mandated in ERISA [95]. The PBGC publishes statistics on its programs annually in its *Pension Insurance Data Book* since 1996 [92].

The Employment Retirement Income Security Act of 1974 (ERISA) was designed to aid and protect retired workers. It required retirement plans disclose information to participants, provide a system by which participants can file grievances and appeals, and set minimum standards [89]. Some information required by ERISA includes “corporate plan sponsors provide participants with audited annual reports, summaries of plan descriptions, and other disclosures” [45]. ERISA also asserted the right of retirement plan participants to sue their plan providers for delivery of services [89]. Additionally, ERISA marked a movement in setting retirement standards from the state to the federal level. ERISA superseded state laws on employee benefits and gave jurisdiction over disputes regarding employee benefit claims to the federal courts [45]. Over time, several amendments to ERISA have been passed, including the Consolidated Omnibus Budget Reconciliation Act of 1974 (COBRA), the Health Insurance Portability and Accountability Act (HIPAA), the Newborns’ and Mothers’ Health Protection Act, the Mental Health Parity Act, and the Womens’ Health and Cancer Rights Act [89].<sup>9</sup> COBRA continues a participant’s health coverage for a limited time after loss of a job and HIPAA provides protections for workers who, “might otherwise suffer discrimination

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<sup>9</sup>Other pieces of legislation that affected ERISA include the Tax Equity and Fiscal Responsibility Act, the Retirement Equity Act, the Revenue Act of 1978, and the Tax Reform Act of 1986 [45].

in health coverage based on factors that relate to an individual’s health” [89]. HIPPA is an important example of regulatory data standardization. Administrative Simplification provisions, “required HHS to adopt national standards for electronic health care transactions and code sets, unique health identifiers, and security” [90].

The Home Mortgage Disclosure Act (HMDA) of 1975 was initially implemented to help discern whether depository institutions were failing to reinvest in their communities. Financial institutions covered by HMDA were required to report aggregates of dollars and locations. The required information did not include racial or other demographic data on loan applications. This model prevailed from HMDA’s passage to the 1989 Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA). One of many amendments to HMDA, FIRREA expanded its scope to more mortgage lenders. FIRREA’s main impact on HMDA was to require lenders to report demographic information such as race, sex, and income, including reports on rejected applications. From FIRREA up through the twenty-first century, HMDA was amended so the data collected could be used to address issues of discrimination. In the early 2000s, HMDA was further amended through changes in regulation rather than through passage of laws. Most significantly, starting in 2004, HMDA required reporting of pricing of loans [43] to support the use of the HMDA Loan Application Register (LAR) data to assess predatory lending and discriminatory pricing.

The Securities Acts Amendments became law on June 4, 1975 [80]. In these Amendments Congress directed the SEC to promote the creation of National Market and National Clearing Systems [27] encompassing several goals. The National Market System was meant to improve competition, liquidity, efficiency and stability in securities markets [60, 105]. The SEC sought methods to exploit advances in computer technology to combine the several regional exchanges into the Intermarket Trading System (ITS) [47, 28]. To that end, on April 28, 1981 the SEC ordered the ITS and the National Association of Securities Dealers (NASD)’s Computer Assisted Execution System (CAES) be automatically linked [28]. Additional

SEC-backed projects include the Consolidated Transaction Reporting System to provide real-time transaction reports for NYSE, AMEX, and regional exchanges and the Composite Quotation System to display quotations and quotation sizes for the Consolidated Transaction System [28]. In an effort to end anti-competitive regulations, the SEC ended fixed minimum commission rates by 1975 [105].

Despite its orders from Congress, ten years after the passage of the Securities Acts Amendments, a National Market System had not materialized. Macey and Haddock pointed to off-board trading restrictions as a key way the SEC could act to improve competition, and noted, “[t]he SEC [...] was concerned that too much freedom in the marketplace might be detrimental. The Commission was particularly concerned with three phenomena: fragmentation of orders, overreaching, and market surveillance. These considerations are the only policy reasons that the SEC has advanced in defense of its failure to ban off-board trading restrictions” [47]. By “fragmentation of orders,” Macey and Haddock mean the SEC was concerned with consequences of transactions occurring outside organized exchanges. “Overreaching” refers to internalization of order flows, meaning that a broker-dealer may sell stock to a client at higher than market prices drawing from shares held in inventory by the broker-dealer. “Market surveillance” means SEC market monitoring responsibilities. Macey and Haddock [47] go on to argue that “fragmentation is an unwarranted fear,” by applying arbitrage logic, that overreaching is a fallacy, and that the SEC had ample market surveillance facility, concluding that there was no valid reason for the SEC’s failure to enact a National Market System.

## 3.6 Constructing the Modern Financial System, 1980 to 1995

During the 1980s and 1990s, the structure of financial regulation in the USA changed dramatically, as summarized in the second panel of Figure 3.2. Impetus for change came from three directions. First, free-market thinking increasingly prevailed in policy debates. Second, globalization forced financial institutions in the USA to compete in ever more competitive international markets against institutions operating in more permissive regulatory environments. USA institutions incessantly lobbied to loosen regulations and level the playing field. Third, during the 1980s, the S&L industry collapsed. The Fed applied the Depression-era authority to set deposit interest rate ceilings (Regulation Q) to passbook deposits at S&Ls for the first time in 1966 [26]. As nominal interest rates rose with inflation through the 1970s, deposits gradually fled to uncapped money market funds, a trend exacerbated by the Volcker Fed's inflation-fighting, which pushed short-term interest rates above twenty percent in 1981. This put S&L balance sheets under severe stress, because the asset portfolios of long-term mortgages could not adjust in pace with the higher funding costs and outflows in deposit liabilities. Congress responded in March 1980 with the Depository Institutions Deregulation and Monetary Control Act (DIDMCA), which phased out interest rate ceilings on deposits and more than doubled deposit insurance coverage. Later that year, the Federal Home Loan announced the first of several reductions in capital requirements for the S&Ls. In 1982, Congress enacted the Garn-St. Germain Depository Institutions Act, which fully eliminated interest rate ceilings on deposits and broadly expanded S&Ls' asset powers. These efforts were inadequate to prop up an industry designed to absorb much lower levels of interest rate risk. Many savings and loans became insolvent. Most teetered on the edge of the abyss. Ultimately the results were disastrous, as bankrupt but fully insured institutions expanded operations into areas of the financial service industry in which they had little or no experience.

The Financial Institutions Reform, Recovery and Enforcement Act of 1989 (FIRREA) was passed in response to the S&L crisis of the 1980s, mainly to restore confidence to the public. FIRREA amended the Home Owner's Loan Act of 1933, replacing the Federal Home Loan Bank Board, and creating the Office of Thrift Supervision (OTS), as seen in the second panel of Figure 3.2. The OTS was created in the Department of the Treasury. To monitor interest rate risk, the OTS implemented the "Net Present Value" (NPV) risk model, which required thrifts to submit aggregated data on the terms and conditions of the full portfolio of assets and liabilities. FIRREA also created the Resolution Trust Corporation to resolve failed S&Ls. This corporation was put under the management of the FDIC. While the FDIC took over the FSLIC's operations through the Resolution Trust Corporation, the explicit successor to FSLIC in FIRREA was the Savings Associations Insurance Fund (SAIF) [65].

Changes in regulations in that period tended to reduce restrictions on the operations of financial institutions, allowing them to enter new lines of business. Interstate and intrastate bank branching was heavily restricted up to the 1970s. Intrastate branching was limited, but deregulation began in the 1970s; interstate branching restrictions began to be lifted starting in 1978. The shift to deregulation was slow and gradual, culminating in the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994. This act allowed nationwide branching starting June 1997, but it also had opt-in and opt-out provisions. The opt-in provision allowed states to pass legislation to allow branching earlier than the June 1997 deadline. Only two states, Texas and Montana, passed legislation to opt out of the provisions of the act [13].

Since the Banking Act of 1933, banks were prevented from engaging in universal banking, or banking in both commercial and investment industries. The Gramm-Leach-Bliley (GLB) Act sought to allow increased competition by removing barriers between the banking sectors of commercial, investment, and insurance, repealing limitations set by the Banking Act and Bank Holding Company Act of 1956. It did this by allowing financial institutions to form

a “financial holding company” which can engage in all three industries. Anticipating the potential problems associated with the merging of personal financial data in these three industries, GLB included several privacy provisions. These provisions included required annual privacy notices for customers and an opt-out provision for customers to disallow financial institutions from sharing personal information with non-affiliates. GLB also required financial institutions “develop policies to promote data security”. A right of enforcement was assigned to federal agencies including the Federal Trade Commission, the Board of Governors of the Federal Reserve, the office of the Comptroller of the Currency, and the SEC. Despite these efforts, the privacy provisions were universally considered a failure soon after the passage of GLB [40].

The Federal Deposit Insurance Corporation Improvement Act of 1991 reformed rules for bank regulators and aimed to implement principles of prompt corrective action (PCA) and least-cost resolution (LCR). The principle of PCA was a response to banking and savings and loan troubles of the 1970s and 80s when regulators delayed taking action. PCA and LCR were designed to realign the incentives of regulators – who may be jockeying for industry jobs – to oversee the industry more conscientiously. To that end, FDICIA mandated more inspections of banks by the FDIC and annual audits of the FDIC by GAO. Subverting this structure, regulators were given discretion, under FDICIA, to set capital/asset thresholds which would trigger additional regulation and restrictions on banks, and immediately set the thresholds low enough for most banks to be considered “adequately capitalized” [5]. “The act also addressed such issues as the need for higher capital levels, risk-based deposit insurance, and a strengthening of the regulatory responsibility for early intervention” [33]. Risk-based deposit insurance was intended to minimize moral hazard distortions on the part of bankers. In this same vein, FDICIA prevented the FDIC from protecting deposits of uninsured depositors – depositors with deposits in excess of \$100,000 [5].

FDICIA addressed the doctrine of “too big to fail.” Effective in 1995, the FDIC was prohib-



ited from protecting “uninsured depositors or creditors at a failed bank if it would result in an increased loss to the deposit insurance fund,” with the exception being the case that the institution is considered “too big to fail” [5]. “Articulated by the Comptroller of the Currency after the failure of the Continental Illinois in 1984, the too-big-to-fail policy is based on the premise that the failure of a large institution could have a domino effect, starting bank runs that could bring down the financial system” [33]. FDICIA actually weakens this policy by requiring, “written approval of two-thirds of the Board of Directors of the FDIC and the Board of Governors of the Federal Reserve System [...] permission from the Secretary of the Treasury, after the secretary has consulted with the President of the United States. The FDIC is also required to recover any losses incurred from protecting uninsured claimants” [33]. It was considered that “too big to fail” policy would only rarely, if ever, be used.

### **3.7 Fine Tuning the System: 2000 until today**

During the last decade, the regulatory system continued to evolve. Some policymakers intended these changes to loosen restrictions on the behavior of financial institutions. These changes are visible in the third and fourth panels of Figure 3.2.

The Commodity Futures Modernization Act of 2000 (December 21, 2000) clarified regulatory jurisdictions between the Commodity Futures Trading Commission (CFTC) and the Securities and Exchange Commission (SEC) over many financial instruments. Title I amends the Commodity Exchange Act, limiting its scope. Title II amends the Securities Act of 1933, Securities Exchange Act of 1934, Commodity Exchange Act, and Shad-Johnson Jurisdictional Accord, “to provide implementing rules necessary for shared oversight by the SEC and CFTC of single stock futures trading” [42]. “Title III provides additional legal certainty for swap agreements by providing guidelines for SEC regulation of equity based swaps” [42]. Title IV further limits the Commodity Exchange Act by clarifying that it does not apply “to

certain swap agreements (including credit and equity swaps), hybrid instruments and other products commonly offered by banks” [42].

The Public Company Accounting Reform and Investor Protection Act of 2002, more commonly referred to as Sarbanes-Oxley (SOX), passed on July 25, 2002 after several “prominent companies [were] involved in financial scandals and bankruptcies: Enron, Worldcom, Xerox, Sunbeam, Waste Management, Adelphia, Tyco, HealthSouth, Global Crossing, and others” [11]. SOX was a direct response to these scandals. SOX contains three main components. First, in an attempt to provide market participants with access to identical information and a level playing field, SOX “forbids preferential disclosures to market analysts,” although this provision may have the unintended consequence of “less total disclosure” [17]. Second, in an attempt to create accountability and monitoring within corporations, SOX requires the CEO and CFO of all publicly traded corporations to sign the balance sheets that they submit to the SEC, opening them up to criminal penalties for perjury should the forms prove fraudulent.<sup>10</sup> In addition, SOX requires publicly traded companies have an independent board of directors. Third, SOX mandated “more monitoring by accountants, in addition to monitoring by independent directors” [17]. SOX created the Public Company Accounting Oversight Board (PCAOB) to “enlist auditors to enforce existing laws against theft and fraud by corporate officers” [11]. The PCAOB is charged with “registering, setting standards for, inspecting, investigating, and disciplining audit firms for public companies” [11]. The PCAOB appears in the third panel of Figure 3.2.

The Sarbanes-Oxley Act also gave the SEC the task of reviewing the Financial Accounting Standards Board’s (FASB’s) process of creating Generally Accepted Accounting Principles (GAAP). Specifically, it was a commonly held belief that Enron had avoided detection for

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<sup>10</sup>This provision returned banks to circumstances that prevailed in the past. From the 1860s through the 1920s, the president and chief financial officer of a nationally chartered bank had to sign their bank’s financial statement and faced civil and criminal liability if the financial statement proved to be inaccurate. The McFadden Act of 1927 allowed the president and chief financial officer to delegate this task to a subordinate who then assumed this legal liability.

so long by adhering to the letter of the rules set down by GAAP. The SEC was asked to determine how long it would take to move from a rules-based system to a principles-based system, the reasoning being that a principles-based system would have exposed Enron earlier than the rules in place under GAAP [8]. After Enron, the FASB was asked, under SOX, to seek an alignment of US GAAP with international standards [8]. Doubts have been raised as to whether convergence is a feasible goal and whether it will ever happen.

The Dodd-Frank Wall Street Reform and Consumer Protection Act, (Pub.L. 111-203, H.R. 4173) (DFA), is a hodgepodge of several unrelated regulations. Passed in July 2010 in response to the financial crisis at the end of the first decade of the twenty-first century, DFA restructured the regulatory system. A few highlights from this act include an overhaul of the bankruptcy code, a re-regulation of most derivatives previously deregulated, and regulations disallowing bailouts in many cases. The act also led to the creation and destruction of many new government agencies. For example, the act led to the creation of the Financial Stability Oversight Council, the elimination of the Office of Thrift Supervision, the creation of the Bureau of Consumer Financial Protection (CFPB), and the creation of the Federal Insurance Office [63]. Especially noteworthy from a financial data perspective is the creation of the Office of Financial Research (OFR) under Title I of the act, with mandates to monitor systemic risk and to standardize and collect positions and transactions data from market participants. One of the OFR's first major initiatives has been the promotion of a global system of legal entity identifiers (LEIs), to facilitate the management and communication of identifiers for counterparties and other obligors. Many of the final implications of DFA will not be known until regulatory agencies create rules to implement their respective mandates.

***“The Volcker Rule*** prohibits proprietary trading and certain fund activities by bank holding companies and their affiliates and imposes enhanced capital and other quantitative limits on such activities by systemically important nonbank financial companies, including systemically important hedge funds” [63, emphasis in the original]. This effectively repeals

Gramm-Leach-Bliley’s deregulation of banking restrictions imposed by the Banking Act of 1933.

As previously mentioned, most derivatives deregulated under the Commodity Futures Modernization Act of 2000 were re-regulated under Dodd-Frank. “Largely following the historical jurisdictional divisions between the CFTC and the SEC, the Act categorizes the derivatives transactions within its scope as either ‘swaps,’ which are subject to primary regulation by the CFTC, ‘security-based swaps,’ which are subject to primary regulation by the SEC, or ‘mixed swaps,’ which are subject to joint regulation by the CFTC and SEC” [63]. The requirement for centralized clearing has the side effect of centralizing information on these transactions, facilitating regulatory data collection.

Nationally recognized statistical rating organizations (NRSROs) have held government-backed significance since the Great Depression. The banking acts of the 1930s required financial institutions to hold high-quality assets, with quality determined by ratings given by commonly used ratings firms. The act did not state the identities of these firms. Over time, this requirement evolved into the notion of NRSRO, and the SEC became the organization that determined which organizations fit into this category. The history of the evolution of this process is opaque, but it seems that the SEC had assumed this role before 1975. An SEC public memo, File No. S7-23-94, from the year 1994, describes the evolution of the commissions oversight authority.<sup>11</sup>

After Dodd-Frank, Fed investigators are not allowed to use NRSRO ratings at all in their evaluation of the risk of any securities. Additionally, Dodd-Frank “requires each NRSRO [Nationally Recognized Statistical Rating Organization] Board to oversee: policies and procedures for management of conflicts of interest; policies and procedures for determining ratings and the effectiveness of internal controls with respect to such policies and procedures; and policies and procedures for compensation and promotion” [63]. NRSROs are now liable for

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<sup>11</sup>SEC File No. S7-23-94, available at <http://www.sec.gov/rules/concept/34-34616.pdf>.

their ratings. “The Act establishes that the enforcement and penalty provisions of the Exchange Act apply to statements made by credit rating agencies in the same manner and to the same extent as they apply to statements made by registered public accounting firms or securities analysts under the securities laws” [63].

Government agencies are now writing the rules that implement the Dodd-Frank legislation. Whether these rules will prevent future financial crises remains to be seen. The authors of this essay are skeptical. Prior to the Great Depression, the US financial system experienced periodic financial panics. Their cause was, in part, the complex and fragmented regulatory system created by the constitutional structure of the US government. During the Great Depression, policymakers prohibited all practices that they believed contributed to financial instability. That regulatory structure prevented financial panics from occurring for fifty years. In the 1990s, our nation dismantled the last of the Depression-era restrictions but took no actions to solve the systemic problems that caused financial instability in the past and that appears to be causing financial instability in the present. Unless our nation deals with the root cause of the problem – fragmented regulatory authority – we should expect financial panics as regularly in the future as they were before the Great Depression.

Table 3.1: Government Agencies

Abbreviation	Name of Agency (and successor)	Key Dates	Authorizing Legislation and Principal Reforms	Function	Data Collections
BFCU	Bureau of Federal Credit Unions (National Credit Union Administration)	1934 -1970	Federal Credit Union Act (1934)	Oversight of Federal Credit Unions	
FRB	Federal Reserve Board of Governors	1935	Banking Act of 1935	Oversight of Federal Reserve System	

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
CEC	Commodity Exchange Commission	1936	Commodity Exchange Act (1936)	Required commodities futures and options to be traded on organized exchanges to be regulated by the GFA.	

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
CFPB	Bureau of Consumer Financial Protection	2010	Wall Street Reform and Consumer Protection Act (2010)	Congress established the CFPB to protect consumers by carrying out Federal consumer financial protection laws. <sup>12</sup>	Reports: <a href="http://www.consumerfinance.gov/reports/">http://www.consumerfinance.gov/reports/</a> Guidance documents: <a href="http://www.consumerfinance.gov/guidance/">http://www.consumerfinance.gov/guidance/</a> Regulations: <a href="http://www.consumerfinance.gov/regulations/">http://www.consumerfinance.gov/regulations/</a>

<sup>12</sup><http://www.consumerfinance.gov/the-bureau/> 2012.



Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
CFTC	Commodity Futures	1974	Amendments to Commodity Exchange Act (1974)	Regulates commodity futures and options markets <sup>13</sup>	Market reports: <a href="http://www.cftc.gov/">http://www.cftc.gov/</a>
	Trading Commission		Commodity Futures Modernization Act (2000)		<a href="http://www.cftc.gov/MarketReports/index.htm">MarketReports/index.htm</a>
			Wall Street Reform and Consumer Protection Act (2010)		
FDIC	Federal Deposit Insurance Corporation	1933	Banking Act of 1933	Insure deposits at commercial banks.	Quarterly call reports <a href="http://www2.fdic.gov/call_tfr_rpts/">http://www2.fdic.gov/call_tfr_rpts/</a>
			Insurance Act of 1950		
			Financial Institutions Reform, Recovery, and Enforcement Act (1989)		
			FDIC Improvement Act of 1991		

<sup>13</sup><http://www.cftc.gov/About/MissionResponsibilities/index.htm> 2012.

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
FFIEC	Federal Financial Institutions Examination Council	1979	Financial Institutions Regulatory and Interest Rate Control Act of 1978	Interagency body empowered to set uniform standards for FRB, FDIC, NCUA, OCC, CFPB; uniform standards for financial institutions. <sup>14</sup>	Financial Institutional Information <a href="http://www.ffiec.gov/financial.htm">http://www.ffiec.gov/financial.htm</a>
FHFA	Federal Housing Finance Agency	2008	Housing and Economic Recovery Act of 2008 <sup>15</sup>	Oversight of secondary mortgage markets Fannie Mae, Freddie Mac, and the Federal Home Loan Banks. (OPAR) Combined OFHEO, FHFB, and the GSE mission office of HUD <sup>16</sup>	Office of Policy Analysis and Research <a href="http://www.fhfa.gov/Default.aspx?Page=5">http://www.fhfa.gov/Default.aspx?Page=5</a>

<sup>14</sup><http://www.ffiec.gov/> 2012.

<sup>15</sup><http://www.fhfa.gov/Default.aspx?Page=5>

<sup>16</sup><http://www.fhfa.gov/Default.aspx?Page=4>

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
FHFB	Federal	1989-	Financial Institutions Re-	Oversight of Federal Home	News Center
	Housing	2008	form, Recovery, and En-	Loan Banks	Archive <a href="http://www.fhfa.gov/Default.aspx?Page=244">http://www.fhfa.gov/Default.aspx?Page=244</a>
	Finance		forcement Act (1989)		
	Board				
FHLBB	Federal	1932-	Federal Home Loan Bank	Oversight of Federal Home	
	Home	1989	Act (1932) Financial In-	Loan Banks	
	Loan Bank		stitutions Reform, Recov-		
	Board		ery, and Enforcement Act		
		(1989)			

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
Fed, FRS	Federal Reserve System	1913	Federal Reserve Act (1913) Banking Act of 1932 Emergency Banking Relief Act (1933) Banking Act of 1933 Banking Act of 1935 Financial Institutions Reform, Recovery and Enforcement Act of 1989 Federal Deposit Insurance Corporation Improvement Act of 1991 Gramm-Leach-Bliley Act (1999) Wall Street Reform and Consumer Protection Act (2010)	Determine and execute USA monetary policy	Data load Program <a href="http://www.federalreserve.gov/datadownload/">http://www.federalreserve.gov/datadownload/</a>

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
FSLIC	Federal Savings and Loan Insurance Corporation (Savings and Insurance Fund)	1934-1989	National Housing Financial Institutions Reform, and Enforcement Act (1934)	Act Insurance counts in S&Ls.	Insurance for savings ac-

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
GAO	Government Accounting Office, Government	1921 Re-named 2004	Budget and Accounting Act of 1921 (42 Stat. 20)	Monitor of Federal activity	Reports and Testimonies, Legal Decisions, and other re-sources
	Accounting Office, Government	1921 Re-named 2004	GAO Human Capital Reform Act of 2004, Pub. L. 108-271, 118 Stat. 811 (2004) <sup>17</sup>		<a href="http://www.gao.gov/researchers.html">http://www.gao.gov/researchers.html</a>
GFA	Grain Futures Administration	1922 - 1974	Grain Futures Act Board of Trade of Chicago v. Olsen, 262 US 1 (1923)	Supervise the trading of commodities futures contracts	

<sup>17</sup><http://www.gao.gov/about/history/articles/working-for-good-government/01-introduction.html> 2012.

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
LCR	Least-cost resolution	1991	FDIC Improvement Act of 1991	A rule for bank failure resolution to align regulator actions with proper monitoring	
NCUA	National Credit Union Administration	1970	Federal Credit Union Act (1934)	Facilitate the availability of credit union services <sup>18</sup>	

<sup>18</sup><http://www.ncua.gov/about/History/Pages/History.aspx> 2012.

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
OCC	Office of the Comptroller of the Currency	1863	National Currency Act (creation 1863) National Banking Act (1864) Emergency Banking Relief Act (1933) Banking Act of 1933 Gramm-Leach-Bliley (1999)	Charter, regulate, and supervise all national banks and federal savings associations <sup>19</sup>	Annual reports: <a href="http://www.occ.gov/publications/publications-by-type/">http://www.occ.gov/publications-by-type/</a> annual-reports/ index-annual-reports.html
OFHEO	Office of Federal Housing Enterprise Oversight	1992-2008	Federal Housing Enterprises Financial Safety and Soundness Act of 1992. Housing and Economic Recovery Act of 2008	Oversight of Fannie Mae and Freddie Mac	

<sup>19</sup><http://www.occ.gov/about/what-we-do/mission/index-about.html> 2012.



Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Key Legislation	Institutions	Function	Data
OTS	Office of Thrift Supervision	1989-2011	Financial Reform, Enforcement Act (1989) Wall Street Reform and Consumer Protection Act (2010)	Institutions and savings banks	Oversight of S&Ls and savings banks	
PBGC	Pension Benefit Guaranty Corporation	1974	Employment Retirement Income Security Act of 1974	Retirement Act of 1974	[T]o encourage the continuation and maintenance of private-sector defined benefit pension plans, provide timely and uninterrupted payment of pension benefits, and keep pension insurance premiums at a minimum <sup>20</sup>	<i>Pension Insurance Data Book</i> (since 1996)

<sup>20</sup><http://www.pbgc.gov/about/who-we-are.html> 2012.

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
PCA	Prompt corrective action	1991	FDIC Improvement Act of 1991	A rule for bank failure resolution to align regulator actions with proper monitoring	
PCAOB	Public Company Accounting Oversight Board	2002	Public Company Accounting Reform and Investor Protection Act of 2002	[O]versee the audits of public companies in order to protect investors and the public interest by promoting informative, accurate, and independent audit reports. <sup>21</sup>	Board public reports: <a href="http://pcaobus.org/Inspections/Pages/PublicReports.aspx">http://pcaobus.org/Inspections/Pages/PublicReports.aspx</a>
RFC	Reconstruction Finance Corporation	1932	Glass-Steagall Act of 1932 (c. 8, 47 Stat. 5)	Authorized to extend loans to all financial institutions in the USA	

<sup>21</sup><http://pcaobus.org/About/Pages/default.aspx> 2012.

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
SAIF	Savings Associ- ations Insurance Fund	1989	Financial Institutions Re- form, Recovery, and En- forcement Act (1989)	Successor to FSLIC after the S&L crisis of the 1980s.	

Table 3.1: Government Agencies *cont.*

Abbreviation	Names	Key Dates	Legislation	Function	Data
SEC	Securities and Exchange Commission	1934	Securities Exchange Act (1934) Securities Amendments (1975) Gramm-Leach-Bliley (1999) Commodity Futures Modernization Act (2000) Public Company Accounting Reform and Investor Protection Act of 2002 Wall Street Reform and Consumer Protection Act (2010)	Oversight of Securities Markets and Firms	EDGAR

Table 3.2: Non-Government Organizations with a Role in Financial Standards and Oversight

Abbreviation	Full Name	Key Dates	Purpose
AcSEC	Accounting Standards Executive Committee		Relevant Data: AICPA RESOURCE Lexis-Nexis: CCH U.S. Master GAAP Guide[53] Issues opinions on behalf of AICPA[7, p. 31]
AICPA	American Institute of Certified Public Accountants	1887 <sup>22</sup>	Relevant Data: AICPA Online Professional Library <sup>23</sup> “[S]ets ethical standards for the profession and U. S. auditing standards for audits of private companies, non-profit organizations and federal, state and local governments.” <sup>24</sup>
AINs	AICPA Accounting Interpretations		
APB	Accounting Principles Board	1958-1973	Set accounting standards.
ARB	Accounting Research Bulletins		Official rulings by the Accounting Procedures Committee[7, p. 34]
CAES	Computer Assisted Execution System		

<sup>22</sup><http://www.aicpa.org/About/Pages/About.aspx> 2012.

<sup>23</sup>[http://www.cpa2biz.com/AST/Main/CPA2BIZ\\_Primary/Accounting/Standards/PRDOVR~PC-WCF-FS/PC-WCF-FS.jsp](http://www.cpa2biz.com/AST/Main/CPA2BIZ_Primary/Accounting/Standards/PRDOVR~PC-WCF-FS/PC-WCF-FS.jsp) 2012.

<sup>24</sup><http://www.aicpa.org/About/Pages/About.aspx> 2012.

Table 3.2: Non-Government Organizations *cont.*

Abbreviation	Full Name	Key Dates	Purpose
CAP	Committee on Accounting Procedure	1939-1959	Created to settle accounting problems as they arose
EITF	Emerging Issues Task Force		Resolve urgent issues before they become widespread
FASB	Financial Accounting Standards Board	1972	Relevant legislation: Public Company Accounting Reform and Investor Protection Act of 2002. “[...] to establish and improve standards of financial accounting and reporting that foster financial reporting by nongovernmental entities that provides decision-useful information to investors and other users of financial reports.” <sup>25</sup>
FINs	FASB Interpretations		“[C]larify or expand upon any accounting pronouncements that have previously been issued, usually addressing very specific topics.” [7, p. 37]

<sup>25</sup><http://www.fasb.org/facts/index.shtml#mission> 2012.

Table 3.2: Non-Government Organizations *cont.*

Abbreviation	Full Name	Key Dates	Purpose
FTB	FASB Technical Bulletins		“[I]ntended to clarify or elaborate upon underlying accounting standards.” [7, p. 51]
GAAP	Generally Accepted Accounting Principles		Relevant legislation: Public Company Accounting Reform and Investor Protection Act of 2002 Accounting standards set by private accounting standards agencies
IASB	International Accounting Standards Board	2001	Sets standards for the International Financial Reporting Standards Foundation <sup>26</sup>
NASD	National Association of Securities Dealers	1938	Relevant legislation: Maloney Act (1938) “Nonprofit organization formed under the joint sponsorship of the investment bankers’ conference and the SEC to comply with the Maloney Act, which provides for the regulation of the OTC” <sup>27</sup>

<sup>26</sup><http://www.ifrs.org/The+organisation/IASCF+and+IASB.htm> 2012.

<sup>27</sup><http://www.nasdaq.com/investing/glossary/n/national-association-of-securities-dealers> 2012.

Table 3.2: Non-Government Organizations *cont.*

Abbreviation	Full Name	Key Dates	Purpose
NRSROs	Nationally Recognized Statistical Ratings Organizations		Relevant legislation: Wall Street Reform and Consumer Protection Act (2010) Organizations that give risk ratings to securities.
SFAS	Statements of Financial Accounting Standards		“[P]rimary source of GAAP to the extent that they supersede any previous pronouncements [...]” [7, p. 40]
SOPs	AICPA Statements of Positions		A set of standards for a particular industry issued by the AcSEC [7, p. 31]

Table 3.3: Regulatory Legislation

Abbreviation	Full Name	Key Dates	Purpose
COBRA	Consolidated Omnibus Budget Reconciliation Act of 1974	1974	Amendment to ERISA.
DFA	Dodd-Frank Wall Street Reform and Consumer Protection Act (2010)	2010	Response to the first financial crisis of the twenty-first century.



Table 3.3: Regulatory Legislation *cont.*

Abbreviation	Full Name	Key Dates	Purpose
ERISA	Employment Retirement Income Security Act	1974	Designed to aid and protect retirees. Related legislation: Consolidated Omnibus Budget Reconciliation Act of 1974 Health Insurance Portability and Accountability Act (HIPAA) Newborns' and Mothers' Health Protection Act Mental Health Parity Act Womens' Health and Cancer Rights Act Tax Equity and Fiscal Responsibility Act Retirement Equity Act Revenue Act of 1978 Tax Reform Act of 1986
FDICIA	FDIC Improvement Act of 1991	1991	Reform rules for bank regulators and implement PCA and LCR.
FIRREA	Financial Institutions Reform, Recovery, and Enforcement Act	1989	Response to the S&L crisis of the 1980s.
GLB	Gramm-Leach-Bliley Act (Financial Services Modernization Act of 1999)	1999	Removed barriers between commercial banking, investment banking, and insurance sectors.
HIPAA	Health Insurance Portability and Accountability Act	1996	Regulatory data standardization <sup>28</sup>

<sup>28</sup> <http://www.dhhs.gov/ocr/privacy/hipaa/administrative/index.html> 2012.

Table 3.3: Regulatory Legislation *cont.*

Abbreviation	Full Name	Key Dates	Purpose
HMDA	Home Mortgage Disclosure Act	1975	Collect data on lending to test for discriminatory practices. Related Legislation: FIRREA (1989)
SOX	Sarbanes-Oxley Act (Public Company Accounting Reform and Investor Protection Act of 2002)	2002	Direct response to financial and accounting scandals, including Enron.
	Amendments to Commodity Exchange Act (1974)	1974	Created CFTC, which succeeded the GFA and CEC.
	Banking Act of 1932	1932	Expanded lending powers of the FRS, aligning their powers with those granted to the RFC.
	Banking Act of 1933	1933	Created the FDIC. Split commercial and investment banks. Imposed stricter regulation on financial institutions. Also known as the Glass-Steagall Act.
	Banking Act of 1935	1935	Increased FDIC coverage. Centralized control of the money supply in the FRS.
	Budget and Accounting Act of 1921 (42 Stat. 20)	1921	Created GAO.

Table 3.3: Regulatory Legislation *cont.*

Abbreviation	Full Name	Key Dates	Purpose
	Commodity Exchange Act (1936)	1936	Required all commodities futures and options be traded on organized exchanges.
	Commodity Futures Modernization Act (2000)	2000	Clarified regulatory jurisdictions between the CFTC and SEC.
	Emergency Banking Relief Act (1933)	1933	Granted expansive powers to the President. Authorized OCC to seize and operate any US bank. Authorized national banks to issue preferred stock. Expanded powers of FRS.
	Federal Credit Union Act (1934)	1934	Established BFCU to regulate credit unions.
	Federal Deposit Insurance Act of 1950	1950	Required FDIC to collect and maintain call reports from banks.
	Federal Home Loan Bank Act (1932)	1932	Created FHLBB to oversee the twelve government-backed home loan banks.
	Federal Housing Enterprises Financial Safety and Soundness Act of 1992	1992	Established OFHEO, which oversees Freddie Mac and Fannie Mae.
	Federal Reserve Act (1913)	1913	Created FRS. Required all national banks to join the FRS, gave permission for state banks to join.

Table 3.3: Regulatory Legislation *cont.*

Abbreviation	Full Name	Key Dates	Purpose
	Financial Institutions Regulatory and Interest Rate Control Act of 1978	1978	Created FFIEC, which is tasked with creating uniform principles and standards across several different government agencies.
GAO	Human Capital Reform Act of 2004, Pub. L. 108-271, 118 Stat. 811 (2004) <sup>29</sup>	2004	Enacted reforms on GAO.
	Grain Futures Act	1922	Established the GFA to oversee commodities futures trading.
	Housing and Economic Recovery Act of 2008 <sup>30</sup>	2008	Enacted reforms on OFHEO.
	National Banking Act (1864)	1864	Allowed for national charters of banks to be regulated by the OCC.
	National Currency Act	1863	Established a national currency printed by the Treasury and issued by commercial banks.
	National Housing Act (1934)	1934	Created FSLIC to insure and regulate the S&L industry.

<sup>29</sup> <http://www.gao.gov/about/history/articles/working-for-good-government/01-introduction.html> 2012.

<sup>30</sup> <http://www.fhfa.gov/Default.aspx?Page=5>

Table 3.3: Regulatory Legislation *cont.*

Abbreviation	Full Name	Key Dates	Purpose
	Securities Acts Amendments (1975)	Amend- 1975	Tasked SEC with creating a National Market and National Clearing System.
	Securities Exchange Act (1934)	Act 1934	Established SEC to regulate securities, especially equities and debt instruments.

# Chapter 4

## Transition from Commodity to Fiat: an Optimal Seigniorage Approach

### 4.1 Introduction

The history of money is a history of commodity money [56, 79, 83]. Inconvertible and intrinsically worthless objects maintaining value as a medium of exchange is a fairly recent phenomenon.<sup>1</sup> Previous experiments in suspension of convertibility, as in the United States during the Civil War, or in Britain during the Napoleonic wars, ended with a resumption of convertibility. Experiments in paper money, such as the Law affair in France, and the four big hyperinflations in Europe in the interwar period demonstrates a problem monetary authorities face — the problem of committing not to overprint [78]. To this day, even the US dollar is not without its value as legal tender; it can be used to settle debts public or private.

Considering the social costs involved in using a commodity — such as gold or silver — it

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<sup>1</sup>Redish (1993) identifies the collapse of Bretton Woods as the start of the contemporary fiat regime[68].

is puzzling why we did not arrive in a fiat system sooner. Sovereigns acting as monetary authorities wish to maximize seigniorage — that is, the difference between the price at which they are selling the money good (in real terms) and the fundamental value of the money good. The fundamental value of a fiat money is zero. The fundamental value of a commodity money can be considered the value of the precious metal within the currency.

This paper builds a model to investigate this question. Within the context of a money search environment, the answer has two parts. Fiat money was not always feasible. The feasibility of fiat money depends on three factors: thickness of markets, competitiveness of those markets, and patience of agents. As these three variables change over time — markets grow thicker, competition leads to more trade surplus going to buyers rather than to sellers, changes in life expectancy increase overall patience — the world switches from a regime of commodity money to one of fiat. Secondly, by modeling the choices of a sovereign monetary authority, the paper shows that the seigniorage-maximizing choice for commodity in the money is decreasing in market thickness and decreasing in patience of agents. My model also allows for other comparative statics.

Section 2 provides a history of money in the USA. Section 3 provides a review of the literature. Section 4 provides the theoretical environment and an interpretation of how that model fits with the history. Section 5 characterizes steady-state equilibria and performs comparative static experiments. Section 6 concludes. Proofs are in the appendices.

## 4.2 History

First, I define terms typically associated with conversations around commodity money that are sometimes taken to be synonymous. Second, I provide an overview of the different types of money used in the USA throughout its history: gold, silver, paper, postage stamps, copper,

Table 4.1: Commodity Money Standards in USA History

Years	Standard
1792-1834	Bimetallic standard, de facto silver
1834-1862	Bimetallic standard, de facto gold
1862-1879	Greenback period, de facto fiat
1879-1933	Gold standard
1934-1973	Limited convertibility gold standard
Post 1973	Fiat: receivable, backed legal tender, not convertible

and nickel. Third, I use episodes in USA history to highlight the transition from commodity money to fiat. Table 4.1 helps track the periods of different monetary standards in the USA.

Commodity money is a good that is intrinsically valued and also circulates as the money good. Fiat money has two definitions. The first definition is money that is valued due to government decree. The second is money which has no value in consumption or production. In modeling I will use the latter definition. Legal tender is defined as money that may be used to clear debts private and public. Convertible money is itself intrinsically worthless, but redeemable for its face value. Backed money has underlying assets that back the face value. Receivable money is acceptable for payment in taxes. Throughout the history of the USA, these different definitions for money will be useful in describing what passed for money.

Gold and silver played key roles as commodity money in the USA. In 1792, the USA set rules for mint and coinage. The dollar was defined in terms of silver. Gold coins were minted in \$10 and \$2.50 denominations. The silver-to-gold ratio was set at 15:1. Silver and gold were official legal tender, but so were British, Portuguese, French, and Spanish coins. In 1834 the silver-to-gold ratio was set to 16:1. The gold was reduced in coins, and this was adjusted again in 1837. The new coins were considered legal tender for old debts. In 1853, small change was minted in silver. Coins under \$5 were legal tender, however this small change was not full-bodied, meaning the face value was greater than intrinsic value. In 1878, the Bland-Allison Act permitted the Treasury sale of silver certificates in exchange for silver. These silver certificates were not legal tender, but they were receivable and they did circulate.



After 1890 these certificates were convertible to gold. It is worth noting that the intrinsic value of the silver certificates was below the face value. There were also gold certificates, which were convertible with a legally defined backing. In 1900, the Gold Standard Act made the gold dollar the unit of account. Silver certificates and silver dollars became legal tender and convertible. In 1963, silver certificates were retired. In 1976, the dollar was no longer defined in terms of gold [18, 34, 77].

Paper money took many forms in the USA. Bills of exchange, which are negotiable debt instruments designed for large commercial purchases between merchants, at one time acted as paper money. Treasury notes have also played that role. During the War of 1812, Treasury notes circulated as currency. They were interest-bearing bonds paid in precious metal, receivable for taxes, but not legal tender. They were issued in low denominations and printed to the same size as bank notes. In 1890, with the Sherman Silver Purchase Act, Treasury notes were issued, but they offered no interest. These notes were convertible to silver, backed by silver, and acted as legal tender. After the Gold Standard Act of 1900, however, Treasury notes were recalled and discontinued. The most well-known form of paper money in USA history is the greenback. After the 1862-1863 Legal Tender Acts, greenbacks were printed and circulated as currency. Greenbacks were not convertible, but they did serve as legal tender. With the 1875 Resumption Act, the supply of greenbacks was reduced and by 1879 the greenback achieved parity with gold and became convertible. This convertibility was suspended in 1933. In 1971, the USA ceased adding greenbacks to circulation. Bank notes also served as paper money in the USA. Initially, state-chartered banks issued convertible and backed bank notes. Sometimes these notes were receivable, but they were not considered legal tender. In 1864, the federal government attempted to gain monopoly note-issue during the Civil War, and so a 10% tax on state bank notes ends the state bank note as currency. This led the state banks to innovate checks. National bank notes — notes issued by banks with a national bank charter — replaced state bank notes. National bank notes were backed by government bond, convertible to gold or legal tender. In 1933 these national bank notes

Table 4.2: Official USA Price of Gold

Years	Price
1792-1833	\$19.39
1834-1836	\$20.69
1837-1933	\$20.67
1934-1971	\$35.00
1972	\$38.00
1973	\$42.22

lost domestic convertibility. In 1934 the Gold Reserve Act retired the national bank note. The last form of USA paper money is the Federal Reserve note. In 1913 the Federal Reserve Act allowed the creation of these convertible notes. In 1933, the Federal Reserve note lost domestic convertibility along with the national bank note and greenback. In 1963, small denominations of Federal Reserve notes were issued. In 1965 and 1968, the gold reserves backing Federal Reserve deposits and notes were repealed. Finally, in 1971, the Federal Reserve notes lost all convertibility, but continue to circulate through today [18, 34, 77].

It is also worth noting that in 1862 postage stamps circulated as small change. During this period, greenback printing led to inflation and silver coins were worth more in foreign trade. This led to fractional currency disappearing from circulation in the USA. This is how postage stamps became money for small change. The Coinage Act of 1965 authorized the USA to use copper and nickel for small change when inflation threatened to drive out the circulation of silver coins [18, 34, 77].

Table 4.2 provides a breakdown of the official USA price of Gold in dollars from 1792 to 1973. After this point the USA did not return to a metallic standard, so the official price became irrelevant. This is visible in figure 4.1, which shows both the official price of money in gold terms as well as the New York market price of gold [59]. Aside from these two prices diverging in the 1970s, it is worth noting that the trend of intrinsic value of the currency is decreasing over time. Also of note are the divergences in 1814 and 1862.

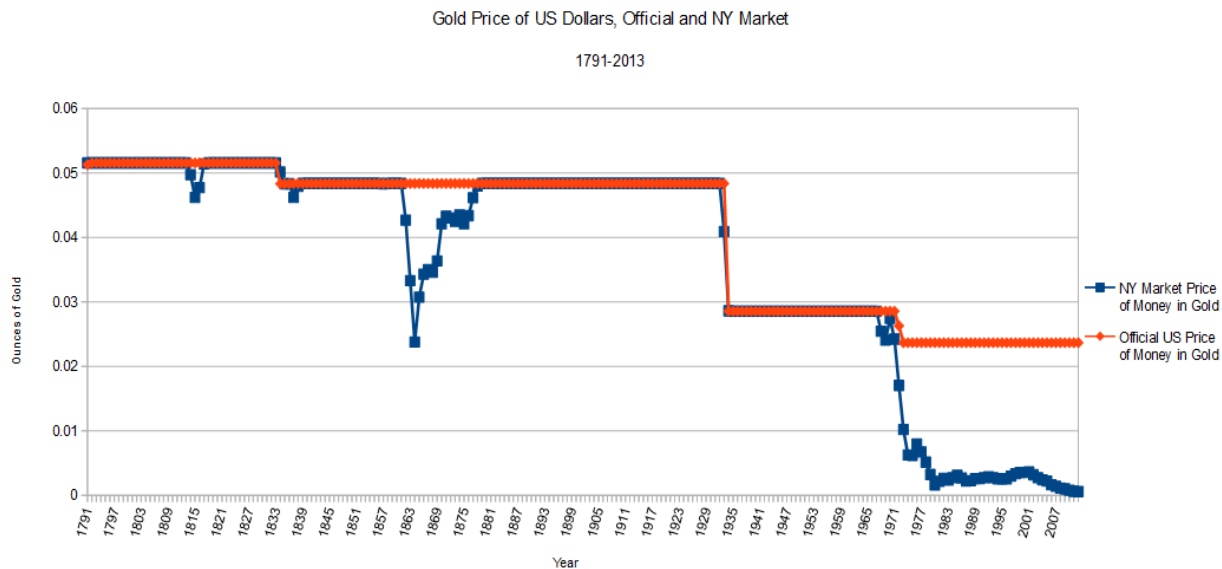


Figure 4.1: Gold Price of USA Dollars 1791-2013[59]

Figure 4.2 highlights the effect of the War of 1812 on convertibility of USA currency. In August 1814 the British burned the capital, which sparked a run on specie. Banks suspended convertibility everywhere except in New England. Though peace arrived in 1815, convertibility did not resume until 1817. The Second Bank of the United States was chartered in 1816 and around this time Congress passed a resolution not to accept unconvertible notes as receivable. The Second Bank then came to an agreement with New York, Philadelphia, Baltimore, and Richmond banks, where they resumed convertibility and any bank which held funds with banks in the resuming cities could draw against funds held by those banks to pay the government. However, the Secretary of the Treasury testified that convertibility still had not become universal as late as 1820 [34].

Figure 4.3 highlights the greenback period in the USA. In 1862 banks suspend convertibility. The federal government declared greenbacks — unconvertible notes — legal tender. Under the National Banking System, the federal government rolled out national bank charters, a new form of organizing banks which previously had only received charter at the state-level.

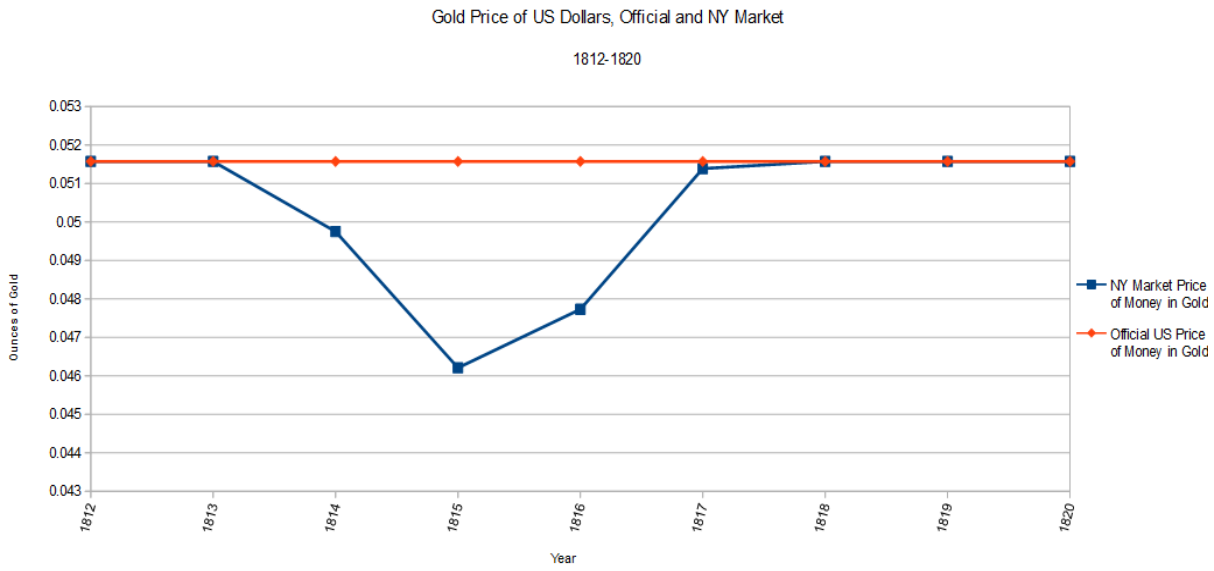


Figure 4.2: Gold Price of USA Dollars 1812-1820[59]

Banks organized under the national charter were granted the privilege of issuing the new national bank notes. This was accompanied by the ten percent tax on state bank notes, which was intended to and succeeded in killing state bank notes. National bank notes were backed by Treasury bonds and the interest served as seigniorage. Quickly, silver disappeared and people resorted to using postage stamps as small change. The Resumption Act of 1875 set greenbacks on a path to convertibility [18, 23, 34].

The final transition to fiat in the USA began in the Great Depression. The USA had been on an official Gold Standard since 1879, but massive bank runs in 1930-1933 led to the suspension of convertibility. All private holdings of gold were nationalized. The Gold Reserve Act of 1934 defined the dollar in terms of gold but did not allow domestic convertibility. The 1944 Bretton Woods Agreement Act fixed exchange rates creating a new international gold standard. Most countries, under Bretton Woods, defined their currency relative to dollars. The International Monetary Fund was created to help countries avoid deflation under the new standard. In order to maintain the gold standard, the USA used inflation to keep gold

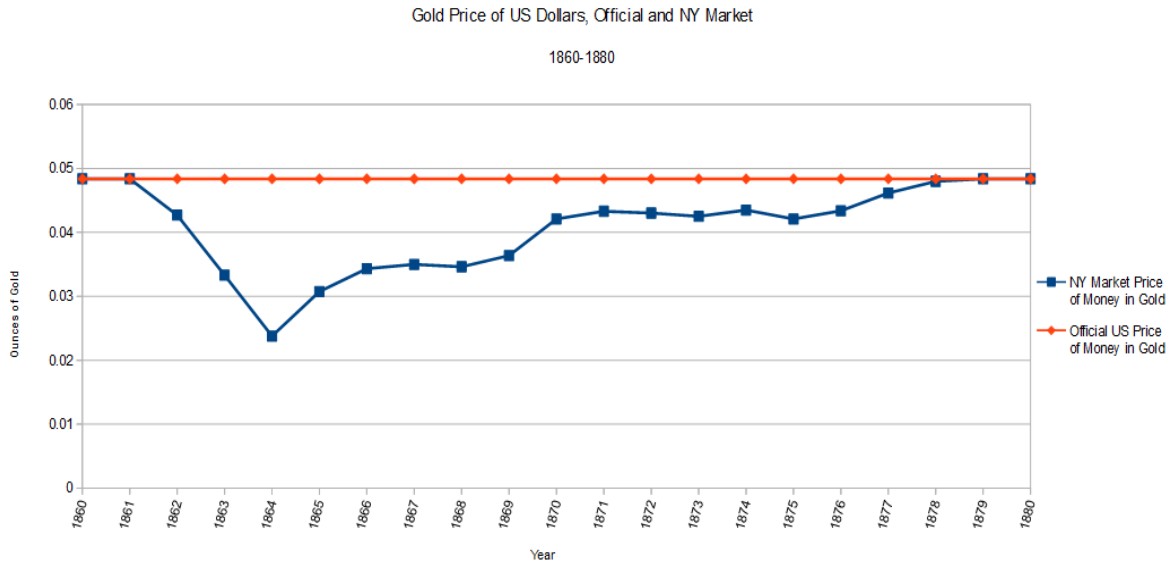


Figure 4.3: Gold Price of USA Dollars 1860-1880[59]

prices stable. The most significant change here is the end of domestic convertibility [18].

The next thirty-two years saw a gradual decline in the intrinsic value of the currency in the USA. In 1965, the Coinage Act allowed the mint to replace silver with copper and nickel. That same year, Congress repealed the gold reserve requirement against Federal Reserve deposits. In 1968, Congress further removed the intrinsic value from the currency by repealing the gold reserve requirement against Federal Reserve notes. Gold pool arrangements collapsed and the market price of gold was allowed to deviate. The gold standard ended with the closing of the gold window — no longer was conversion at face value. In August 1971, in what was expected to be a temporary move, Nixon suspended convertibility. The Smithsonian Agreement in December 1972 devalued the dollar and suspended convertibility in international transactions. The Treasury then devalued the dollar in the following February and two weeks following this move the dollar was allowed to float. By October 1976 the USA dollar was no longer defined in terms of gold. The USA had transitioned to a fiat currency [18].

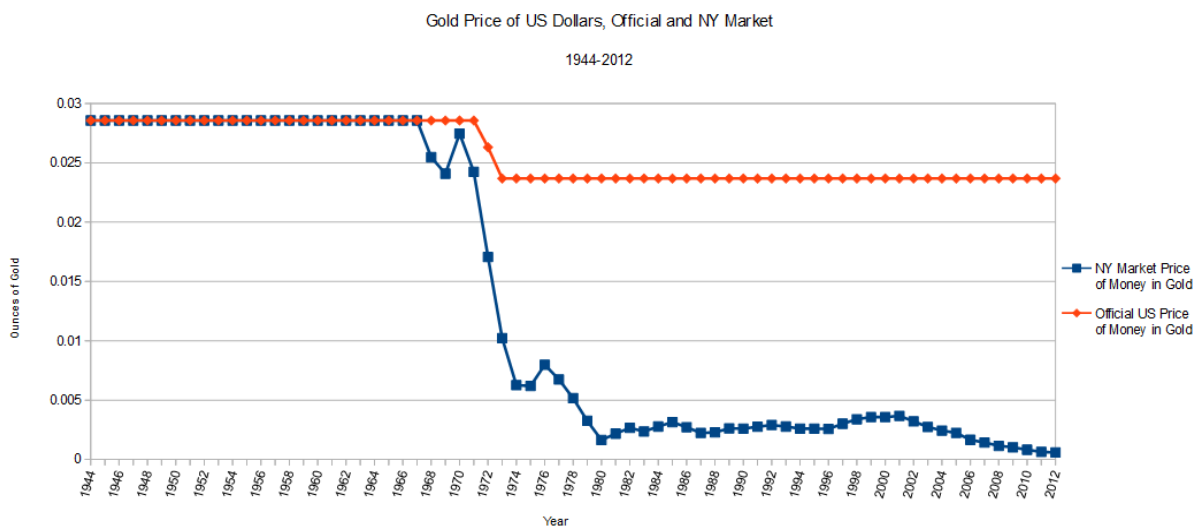


Figure 4.4: Gold Price of USA Dollars 1944-2012[59]

We live in a world of inconvertible money that is issued by a monopoly, which is also the government. This money can be used to settle all debts, private or public — it is legal tender. The world was not always thus.

In the United States, the country’s earliest experiment with paper money was the Continental, unbacked paper money issued by the Continental Congress. By the end of the revolution, the Continental was valueless. The Continental Congress faced a problem of commitment — the commitment not to overprint the currency. This is a perennial monetary problem. Whether looking at early twenty-first century Zimbabwe, interwar Germany, or seventeenth century Castile, the problem remains the same. Overprinting the currency leads to inflation. However, if there are no limits to how much currency the government can print, then the government cannot stop itself from printing or minting more money in the next period.

Tying the currency to an intrinsic value was the traditional method to circumvent the commitment problem. There were two ways to execute this: convertibility and adding commodity value directly to the currency. Convertibility meant the issuer stood ready to convert the

currency, itself a mere token of value, into its precious metal at face value. Issuers may be the sovereign or, as in the case of the United States between the Second Bank and the National Banking System, the issuers may be individual banks. Convertibility had two effects. The promise to convert gave a value below which the money could not fall. It also created a restriction on the amount of money that could be issued. Given that holders of the money may return to the issuer at any point, issuers had to hold sufficient reserves to satisfy the demands of the money holders.

The other method of commitment is to issue commodity money. In the case of commodity money issued by the sovereign, the sovereign is limited in how much he can issue based on the market price of the commodity which will be used in the money. This constraint prevents the sovereign from overissuing and inflating the money. In the case of free minting, the sovereign does not choose the amount of currency issued, only the amount of commodity that goes into the money and the fee charged by the mint for the coinage of new money — this is the seigniorage fee.

In the model that follows, the seigniorage fee will be the difference between the price of money and the commodity value of the money. The commodity value of the money will be represented as a present discounted value of dividends. In the model, the sovereign sells a perpetuity which delivers a dividend. To take this literally requires the belief that the sovereign can commit to pay the dividend. This seems like a strong assumption, but as discussed, this commitment can be seen as the currency being imbued with commodity value at its creation.

### 4.3 Literature Review

In Wallace (1978), money is defined as fiat if it is inconvertible and intrinsically useless [102]. Inconvertibility means that there is no one standing by ready to exchange the money for goods or services. Intrinsically useless means money neither delivers direct utility nor can be used for production. It is important to note that the term, “fiat,” originally referred to a money so decreed by the legal authority. In the theoretical sense, the model of the sovereign is only fiat if the dividend on the perpetuity is chosen to be zero. In the historical sense, the money is fiat inasmuch as it is issued by the sovereign — though the sovereign cannot enforce the use of the money and faces the behavior of peasants as a constraint.

In Sargent and Velde (2002) the history of debasements and coin shortages is explained as a process of learning the correct model of managing a monetary system [79]. In their model, convertibility — the promise by government to convert smaller denominations into precious metal — allowed small denominations to circulate within a commodity money regime. The difference between the two is convertibility allows some float for the issuer of the currency<sup>2</sup> and that convertibility requires more commitment from the monetary authority. Commodity money, on the other hand, embeds the commitment within the currency itself. As Redish (1993) describes, the commodity within the currency acts as an anchor to its value [68].

While this paper does not have something to say directly regarding Gresham’s law, the literature on Gresham’s law does provide a source of inspiration for this research. Fetter (1932) provides a clear history of the origin of Gresham’s law — which was not, in fact, originated by Gresham [21]. While Fetter points to MacLeod and Jevons as the first users of the law, John Stuart Mill’s posthumously published essays, “On Socialism” seem to echo the law as well [52]. Dutu, Nosal, and Rocheteau (2005) review the literature on Gresham’s law — the conjecture that bad money drives out good — as coming from two strains:

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<sup>2</sup>An examination of the value to an issuer of float on a note is covered by Wallace and Zhu (2007) [103].



the legal interventions of exchange rates and asymmetric information [15]. Dutu (2004) provides an excellent anecdote regarding debasements and describes how moneychangers drive out an undervalued currency [14, p. 562]. Velde, Weber, and Wright (1999) provide a unified framework for discussing Gresham's law and the history of debasements [100]. They work within the Shi-Trejos-Wright search and matching framework. They provide a theory of "by tale" and "by weight" equilibria with a comparative statics interpretation of Gresham. Whereas in the Shi-Trejos-Wright framework it is necessary to model the liquidity gain to agents who turn in their currency during a debasement as an exogenous side payment, the framework in this paper allows an explicit discussion of the liquidity value of money within the model. They find that private information is required to see circulation by tale or Gresham's law. Rolnick and Weber (1986) contest Gresham's law and argue that, "bad money should drive good money to a premium" [76]. Greenfield and Rockoff (1995) provide seven historical cases to test this hypothesis, and find that Gresham's law survives the tests better than Rolnick and Weber [31]. Redish (1993) provides a history of the transition from commodity money to fiat money and notes, "[...U]nlike the situation in the textbook commodity money world, in practice the monetary authority played a role in the commodity money standard, and the monetary authority could benefit [...] from depreciating the currency" [68]. Sargent and Velde (2002) push this history with respect to a cash-in-advance model for management of commodity money standard [79]. Redish and Weber (2010) provides a search and matching model to micro-found the use of money without resorting to cash-in-advance [69].

In Ritter (1995), a stylized history is presented with a monetary search model to explain the puzzle of why, if it were optimal from the perspective of a seigniorage-maximizing government to print fiat money, do we not observe fiat money everywhere in history [74]. The strength of this paper is in the simplicity of the model to explain this puzzle. Namely, Ritter's resolution to the puzzle is that a government which cannot credibly commit itself not to overprint its currency will only be able to produce intrinsically worthless currency in cases where the

public knows the government, constrained by its own impatience and size, is seigniorage-maximizing by not overprinting. Another strength of the Ritter model is its examination of the transition path from barter to fiat currency.

It is unfortunate Ritter's stylized history does not match actual history. The history of money begins with credit, not barter, as has been documented by anthropologists and archaeologists of Mesopotamia. Money as we model it arises exactly when the frictions which make money essential encroach upon credit arrangements — public records become unwieldy, villages and cities become too large for reputation to be common knowledge. When money does arise it does not replace barter, it augments credit; it is not fiat money, it is commodity money. The history of currency in Europe according to Shaw (1896) is one of continuous debasement [83]. Concurrently, trade across Europe expanded; markets became more competitive and integrated.

## 4.4 Environment

The environment is similar to Lagos and Wright (2005) and follows Nosal and Rocheteau (2011) [44, 57]. The economy consists of a continuum of agents called buyers and a continuum of agents called sellers, each normalized to unity. Time is discrete and continues forever. Each period of time is divided into two stages. In the first stage, agents trade consumption goods in a decentralized market (DM) where they are matched bilaterally and at random. In the second stage, agents can trade assets and goods in a competitive market (CM). The good traded in the CM is taken as the numéraire. DM and CM goods perish between stages. During the CM both are capable of production and consumption. During the DM the buyers wish to consume but cannot produce and sellers do not wish to consume but can produce. In addition to these agents, collectively referred to as peasants, there is a single agent called the sovereign, which cannot produce or consume in the DM but can produce and consume

in the CM.

The lifetime expected utility of a buyer is given by

$$\mathbb{E} \sum_{t=0}^{\infty} \beta^t [u(q_t) + x_t],$$

where  $\beta = 1/(1+r) \in (0,1)$  is a discount factor,  $q_t \in \mathbb{R}_+$  is the consumption of the DM good,  $x_t \in \mathbb{R}$  is the consumption of the numéraire good; when  $x_t < 0$  it is interpreted as production. The utility function in the DM,  $u(q)$ , is defined on  $[0, \infty)$ , is increasing, twice differentiable,  $u'(0) = \infty$ ,  $u'(\infty) = 0$ ,  $u'(q) > 0$ ,  $u''(q) < 0$ , and  $u(0) = 0$ .

The lifetime expected utility of a seller is

$$\mathbb{E} \sum_{t=0}^{\infty} \beta^t [-c(q_t) + x_t],$$

where  $c$  is the DM production technology, defined on  $[0, \infty)$ , is increasing, twice differentiable,  $c'(0) = 0$ ,  $c'(\infty) = \infty$ ,  $c'(q) > 0$ ,  $c''(q) > 0$ , and  $c(0) = 0$ .

Agents in the DM lack commitment and individual trading histories are private information. As there exists a continuum of agents, agents who have matched in the DM will meet again with probability zero. Buyers that match with sellers in the DM cannot commit to repay sellers at a future date because the threat of punishment is, in expectation, zero. Unsecured credit cannot be used; money is essential.

The sovereign's preferences are given by

$$\sum_{t=1}^{\infty} \beta^t x_t,$$

where  $x_t$  is the consumption (or production, if negative) in the CM. The sovereign sells a fixed supply,  $A$ , of perpetuities at the beginning of time in the CM at market price  $\phi$  in terms

of the numéraire. Perpetuities are recognizable (cannot be counterfeited), durable, divisible, and portable (costless to carry). The dividend promised on the perpetuities,  $\kappa \in \mathbb{R}_+$ , is chosen by the sovereign and paid to the bearer of the asset in the CM each period. Assume the sovereign can commit to its promise to pay  $\kappa$  each period.

#### 4.4.1 Interpretations

On the face of it, the assumption that a sovereign can commit to pay dividends may seem strong. This assumption can be reinterpreted as the sovereign choosing the precious metal value of currency. The literal commodity aspect of the currency can be interpreted as delivering  $\kappa$  in three different ways: (i) the commodity is accepted by foreign merchants so there is some outside option to the money, as in Velde, Weber, and Wright (1999), (ii) the precious metals are intrinsically valued — people enjoy holding shiny objects, (iii) the money can be melted down at any point if the precious metal in the coin becomes more valuable than the circulating value [100]. In this sense, the present discounted value of all future dividend payments are paid out by the sovereign when the currency is minted.

### 4.5 Equilibrium

Begin by studying the steady-state, which assumes the numéraire price of money is constant over time.

#### 4.5.1 Peasants

Equilibria are characterized by moving backward from the description of peasants' choices in the CM to the determination of quantities in the DM.

Let  $W^b(a)$  denote the lifetime expected utility of a buyer in the CM holding  $a$  perpetuities in units of the numéraire good. Let  $V^b$  be its value function in the DM. This gives

$$W^b(a) = \max_{x, a' \geq 0} [x + \beta V^b(a')] \quad (4.1)$$

$$\text{s.t. } x + a'\phi = a(\phi + \kappa). \quad (4.2)$$

The first term in (4.1) is the consumption (or production if negative) of CM good. The second is the discounted continuation value in the next period. The household chooses CM consumption/production, and liquid assets,  $a$ , to maximize lifetime expected utility subject to the budget constraint (4.2). The left side of the budget constraint is composed of CM consumption/production and purchase of perpetuities,  $a'$ . Gross returns to assets are on the right side of the budget constraint. This can be rewritten more succinctly as

$$W^b(a) = a(\phi + \kappa) + \max_{a' \geq 0} [-\phi a' + \beta V^b(a')]. \quad (4.3)$$

Note that  $W^b(a)$  is linear in its wealth,  $a(\phi + \kappa)$ . The choice of assets for the next period,  $a'$ , is independent of the assets held at the beginning of the period,  $a$ .

The value function for a buyer holding  $a$  real units in the DM is

$$V^b(a) = \sigma \{u(q) + W^b[a - d(q)]\} + (1 - \sigma)W^b(a). \quad (4.4)$$

With probability  $\sigma$  buyers match with sellers and trade  $d(q) \leq a$  for  $q$  units of DM good. The linearity of  $W^b(a)$  allows this to be rewritten as

$$V^b(a) = \sigma [u(q) - d(q)(\phi + \kappa)] + W^b(a). \quad (4.5)$$

Terms of trade in the DM are determined through a proportional bargaining rule, where the

buyer receives a constant share,  $\theta$ , of the total surplus, and the seller receives the remaining  $(1 - \theta)$ .<sup>3</sup> The buyer faces the following problem:

$$\max_{q \geq 0} [u(q) - d(\phi + \kappa)] \quad (4.6)$$

$$\text{s.t. } u(q) - d(\phi + \kappa) = \frac{\theta}{1 - \theta} [d(\phi + \kappa) - c(q)] \quad (4.7)$$

$$d \leq a. \quad (4.8)$$

The buyer maximizes utility from consumption of DM good net of a transfer of assets,  $d$  to the seller. The value to the buyer of the assets  $d$  is  $a(\phi + \kappa)$ . The assets a buyer can transfer are limited to those brought into the DM, (4.8). The trade surplus is divided according to (4.7), which pins down  $d$ . This can be rewritten as

$$\max_{q \geq 0} \theta[u(q) - c(q)] \quad (4.9)$$

$$\text{s.t. } \theta c(q) + (1 - \theta)u(q) \leq a(\phi + \kappa). \quad (4.10)$$

Note that (4.10) will hold at equality if the buyer does not bring more than enough assets to afford  $q^*$ . For ease of discussion, define  $z(q) \equiv \theta c(q) + (1 - \theta)u(q)$ . From the properties of  $u$  and  $c$ ,  $z(0) = 0$ ,  $z(\infty) = \infty$ ,  $z'(q) = \theta c'(q) + (1 - \theta)u'(q) > 0$ ,  $z'(0) = \infty$ , and  $z'(\infty) = \infty$ . As  $z$  is increasing,  $z$  is invertible. Concavity of  $z(q)$  is determined by its second derivative. See figure 4.5. If the buyer brings assets into the DM such that  $a(\phi + \kappa) \geq z(q^*)$ , then the buyer will offer  $d = z(q^*)/(\phi + \kappa)$  in exchange for  $q = q^*$  from the seller. Otherwise, if  $a(\phi + \kappa) < z(q^*)$ , the buyer will offer  $d = a$  in exchange for  $q = z^{-1}[a(\phi + \kappa)]$ .

Advancing (4.5) one period ahead to substitute  $V^b(a)$  into the maximization problem in (4.3)

---

<sup>3</sup>As discussed in Aruoba, Rocheteau, and Waller (2007), proportional bargaining differs from Nash bargaining in its axiom of strong monotonicity, which has significant implications for the efficiency of trade equilibria. Proportional bargaining does not exhibit the inefficiently low amounts traded Nash bargaining can prescribe [3].

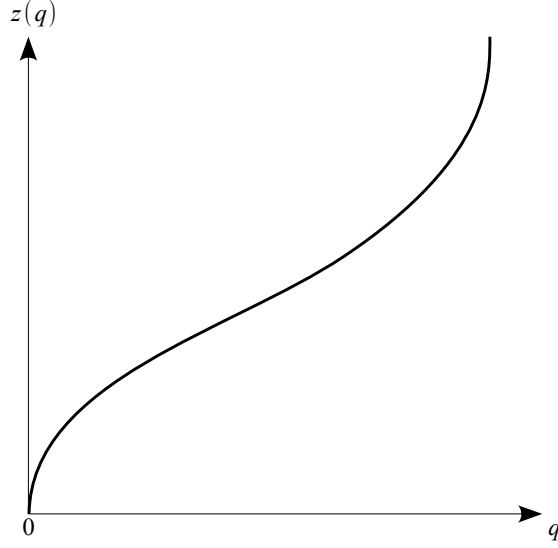


Figure 4.5: The amount of money a buyer trades to a seller in exchange for DM goods,  $z(q) \equiv \theta c(q) + (1 - \theta)u(q)$ .

and applying the proportional bargaining solution yields

$$\max_{a \geq 0} \{ -\phi a + \beta \{ \sigma \theta [u(q) - c(q)] + W^b(a) \} \}$$

Linearity of  $W^b$  and independence of future choices of asset holdings allow this problem to be rewritten as

$$\max_{a \geq 0} \{ -r(\phi - \phi^*)a + \sigma \theta \{ u[q(a)] - c[q(a)] \} \}, \quad (4.11)$$

where  $\phi^* = \kappa/r$ , the fundamental value of the perpetuity. The solution to this problem is given by

$$-r(\phi - \phi^*) + \sigma \theta \mathcal{L}(q)(\phi + \kappa) \leq 0, \quad (4.12)$$

where  $\mathcal{L}(q) \equiv [u'(q) - c'(q)] / [\theta c'(q) + (1 - \theta)u'(q)]$ . Note that  $\mathcal{L}(0) = 1/(1 - \theta)$ ,  $\mathcal{L}(q^*) = 0$ , and  $\mathcal{L}'(q) < 0$ . Figure 4.6 illustrates  $\mathcal{L}(q)$ . This figure depicts  $\mathcal{L}$  as concave, which is guaranteed

with a technical assumption on the relative third derivatives of  $u(q)$  and  $c(q)$ .

**Assumption 4.1.** For all  $q \in [0, q^*]$ ,  $c'''(q) > 0$  and

$$u'''(q) - c'''(q) < 2c''(q) \frac{u''(q)c'(q) - c''(q)u'(q)}{[c'(q)]^3}.$$

**Lemma 4.1.** If Assumption 4.1 is true, then  $\mathcal{L}(q)$  is concave.

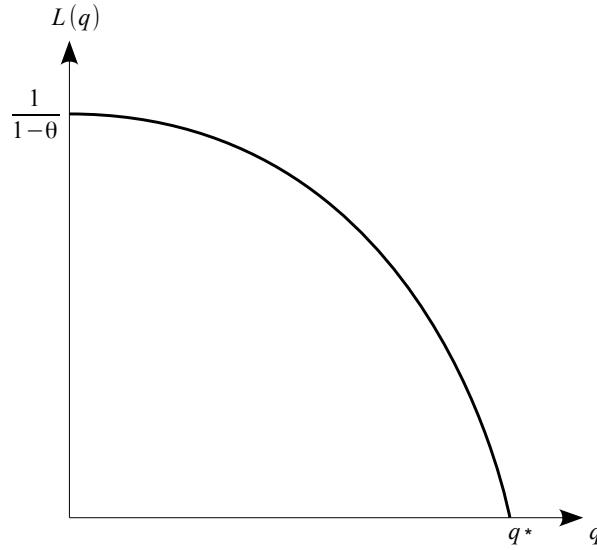


Figure 4.6: The liquidity term,  $\mathcal{L}(q) \equiv [u'(q) - c'(q)]/[\theta c'(q) + (1 - \theta)u'(q)]$ .

The corner solution,  $q = 0$ , occurs when

$$-r \frac{\phi - \phi^*}{\phi + \kappa} + \frac{\sigma\theta}{1 - \theta} < 0. \tag{4.13}$$

When  $\kappa = 0$ , this provides a condition on the price such that fiat money will be infeasible. Figure 4.7 illustrates the region in  $\theta - \sigma$  space where fiat money is feasible and where it is infeasible.

When the solution is interior, there are three cases to consider. If  $\phi - \phi^* < 0$ , then (4.11)



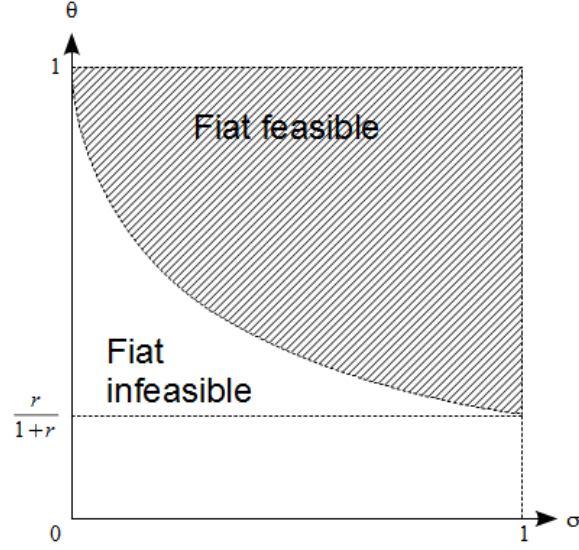


Figure 4.7: The curve in the figure graphs  $\theta = r/(r + \sigma)$ , the boundary of the corner solution to (4.12). The shaded region is where, for a given  $r$ , the parameters  $\sigma$  and  $\theta$  are such that fiat money ( $\kappa = 0$ ) is feasible.

has no solution; unbounded  $a$  will be demanded. If  $\phi - \phi^* = 0$ , then any  $a \geq z(q^*)/(\phi + \kappa)$  is a solution. If  $\phi - \phi^* > 0$ , then demand will be single-valued<sup>4</sup> where  $a = z(q)/(\phi + \kappa)$ . As  $\phi - \phi^* > 0$ , this implies  $u'(q) - c'(q) > 0$  where  $q = z^{-1}[a(\phi + \kappa)]$ , and hence  $q < q^*$ .

Sellers have no demand for assets. Let  $W^s(a)$  denote the lifetime expected utility of a seller entering the CM with  $a$  perpetuities. Let  $V^s$  be the value function for a seller in the DM. This gives

$$W^s(a) = \max_{x, a' \geq 0} [x + \beta V^s(a')] \quad (4.14)$$

$$s.t. \ x + a'\phi = a(\phi + \kappa). \quad (4.15)$$

<sup>4</sup>To prove this, note that when (4.12) has an interior solution,

$$r \frac{\phi - \phi^*}{\phi + \kappa} = \sigma \theta \mathcal{L}(q).$$

The left-hand side is increasing in  $\phi$ . The right-hand side is decreasing in  $\phi$  and  $a$ .

This can be rewritten as

$$W^s(a) = a(\phi + \kappa) + \max_{a' \geq 0} [-a'\phi + \beta V^s(a')].$$

Note that, as with the buyer's CM value function, the seller's CM value function is linear in asset holdings and its choice of assets next period is independent of previous holdings.

The value function for the seller holding  $a$  units of assets in the DM is

$$V^s(a) = \sigma\{W^s(a + d) - c(q)\} + (1 - \sigma)W^s(a). \quad (4.16)$$

This can be rewritten as

$$V^s(a) = \sigma[d(\phi + \kappa) - c(q)] + W^s(a)$$

using the linearity of  $W^s$ . Applying the solution to the proportional bargaining problem and substituting  $V^s$  into  $W^s$ :

$$\max_{a \geq 0} \left\{ -a\phi + \beta\{\sigma(1 - \theta)[u(q) - c(q)] + a(\phi + \kappa)\} \right\}.$$

Unlike the buyer, for whom a change in the amount of assets brought into the DM determines the amount of DM good traded, the amount of DM good the seller receives does not depend on the assets the seller carries. The problem, then, reduces to

$$\max_{a \geq 0} [-a(\phi - \phi^*)].$$

There are three cases to consider. If  $\phi - \phi^* < 0$ , then there is no solution; unbounded  $a$  will be demanded. If  $\phi - \phi^* = 0$ , then any  $a$  is a solution. As the seller is indifferent, one can assume zero assets are demanded. If  $\phi - \phi^* > 0$ , then demand will be zero.

Aggregate demand is the correspondence

$$A^d(\phi) = \left\{ \int_{[0,1]} a(i) di : a(i) \text{ is a solution to (4.11)} \right\}, \quad (4.17)$$

where  $[0, 1]$  is the measure of buyers and  $a(i)$  is the asset demand for buyer  $i \in [0, 1]$ . Aggregate demand,  $A^d(\phi)$  is the correspondence  $[z(q^*)/(\phi + \kappa), \infty)$  for  $\phi = \phi^*$  and equals  $z(q)/(\phi + \kappa)$  for  $\phi > \phi^*$ .

To summarize, the buyer takes  $(\phi, \kappa, A)$  as given and chooses  $(q, d, a)$ . If  $\phi > \phi^*$ , these decisions are described by

$$q = \begin{cases} q^* : & a(\phi + \kappa) \geq z(q^*) \\ z^{-1}[a(\phi + \kappa)] : & \text{else} \end{cases} \quad (4.18)$$

$$d = \frac{z(q)}{\phi + \kappa} \quad (4.19)$$

$$r(\phi - \phi^*) = \sigma\theta(\phi + \kappa)\mathcal{L}(q) \quad (4.20)$$

where  $z(q) \equiv \theta c(q) + (1 - \theta)u(q)$  and  $\mathcal{L}(q) \equiv [u'(q) - c'(q)]/[\theta c'(q) + (1 - \theta)u'(q)]$ .

## 4.5.2 Sovereign

The sovereign faces the following program:

$$\max_{A \geq 0, \kappa \geq 0, \phi \geq 0} A(\phi - \phi^*) \quad (4.21)$$

$$\text{s.t. } A \in A^d(\phi). \quad (4.22)$$

The price of money is determined endogenously according to the pricing equation (4.12). The

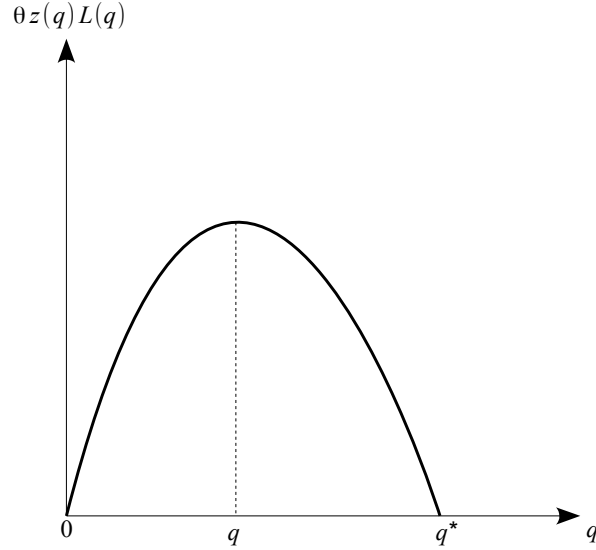


Figure 4.8: The sovereign's problem can be rewritten to maximize  $\theta z(q)\mathcal{L}(q)$ .

dividend is restricted to being positive. A negative dividend would require the sovereign to have the power to enforce collection of the negative dividend each CM. While a commodity money interpretation of the model might cast this as money that is costly to carry, a sovereign free to dispose of a costly asset would do so immediately and prefer to employ a fiat money. The sovereign's program can be rewritten as

$$\max_{\kappa \geq 0, \phi \geq 0} \theta z(q)\mathcal{L}(q) \tag{4.23}$$

The following technical assumption on the relative third derivatives of the functions  $u(q)$  and  $c(q)$  guarantees the maximand is concave.

**Assumption 4.2.** For all  $q \in [0, q^*]$ ,  $c'''(q) > 0$  and

$$u'''(q) - c'''(q) < 2c''(q) \frac{u''(q)c'(q) - c''(q)u'(q)}{[c'(q)]^3} - c''(q)[u'(q)]^4 \frac{u'(q) - c'(q)}{c(q)[c'(q)]^4}.$$

**Lemma 4.2.** If Assumption 4.2 is true, then Assumption 4.1 is true.

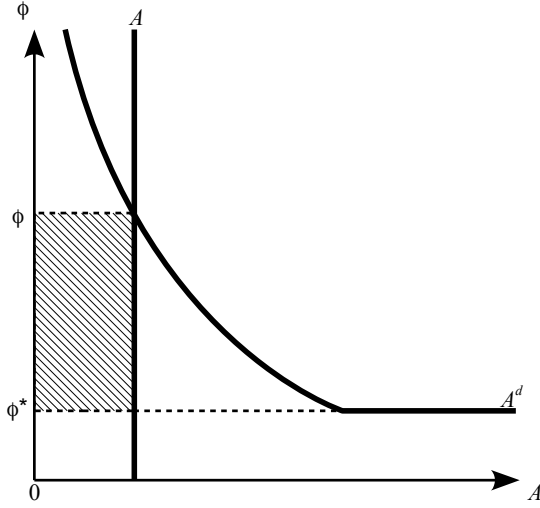


Figure 4.9: The demand  $A^d$  for assets and supply  $A$  chosen by the sovereign to maximize seigniorage, the shaded region.

**Lemma 4.3.** *If Assumption 4.2 is true, then  $z(q)\mathcal{L}(q)$  is concave.*

Taking the first order condition, for finite  $\kappa$ ,

$$\frac{\mathcal{L}'(q)/\mathcal{L}(q)}{z'(q)/z(q)} = -1. \quad (4.24)$$

The  $\mathcal{L}(\cdot)$  function captures a liquidity term, as can be seen in (4.20). The  $z(\cdot)$  function captures the cost to the buyer in a bilateral trade, as in (4.19). Equation (4.24) says that the sovereign will choose  $\kappa$  such that the buyer's trade cost elasticity of the liquidity term is unit. The intuition behind this is simple. A buyer demands assets to trade more of the DM good. As the access to assets rises, so does the trade cost in a match. This is maximized at  $q^*$ . However, at  $q^*$  there will be no liquidity premium. The liquidity premium is decreasing in  $q$ . The sovereign trades off the demand for assets, which is increasing in  $q$ , and the captured liquidity premium, which decreases in  $q$ . This is understood most clearly by noting that, in equilibrium,  $q = \mathcal{L}^{-1}\{[r(\phi - \phi^*)]/[\sigma\theta(\phi + \kappa)]\}$ , which is increasing in  $\kappa$ .

Let  $q$  denote the quantity of DM good the buyer chooses given the sovereign's choice of

$(\kappa, A, \phi)$ . From (4.20):

$$q = \mathcal{L}^{-1} \left[ \frac{r(\phi - \phi^*)}{\sigma\theta(\phi + \kappa)} \right].$$

As  $\mathcal{L}(q)$  is decreasing in  $q$ ,  $\mathcal{L}(0) = 1/(1 - \theta)$ ,  $\mathcal{L}(q^*) = 0$ , and the fact that  $r > 0$ ,  $\phi$  is a decreasing function of  $q$ , see right graph of Figure 4.9. At  $q^*$ , there is no liquidity premium, so the asset is priced at its fundamental value,  $\phi^*$ . If the price were to fall below the fundamental value,  $q^*$  would still be achieved, though an infinite quantity of the asset would be demanded. The price of the asset is increasing in the fundamental value.

### 4.5.3 Steady-State Equilibria

Comparative statics are examined with steady-state equilibria.

**Definition 4.1.** *A steady-state equilibrium is a sequence of  $\{q_t, \phi_t, d_t, a_t, A_t, \kappa_t\}_{t=0}^{\infty}$  such that*

1.  $q_t = q, \phi_t = \phi, d_t = d, a_t = a, A_t = A, \kappa_t = \kappa \forall t \geq 0$ ,
2. agents bargain to determine  $\{q, d\}$  (4.6), (4.7), (4.8),
3. agents choose  $a$  to maximize utility (4.11),
4. the sovereign chooses  $\{A, \kappa\}$  to maximize seigniorage subject to the demand for assets (4.21), (4.22),
5. prices follow  $z(q) \equiv \theta c(q) + (1 - \theta)u(q) = a(\phi + \kappa)$ ,
6. and markets clear  $A = a$ .

**Theorem 4.4.** *In a steady-state equilibrium, fiat currency ( $\kappa = 0$ ) is feasible when*

$$-r + \frac{\sigma\theta}{1 - \theta} \geq 0. \tag{4.25}$$

**Corollary 4.5.** *In a steady-state equilibrium,*

- (i) *Fiat currency will be infeasible for any  $(\sigma, \theta) \in [0, 1] \times [0, 1)$  pair if  $r \rightarrow \infty$ .*
- (ii) *Fiat currency will be feasible for any  $(\sigma, \theta) \in [0, 1] \times [0, 1]$  pair if  $r = 0$ .*

The curve in Figure 4.7 graphs  $\theta = r/(r + \sigma)$ , the boundary of the corner solution to (4.12). To the left, the graph approaches but does not attain  $(0, 1)$ . To the right, the graph attains  $(1, r/(1 + r))$ . The region, **Fiat feasible**, is where, for a given  $r$ , the parameters  $\sigma$  and  $\theta$  are such that fiat money ( $\kappa = 0$ ) is feasible. Below this region, only commodity money can circulate; this region attains the corner solution to (4.12) for  $\kappa = 0$ . Note that as  $r \rightarrow \infty$  fiat money becomes infeasible for all  $(\sigma, \theta)$  pairs. As  $r \rightarrow 0$ , the right part of the graph approaches  $(1, 0)$  and the **Fiat feasible** region becomes the entire region  $[0, 1] \times [0, 1]$ . The interpretation of Proposition 4.4 and Figure 4.7 is as markets grow thicker ( $\sigma$  increases), or as the markup decreases ( $\theta$  increases), or as peasants become more patient ( $r$  decreases), fiat currency can become feasible. This means that commodity money can be feasible for some values of  $(\sigma, \theta, r)$ , where, for those same values, fiat is infeasible. Without a commodity value to the currency peasants are unwilling to circulate money.

**Theorem 4.6.** *In a steady-state equilibrium, normalizing  $A = 1$ ,*

- (i) *An increase in  $r$  will cause no change in  $q$ , a decrease in  $\phi$ , and an increase in  $\kappa$ .*
- (ii) *An increase in  $\sigma$  will cause no change in  $q$ , an increase in  $\phi$ , and a decrease in  $\kappa$ .*

Proposition 4.6 gives the comparative statics for the rate of time preference and matching probability. As agents become more patient, the seigniorage-maximizing sovereign will choose a lower amount of commodity to put in the money. Seigniorage-maximizing sovereigns

will also put less commodity in the money as matching probabilities increase. This can be interpreted as markets growing thicker and more integrated. As the probability a peasant can find a match grows, the usefulness of money grows. The liquidity value of money grows accordingly, and the amount of commodity required in the money for peasants to hold it falls.

Both of these results can be viewed as movement starting within the **Fiat infeasible** region of figure 4.7. An increase in  $\sigma$  is a movement to the right, toward the **Fiat feasible** region. As fiat becomes more feasible, the seigniorage-maximizing sovereign makes the currency more fiat and less commodity. The bound,  $r/(1+r)$  decreases as  $r$  decreases, so for any point in **Fiat infeasible** the boundary of feasibility for fiat money comes closer, and the seigniorage-maximizing sovereign reduces the commodity-ness of the currency in response.

#### 4.5.4 Money Growth and Optimal Monetary Policy

The environment, as discussed above, does not consider money growth. This section establishes a connection between standard money growth in the Lagos-Wright framework and the choice of return on the asset in the seigniorage model above. It will be shown that the optimal monetary policy corresponds to a choice of zero seigniorage, but not zero dividend.

Consider the standard Lagos-Wright fiat money framework with a constant gross rate of money growth,  $\gamma$ . The buyers face a first-order condition that determines their asset holdings as follows:

$$-\frac{\gamma - \beta}{\beta} + \sigma\theta\mathcal{L}(q) \leq 0. \tag{4.26}$$



This is analogous to (4.12), and these conditions are equivalent for

$$\gamma = \frac{\phi}{\phi + \kappa}. \quad (4.27)$$

The range of  $\gamma$  is  $[\beta, \beta [1 + \sigma\theta/(1 - \theta)]]$  — if  $\gamma < \beta$ , then the demand for money would be unbounded and if  $\gamma > \beta [1 + \sigma\theta/(1 - \theta)]$ , then money would not be valued sufficiently to purchase any DM good. In the environment described above, every  $(\phi, \kappa)$  pair can be replicated in a pure fiat environment with a gross growth rate of money,  $\gamma = \phi/(\phi + \kappa)$ . However, the point of the environment above is that sometimes the primitives,  $(r, \sigma, \theta)$ , of an environment make fiat infeasible. If fiat were infeasible, the question then is, given a target gross growth rate of money,  $\gamma$ , and a stationary price of money,  $\phi$ , what amount of dividend,  $\kappa$ , generates an analogous economy?

First, note that the range of  $\gamma$  can be divided:

$$\gamma \in \begin{cases} [\beta, 1) & : & \text{deflation} \\ \{1\} & : & \text{no money growth} \\ (1, \beta [1 + \sigma\theta/(1 - \theta)]] & : & \text{inflation.} \end{cases} \quad (4.28)$$

From (4.27) it is immediately obvious

$$\begin{aligned} > & : & \text{deflation} \\ \kappa = 0 & : & \text{no money growth} \\ < & : & \text{inflation.} \end{aligned} \quad (4.29)$$

If the dividend could be negative — if the sovereign could collect a tax on the currency — this would be equivalent to the inflation tax in a fiat money model with gross money growth greater than one. A positive dividend corresponds to deflation. The Friedman rule in the Lagos-Wright framework is well-known to be  $\gamma = \beta$ . From this result, the optimal amount

of dividend that corresponds to the optimal monetary policy is  $\kappa = r\phi$  for a given  $\phi$ .

Returning to the original question, given  $(r, \sigma, \theta)$ , assume fiat is infeasible. From Proposition 4.4, this implies  $r > \sigma\theta/(1 - \theta)$ . Furthermore, this implies

$$\beta \left( 1 + \frac{\sigma\theta}{1 - \theta} \right) < 1. \tag{4.30}$$

The left-hand side of this inequality is the upperbound of  $\gamma$  such that money is still valued. When this upperbound is less than one, fiat money is only valued under deflation. In the commodity money environment, this requires  $\kappa > 0$  — specifically,  $\kappa = \phi(1 - \gamma)/\gamma$ .

## 4.6 Conclusion

The reason it took so long for fiat money to be the norm is that people decide whether they wish to hold a good as money depending on market thickness, competitiveness of markets, and their patience. There has been a long-run trend towards market integration, lower trade surpluses to sellers, and increased life expectancy, which have affected the feasibility of fiat. Self-interested sovereigns take the behavior of their subjects into account when attempting to maximize seigniorage. To this end, seigniorage is maximized when fiat is infeasible by adding intrinsic value — historically, in the form of precious metal or promises of convertibility — to the currency. Sovereigns are willing to pay this price because they can manufacture a scarcity in the money that gives it a liquidity premium. The premium is then extracted as seigniorage.

# Chapter 5

## Transitions: Extensions to the Optimal Seigniorage Approach

### 5.1 Introduction

In this chapter, I extend the benchmark model of the previous chapter to consider more specific historical questions. In Section 5.2, I model commodity money as intrinsically worthless, but convertible for consumption goods. In Section 5.3, instead of modeling the sovereign as a single agent that does not participate in trade, I model the sovereign as an oligarchy of buyers. In Section 5.4, I give the seigniorage-maximizing sovereign two types of perpetuities with which it may create currency. In Section 5.5, I model the transition from credit at the village level to the adoption of money for use with strangers. In Section 5.6, I model the Aztec government's control over money growth despite the "free minting" available to all. In Section 5.7, I conclude.

## 5.2 Convertibility

The following section investigates the theoretical underpinnings of a type of commodity money observed in history: convertible money. Convertible money is often viewed as the stepping stone to fiat. Paper money is issued backed by some amount of commodity money. If the money is convertible, the paper money can be redeemed in commodity money upon demand. During the free banking era in the United States (1837-1864), individual banks were granted the right to print their own paper money, so long as that money were properly backed by state bonds and redeemable for their gold value. During crises it sometimes became necessary for the banks to suspend their convertibility feature.

From the perspective of the history of monetary and economic thought, this discussion resolves a long debate between what are frequently called the quantity theory and real bills doctrine. Real bills has come in many forms but the latest incarnation is a backing theory of money, the theory that money is valued because there is an asset backing it. In the following section I discuss models of convertible money to understand the role convertibility itself plays. I find that a currency that circulates (formally: is not redeemed immediately) does not resemble commodity money as modeled in the previous section. If fiat were not valued, then convertible money can circulate if an agent is required to search for an agent who will redeem.

The following subsection is structured as follows. First, I create a benchmark with one-period Lucas trees. These assets cannot be redeemed upon issue and are completely redeemed the following period. Second, I provide a model of convertible money where it is costless to redeem. Finally, I model convertible money that is costly to redeem and consider comparative statics.

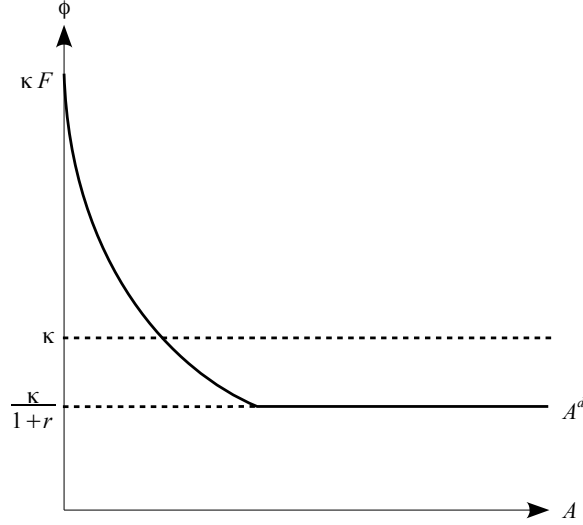


Figure 5.1: The graph of the demand for one-period Lucas Trees. Note that the fundamental value is  $\kappa/(1+r)$  since the asset cannot be converted the period it is issued. The maximum price is  $\kappa F$ , where  $F = [1 + \sigma\theta/(1 - \theta)]/(1 + r)$ . When  $F \geq 1$ , fiat is feasible; when  $F < 1$  fiat is not feasible. If this asset were immediately convertible for  $\kappa$ , then if fiat were not feasible as money, neither would this asset serve as money, for the upperbound of the price would fall below  $\kappa$ .

### 5.2.1 One-Period Lucas Tree

The environment is the same as in the benchmark except for the particulars of money. Money is issued as one-period Lucas trees that pay a dividend the period following their issue. In this way, the entirety of the money supply is redeemed every period for  $\kappa$ , which means the fundamental value of the asset at sale is  $\kappa/(1+r)$ . As in the previous model, sellers do not benefit from trade by bringing money into a match. If the price of the asset is above the fundamental, there will be no seller-driven demand for it. Below are the Bellman equations characterizing the value functions of the buyer in CM and DM, respectively.

$$\begin{aligned}
 W^b(a) &= \max_{x, a' \geq 0} [x + \beta V^b(a')] \\
 &\text{s.t. } x + a'\phi \leq a\kappa \\
 V^b(a) &= \sigma[u(q) + W^b(a-d)] + (1-\sigma)W^b(a)
 \end{aligned}$$

The bargaining problem looks similar to the benchmark, except the value of the asset in the following period is  $\kappa$ , not  $\kappa + \phi$ .

$$\begin{aligned} \max \quad & \theta[u(q) - c(q)] \\ \text{s.t.} \quad & (1 - \theta)u(q) + \theta c(q) \leq \kappa a \end{aligned}$$

Applying backwards induction, the following condition arises between the fundamental value and price of money:

$$\phi \geq \kappa \frac{1 + \sigma\theta\mathcal{L}(q)}{1 + r} \geq \frac{\kappa}{1 + r}.$$

Note that as  $A \rightarrow 0$ ,  $q \rightarrow 0$ ,  $\mathcal{L}(q) \rightarrow 1/(1 - \theta)$ , so

$$\phi \rightarrow \kappa \frac{1 + \frac{\sigma\theta}{1-\theta}}{1 + r}$$

Relating this kind of commodity money to the benchmark, the questions are, “If fiat money is not valued, will commodity money be valued? If so, does the level of commodity in the money matter?” From the benchmark we know fiat is not feasible if

$$\frac{\sigma\theta}{1 - \theta} < r.$$

If fiat is not feasible, then from above, the bounds on  $\phi$  are

$$\kappa \frac{1 + \frac{\sigma\theta}{1-\theta}}{1 + r} \geq \phi \geq \frac{\kappa}{1 + r}$$

and the upperbound is less than  $\kappa$ .

Setting a price floor at  $\kappa$ , as allowing convertibility for  $\kappa$  would do, would mean the currency would only be valued if fiat money were also valued. Note that the level of  $\kappa$  does not matter

so long as  $\kappa > 0$ .

For these one-period Lucas trees, the price can fall below  $\kappa$  because they are only redeemable in the following period. In a situation with convertible money, redemption is available at any time. This means price cannot fall below  $\kappa$ , or an unbounded quantity would be demanded at  $\phi < \kappa$  and immediately redeemed for unbounded profit. In order to avoid a currency where convertibility does not provide any benefit over fiat money, one could restrict money not to be convertible until the following period, as in the model above.

### 5.2.2 Costless Redemption Convertibility

Assume that the asset provides no dividend, but can be converted to  $\kappa$  units of general good during any CM. Let  $W^b(a)$  denote the lifetime expected utility of a buyer in the CM holding  $a$  perpetuities in units of the numéraire good. Let  $V^b$  be its value function in the DM.

$$W^b(a) = \max_{x, a' \geq 0, \omega \in [0,1]} [x + \beta V^b(a')] \quad (5.1)$$

$$s.t. \ x + a'\phi = a[(1 - \omega)\phi + \omega\kappa]. \quad (5.2)$$

The difference between this program and the problem of the buyer in the CM in the original version is the right-hand side of the budget constraint. The buyer decides what fraction of assets,  $\omega$ , he wants to convert into  $\kappa$  units of the general good. The rest are sold at price  $\phi$ . The constraint can be substituted into the value function:

$$W^b(a) = \max_{a' \geq 0, \omega \in [0,1]} [-a'\phi + a[(1 - \omega)\phi + \omega\kappa] + \beta V^b(a')]. \quad (5.3)$$

Note that the choice of  $\omega$  is independent of the choice of  $a'$ :

$$W^b(a) = a \max_{\omega \in [0,1]} [(1 - \omega)\phi + \omega\kappa] + \max_{a' \geq 0} [-a'\phi + \beta V^b(a')]. \quad (5.4)$$

This is a linear program, so the buyer will choose  $\omega = 0$  if  $\phi > \kappa$ ,  $\omega = 1$  if  $\phi < \kappa$  and may choose any  $\omega \in [0, 1]$  if  $\phi = \kappa$ . All buyers are symmetric. This implies the case where  $\phi < \kappa$  will immediately lead to all currency being converted immediately — the asset will disappear. A stationary solution with  $\phi > 0$  is only possible for  $\phi \geq \kappa$ .

The interpretation of convertibility can either be that the sovereign stands ready to convert token currency for its backed value,  $\kappa$ , or that the currency has an intrinsic value that can be obtained through a costless melting process.<sup>1</sup>

$$V^b(a) = \sigma \{u(q) - d \max_{\omega \in [0,1]} [(1 - \omega)\phi + \omega\kappa]\} + W^b(a) \quad (5.5)$$

The choice of assets is determined by the following problem for the buyer:

$$\max_{a \geq 0} \{-a\phi r + a \max_{\omega \in [0,1]} \omega(\kappa - \phi) + \sigma\theta[u(q) - c(q)]\}. \quad (5.6)$$

Stationarity in an environment without money growth requires either no money to be held or none of it to be converted. If money cannot be converted, the option value will not be exercised in equilibrium. Any equilibrium where the option value is not exercised but money is valued must be one where fiat is feasible.

Convertible currency does not give you the same properties as a bond that pays dividends each period.

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<sup>1</sup>Historically, the melting process was subject to a cost called seigniorage.



### 5.2.3 Costly Redemption Convertibility

It is less than realistic to assume that paper money could be converted costlessly. For instance, during the Napoleonic wars, Great Britain suspended convertibility of paper money. At this time, the Bank of England monopolized paper money issue within the city of London. To convert your paper money you needed to go directly to the Bank of England. Another example comes from the Free Banking era in the United States (1837-1864). During this era, state-chartered banks were given authority to issue currency under the requirement they redeem their notes for gold at face value. Gorton (1999) and Ales et al (2008) provide history and theory for the discounting of bank notes from this era [1, 30]. Notes circulated below their face value; it was costly to locate the note issuers to redeem for the face value. Famously, Nicholas Biddle, president of the Second Bank of the United States, used the threat of sending large quantities of notes for redemption at state banks to keep other banks in line with his policies [34].

A model for convertibility ought to take these observations into account. Whereas the previous model of convertible money does not provide any benefit over fiat, the following model does. As in the one-period Lucas tree model, an agent cannot redeem their paper money for the backed value immediately. Agents search and randomly match with currency issuers as well as sellers in the decentralized market. Currency issuers must redeem for face value  $\kappa$  if the agent so desires.

This way of modeling convertibility, where agents need to endure search and matching costs, gives rise to a mode where the value of money can, in equilibrium, fall below the face value of the currency. Suspension of convertibility is modeled as a decrease in the match rate with currency issuers. This is in contrast to the previous model where suspension is modeled as eliminating the option to redeem in the centralized market completely.

$$W^b(a) = \max_{x, a'} [x + \beta V^b(a')] \quad (5.7)$$

$$\text{s.t. } x + \phi a' \leq a\phi \quad (5.8)$$

$$\implies W^b(a) = a\phi + \max_{a'} [-\phi a' + \beta V^b(a')] \quad (5.9)$$

$$V^b(a) = \sigma[u(q) + W^b(a - d)] + \omega[d_g \kappa + W^b(a - d_g)] + (1 - \sigma - \omega)W^b(a) \quad (5.10)$$

$$\implies V^b(a) = \sigma[u(q) - \phi d] + \omega[d_g \kappa - \phi d_g] + W^b(a) \quad (5.11)$$

When an agent carrying the money good encounters the currency issuer in the decentralized market, they may redeem  $d_g \leq a$  of their assets for face value.

In a match, buyers and sellers bargain following the proportional bargaining rule. The buyer's bargaining problem is:

$$\max_{q \geq 0} [u(q) - d\phi] \quad (5.12)$$

$$\text{s.t. } u(q) - d\phi = \frac{\theta}{1 - \theta} [d\phi - c(q)] \quad (5.13)$$

$$d \leq a. \quad (5.14)$$

Proportional bargaining between buyer and seller implies  $z(q) = d\phi \leq a\phi$ . Applying backwards induction to solve for the buyer's problem yields

$$\max_{a \geq 0, \pi \in [0, 1]} \{-r\phi a + \sigma\theta[u(q) - c(q)] + \omega d_g(\kappa - \phi)\} \quad (5.15)$$

$$\text{s.t. } d_g = a\pi. \quad (5.16)$$

Note that  $\pi$  represents the choice of agents whether or not to redeem, where  $\pi = 0$  if agents do not wish to redeem,  $\pi = 1$  if agents wish to redeem and  $\pi \in [0, 1]$  if agents are indifferent. The interesting case to examine, as before, is when  $\kappa > \phi$  and fiat is no longer feasible,  $\sigma\theta\mathcal{L}(q) - r < 0$ . In this case,

$$\phi = \frac{\omega\kappa}{\omega - [\sigma\theta\mathcal{L}(q) - r]}$$

As in the benchmark, the amount of commodity-ness in the currency is determined by a seigniorage maximizing sovereign. Unlike the benchmark, the sovereign only needs to redeem the currency under the restrictions that agents must meet them in the DM and agents must want to redeem their currency. Then the sovereign's problem is

$$\max A[\phi + \omega\pi \sum_{t=1}^{\infty} \beta^t(\phi - \kappa)] \tag{5.17}$$

$$s.t. A \in A^d(\phi), \tag{5.18}$$

where  $A^d(\phi)$  is determined by (5.15).

In the case  $\kappa > \phi$ ,  $\pi = 1$  and the sovereign's problem reduces to

$$\max \theta z(q)\mathcal{L}(q), \tag{5.19}$$

which is the same as in the benchmark. This means the sovereign will choose an amount of commodity in the currency to target a quantity of trade in the DM regardless of  $\sigma$  and  $r$  — parameters denoting thickness of markets and patience of the agents.

**Definition 5.1.** *A steady-state equilibrium is a sequence of  $\{q_t, \phi_t, d_t, d_{gt}, \pi_t, a_t, A_t, \kappa_t, \omega_t\}_{t=0}^{\infty}$  such that*

1.  $q_t = q, \phi_t = \phi, d_t = d, d_{gt} = d_g, \pi_t = \pi, a_t = a, A_t = A, \kappa_t = \kappa, \omega_t = \omega \forall t \geq 0,$
2. *agents bargain to determine  $\{q, d\}$  (5.12), (5.13), (5.14),*
3. *agents choose  $\{a, d_g, \pi\}$  to maximize utility (5.15), (5.16)*
4. *the sovereign chooses  $\{A, \kappa, \omega\}$  to maximize seigniorage subject to the demand for assets (5.17), (5.18),*
5. *prices follow  $z(q) \equiv \theta c(q) + (1 - \theta)u(q) = a\phi,$*
6. *and markets clear  $A = a.$*

**Theorem 5.1.** *In a steady-state equilibrium, normalizing  $A\kappa = 1,$*

- (i) *An increase in  $r$  will cause no change in  $q,$  a decrease in  $\phi,$  and an increase in  $\omega.$*
- (ii) *An increase in  $\sigma$  will cause no change in  $q,$  an increase in  $\phi,$  and a decrease in  $\omega.$*

While this fits the long-run pattern of governments making their currency more and more fiat, making convertible money less easily convertible over time, it does not explain temporary suspensions of convertibility. A temporary suspension might be considered an exogenous increase in  $r$  — agents become suddenly less patient. In the model, the government would respond to the impatience by making it easier to convert money. In reality, a suspension meant the opposite.

### 5.3 Oligarchy

Assume that instead of a single sovereign, there is instead an oligarchy,  $\alpha \in [0, 1]$  fraction of buyers that, as we assumed with the sovereign, can commit to paying a dividend,  $\kappa$ , on a perpetuity sold at the beginning of time. The peasants' problems do not change, but the oligarchy's problem becomes

$$\max_{A \geq 0, \kappa \geq 0, \phi \geq 0} [A(\phi - \phi^*) + \alpha W^b(0)] \quad (5.20)$$

$$s.t. A \in A^d(\phi). \quad (5.21)$$

In the problem with a single sovereign that does not consume in the DM, the scarcity of the asset increases its liquidity value, and hence seigniorage. The oligarchy must face the tradeoff between seigniorage and trade surplus. The sovereign's problem can be rewritten as

$$\max_{\kappa \geq 0, \phi \geq 0} \{(1 - \alpha)z(q)\mathcal{L}(q) + \alpha[u(q) - c(q)]\}. \quad (5.22)$$

**Definition 5.2.** A steady-state equilibrium is a sequence of  $\{q_t, \phi_t, d_t, a_t, A_t, \kappa_t\}_{t=0}^{\infty}$  such that

1.  $q_t = q, \phi_t = \phi, d_t = d, a_t = a, A_t = A, \kappa_t = \kappa \forall t \geq 0$ ,
2. agents bargain to determine  $\{q, d\}$  (4.6), (4.7), (4.8),
3. agents choose  $a$  to maximize utility (4.11),
4. the sovereign chooses  $\{A, \kappa\}$  to maximize seigniorage subject to the demand for assets (5.20), (5.21),
5. prices follow  $z(q) \equiv \theta c(q) + (1 - \theta)u(q) = a(\phi + \kappa)$ ,
6. and markets clear  $A = a$ .

Following the initial formulation,  $A$  is normalized to one. This program is concave if  $z(q)\mathcal{L}(q)$  is concave. The oligarchy's problem is once again rewritten as if they were choosing  $q$ . The DM trade surplus term will lead to the choice of a greater  $q$ .

**Theorem 5.2.** *As  $\alpha$  increases, equilibrium  $q$  increases and  $\kappa$  increases.*

**Corollary 5.3.** *As  $\alpha \rightarrow 1$ ,  $q \rightarrow q^*$ .*

As those with a greater interest in the value of currency for its use in trade gain influence over the sovereignty, the oligarchy approaches a welfare-maximizing planner. As established in Chapter 4, greater dividend in the currency is analogous to more deflation in a fiat money economy. By analogy, as the oligarchy grows, the Friedman-rule equivalent level of dividend is approached, where seigniorage is zero and there is sufficient currency that trade surplus is maximized.

## 5.4 Two Currencies

Historically, gold and silver were both used as commodity money. The model as previously presented can be interpreted as an abstraction from the kind of metal actually used in the money. What follows is a step closer to reality, allowing for two commodity monies. By explicitly modeling two currencies, the model gives predictions regarding the exchange rate.

Consider the same environment for two commodity monies, *red* and *blue*. A buyer's value function in the CM is:

$$W(a_b, a_r) = a_b(\phi_b + \kappa_b) + a_r(\phi_r + \kappa_r) + \max_{a'_b, a'_r} \{-\phi_b a'_b - \phi_r a'_r + \beta V(a'_b, a'_r)\}, \quad (5.23)$$

where the  $r$  subscript denotes *red* and  $b$  denotes *blue*. The buyer's value function in the DM

is:

$$V(a_b, a_r) = \sigma \{u[q(a_b, a_r)] - d_b(q)(\phi_b + \kappa_b) - d_r(q)(\phi_r + \kappa_r)\} + W(a_b, a_r). \quad (5.24)$$

The buyer's bargaining problem is

$$\max_{q \geq 0} [u(q) - d_r(\phi_r + \kappa_r) - d_b(\phi_b + \kappa_b)] \quad (5.25)$$

$$\text{s.t. } u(q) - d_r(\phi_r + \kappa_r) - d_b(\phi_b + \kappa_b) = \frac{\theta}{1 - \theta} [d_r(\phi_r + \kappa_r) + d_b(\phi_b + \kappa_b) - c(q)] \quad (5.26)$$

$$d_r \leq a_r \quad (5.27)$$

$$d_b \leq a_b. \quad (5.28)$$

The buyer's choice of assets can be written as:

$$\max_{a_b, a_r} - a_b r \left( \phi_b - \frac{\kappa_b}{r} \right) - a_r r \left( \phi_r - \frac{\kappa_r}{r} \right) + \sigma \theta [u(q) - c(q)] \quad (5.29)$$

$$\text{s.t. } \theta c(q) + (1 - \theta)u(q) = a_b(\phi_b + \kappa_b) + a_r(\phi_r + \kappa_r). \quad (5.30)$$

Assuming an interior solution:

$$\frac{\sigma \theta [u'(q) - c'(q)]}{\theta c'(q) + (1 - \theta)u'(q)} = r \frac{\phi_b - \frac{\kappa_b}{r}}{\phi_b + \kappa_b} = r \frac{\phi_r - \frac{\kappa_r}{r}}{\phi_r + \kappa_r} \quad (5.31)$$

Assuming the following relation between the prices and dividends of the two currencies,

$$\phi_b = \delta \phi_r \quad (5.32)$$

$$\kappa_b = \epsilon \kappa_r, \quad (5.33)$$

and using the previous equality gives

$$\frac{\delta\phi_r - \epsilon\frac{\kappa_r}{r}}{\delta\phi_r + \epsilon\kappa_r} = \frac{\phi_r - \frac{\kappa_r}{r}}{\phi_r + \kappa_r}. \quad (5.34)$$

It is obvious this equation will be true when  $\delta = \epsilon$ .

From this the exchange rate is derived:

$$\phi_b = \frac{\kappa_b}{\kappa_r}\phi_r. \quad (5.35)$$

If this exchange rate does not hold, the overpriced money will stop circulating. An incident from history that illustrates this prediction comes from Britain. As master of the mint, Sir Isaac Newton in 1717 set a high silver-price of gold. This price led to silver flowing out of the country, effectively creating the first gold standard in Britain.

The sovereign faces the following program:

$$\max_{A_r \geq 0, \kappa_r \geq 0, \phi_r \geq 0, A_b \geq 0, \kappa_b \geq 0, \phi_b \geq 0} A_r (\phi_r - \phi_r^*) + A_b (\phi_b - \phi_b^*) \quad (5.36)$$

$$\text{s.t. } A_r \in A_r^d(\phi_r) \quad (5.37)$$

$$A_b \in A_b^d(\phi_b). \quad (5.38)$$

This also can be rewritten as

$$\max \theta z(q)\mathcal{L}(q). \quad (5.39)$$

**Definition 5.3.** *A steady-state equilibrium is a sequence of  $\{q_t, \phi_{rt}, d_{rt}, a_{rt}, A_{rt}, \kappa_{rt}, \phi_{bt}, d_{bt}, a_{bt}, A_{bt}, \kappa_{bt}\}_{t=0}^{\infty}$  such that*



1.  $q_t = q, \phi_{rt} = \phi_r, d_{rt} = d_r, a_{rt} = a_r, A_{rt} = A_r, \kappa_{rt} = \kappa_r, \phi_{bt} = \phi_b, d_{bt} = d_b, a_{bt} = a_b, A_{bt} = A_b, \kappa_{bt} = \kappa_b \forall t \geq 0,$
2. *agents bargain to determine  $\{q, d_r, d_b\}$  (5.25), (5.26), (5.27), (5.28),*
3. *agents choose  $\{a_r, a_b\}$  to maximize utility (5.29), (5.30)*
4. *the sovereign chooses  $\{A_r, \kappa_r, A_b, \kappa_b\}$  to maximize seigniorage subject to the demand for assets (5.36), (5.37), (5.38),*
5. *prices follow  $z(q) \equiv \theta c(q) + (1 - \theta)u(q) = a_r(\phi_r + \kappa_r) + a_b(\phi_b + \kappa_b),$*
6. *and markets clear  $A_r = a_r, A_b = a_b.$*

In the situation where there is no limit to the availability of the commodities used to create the currencies, the sovereign is indifferent between *red* and *blue*. The total amount of commodity-ness in the currency is used to target the  $q$  that maximizes seigniorage and the sovereign has no preference regarding what mix of currency is used to do that.

## 5.5 Money and Credit

Typical assumptions, such as anonymity and limited record keeping, are required to make money essential in a monetary model. Historically, these assumptions are strange on a village-level. Peasants that live together know each other. They have long-lasting relationships. Reputations matter in the village. These are conditions that can allow credit — formal or informal — to arise. For money to serve a role, some interactions need to be anonymous. The historical analogue can be considered the *faire*. In a *faire* merchants come to a village to sell their wares before moving on to the next town. These trading opportunities cannot make use of credit, as there is no record keeping and the merchants may not pass through that town again. To capture this aspect of trade, I model the village and the *faire*.

There are two decentralized markets, the village and the faire. At the end of the CM agents go to the village with probability  $\epsilon$  and go to the faire with probability  $1 - \epsilon$ . At the faire agents search and match with agents whom they will meet again with probability zero. This should be considered the same as the DM in the previous versions. The village is different in that credit through public record keeping is available. Individuals may issue one-period IOUs (that fully depreciate at the end of the CM) to agents they meet in the village DM. Because these notes fully depreciate at the end of the following CM they will not circulate across periods — they will either be redeemed in the CM or their issuers will default and the notes will fully depreciate. If an agent defaults they will be punished by never being allowed to use credit again.

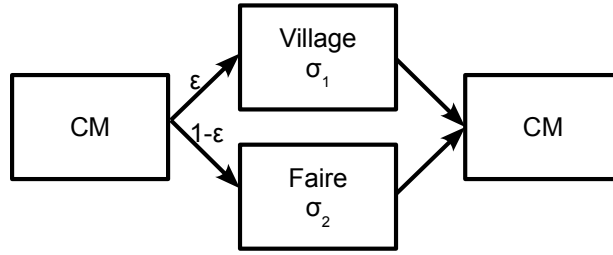


Figure 5.2: With probability  $\epsilon$  agents go to the village, where credit is possible, and may match with probability  $\sigma_1$ . With probability  $1 - \epsilon$  they go to the faire, where they match with probability  $\sigma_2$ .

The buyer's value functions in the CM, when they have access to credit (assuming no default) and when they are being punished, respectively, are as follows:

$$W(a, b) = a(\phi + \kappa) - b + \max_{a' \geq 0} \{-a'\phi + \beta[\epsilon V(a') + (1 - \epsilon)F(a')]\} \quad (5.40)$$

$$W_p(a) = a(\phi + \kappa) + \max_{a' \geq 0} \{-a'\phi + \beta[\epsilon V_p(a') + (1 - \epsilon)F_p(a')]\}, \quad (5.41)$$

where the subscript  $p$  denotes a buyer who will be punished by not having access to credit,  $V$  represents the value function for a buyer in the village DM and  $F$  represents the value function for a buyer in the faire DM. Note  $W(a, b)$  is linear in  $a$  and in  $b$  and  $W_p(a)$  is linear

in  $a$ . The DM value functions are:

$$V(a) = \sigma_1[u(x) + W(a, b)] + (1 - \sigma_1)W(a, 0) \quad (5.42)$$

$$V_p(a) = \sigma_1[u(q) + W_p(a - d)] + (1 - \sigma_1)W_p(a) \quad (5.43)$$

$$F(a) = \sigma_2[u(q) + W(a - d, 0)] + (1 - \sigma_2)W(a, 0) \quad (5.44)$$

$$F_p(a) = \sigma_2[u(q) + W_p(a - d)] + (1 - \sigma_2)W_p(a). \quad (5.45)$$

Again, the subscript,  $p$  denotes a punished buyer,  $\sigma_1$  denotes the match probability in the village and  $\sigma_2$  denotes the match probability in the faire.

When a punished buyer matches with a seller in the village, the buyer can only trade with money. Assuming a proportional bargaining rule, the buyer's problem is exactly the same as a matched buyer faces at the faire, whether punished or unpunished. When an unpunished buyer matches with a seller in the village, the buyer can use credit:

$$\max_{x, b, d} u(x) - b - d(\phi + \kappa) \quad (5.46)$$

$$\text{s.t. } u(x) - b - d(\phi + \kappa) = \frac{\theta}{1 - \theta}[b + d(\phi + \kappa) - c(x)] \quad (5.47)$$

$$d \leq a \quad (5.48)$$

$$b \leq \bar{b}, \quad (5.49)$$

where  $\bar{b}$  is the endogenous borrowing limit. Assuming a proportional bargaining rule, the punished buyer's value function in the CM can be rewritten as

$$W_p(a) = a(\phi + \kappa) + \max_{a' \geq 0} \{ -a'\phi + \beta\{\theta\sigma_\epsilon[u(q) - c(q)] + a'(\phi + \kappa) + W_p(0)\} \} \quad (5.50)$$

$$rW_p(0) = \max_a \{ -r(\phi - \phi^*)a + \theta\sigma_\epsilon[u(q) - c(q)] \}. \quad (5.51)$$

Above,  $\sigma_\epsilon$  denotes  $\epsilon\sigma_1 + (1 - \epsilon)\sigma_2$ , the expected match probability before knowing whether

the buyer is going into faire or village. Note that  $W(a, b)$  can be rewritten

$$W(a, b) = a(\phi + \kappa) - b + \max_{a' \geq 0} [-a'\phi + \beta[\theta\epsilon\sigma_1[u(x) - c(x)] + \theta(1 - \epsilon)\sigma_2[u(q) - c(q)] + a'(\phi + \kappa) + W(0, 0)]]. \quad (5.52)$$

This provides an endogenous borrowing limit based on the no-default constraint:

$$b \leq \bar{b} = \beta \max_{a' \geq 0} \{-r(\phi - \phi^*)a' + \theta(1 - \epsilon)\sigma_2[u(q) - c(q)] + \theta\epsilon\sigma_1[u(x) - c(x)]\} + \beta W(0, 0) - W_p(0) \quad (5.53)$$

$$b + d(\phi + \kappa) = \theta c(x) + (1 - \theta)u(x). \quad (5.54)$$

**Definition 5.4.** *A steady-state equilibrium is a sequence of  $\{q_t, x_t, \phi_t, d_t, a_t, b_t, \bar{b}_t A_t, \kappa_t\}_{t=0}^{\infty}$  such that*

1.  $q_t = q, x_t = x, \phi_t = \phi, d_t = d, a_t = a, b_t = b, \bar{b}_t = \bar{b}, A_t = A, \kappa_t = \kappa \forall t \geq 0$ ,
2. agents bargain to determine  $\{q, d, b\}$  (4.6), (4.7), (4.8), (5.46), (5.47), (5.48), (5.49),
3. agents choose  $a$  to maximize utility (5.52)
4. the sovereign chooses  $\{A, \kappa\}$  to maximize seigniorage subject to the demand for assets (4.21), (4.22),
5. prices follow  $z(q) \equiv \theta c(q) + (1 - \theta)u(q) = a(\phi + \kappa) + \bar{b}$ ,
6. the no-default constraint holds (5.53),
7. and markets clear  $A = a$ .

The amount the buyer can purchase when in the village is at least as much as he can purchase in the faire, as he will bring the same amount  $a$  into either meeting, not knowing

which decentralized market he will attend next. This is true because the credit available in the village cannot decrease the amount produced in a match. The endogenous borrowing limit is increasing in  $\sigma_1$  — the greater your match probability within the village, the more credit is available. As  $x \geq q$ , and  $x \leq q^*$ ,  $u(x) - c(x) \geq u(q) - c(q)$ , so the borrowing limit is increasing in  $\epsilon$ , the probability of going to the village.

The interpretation here is in line with the history. As the number of trades which can be supported by reputation and punishment, as modeled by the village credit, decreases, either because the probability of finding what you need within your own village decreases, or as the probability of doing business in the village at all decreases relative to trading with merchants — strangers — as modeled by the faire, the borrowing limit falls and credit is used less. This represents a transition from credit to currency as markets grow thicker and more integrated.

## 5.6 Aztec Money

Weatherford's *The History of Money* provides some stylized facts about the early money of Aztec culture. One commodity used for money was the cacao seed, also called beans. Pods from the cacao tree bore seeds which, after preservation, could last for months. These seeds were eventually ground up and consumed as part of a chocolate drink [104, p. 18-19]. In the mean time, preserved cacao seeds were used as a medium of exchange. Weatherford reports cacao was used to purchase “fruits and vegetables such as corn, tomatoes, chilies, squash, chayotes, and peanuts; jewelry made of gold, silver, jade, and turquoise; manufactured goods such as sandals, clothing, feathered capes, cotton padded armor, weapons, pottery, and baskets; meats such as fish, venison, duck; and specialty goods such as alcohol and slaves” [104, p. 17-18]. Despite the variety of goods for which cacao was accepted in exchange, there were a couple quirks to their usage. Firstly, the cacao was used as small change in barter agreements with indivisible goods. Secondly, the marketplace was a specially designated

area monitored by government officials. In these marketplaces, prices were regulated and enforced by the threat of death for serious offenses. A final note of interest regarding cacao as money: it was counterfeited. The seeds could be shelled, essentially, and then filled with mud. These counterfeit seeds would be mixed with genuine cacao in sales.

In what follows I provide a model to try to match some stylized facts from the history of Aztec cacao money:

1. there was an essentially “free-minting” policy regarding the creation of new cacao money; if you were willing to pay the physical cost to preserve more cacao, you could literally make money;
2. preserved cacao depreciated after a few months, at which point it was consumed;
3. prices in the centralized market were regulated by the government.

Aspects that are interesting but I will not attempt to capture with this model include:

- cacao used as small change in a world of indivisible goods dominated by barter exchange;
- counterfeiting.

The framework is essentially the same as the benchmark provided above, with some important differences. Agents may choose to preserve new cacao at a convex cost  $\pi(\cdot)$  in the CM. Agents may choose to consume cacao for linear utility  $\kappa$ . Cacao depreciates and is only good for consumption, not as a medium of exchange, at rate  $\delta$ . Let  $\mu$  denote the newly preserved cacao in a period, let  $c$  denote the amount of cacao chosen by an agent to be consumed in a period over and above the  $\delta$  proportion of holdings that must be consumed due to depreciation. As usual,  $\gamma$  represents the gross growth rate of money, but this is not directly

controlled by the government, as there are no barriers to the production of new cacao for agents. Instead, the government may control  $\phi$ , the CM-good price of cacao.

Buyers in the CM enter with an amount of cacao,  $m$ , and choose how much CM good to produce or consume,  $x$ , how much of their cacao holdings to consume,  $c$ , how much new cacao to produce,  $\mu$ , and how much to accumulate to take to the next DM,  $m'$ .

$$W^b(m) = \max_{x,c,\mu,m'} [x + \kappa(\delta m + c) - \pi(\mu) + \beta V^b(m')] \quad (5.55)$$

$$\text{s.t. } x + \phi m' = (1 - \delta)m\phi + [\mu - c]\phi. \quad (5.56)$$

This can be consolidated:

$$W^b(m) = [(1 - \delta)\phi + \kappa\delta]m + \max_c [-\phi c + \kappa c] + \max_\mu [\phi\mu - \pi(\mu)] \\ + \max_{m'} [-\phi m' + \beta V^b(m')].$$

The amount of newly created cacao each period,  $\mu$ , is determined by the CM-good price of cacao,  $\phi$ , and the cost of preserving cacao,  $\pi(\cdot)$ . The amount consumed,  $c$  is determined by the CM-good price of cacao, the utility of consumption, and how much the agent is already consuming due to depreciation. The gross growth rate of money,  $\gamma$ , which is taken as given by each agent, is the ratio of the sum of the undepreciated cacao,  $(1 - \delta)m$ , and the newly preserved cacao,  $\mu$ , less the consumed cacao,  $c$ , to the previous amount of cacao,  $m$ . It is worth noting that if  $\phi < \kappa$  agents will demand unbounded amounts of cacao for pure consumption. Cacao as a currency would disappear. If  $\phi > \kappa$  then  $c^* = 0$  and the only cacao consumed will be due to depreciation. From here on out it will be assumed  $\phi > \kappa$ . As in the benchmark model,  $W^b(m)$  is linear in  $m$  and the choice of  $m'$  is independent of  $m$ .

The buyer's value function in the DM is

$$V^b(m) = \sigma\{u(q) - [(1 - \delta)\phi + \delta\kappa]d\} + W^b(m).$$

Proportional bargaining within a match yields

$$d = \frac{z(q)}{(1 - \delta)\phi + \delta\kappa}. \quad (5.57)$$

Backwards induction and the first order condition yields a condition that determines how buyers choose cacao money holdings:

$$(i + \delta)\left[\phi - \kappa \frac{\delta}{i + \delta}\right] = \sigma\theta\mathcal{L}(q)[(1 - \delta)\phi + \delta\kappa].$$

The gross growth rate of money is

$$\gamma = \frac{(1 - \delta)m + 2\mu}{m},$$

where the 2 arises from the fact both buyers and sellers will preserve more cacao to use as money in the CM. The nominal interest rate,  $i$ , equals  $(\gamma - \beta)/\beta$ . The decision to create new money is determined by the first-order condition,  $\phi = \pi'(\mu)$ .

Returning to the facts I sought to match, “free-minting” is achieved through the unregulated creation of new money. Every agent has access to money-creating technology  $\pi(\mu)$ . The depreciation rate  $\delta$  achieves the consumption of cacao after a certain period. Finally, the first-order condition,  $\phi = \pi'(\mu)$  demonstrates that  $\mu$ , the amount of new cacao money an individual finds optimal to produce, is controlled through the government's control of the prices,  $\phi$ . From the expression for the gross growth rate of money, it is clear the control of  $\mu$  gives the government control over  $\gamma$ .



## 5.7 Conclusion

In my model of convertible money, the seigniorage-maximizing sovereign increases the costliness of redemption as agents are more patient and markets are thicker, so over time it becomes more and more difficult to convert money. This matches the long-run trends of convertible money becoming more and more fiat. In my oligarchical model of the sovereign, the oligarchy has to trade-off seigniorage and future gains from trade. Whereas the benchmark sovereign does not have incentive to create the socially optimal amount of money for the economy — because in this case, there is no seigniorage to be gained — as the oligarchy becomes more and more representative, the short-term benefit of seigniorage becomes less and less a priority. At full representation, the oligarchy chooses the socially optimal amount of money. In my model of two currencies I find the sovereign only cares about the total amount of commodity in the money supply as a whole. In my model of the village and the faire, I found the endogenous credit limit decreases as the probability of trading within your village decreases, thus illustrating a transition from credit to money. Finally, in my model of the Aztec economy, I show that the Aztec government can control the growth rate of money through price controls despite a “free-minting” regime.

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# Appendix A

## Proofs

*Proof of Lemma 4.1.* First, it is important to note that

$$0 \leq c(q) \leq \theta c(q) + (1 - \theta)u(q) \leq u(q) \quad \forall q \in [0, q^*] \quad (\text{A.1})$$

$$0 \leq c'(q) \leq \theta c'(q) + (1 - \theta)u'(q) \leq u'(q) \quad \forall q \in [0, q^*] \quad (\text{A.2})$$

$$u''(q) \leq \theta c''(q) + (1 - \theta)u''(q) \leq c''(q) \quad \forall q \in [0, q^*]. \quad (\text{A.3})$$

For  $q \in [0, q^*]$ , by Assumption 4.1,

$$\begin{aligned} u'''(q) - c'''(q) &< \frac{2c''(q)[u''(q)c'(q) - c''(q)u'(q)]}{[c'(q)]^3} \\ \implies u'''(q)c'(q) - c'''(q)c'(q) &< \frac{2c''(q)[u''(q)c'(q) - c''(q)u'(q)]}{[c'(q)]^2} \\ \implies u'''(q)c'(q) - c'''(q)u'(q) &< \frac{2c''(q)[u''(q)c'(q) - c''(q)u'(q)]}{[c'(q)]^2} \\ \implies [u'''(q)c'(q) - c'''(q)u'(q)][c'(q)]^2 - 2c''(q)[u''(q)c'(q) - c''(q)u'(q)] &< 0 \\ \implies \frac{[u'''(q)c'(q) - c'''(q)u'(q)][c'(q)]^2}{[\theta c'(q) + (1 - \theta)u'(q)]^4} - \frac{2c''(q)[u''(q)c'(q) - c''(q)u'(q)]}{[\theta c'(q) + (1 - \theta)u'(q)]^4} &< 0 \\ \implies \mathcal{L}''(q) &< 0. \end{aligned}$$

The third line follows from  $c'''(q) > 0$  for all  $q \in [0, q^*]$ . This line implies  $u'''(q)c'(q) - c'''(q)u'(q) < 0$ . The final line follows from (A.1)-(A.3), the signs of the expressions, and the second derivative of  $\mathcal{L}(q)$ . As  $\mathcal{L}(q)$  is twice continuously differentiable and its second derivative is negative for all  $q \in [0, q^*]$ , then by Theorem M.C.2 from Mas-Colell, Whinston, and Green (1995),  $\mathcal{L}(q)$  is concave [48].  $\square$

*Proof of Lemma 4.2.* Note that  $c''(q)[u'(q) - c'(q)]/u(q) \geq 0$  for  $q \in [0, q^*]$ . Therefore,

$$u'''(q) - c'''(q) < 2c''(q) \frac{u''(q)c'(q) - c''(q)u'(q)}{[c'(q)]^3} - c''(q)[u'(q)]^4 \frac{u'(q) - c'(q)}{c(q)[c'(q)]^4} \leq 2c''(q) \frac{u''(q)c'(q) - c''(q)u'(q)}{[c'(q)]^3}.$$

$\square$

*Proof of Lemma 4.3.*

$$\begin{aligned} u'''(q) - c'''(q) &< 2c''(q) \frac{u''(q)c'(q) - c''(q)u'(q)}{[c'(q)]^3} - c''(q)[u'(q)]^4 \frac{u'(q) - c'(q)}{c(q)[c'(q)]^4} \\ \implies u'''(q)c'(q) - c'''(q)u'(q) &< 2c''(q) \frac{u''(q)c'(q) - c''(q)u'(q)}{[c'(q)]^2} - c''(q)[u'(q)]^4 \frac{u'(q) - c'(q)}{[\theta c(q) + (1 - \theta)u(q)][c'(q)]^3} \\ \implies u'''(q)c'(q) - c'''(q)u'(q) &< 2c''(q) \frac{u''(q)c'(q) - c''(q)u'(q)}{[c'(q)]^2} - c''(q)[u'(q)]^4 \frac{u'(q) - c'(q)}{[\theta c(q) + (1 - \theta)u(q)][c'(q)]^3} - \frac{2[u'(q)]^3[u''(q)c'(q) - c''(q)u'(q)]}{[\theta c(q) + (1 - \theta)u(q)][c'(q)]^2} \end{aligned}$$

$$\begin{aligned}
&\implies [u'''(q)c'(q) - c'''(q)u'(q)] \frac{[c'(q)]^2[\theta c(q) + (1 - \theta)u(q)]}{[u'(q)]^4} < \\
&\quad 2c''(q)[\theta c(q) + (1 - \theta)u(q)] \frac{u''(q)c'(q) - c''(q)u'(q)}{[u'(q)]^4} - \\
&\quad c''(q) \frac{u'(q) - c'(q)}{c'(q)} - \frac{2[u''(q)c'(q) - c''(q)u'(q)]}{u'(q)} \\
&\implies c''(q) \frac{u'(q) - c'(q)}{c'(q)} + \frac{2[u''(q)c'(q) - c''(q)u'(q)]}{u'(q)} + \\
&\quad [\theta c(q) + (1 - \theta)u(q)] \frac{[u'''(q)c'(q) - c'''(q)u'(q)][c'(q)]^2 - 2c''(q)[u''(q)c'(q) - c''(q)u'(q)]}{[u'(q)]^4} \\
&\quad < 0 \\
&\implies \frac{d^2}{dq^2}[z(q)\mathcal{L}(q)] < 0.
\end{aligned}$$

The second line follows using the same reasoning as in the proof of Lemma 4.1. The third line is true because it is adding a positive term (subtracting a negative) to the right-hand side. Note that in the penultimate step, the last expression on the left-hand side is negative. The final line follows from (A.1)-(A.3) and the fact the second derivative of  $z(q)\mathcal{L}(q)$  is less than or equal to the left-hand side of the previous line. As  $z(q)\mathcal{L}(q)$  is twice continuously differentiable and its second derivative is negative for all  $q \in [0, q^*]$ , then by Theorem M.C.2 from Mas-Colell, Whinston, and Green (1995),  $z(q)\mathcal{L}(q)$  is concave [48].  $\square$

*Proof of Proposition 4.4.* (i) Taking the corner solution to the buyer's choice of assets, (4.12), and setting  $d = 0$  gives  $-r + \sigma\theta/(1 - \theta) < 0$ . Therefore,  $-r + \sigma\theta/(1 - \theta) \geq 0$  is the region where the corner solution is not attained.

(ii) For any  $\theta < 1$  and  $\sigma \in [0, 1]$ , there exists an  $r > \sigma\theta/(1 - \theta)$ . From (i), this implies fiat is infeasible. As  $r \rightarrow \infty$ , fiat is infeasible for all  $(\sigma, \theta) \in [0, 1] \times [0, 1)$ .

(iii) If  $r = 0$ , given that  $\sigma \in [0, 1]$  and  $\theta \in [0, 1]$ ,  $\sigma\theta/(1 - \theta) \geq 0$  for all  $(\sigma, \theta)$  pairs. From (i) this implies fiat is feasible for all  $(\sigma, \theta)$  pairs.

□

*Proof.* Proof of Proposition 4.6

- (i) Note that the sovereign's problem does not change when  $r$  increases. This implies the sovereign will choose  $(\phi, \kappa, A)$  such that the same  $q$  is chosen by buyers. To simplify matters,  $A$  is normalized to 1. Note that the demand for assets can be rewritten as  $\phi = z(q)/A - \kappa$ . Also note that the pricing equation can be rewritten as  $\phi = \kappa\{(1+r)/[r - \sigma\theta\mathcal{L}(q)] - 1\}$ . In equilibrium,  $z(q)/A$ , when  $A$  is normalized, will not change. This implies  $\kappa\{(1+r)/[r - \sigma\theta\mathcal{L}(q)]\}$  must not change. When  $r$  increases,  $(1+r)/[r - \sigma\theta\mathcal{L}(q)]$  decreases. Therefore,  $\kappa$  must increase. This also implies  $\phi$  decreases.
- (ii) The proof is similar to (i). The sovereign's problem does not change when  $\sigma$  increases, so the sovereign will choose  $(\phi, \kappa)$  such that the same  $q$  is chosen by buyers. Combining the pricing equation and the demand for assets implies  $\kappa$  must decrease, since  $(1+r)/[r - \sigma\theta\mathcal{L}(q)]$  increases. This further implies  $\phi$  increases.

□

*Proof.* Proof of Proposition 5.2 Note that  $q \in [0, q^*] \subset \mathbb{R}$  and  $\alpha \in [0, 1] \subset \mathbb{R}$ . Define  $f(q, \alpha) = (1 - \alpha)z(q)\mathcal{L}(q) + \alpha[u(q) - c(q)]$ . Note that

$$\frac{\partial^2}{\partial q \partial \alpha} f(q, \alpha) = -z(q)\mathcal{L}'(q) \geq 0.$$

This implies  $f(q, \alpha)$  has increasing differences in  $(q, \alpha)$ . Then, by Corollary 2.6.1 from Topkis (1998),  $f(q, \alpha)$  is supermodular [99]. These results satisfy the conditions for Theorem 2.8.1 from Topkis (1998) [99]. Therefore,  $\arg \max_{q \in [0, q^*], \alpha \in [0, 1]} f(q, \alpha)$  is increasing in  $\alpha$  over  $\alpha \in [0, 1]$ .

Following similar reasoning as in the proof of Proposition 4.6, the demand for assets can be written as  $\phi = z(q)/A - \kappa$ . The assets,  $A$  are normalized to one. From the pricing equation,  $\phi = \kappa\{(1+r)/[r - \sigma\theta\mathcal{L}(q)] - 1\}$ . As  $\alpha$  increases, equilibrium  $q$  increases. This implies  $\kappa(1+r)/[r - \sigma\theta\mathcal{L}(q)]$  must increase. As  $q$  increases,  $\mathcal{L}(q)$  decreases, therefore for the entire expression to increase,  $\kappa$  must increase. □