THREE ESSAYS ON INFLATIONARY MONETARY POLICY AND POLITICAL ECONOMY

by

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A Dissertation
Submitted to the
Graduate Faculty
of
George Mason University
In Partial fulfillment of
The Requirements for the Degree
of
Doctor of Philosophy
Economics

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Date: _____ Spring Semester 2020
George Mason University
Fairfax, VA

Three Essays on Inflationary Monetary Policy and Political Economy

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Dedication

To my father - I miss you everyday and still strive to make you proud.

Acknowledgments

My father used to remind me that I am "standing on the shoulders of giants." There are indeed so many shoulders upon whom I stand. Were I to name them all and mention their contribution, this dissertation would turn into a footnote. Still, I would like to acknowledge those who bear my weight most directly.

George Mason University was an enriching place in which to learn. I want to thank all of my committee members, each of whom left his indelible mark on me. Donald Boudreaux inspired me to pursue a PhD in economics, Alex Tabarrok pushed me to be a scholar, and Carlos Ramirez mentored my field of study. I also want to thank Peter Boettke who instilled in me a love of teaching economics and Russ Roberts who, despite only meeting three times, inspired me from afar. I certainly owe a debt to Mary Jackson, who steered me through the graduate school process. As part of that process, I want to thank the Mercatus Fellowship Program for their generous financial and intellectual support. Finally, there are numerous peers who lifted me up through my years at GMU. I owe a special thanks to Bryan Cutsinger, who has simultaneously been a friend, mentor, co-author, peer, and teacher. Bryan was also a member of my study group, or "Island of Misfit Toys", which included Slade Mendenhall, Linan Peng, Ennio Piano, Bob Hazel, Patricia Saenz-Armstrong, and Garrett Wood. We spent many late nights exchanging ideas, our shared love of learning, and our dreams. Thank you all for the help, confusion, clarity, and friendship. Kudos to would-be members of the study group, Louis Rouanet and Henry Thompson, excluded only on account of being in later cohorts.

I would like to thank my family and friends for their continued support. Particularly, I want to thank my mother, Beth Ingber, and in-laws, Frank and Cheryl Stearn, who have believed in me and offered immeasurable support. I am truly blessed. Most of all, I owe a huge debt of gratitude to my wife, Christine. She helped me figure out my three passions: loving her, being a father, and learning. She has shaped me into a better person. During this challenge she continued to nourish me with love, prodded me on, and delivered two beautiful children. I owe her everything.

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Abstract

THREE ESSAYS ON INFLATIONARY MONETARY POLICY AND POLITICAL ECONOMY

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George Mason University, 2020

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My dissertation studies inflationary monetary policy, with consideration of the relevant political and institutional frameworks. All three essays connect seigniorage, the revenue from currency creation, with the underlying policy stakeholders and monetary institutions. This work demonstrates the importance of endogenizing the influence of political factors when analyzing economic policy outcomes.

Chapter 1 asks the question, is seigniorage-optimizing policy in fact linked with welfare enhancing or self-defeating outcomes? The chapter considers empirical evidence in answering the question, suggesting that, on average, seigniorage optimization is self defeating – leading to decreases in real Gross Domestic Product. In addition, the chapter includes a history of seigniorage, a summary seigniorage measurement, optimal seigniorage theories, and a survey of the political factors which lead to an inflationary monetary policy.

I follow in Chapter 2 with an in-depth empirical examination of confederate monetary policy during the Civil War. Confederate attempts at monetary reform reveal a policy inconsistent with seigniorage maximization, and that it was the bifurcation of the Confederate Congress into two groups – those representing areas outside of Confederate control and those representing the rebel government's interior – that instantiated the sub-optimal policy.

The final chapter describes the natural experiment that is the hyperinflation during the end of the French Revolution. Analyzing Structural breaks in the cointegrating relationship between real money balances and the changes in inflation rates suggests that constitutional changes should be considered among the the determinants of the demand curve for real money balances. Thus, this chapter considers the role that rules governing the creation of money play, in influencing the public's demand for money and the maximum effectiveness of inflationary finance.

Chapter 1: Is Seigniorage Optimal?

1.1 Introduction

Does seigniorage (the revenue derived from money creation), buttress or undermine long-run economic development? Economic principles and academic literature articulate the association between seigniorage and inflation, inelastic money demand, market power in the issuance of currency, a lack of financing alternatives, and sub-optimal monetary institutions. This correlation suggests that, at the very least, seigniorage offers a costly means of finance. Why then would regimes choose a "second-best", or "fifth-best", option for financing? That same body of research readily suggests seigniorage becomes a prominent means of finance when other options are exhausted or unavailable. For example, Cukierman et al. (1992), conjectures that economies with weaker institutions might be unable to build efficient and enforceable tax systems, leading them to use seigniorage.

Despite the long tradition of seigniorage research, which can predominantly be divided into three strains –estimating seigniorage, describing the political economy of a seigniorage regime, or modeling seigniorage optimums– there is surprisingly little research on the relationship between seigniorage and economic growth. In short, does the use of seigniorage, even if it is the only financing option left, lead to a more robust economy?

This chapter offers two contributions to the body of seigniorage research. The first contribution is that it offers a preliminary answer by examining seigniorage policy as a predictor of economic outcomes. That is, this paper is concerned with policy outcomes: is seigniorage a step which leads to improved economic performance, or does seigniorage continue to produce the symptoms for which it is intended to cure?

The answer to this question not only pushes the boundaries of economics ever-outward in the pursuit of greater knowledge, but it also has important implications for the role

of economist *qua* advisor, who at various moments in history have been in support and against inflationary finance. "[T]he economists are at this moment called upon to say how to extricate the free world from the serious threat of accelerating inflation which, it must be admitted, has been brought about by policies which the majority of economists recommended and even urged governments to pursue" (Hayek, 1989).

In order to answer this question, I synthesize the three traditions in the seigniorage literature. Authors Click (1998) and Honohan (1996), for example, consider how seigniorage is measured. Authors Cagan (1956), Bailey (1956) and Mankiw (1987) examine seigniorage as a policy instrument with diminishing and potentially negative returns.[1] Such work is highly instrumental as it attempts to find the maximum amount of revenue can a government raise in a given period via seigniorage. Yet other scholars such as Cukierman et al. (1992), Fischer (1982), or Aisen & Veiga (2008) explain the political economy factors surrounding seigniorage. These studies consider how political factors constrain common means of finance (such as taxation) such that seigniorage becomes a viable financing alternative.

My study examines the relationship between seigniorage and growth by constructing a proximity variable between the actual flow of seigniorage and estimates of the theoretically derived optimal flow. One might consider this a measurement of the gap between the theoretically conceivable revenue-maximizing rate and empirically measurable rate. I combine this new metric with an economic and political panel data set of 51 different countries over a 55 year period in order to determine the relevance of this proximity variable as a predictor of economic growth.

My results suggest that, on average and *ceteris paribus*, increasing the gap between actual seigniorage revenue and a theoretically derived seigniorage optimum is associated with increases in real Gross Domestic Product (GDP).[2] That is, increased reliance on seigniorage does not appear to be a predictor of growth. While increased reliance on seigniorage is

[1] That is, seigniorage is concave with respect to money growth, $f''s < 0$.

[2] It should be noted that the use of real GDP is an incomplete measure of economic growth. Indicators such as consumption, income, purchasing power, Gross National Product, foreign investment and others, offer a better picture together. However, international data is inconsistent on such measures, making a cross-country comparison difficult. Thus, productivity is the indicator herein used to describe economic growth.

often the result of the inability to finance the government by other means, it is evidently a costly instrument. Using seigniorage to maintain economic economic growth is like using pain relievers to fix a broken leg: the prescription addresses the symptoms at the expense of resolving the root cause. Not only is the prescribed solution unlikely to resolve the root cause, but it is likely to have long lasting and costly consequences (such as drug addiction). A monetary policy which seeks to optimize seigniorage, as a means for finance, results in costly decreases in productivity.

The second contribution this chapter makes is that it includes a history of economic thought argument. Histories of seigniorage policy abound in the literature, but they generally fall into two camps: they are either presented in the contexts of estimating/modelling seigniorage, or they are part of accounts of the history of money. This contribution builds on that latter tradition, where seigniorage is a function of the type of currency issued and monopoly power in currency production, constrained by its costs to produce. Costs are typically described in terms of minting coinage in commodity currencies and inflation in fiat regimes.[3] This chapter argues that poor economic growth is a political constraint or cost on seigniorage as well.

The chapter is structured as follows: a history of thought section, relating to seigniorage, is presented in Section 1.2. Section 1.3 describes the theory and empiricism used to estimate and optimize seigniorage. The dataset and models, used to understand the ultimate effects of seigniorage, are described in Section 1.4. Section 1.5 presents the empirical results, and Section 1.6 concludes the chapter.

1.2 A Background on Inflationary Finance

1.2.1 Seigniorage in Economic Thought

Recognizing seigniorage as a product of the type of money exchanged and industrial organization in the currency market, allows for an understanding of the benefits and costs

[3] According to Reich (2017, 26), credit currencies are seldom discussed compared to the "analyses of seigniorage in commodity or fiat currency regimes".

facing an inflationary regime. Authors such as L. H. White (1999) and Reich (2017) explain seigniorage as an outgrowth of the type of currency in circulation and the organization of money supply, bounded by the costs of production and the limits of inflation expectations. However, seigniorage policy is constrained by political costs as well. Authors such as Aisen & Veiga (2005), Cutsinger & Ingber (2019), and Cukierman et al. (1992), in a public choice vein, describe some of those costs.

This study ultimately suggests that modern seigniorage is bounded by the political fallout from a decline in economic growth. Seigniorage policy requires some grasp of its history and relationship with money. As Brunner & Meltzer (1971) notes, money's vast social productivity arises from the its role in reducing transaction and information costs by serving as a standardized medium of exchange. Such benefits, as with any other good or service, are not provided at zero cost. At the very least, revenue received from producing and maintaining a money stock covers its production costs and, depending on competition in the market for currency, profit for its producers.

Carl Menger, in his *On the Origin of Money* (Menger, 1892), offers one of the earliest theories of money. Menger frames money as an emergent market phenomenon, the result of overcoming the costs associated with a 'coincidence of wants' and the recognition that commodities differ in 'saleable' quality, leading to their import as a medium of exchange. That is, goods converge into a medium of exchange when they are widely available and the costs of buying, holding, transporting, and reselling the good is relatively small.

While tracing its emergence and utility, Menger also argues that the rise of money closely coincides with control thereof by a sovereign power: "The fixing of a coinage so as to include all grades of value (*Wertstufen*), and the establishment and maintenance of coined pieces so as to win public confidence and, as far as possible, to forestall risk concerning their genuineness, weight, and fineness, and above all the ensuring their circulation in general, have been everywhere recognised as important functions of state administration"1892. Early scholars of money evidently recognized state manipulation of currency as an important factor worthy of further study and Menger's conception laid the foundation for later work

on seigniorage as a method of state finance.[4] Selgin & White, for example, suggest (Selgin & White, 1999) that governments generally unnecessarily monopolized the coinage industry: "There are ample signs that governments have wanted to exercise monopoly over money production so as to reap the monopoly profits known as *seigniorage*."

Thus, seigniorage, as a practice, emerged alongside the institution of commodity money as a medium of exchange. That is, once a particular specie becomes a common good, whether brought to the market by a government or by catallaxy, the payoff to verifying its value rises since users cannot always easily distinguish real currency from fake. Therefore, independent third-parties or governments satisfy this demand for quality by creating (costly) uniform standards (such as stamping the specie or stipulating a standard weight and metal content) and verification procedures in order to preserve the exchangeability of a particular specie. That said, those organizations which supply "verification" of specie can themselves profit by devaluing said specie. This is seigniorage. It is evident that Menger's theory of money, the emergence of a common good that facilitates trade by lowering transaction costs, is fundamental to understanding seigniorage, wherein its provision is not an economically free good.

L. H. White (1999) argues that, despite having monopoly power, central monetary authorities face costs to maintain a commodity-backed currency, and that, once paper is widely circulated[5], the next natural step in the evolution of money is the rise of a fiat currency: "In historical practice, a nation's switch to fiat money was typically made by central government first granting legal monopoly of note-issue to a single institution, a central bank, whose liabilities became as widely accepted as specie, and displaced specie as

[4]Note that the close relationship between money and the state is not a theoretical one as L. H. White (1999) shows: "Mints arose spontaneously, then, to meet the demand for authentication services. With the development of coinage, the marketability of coined metal became discontinuously greater that that of uncoined metal."

[5]L. H. White (1999) explains how a specie money facilitates the emergence of the fundamental monetary institution, banks. It is from these institutions that commodity-backed paper currency, in the form of commercial bank notes, emerges and circulates. First, banking evolved because it economizes the transaction costs associated with the protection and storage of specie. Second, when backed by specie stored in the vault of a bank, bank issued notes naturally emerge because the costs of transporting large sums is cheaper than that of coinage. Moreover, relative to coins, paper money meets Menger's conditions for a saleable good: it is widely available, cheap to produce, and easily held.

the reserves for other banks. The government then suspended, permanently, the redemption of the central bank's liabilities. With there permanent suspension, central bank notes and deposits became fiat currency" (p 19).

To be clear, the concept of seigniorage extends to both commodity-backed and fiat paper currencies. The opportunity to charge a minting fee or debase a currency in circulation, is only nominally different from describing seigniorage as the profit derived from the production of new money. Thus, according to Keynes (1923), the capacity to profit from seigniorage persists regardless of the type of currency. That said, its revenue-raising effectiveness is greatest when issuers have market power in the production of that currency. This latter point, that seigniorage can only be utilized when currency producers have market power and therefore face an inelastic demand curve, is made by Phelps (1973).

Incidentally, the term seigniorage, also spelled 'seignorage' or 'seigneurage', was an amalgamation of two French words, dating back to the commodity money of the middle ages. The *seigneur* was the lord or representative of the crown, with the power to mint money. Those with precious metal could take it to such an empowered body, and, for a fee called *brassage*, have a coin stamped. Here, seigniorage was earned as the difference between the face value of a coin and its costs of production, plus mintage fee. Or, as the remaining high value metal after debasing the coin. Debasement took the form of changes in either the weight, the fineness, the alloy, or the mint ratios of high and low value metal.

That the term is etymologically French comports with France's excessive use of seigniorage during the middle ages. More importantly, this particular example in monetary history coincides with political economy factors that occur in other seigniorage regimes. According to Bordo (1986) and Wolfe (1972), three pressures underpinned the French propensity to print: first, the exigencies of war in the 14^{th} and 15^{th} centuries incentivized sovereigns to find non-traditional revenue-raising methods; second, for the first time the Crown controlled a centralized monetary authority; and third, other sources of fiscal revenue (borrowing or taxation) were prohibitively costly to use at the time. Such factors reveal that, even in

its earliest incarnations, seigniorage was not limited to a 'minting fee'. The ability of government to spend debased specie (newly printed and less valuable currency) allows the government to finance its expenditures beyond traditional means. It follows, then, that this tool creates incentives for political agents not constitutionally constrained to abuse their authority, suggesting that a seigniorage policy cannot be divorced from its underlying institutional structure. Moreover, circulating less valuable money that can be exchanged with existing higher-valued money dilutes the value of existing money through the market process; simultaneously raising prices and lowering purchasing power.

The dilution of money principally effects people that hold money. Thus, seigniorage is implicitly a tax on money holders.Seigniorage is often discussed and analyzed in terms of an "inflation tax," a term that was coined by (Friedman, 1953). In Friedman terms, a nation's monetary authority can increase monetary seigniorage by increasing the supply of base money relative to its demand: "Because the resulting rising price level reduces the real value of the public's base money holdings, the public will demand more nominal base money balances to make up for the price-level-induced decline in its real cash balances. As a result, the price rise produces an increase in monetary seigniorage" (Click, 1998).

It follows that governments choose some mixture of taxation, debt, and seigniorage revenue to finance their expenditures. Chelliah et al. (1975), suggests that the countries' ability to tax is a 'technologically' constrained by their stage of development and by the structure of their economies (e.g. size of the agricultural sector in GDP). When tax collecting costs are high and tax evasion pervasive, countries might use seigniorage more frequently. Thus, governments, either by strategy or constraint, choose the level of seigniorage revenue according to some optimization problem.

This "Theory of Optimal Taxation"[6] suggests that governments, when choosing the optimal combination of taxes to finance their expenditures, equate the marginal cost of the seigniorage tax with that of output taxes, minimizing the welfare loss to an economy. Thus, it is only optimal for governments to rely on seigniorage if other taxes are highly

[6]see Phelps (1973), Végh (1995), and Aizenman (1992).

distortionary.

Click (1998) estimates a model using 90 countries, from 1971–90, and finds that only 40% of the cross-country variation in seigniorage can be explained with the Theory of Optimal Taxation. Edwards & Tabellini (1991) and Cukierman et al. (1992) similarly show that developing countries do not raise revenue according to optimal theory. In other words, countries that theoretically "ought" to use seigniorage more often refrain from doing so. The failure of this theory to explain much of the cross-country differences suggests that "something else matters," namely, that political bodies and institutions need to be endogenized.[7]

Is it possible that economic performance is among the reasons why seigniorage is not maximized? The connection between economic performance and political markets is a well established literature. Bernhard et al. (2001), Niemi et al. (1995), and Brender (2003) are just a few that show economic performance has an effect on election results. If seigniorage has a detrimental effect on economic performance, as will be shown in the empirical section, it stands to reason that seigniorage is bound by the incentives of political actors. In other words, an implication of the empirical work that follows suggests that political actors made be held accountable for maximizing seigniorage. However, in order to understand that possibility, some detail as to seigniorage estimation and modelling must follow.

1.3 Estimating and Optimizing Seigniorage

According to Neumann (1992), several methods have been developed for estimating seigniorage. The first, *Monetary Seigniorage* is defined by the net changed in base money, where the costs of money production and maintenance are zero. In other words, because the marginal cost of issuing new paper currency is ostensibly zero, any new money creation that allows

[7] A body of literature on endogenizing political constraints on seigniorage is budding. Cutsinger & Ingber (2019) look at the regional incentives that political agents faced among the Confederate States, during the U.S. Civil War, as a reason for sub-optimal seigniorage policy. Cukierman et al. (1992) develop a theoretical model whereby political instability and ideological polarization determine the equilibrium efficiency of the tax system and the resulting combination of tax revenues and seigniorage that governments use.

the government to enter the market is revenue. Second, *Opportunity Cost Seigniorage* explicitly accounts for the opportunity costs of money holders. That is, since money holders bear the costs associated with the dilution of their purchasing power under an inflationary regime, seigniorage is equal to the potential alternative, i.e. the value of their holdings had they experienced no dilution.

Monetary seigniorage is defined as the net change in base money outstanding, deflated by the consumer price level. Monetary seigniorage measures the transaction value of non-monetary assets that the central bank receives from the public in exchange for an increase in the monetary base. Because the data necessary to calculate this measure are easily available, the concept of monetary seigniorage has been widely used and measured by monetary economists.[8] Monetary seigniorage is described by the following equation, where ΔM denotes the growth in base money holdings, and P is the consumer price level:

$$S = \frac{\Delta M}{P} \tag{1.1}$$

Opportunity Cost Seigniorage is defined by the total opportunity costs of money holders. Considering that the revenue from seigniorage, by definition, represents a tax on money holders, seigniorage can be calculated as the additional real income individuals would have earned, had they held interest earning assets instead of non-interest-earning money. In other words, the revenue of the government is equal to the foregone income of money holders. Several studies have used this approach to measure seigniorage.[9] In this case, seigniorage is represented as follows, where M denotes total base money holdings, r is the representative nominal rate of return on assets other than base money, and P is the consumer price level:

$$S = \frac{rM}{P} \tag{1.2}$$

The typical models of seigniorage maximization require the government to choose a path

[8]See Friedman (1971b), Calvo (1978), Fischer (1982), Dornbusch (1988), and Grilli (1989)
[9]See Bailey (1956), Johnson (1969), Auernheimer (1974) and Barro (1972)

of revenue finance according to some set of exogenously determined stochastic expenditure requirements. In the money literature, seigniorage optimization has often followed two traditions. The first, associated with Cagan (1956) and Bailey (1956),[10] considers a demand function for money, given monopoly power in the production of currency, where the revenue of seigniorage is maximized when the growth in the money stock is multiplied by the price of currency when demand is unit-elastic. The second, as pioneered by Mankiw (1987), considers the opportunity costs of money holders, as the optimizing constraint.

The *Bailey-Cagan* approach begins with a simple money demand function, seen in equation (1.3).

$$(\frac{M}{P})^d = e^{-\alpha g_M - \gamma} \tag{1.3}$$

Where the independent variable is real money demand, and the exponent on the exponential function is negative, suggesting a downward sloping and diminishing demand curve. This ensures an increasingly expensive trade-off between the money stock and inflation increasingly expensive.[11] Reducing the equation into regression form, by taking logs and interpreting the change in the growth of money as the expected change in prices, we get the following equation:[12]

[10]This approach is so named because Martin Bailey (1956) and Philip Cagan (1956) were the first to apply this type of analysis to episodes of hyperinflation.

[11]Under our assumptions, $-\alpha$ is the semi-elasticity of the money demand function with respect to the growth rate of the money stock, and γ is a scale parameter - the smaller γ becomes the greater is real money demand for any given growth rate of the money stock. Notice that γ includes traditional determinants of demand, a stylized assumption of the model. This is common when studying episodes of severe inflation to ignore movements in real variables - such as income or the real rate of interest - because movements in the price level and money stock swamp the movements of real variables. Given this, and assuming that the Fisher effect holds in each period, this function can be rewritten as:

$$m_t - p_t = (\alpha_0 + \alpha_1 y + \alpha_2 r) + \alpha_2 \Delta p^e_{t+1}$$

where r denotes the real interest rate. Letting $\gamma = (\alpha_0 + \alpha_1 y + \alpha_2 r)$, and $\alpha_2 = \alpha$, the relationship between equation (1.3) and the more common sort of money demand function considered here:

$$m_t - p_t = \alpha_0 + \alpha_1 y_t + \alpha_2 R_t + u_t$$

where y_t denotes the log of income and R_t the nominal interest rate, is now evident.

[12]Here, m_t and p_t denote the logs of the money stock and the price level, respectively; Δp^e_{t+1} reflects the public's expectations of the inflation rate between the current period and the subsequent one; u_t denotes "white noise" disturbances to the demand for real money balances, i.e., $u_t \backsim N(0, \sigma^2_u)$; and α and γ are the

$$m_t - p_t = \gamma + \alpha \Delta p^e_{t+1} + u_t, \quad \alpha < 0 \tag{1.4}$$

Assuming the public forms its inflation expectation as a function of the time profile of money stock and the monetary authority's future behavior, the *Bailey-Cagan* demand function defines the relationship between the money stock and the price level. An inverse demand function can be translated into revenue, associated with an inverse parabolic function. That is, if seigniorage is defined according to the monetary seigniorage tradition in equation (1.1) then we can derive the following, where equation (1.1) is interposed into equation (1.3):[13]

$$S = e^{-\alpha(\Delta M/M)-\gamma} * \Delta M \tag{1.5}$$

Thus, the *Bailey-Cagan* tradition allows for the estimation of a seigniorage maximum, or optimal seigniorage policy.[14] To maximize the present value of seigniorage, the government must select a time path for monetary policy that accounts for the effect that higher rates of expected inflation have on the quantity of real money balances demanded by the public. As per the theory of monopoly, the policy path that maximizes seigniorage is unit elastic in each period.

Using equation (1.5), it can be shown that:

$$\eta = \alpha \Delta p^e_{t+1} \tag{1.6}$$

where η denotes the elasticity of demand for real money balances with respect to the expected rate of inflation. Recalling that $\alpha < 0$, and setting the right-hand side of equation (1.6) to -1, the policy path that maximizes the government's revenue from money creation

parameters to be estimated.

[13]Notice that g_M is rewritten as $\frac{\Delta M}{M}$ and the denominator cancels out with the numerator from equation (1.1), which gives us the identity in equation (1.5).

[14]The model assumes that the government has a monopoly over the creation of money and that the money takes only one form. Also, that the marginal cost of producing money are zero. Under these assumptions, the actual inflation rate will only deviate from the expected rate when there are random shocks to the public's demand for real money balances.

equals the inverse of α:

$$\Delta p^e_{t+1} = \frac{1}{\alpha} \tag{1.7}$$

in each period. If the government were to select a policy path where $\Delta p^e_{t+1} > 1/\alpha$, the revenue contribution from the higher inflation rate would be more than offset by the decreased revenue brought on by a reduced tax base. Likewise, if $\Delta p^e_{t+1} < 1/\alpha$, the government could increase its seigniorage revenue by selecting a policy path with a higher rate of money growth. In sum, the *Bailey-Cagan* approach implies that the government faces a menu of policy paths, each involving a trade off between inflation and seigniorage revenue, and that it can select from any one of these paths without affecting the public's demand for real money balances.

Unfortunately, the *Bailey-Cagan* approach relies on there being a hyperinflation to estimate a steady money demand function. Thus, it is of limited use when looking at seigniorage across regimes that have modest inflation targets. Thus, the empirical section will rely on both types of seigniorage measures, monetary and opportunity cost, and define seigniorage optimums according to Mankiw.

The *Mankiw* tradition begins with the government as a social optimizer, wherein there is some tax objective function, or social loss function, that is minimized by the present discounted value of welfare costs. For simplicity's sake, the equations here are in discrete time, despite Mankiw's original use of continuous equations Mankiw (1987). The government chooses the level of taxation through either a levied tax or through seigniorage. Here seigniorage is defined according to the opportunity cost measurement in equation (1.2).

$$E_0 \sum_{i=0}^{\infty} \beta^t \frac{1}{2} [\alpha {\tau_t}^2 + b {s_t}^2] \tag{1.8}$$

such that:

$$g_t = \tau_t + s_t + d_t - (1+\delta) d_{t-1} \tag{1.9}$$

The objective function calculates dead weight loss by estimating the Harberger triangle.[15] It begins with an exogenous set of government expenditures E_0. Here parameter β is the discount factor in the government's future revenue, and revenue is a function of taxes levied (τ) and seigniorage (s). Conventional taxation and seigniorage are associated with quadratic deadweight losses of welfare, denoted as $\frac{1}{2}[\alpha {\tau_t}^2 + b{s_t}^2]$ in each period t. The welfare loss associated from either form of taxation is assumed to be an increasing function of revenue as a portion of output, where a and b are positive ratios of output that determine the marginal excess burdens of each form of taxation.[16]

The intertemporal budget constraint in equation (1.9) considers government spending, g_t, as a function of seigniorage (s_t), the growth rate of the outstanding debt/output ratio due to interest accrual (d_t), interest (δ)[17] and solvency (d_{t-1}).

Upon taking first order conditions and solving for the minimum condition, we see that the marginal social cost of raising revenue through direct taxation contemporaneously equals that of seigniorage revenue:

$$\alpha\tau_t = bs_t \tag{1.10}$$

Since government expenditures, debt, and interest are considered exogenous to the model we can estimate for the marginal effect or amount of seigniorage, as defined in equation(1.2), necessary to project onto taxation:

$$\tau_t = \frac{b}{\alpha}\frac{rM}{P} \tag{1.11}$$

That is, to maximize the present value of seigniorage, the government must select a time

[15]This is the set of expenditures multiplied by present value revenue, and then cut in half to approximate the area of a triangle.

[16]In equilibrium, the marginal deadweight loss from each source of revenue will be equal, and more revenues will be raised by the less costly form of taxation.

[17]Here debt is only that in excess of output growth, and is assumed to be constant for simplicity. Thus, part of the interest, δ, on the national debt is offset by regular growth of the economy. Note, δ must be positive, indicating that the real interest rate in the economy exceeds the real growth rate of the economy.

path for monetary policy that equilibrates the marginal costs of seigniorage and traditional taxation, with consideration for the effect that higher rates of expected inflation have on the quantity of real money balances demanded by the public. This identity is shown here:

$$s^* = g_t - s_t(1 - \frac{b}{\alpha}) - d_t + (1 + \delta)d_{t-1} \tag{1.12}$$

1.4 Data and the Empirical Model

As is now clear, much of the previous work on seigniorage covers seigniorage as a financial tool of the state. That said, previous work does not take steps to identify all the potential costs of seigniorage finance. This paper goes some way in rectifying this gap.

In order to do so, I begin with a collection of data from Aisen & Veiga (2008). The authors generously shared their data, that this study might stand on the shoulders of theirs. It is composed of annual data on political,institutional and economic variables for the years 1950 to 2000. The data includes 51 countries with variables from several sources of political and institutional data.[18] The Aisen & Veiga (2008) data combines several sources including the Cross National Time Series Data Archive (CNTS), the Polity IV dataset, the Database of Political Institutions(DPI 3.0);the State Failure Task Force dataset (SFTF), and the Freedom House ratings. Their data also includes, the World Bank's World Development Indicators (WDI) and Global Development Network Growth Database (GDN), the International Monetary Fund's International Financial Statistics (IFS), the Penn World Tables (PWT 6.1), and the Euro money credit worthiness ratings. Finally, additional data was necessary to calculate optimal seigniorage flows. Population and price data were merged onto the dataset using the United Nations[19] and IFS, respectively.

To investigate the effect of seigniorage on economic indicators, seigniorage is defined according the two traditions above, that of Monetary Seigniorage and Opportunity Costs,

[18]Originally the data included 100 countries and began in 1945. However, their study did not estimate seigniorage optimums. Some of the data required to estimate those optimums were missing.

[19]https://population.un.org/wpp/Download/Standard/Population/

respectively: (1) the change in reserve money (line 14a of IFS–IMF) as a percentage of prices; (2) the base money in reserve money (line 14a of IFS–IMF) multiplied by the available interest rate[20], as a percentage of prices. Optimal flows from seigniorage were determined according to the *Mankiw* tradition, in equation (1.11).[21] Using parameter estimates of $\frac{b}{\alpha}$, from equation (1.11), for each of the 51 countries in the dataset, estimates of optimal seigniorage are produced. The vector of these parameters can be seen in the Appendix.

To obtain the optimal level of seigniorage for each country, the parameter is multiplied by the flow from seigniorage in each period. The resulting time series represents the amount of seigniorage, averaged over time, that equilibrates the marginal cost of seigniorage relative to other forms of government finance. Hence, we have a measure of optimal flows of seigniorage.

Using both the flows from seigniorage and their contemporaneous optimums, I generate a proximity variable, as the absolute difference between the two variables. It is true that some countries may be beyond their maximal flows, suggesting that the difference from the maximum may have different interpretations, depending on the side of the curve. However, controlling for each country, as well as for period's of hyperinflation, we can simplify the interpretation. By taking logs of the difference, it is possible to model how percent changes in the gap, between optimal levels and current levels, effect the percent change in real GDP. Presumably, if the gap increases and GDP increases, then regime's that steer clear of the optimum are better off, and vice versa.

Table (1.1) estimates panel data models, controlling for countries[22] and decade fixed effects.[23] The model controls for the growth in GDP among a country's trading partners, as such growth offers additional elasticity in fundraising efforts. The model considers indices on civil liberties, political rights, religious homogeneity, and conflict. These factors

[20] As the countries involved in this study have open economies, with varying rates of risk, the rate chosen here was the United States Treasury Bill. This choice was made to keep seigniorage estimates from being biased upward due to unrelated risk.

[21] As noted earlier, Cagan's demand function depends on there being a hyper-inflation, which is not the case for much of the countries used in the dataset. Thus, without endogenizing factors beyond changes in prices, Cagan's approach would bias measures of the optimum.

[22] Only the first 15 countries are displayed in table (1.1) The remaining country effects are displayed in the Appendix.

[23] The omitted country, for fixed effects comparison, is Argentina.

can enable regimes to extract more seigniorage, as they change the incentives for money demanders to substitute out of a currency. The model controls for linear and exponential trends, as inflation can take both paths.

Regardless of the seigniorage measure, opportunity cost or monetary, the coefficient on the proximity to optimal seigniorage is remarkably close and statistically significant at the 99^{th} percentile. That is, if the seigniorage policy moves away from its optimum by 1%, then one can expect real GDP to increase by approximately .018%. Thus, policies which move away from seigniorage are typically welfare enhancing.

Table 1.1: Estimating Percent Change in Real GDP

	(1) Logged Real GDP	(2) Logged Real GDP
Opportuntiy Cost Seigniorage Proximity	0.0187**	
	(0.00571)	
Monetary Seigniorage Proximity		0.0186**
		(0.00572)
Australia	0	0
	(.)	(.)
Austria	2.057***	2.056***
	(0.158)	(0.158)
Bahrain	0.997***	1.079***
	(0.150)	(0.156)
Barbados	2.863***	2.862***
	(0.159)	(0.159)
Belarus	5.774***	5.776***
	(0.136)	(0.136)
Belgium	1.772***	1.772***
	(0.145)	(0.145)
Belize	0	0
	(.)	(.)
Bhutan	4.893***	4.892***
	(0.164)	(0.164)
Botswana	-0.412*	-0.413*
	(0.189)	(0.189)
Brazil	2.987***	2.987***
	(0.155)	(0.155)
Bulgaria	0	0
	(.)	(.)
Burkina Faso	0	0
	(.)	(.)
Burundi	1.849***	1.848***
	(0.141)	(0.141)
Cameroon	4.071***	4.071***
	(0.179)	(0.179)
GDP Growth of Trading Partners	0.00868	0.00868
	(0.00461)	(0.00462)
Political Rights	0.0164*	0.0164*
	(0.00721)	(0.00721)
Civil Liberties	0.0209*	0.0208*
	(0.00869)	(0.00869)
Agricultural (% GDP)	-0.00845***	-0.00846***
	(0.00187)	(0.00187)
1960s	0	0
	(.)	(.)
1970s	0	0
	(.)	(.)
1980s	0.0718*	0.0726*
	(0.0337)	(0.0337)
1990s	0.0874	0.0881
	(0.0475)	(0.0475)
Trend	0.0385**	0.0384**
	(0.0138)	(0.0138)
Trend Squared	-0.000199	-0.000199
	(0.000241)	(0.000241)
Religious Homogeneity	-0.165	-0.165
	(0.0904)	(0.0904)
Upheaval	-0.00580***	-0.00581***
	(0.00113)	(0.00113)
GDP Growth Rate	0.00113	0.00114
	(0.00123)	(0.00123)
Hyper Inflation	-0.0232	-0.0232
	(0.0234)	(0.0235)
Inflation Rate	-0.00000360	-0.00000352
	(0.0000128)	(0.0000128)
Intercept	18.56***	18.57***
	(0.273)	(0.273)
N	603	603
R^2	0.994	0.994

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

1.5 Conclusion

Many scholars have defined seigniorage, considered its history, developed models for optimizing policies, and studied the political realities associated with seigniorage. This author was unable to find a study that sought evidence for the effectiveness of seigniorage. Whatever the political realities that lead to a seigniorage optimizing policy, whether it be war time, debt, its saliance as tax, or an inability to raise other funds, the Theory of Optimal Taxation suggests that the governments tax to enhance welfare and productivity. Seigniorage may help win the war, pay the debt, but it likely does not put the country on a better fiscal footing, on average.

Using real GDP as a measure of welfare, this study finds evidence that seigniorage leads to self defeating ends. Recalling an analogy from earlier, seigniorage policy may be akin to a pain relief medicine. Pain relief does not solve the issues that cause pain for the patient, it merely addresses the symptom. Moreover, pain relief medication can lead to issues such as addiction and decreased effectiveness over time. Thus, seigniorage might stave off the pain associated with financing constraints, it might help win the war, or pay off the nominal debt burden. However, it comes with a price, the expectation that real GDP will fall upon its usage.

Several questions follow, such as, what is the cure, or are there other forms of pain relief? The former, is well-studied. That is, scholars have long considered the institutional factors, the endowment requirements, the policy prescriptions and the politics surrounding regimes that coordinate a healthy system of government finance.The latter, is the question that follows from this study. If seigniorage leads to lower real GDP, on average, what are some of the alternatives? Should countries default on some debt, invite some sort of austerity, exacerbate the debt, repudiate the currency, or something else? Or, is seigniorage the better choice given those alternatives? Given that seigniorage is often the choice, when seemingly no other political choice is available or the easy choice as it is less salient to the public, what are the long term trade-offs between a seigniorage policy and other politically less popular choices? Related work might consider if a particular austerity policy or debt

finance, as opposed to seigniorage, lead to increases in real GDP, on average. Unfortunately, the choice remains stark, as data are limited, and modelling techniques, across limited cross-country-level examples, are difficult. Moreover, the association between seigniorage and poor economic performance suggests the possibility that seigniorage is bounded by the political incentives associated with economic growth. Thus, it is likely that political agents who are attracted to seigniorage as a tax and means of finance – for its lack of salience to the public, that it often is outside congressional or parliamentary authority, or its immediacy – are simultaneously wary of the political costs. To this end, future research might directly tie a metric like the 'seigniorage-proximity' variable, used in this study, to some ratio of parliamentary or congressional turnover.

Chapter 2: Seigniorage in the Civil War South[1]

2.1 Introduction

Between 1861 and 1865, the price level in the Confederacy skyrocketed by 5,000 percent, propelled, in part, by the rebel government's reliance on the printing press (Burdekin & Langdana, 1993; Lerner, 1955). Unlike the Union, which relied primarily on long-term loans, nearly 60 percent of the Confederacy's expenditures were financed with revenue from seigniorage – income that the government derived by using the newly-printed Treasury notes, known as graybacks, to purchase the goods and services it required (Ball, 1991, 255). In consequence, the quantity of outstanding Treasury notes increased by 780 percent, resulting in one of the worst inflationary episodes in U.S. history (Godfrey, 1978, 118-119).[2]

Perhaps surprisingly, some Civil War historians have argued that the South could have benefited financially from printing more money than it did. J. C. Schwab (1901), for example, argues that efforts by the Confederacy to reform the currency (i.e., to reduce the quantity of currency in circulation) "wrecked the government's finances beyond the hope of saving them from utter ruin" (69). Likewise, Godfrey (1978) concludes that the financial collapse of the South was due to the government "not recognizing that currency issues were its most expedient method of commanding resources" (37). Did the South fail to take full advantage of the printing press as Schwab and Godfrey suggest, and if not, why? In this paper, we examine the political factors that contributed to the passage of the reforms, and then use them to evaluate whether the rate of monetary expansion in the

[1]This chapter was written with then fellow GMU student Bryan Cutsinger. After the collaboration, Dr. Cutsinger graduated and is now affiliated with Angelo State University. In addition, this chapter was published in Explorations in Economic History (2019).

[2]This outcome is consistent with the consensus among economists that episodes of high inflation are often the result of the government's need to raise seigniorage revenue to finance high budget deficits. See Sargent (1982), for example.

South was below that which would have maximized the revenue from seigniorage.

The literature on the Confederate economy has chronicled and examined the Confederacy's finances (J. C. Schwab, 1901; Todd, 1954), the South's monetary and fiscal programs (Godfrey, 1978; Lerner, 1954, 1955; Morgan, 1985), and the role that these programs played in contributing to the Confederacy's defeat (Ball, 1991). Inquiries into the determinants of the grayback's value have found that its purchasing power was a function of both the quantity of notes in circulation as well as money-holders' expectations of Southern success, which was due to the peculiar nature of the Confederate currency (Burdekin & Langdana, 1993; Burdekin & Weidenmier, 2001, 2003; Davis & Pecquet, 1990; McCandless, 1996; Pecquet et al., 2004; Weidenmier, 2002).[3] While a subset of these studies have used the currency reforms to evaluate the link between money and prices, the effect of the reforms on seigniorage in the Civil War South remains understudied.

Given the Confederate Congress' role in the conduct of monetary policy, and the currency reforms in particular, any analysis of the South's currency policies must account for the political factors that influenced the rebel government's monetary strategy. One of the important themes that emerges from the literature on the political economy of the Confederacy is that the rebel government's economic policies reflected both legislators' private interests as well as those of their constituencies, and that as Union forces made inroads into the South's territory, economic policy evolved in a manner consistent with those interests.[4] For instance, Ekelund et al. (2010) find that despite the widespread commitment to free trade in the South, Union occupation influenced the way in which legislators voted for currency reform late in the war.[5] Likewise, Razaghian (2004), finds that as the war progressed, and the prospects of victory dimmed, the Confederacy's fiscal policies shifted to reflect the

[3] Although the Confederate currency is often described as being a fiat money, it was in fact a credit money due to the promise to redeem the notes in exchange for specie following the end of the war. See Mises (Mises, 1981) for a discussion of the distinction between these two types of monies. We thank George Selgin for bringing this to our attention.

[4] See McCormick & Tollison (1981) for an overview of the interest-group theory of government.

[5] See McGuire & Van Cott (2002) for a discussion of the South's commitment to free trade and the Confederate Constitution.

private interests of the legislators and those that they represented. Of course, these findings do not imply that party affiliation and secessionist ideology were unimportant; indeed, there is an extensive literature that suggests that those factors did in fact influence Confederate policy (see, for example, Alexander & Beringer, (1972); Jenkins, (1999; 2000)).[6] What these findings do imply, however, is that in order to understand the South's currency policies it is necessary to consider both the private interests of the legislators (as well as the interests of those that they represented) and the influence that these interests had on policy outcomes. While this literature has analyzed the roll call voting records for many of the South's policies, no analysis of the political factors that influenced support for the currency reforms has been conducted.

We build on these literatures in two ways. Our first contribution is to examine the roll call voting records from the final, and most significant currency reform to determine which factors influenced legislative support for this measure. In Section 3, we combine these records with biographic and demographic information on both Confederate legislators as well as the districts that they represented, and, using logistic analysis, find that representing an area no longer under the rebel government's control increased the likelihood that a legislator would vote for the reform by over 90 percent. Our results are consistent Ekelund et al. (2010) and Razaghian (2004) findings that the Union's incursion into the South influenced Confederate policy. We argue that this factor bifurcated the Confederate representatives into two groups: those who represented the Confederacy's interior, where graybacks continued to circulate, and those who represented areas that were outside of Confederate control, where graybacks were no longer a part of people's asset portfolios, with those in the latter group naturally supporting more drastic reforms because they would not have had to bear the full cost of the reforms' effects.

Our second contribution builds on the research that examines the Confederate economy. We use Cagan's (1956) model of inflationary finance to evaluate the effect that the currency reforms on the flow of seigniorage.[7] The relevant implication of this model, which we derive

[6]For an historical account of the Confederate Congress, see Yearns (2010).

[7]In addition to Cagan's (1956) initial analysis, which examined hyperinflations in Austria, Germany,

in Section 4, is that once the money-holding public anticipates the inflation brought on by additional monetary expansion, the potential revenue from seigniorage becomes finite and eventually declines as the demand for money becomes increasingly elastic. Thus, the model provides a framework to determine whether the Confederacy was maximizing the revenue from seigniorage by observing how the flow of seigniorage responded to efforts by the Confederate Congress to reform the currency. We use the currency reforms as event studies and find that the rate of monetary expansion in the South was below that which would have maximized the revenue from seigniorage. Our results, which we present in Section 5, indicate that the currency reforms reduced the flow of seigniorage by approximately 57 percent, depriving the Confederacy of much-needed revenue.

2.2 A Brief History of Confederate Monetary Policy

From the outset of the war, the Confederacy had difficulty raising revenue through traditional means. Figure 2.1, which is a graphical representation of Burdekin and Langdana's (1993, 354-355) estimates of the real revenue and expenditure flows in the Confederacy, illustrates the sizable budget deficit the rebel government faced. Here, we have excluded revenue from seigniorage to highlight the trivial contribution that revenue from taxes and bond finance made relative to the Confederacy's real expenditures. Beginning in November 1861, the gap between non-seigniorage revenues and expenditures began to widen significantly, shrinking somewhat between October 1863 and April 1864, only to widen again late that same year.

Greece, Hungary, Poland, and Russia, this approach has been found to be applicable to a number of inflationary episodes including those in Argentina, Bolivia, and Brazil (Phylaktis & Taylor, 1993); Belarus (Korosteleva, 2007); Mexico (Loviscek, 1996; Turner & Benavides, 2001); and Yugoslavia (Frenkel & Taylor, 1993). Consideration was also given to alternative models of seigniorage. Mankiw (1987) has a model of optimal seigniorage wherein the monetary and fiscal authorities minimize the social losses from inflation and taxation subject to the government's intertemporal budget constraint. One of the testable implications of this model for which data on the Confederacy is available is that inflation should follow a random walk. In our analysis of Confederate inflation, however, we did not find any evidence to support this implication. Accordingly, we did not attempt any further analysis of Confederate seigniorage using this model (details are available from the authors upon request).

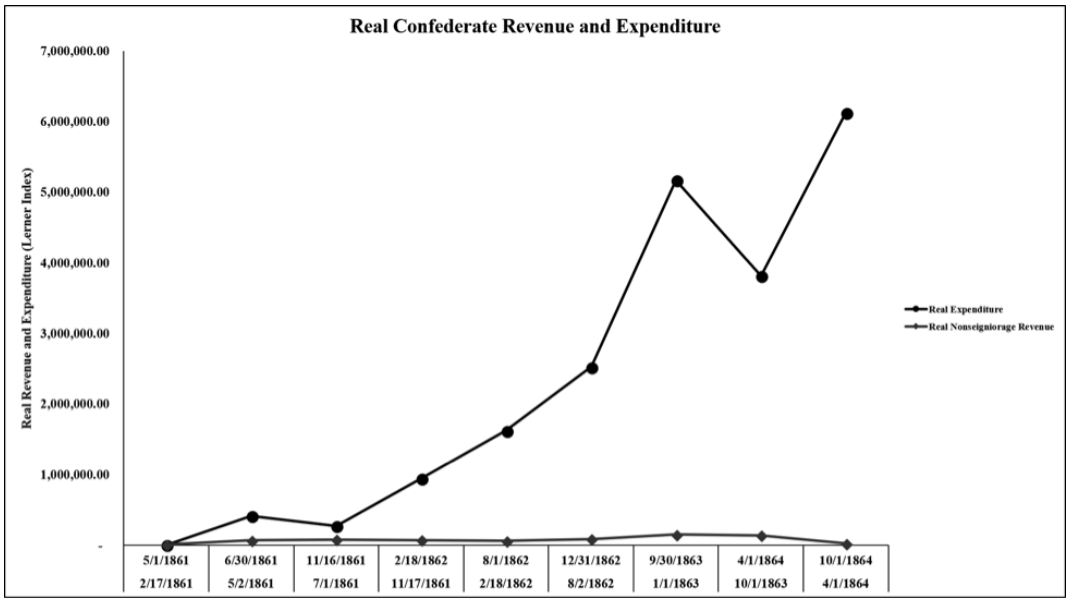

Figure 2.1: Real Confederate Revenue and Expenditure Source: Burdekin and Langdana (1993, 354)

To cover the expanding deficit, the Confederacy resorted to the printing press, issuing both interest- and noninterest-bearing Treasury notes that became the dominant form of money in the South for the duration of the war. Figure 2.2, which is also based on Burdekin and Langdana's (1993, 354) estimates, highlights the central role that non-interest-bearing Treasury notes played in supplying the Southern government with income. Beginning in July 1861, these notes became the Confederacy's primary source of revenue and remained so until 1864. Figure 2.2 also highlights the abrupt shift away from the South's early reliance upon bond finance. Initially, the Confederate Congress approved two loans: the $15 million loan and the $100 million loan, both of which paid 8 percent interest in specie semiannually (Todd, 1954, 26 & 31). The former loan was guaranteed by an export duty on cotton that was supposed to be paid either in gold or interest coupons on the loan. Due to the Union blockade and the South's self-imposed cotton embargo, however, the export duty did not raise a significant amount of revenue. Eventually, the Confederacy was forced to default

on its commitment to make coupon payments in gold due to a lack of specie and opted to use Treasury notes instead. Given the rising inflation, this decision reduced the potential revenue that could have been raised by from bond finance. As Ball notes, however, this issue could have been avoided with a more careful use of the South's available specie (Ball, 1991, 123).[8]

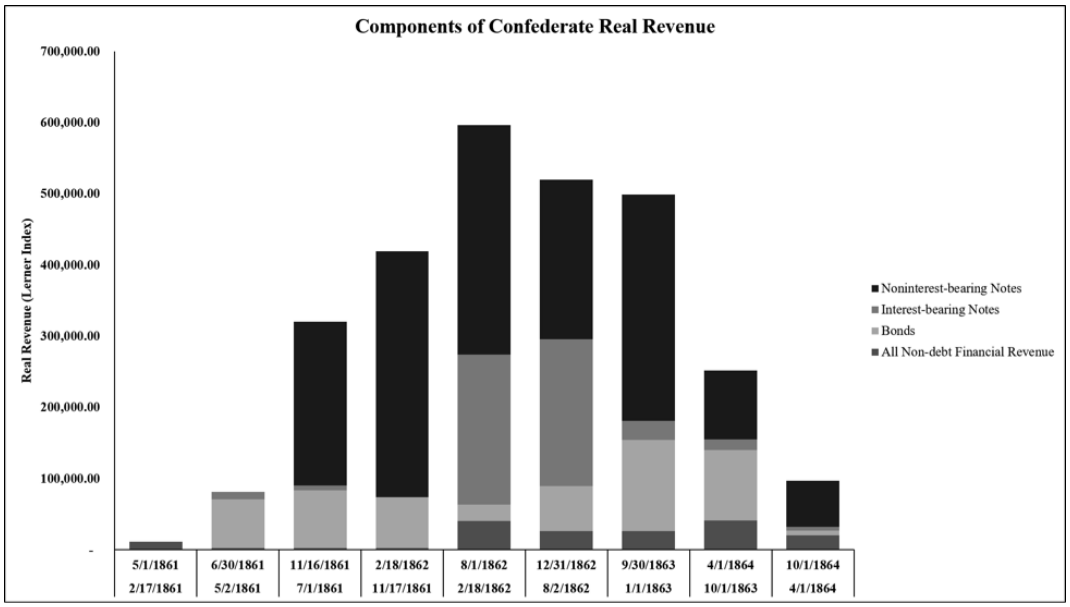

Figure 2.2: Components of Confederate Real Revenue Source: Burdekin and Langdana (1993 354)

The Confederate money stock consisted of four primary components: state-issued currency, bank deposits, bank notes, and Confederate Treasury notes. These data are shown in Figure 2.3. The largest component of the Confederate money stock consisted of Confederate

[8]The Confederacy also tried to take advantage of European financial markets. The Erlanger Loan of 1863 being the most well-known example. Grossman & Han (1996) argue that the reason the Confederacy did not rely more upon external financing was due to the fact the South's prewar resource endowment was large relative to its postwar endowment, and thus required little outside funding to accomplish the optimal amount of consumption smoothing. See Gentry (1970), Brown & Burdekin (2000), and Weidenmier (2000) for additional analyses of the Erlanger Loan.

Treasury notes. In July 1861, these notes represented only 2 percent of the money stock but by the end of the war this fraction had increased to approximately 90 percent. The Confederate currency was comprised of three types of notes: general currency, interest-bearing Treasury notes, and call certificates. General currency consisted of noninterest-bearing Treasury notes and were issued in denominations of up to $100. The interest-bearing Treasury notes were of two types. The first type paid 3.65 percent interest per year and the second type paid 7.3 percent interest per year. These interest-bearing notes both circulated as currency and were held by banks as reserves to offset deposits. Call certificates were exchangeable on demand for Treasury notes in the amount of the principle and interest due.

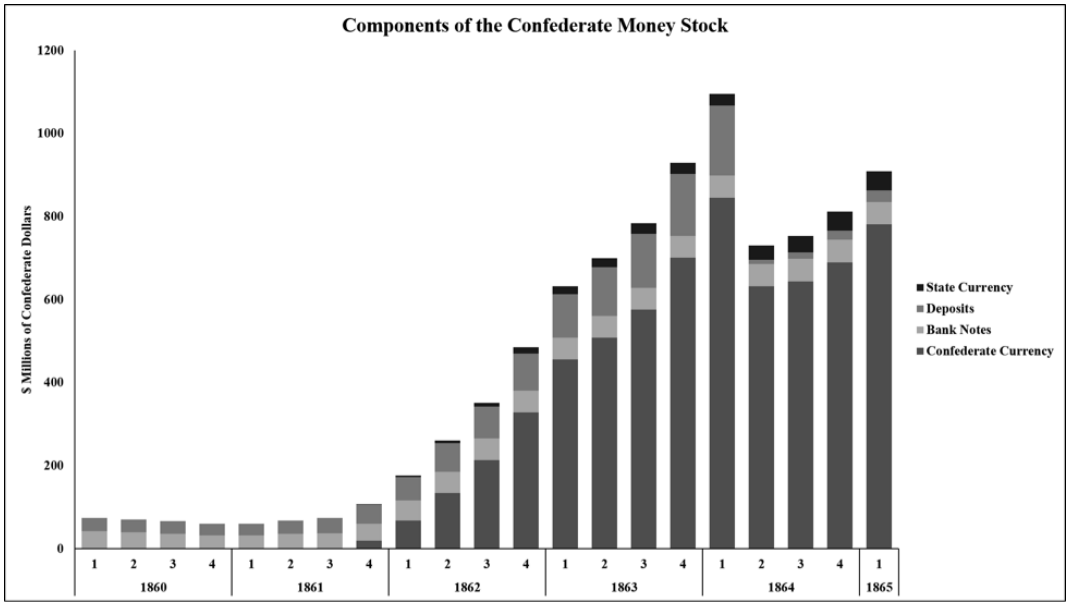

Figure 2.3: Components of the Confederate Money Stock Source: Godfrey (1978, 118-119)

The Confederacy's reliance upon inflationary finance resulted in a substantial increase in the money stock, which in turn, caused the price level in the South to increase significantly.

Between 1861 and 1865, the quantity of Treasury notes in circulation increased by 780 percent, while the total money stock increased by 1,700 percent (Godfrey, 1978, 118-119). Over that same time period, prices in the South increased by 5,000 percent, or at a rate equal to 10 percent per month (Burdekin & Weidenmier, 2003; Lerner, 1955). Figure 2.4 illustrates the time paths of the price level and the money supply during the war. Two additional factors contributed to the grayback's depreciation. First, real income declined, although it is difficult to know by precisely how much since no reliable estimates of real output in the Confederacy exist.[9] Second, Confederate Treasury notes were to be redeemable in specie following a peace treaty with the Union. Consequently, their value was not only a function of the quantity of notes in circulation but was also a function of people's expectations of Confederate victory. Thus, as the prospects of Confederacy victory diminished, so too did the value of the South's Treasury notes.

[9]One was produced by Lerner (1956, 174), who, using reports by Confederate Treasury Secretary Memminger in 1863 stating that velocity of circulation had decreased by two-thirds its pre-war rate, estimated that real income had fallen by 40 percent.

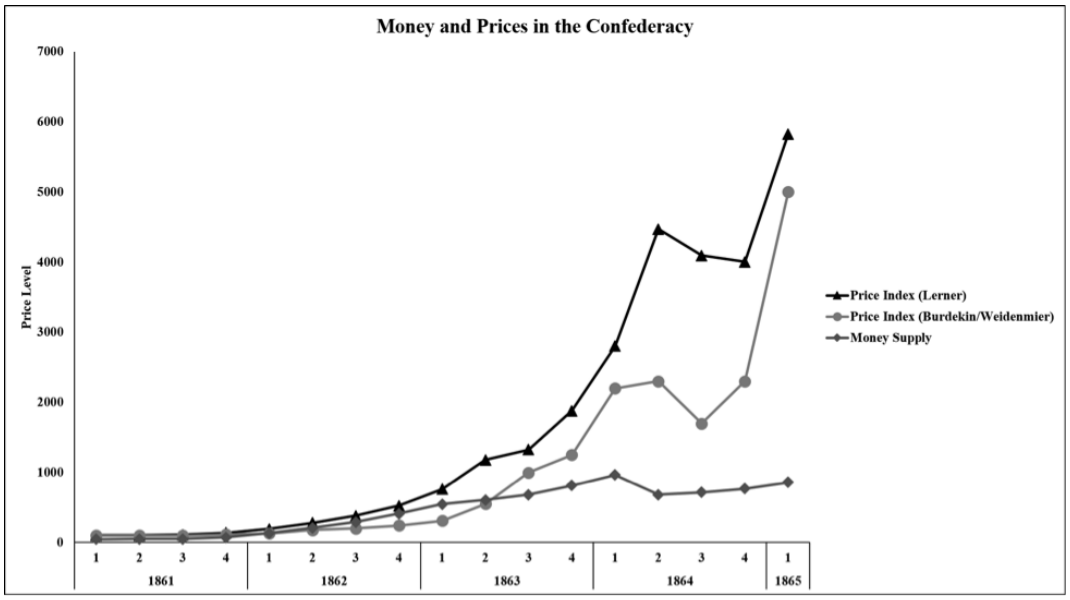

Figure 2.4: Prices in the Confederacy Source: Burdekin and Weidenmier (2003, 431), Godfrey (1978, 118-119), Lerner (1955, 24)

As Figure 2.5 indicates, at least initially, the real value of the Confederate money stock increased despite the rapid expansion in the number of graybacks.[10] Depending on the price index used, the real value of the Confederate Treasury notes peaked around the end of 1862 or the beginning of 1863 and declined steadily thereafter. The difference in the behavior of the two series is likely attributable to the fact that the Burdekin and Weidenmier series is based on gold price quotations whereas the Lerner index was constructed using wholesale prices for the Eastern region of the Confederacy. Based on Figure 2.5, it seems reasonable to conclude that, at least prior to the end of 1862, commodity prices adjusted more rapidly to the increase in Confederate Treasury notes than did gold prices.

[10]Per the quantity equation, the real value of the money stock, M/P, is defined as the ratio of real output to velocity:

$$\frac{M}{P} = \frac{y}{V}$$

Between 1861 and the end of 1862, it appears that velocity fell below its long-run equilibrium due to an excess supply of money brought on by the Confederacy's monetary expansion.

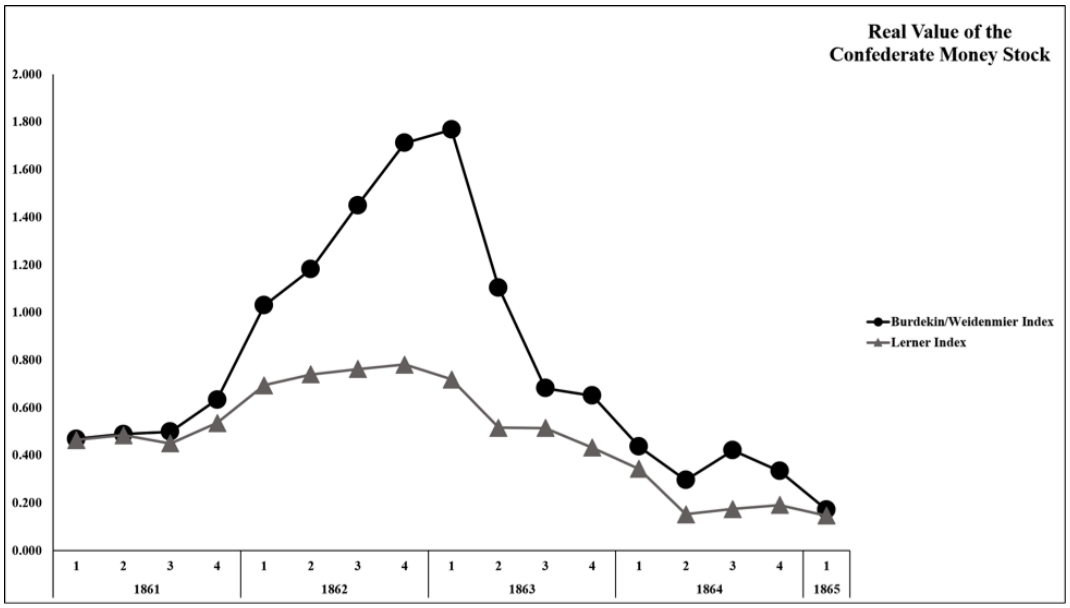

Figure 2.5: Real Value of the Confederate Money Stock Source: Burdekin and Weidenmier (2003, 431), Godfrey (1978, 118-119), Lerner (1955, 24)

What accounts for the decline in the real value of the Confederate currency at the end of 1862? At the outset of the war, both the Union and the Confederacy expected that the rebellion would be over quickly. After the Battle of Antietam in September 1862 and the Emancipation Proclamation in January 1863, however, it became evident that there would not be a swift resolution to the conflict. Recognizing the reality of the situation, noteholders, who up to that point had been willing to hold graybacks due to their expectation that they would be redeemable for specie in the near future, quickly exchanged their notes once it became evident that Southern victory may be a long way off, if it were to come at all (Pecquet et al., 2004; Weidenmier, 2002).

By October 1862, prices in the Confederacy were approximately 420 percent higher than their pre-war level Lerner (1955, 24). Confederate Treasury Secretary Christopher Memminger warned Confederate lawmakers that the quantity of notes in circulation would soon be double what he regarded as the desirable maximum of $150 million (Yearns, 2010, 197).

Writing to Jefferson Davis around the same time, Memminger (as quoted in Todd (1954, 109)) reiterated his concern that the Confederate monetary situation may soon become unstable, noting that:

> When it is remembered that the circulation of all the Confederate States before the present war was less than one hundred millions, it becomes obvious that so large an increase must produce depreciation and final disaster, unless sufficient remedies are provided.

To prevent the circulation of Confederate Treasury notes from becoming too large, Memminger proposed that Congress place a time limitation on funding notes into 8 percent bonds (Ball, 1991, 179). In response, Congress adopted the first of three currency reforms on October 13, 1862 stipulating that Treasury notes issued prior to December 1, of that same year would continue to be exchangeable for 8 percent bonds until April 22, 1863, after which point such notes would only be redeemable for 7 percent bonds. Memminger, relying on a crude version of the quantity theory of money, defended what was essentially an abrogation of the agreement printed on each and every Treasury note by arguing that following the reform, the value of the remaining currency outstanding would appreciate, thus leaving noteholders with the same purchasing power (Memminger, 1863b, 9).

As it happened, however, the reform had the opposite effect. As Lerner (1954, 516) notes, rather than reduce inflation, the act increased velocity as noteholders attempted to exchange their notes prior to the April 1863 deadline, thus causing commodity prices to increase. Once the reform took effect, however, the growth rate of Confederate Treasury notes fell by 27 percentage points from the previous quarter, which temporarily arrested the grayback's ongoing depreciation (Godfrey, 1978, 118-119). Nonetheless, this temporary abatement was not large enough to offset the prior increase in commodity prices, and consequently, the purchasing power of the grayback declined (Burdekin & Weidenmier, 2003).

By January 1863, prices in the Confederacy had risen an additional 44 percent since

Congress had adopted the first currency reform (Lerner, 1955, 24). Memminger (1863b, 5) urged the Confederate Congress to reduce the circulation, arguing that:

> . . . the mere fact that its actual volume has been increased threefold would lead us to expect a corresponding increase in prices. Such increase, although eventually certain, does not usually appear at the same moment with the expansion. Prices will reach the height adjusted by the scale of issues, and they can only be restored to their usual condition by a return to the normal standard of currency. In other words, the only remedy for an inflated currency is a reduction of the circulating medium.

Memminger proposed that the Confederate Congress adopt a compulsory funding program that would, after a certain date, repudiate those notes issued prior to December 1, 1862, which would then make it possible for the Treasury to issue $200 million worth of new notes and thereby reduce inflation (Memminger, 1863b, 7). Prior to the first currency reform going into effect, the Confederate Congress adopted a funding act on March 23, 1863 that separated non-interest-bearing treasury notes into two categories. Those printed prior to December 1, 1862 could be exchanged for 8 percent bonds until April 22, 1863 and for 7 percent bonds until August that same year. After that point, the notes would no longer be fundable, although they retained their tax-receivable status and would still be redeemable for specie six months after the war ended. Those notes printed between December 1, 1862 and April 6, 1863 could be exchanged for 7 percent bonds until August 1, 1863 and for 4 percent bonds thereafter. They too retained their tax-receivable status.

Unlike the first reform, however, the second removed comparatively little currency from circulation. Todd (1954, 37) estimates that the first reform withdrew $163 million notes out of circulation, whereas the second only removed $21 million (72). Indeed, Godfrey's estimates indicate that the quantity of notes in circulation actually increased by 2 percentage points during the third quarter of 1863 when the act's provisions went into effect. Consequently, the second reform was unsuccessful in terms of reducing the rate of currency depreciation (Burdekin & Weidenmier, 2003).

By December 1863, prices in the Confederacy were over 2,000 percent higher than their January 1861 level (Lerner, 1955, 24). Secretary Memminger reported to the Confederate Congress that the previous reforms had failed to reduce the outstanding currency from $700 million to the desired $200 million (Memminger, 1863a, 4). In fact, despite the South's efforts to reform the currency, the quantity of Treasury notes in circulation had doubled over the previous year. Secretary Memminger (1863a, 5) made his position on the matter plain to Congress, stating that, "the currency must be reduced." To address the shortcomings of the previous reforms, and to generate the revenue necessary to fund the government's expenses, he proposed that the government issue $1 billion in 6% 20-year bonds, which would be tax exempt until April 1864 (July 1864, west of the Mississippi), after which point, those in possession of the old notes would not be allowed to exchange their currency for Confederate bonds and those still outstanding would be considered repudiated. Finally, Memminger asked Congress to authorize $200 million of new Treasury notes, the quantity of which would thereafter remain fixed to limit inflation (Confederate States of America. & Memminger, 1863, 8).

Members of the Confederate House also made a variety of reform proposals. Critically, as Ball (1991, 185) notes, all of these schemes were "disguised forms of debt scaling or repudiation." As we discuss in the following section, this type of repudiation would have affected those Southerners living in the interior of the Confederacy differently than it would have those living in areas occupied by the Union, and thus, would have influenced the pattern of political support for reform. Unable to reach agreement, the House created the Special Committee on the Currency, which proposed a bill to tax, fund, and limit the currency that was similar to Memminger's proposal. The measure would allow all non-interest-bearing notes to be funded in 6 percent bonds until March 1864 and into 4 percent bonds until May 1, after which point the notes could be exchanged for bonds at a rate of $0.25 on the dollar until August when those notes that remained outstanding would be repudiated. The Special Committee also authorized the Secretary to issue $200 million in new notes with a guarantee of a maximum future circulation of $250 million.

Representatives from the Atlantic coast states and Alabama, where the concentration of graybacks was greatest, were generally opposed to the Special Committee's bill (Yearns, 2010, 206). However, their efforts to moderate the proposed reform were unsuccessful, and on January 16, 1864, the bill passed the Confederate House of Representatives by a vote of 38 to 32 (*Journal of the Congress of the Confederate States of America, 1861-1865,* 1904, 644). The Confederate Senate, however, was unwilling to adopt the House measure. To resolve the issue, both houses agreed to a conference committee, where the House bill was moderated by concessions intended to alleviate the Senate's concerns. Despite these concessions, those legislators from Atlantic coast states and Alabama generally continued to oppose the measure; indeed, 25 of the 34 votes against the final reform bill represented states where the concentration of graybacks remained the greatest (*Journal of the Congress of the Confederate States of America, 1861-1865,* 1904, 843). As Memminger's biographer, Henry D. Capers (1893, 348) put the matter, the reform was "at best but a compromise between opposing factions."

The final reform was passed on February 17, 1864. The act split non-interest-bearing notes into four categories. Notes with a face value less than $5 were not affected by the reform. $5 notes would be tax-receivable and exchangeable at par for 4 percent bonds until July 1, 1864, after which point they were fundable at two-thirds their face value until January 1, 1865 when all remaining $5 notes would be taxed at 100 percent. Those notes between $5 and $100, which comprised the majority of the outstanding graybacks, were treated similarly except that they were only exchangeable for bonds at par until April 1, 1864. Finally, $100 notes, of which there were $200 million in circulation, could be exchanged for bonds at par until April 1, 1864, after which point they were no longer tax-receivable and subject to an immediate 33.33 percent tax as well as to a 10 percent per month tax until they were exchanged for bonds.

The final currency reform reduced the growth rate of Confederate Treasury notes in the second quarter of 1864 by 45 percentage points and successfully halted the advance of prices in the Confederacy as is evident in Figure 2.3 (Godfrey, 1978, 118–119). Like

the first reform, however, the temporary reduction in the rate of currency deprecation was insufficient to offset the increase in commodity prices that occurred prior to April 1, 1864 (Burdekin & Weidenmier, 2001, 2003).[11] Critically, the act deprived the Confederacy of much-needed revenue, which can be clearly seen in Figure 2.2. As Godfrey (1978, 37) notes, the reform required the Treasury to allocate nearly half of its $46 million per month note-issuing capacity to exchanging new notes authorized by the currency reform, which left the Treasury with only $26 million per month to use for war expenditures. As a result, the rebel government fell further behind in meeting its financial obligations, with arrears in payment increasing by 133 percent from $150 million in January 1864 to $350 million in October of that same year (Ball, 1991, 296). Despite being repudiated, the quantity of old currency outstanding was so large that Congress was forced to defer the penalty date of January 1, 1865, thereby making the old notes tax-receivable and fundable in 4 percent bonds until July 1, 1865 (1991, 188). Deprived of its most significant source of the revenue, the rebel government had no choice but to rely once again on the printing press, and by October 1864 the quantity of outstanding Treasury notes in circulation, both and old and new, stood at $689 million (Godfrey, 1978, 36).

2.3 The Politics of Confederate Currency Reform

All three of the currency reforms were adopted during the first session of the Confederate Congress, which was split into four sessions. The first and final reforms were passed on the final days of the second and fourth sessions, respectively, while the second reform was passed in the middle of the third session. Unfortunately, roll call voting records for the first two reforms do not exist since the votes were taken during a secret session. Thus, our analysis of the political factors that influenced the currency reforms is confined to the final, and most significant one.

As we discussed in the previous section, the congressional debates over the various proposals to reform the currency in late 1863 and early 1864 pitted representatives from the

[11] For an analysis of the reform's effect west of the Mississippi, see Pecquet (1987).

Eastern states and Alabama, where graybacks continued to circulate, against those from the states that were occupied by the Union or cut off from Confederate control, where the circulation of graybacks had greatly diminished. That the Confederate House of Representatives would be divided along these lines is not surprising given the magnitude of the currency repudiation being debated. The proposed repudiation of the currency was essentially equivalent to the rebel government defaulting on a fraction of its debt, and would have involved noteholders only receiving one dollar for every ten they had lent the government (Ball, 1991, 185). Those primarily affected by such a default would have been concentrated in the interior of the Confederacy. And while, per Ricardian equivalence, such a repudiation would have represented a reduction of future tax obligations, the benefits of this reduction would have disproportionately accrued to those not affected by the partial default, i.e., those living in areas where graybacks were no longer circulating (Barro, 1974). [12]

To test whether being outside of Confederate control affected a legislator's support for the 1864 currency reform, we constructed a data set that combines the roll call voting records for the reform with biographical information on each representative that participated in the vote along with information on their district.[13] The roll call records come from the Confederate States of America. & United States. (1904), while the biographical and district information were collected from Alexander and Beringer's (1972) analysis of the members of the Confederate legislature and Martis' (1994) historical atlas of the Confederate Congress. The biographical characteristics include three political variables: party, views on secession, and lame duck status, as well as three economic variables: occupation, personal slave holdings, and 1860 estate value. We constructed the occupation variable such that the effect of being a lawyer or planter could be analyzed separately from other professions. Here, we are assuming that being a lawyer may indicate being part of the political elite and working in agriculture may indicate being part of the planter class. Data on each legislator's

[12]Such a bifurcation had effects on policy effects that extend beyond monetary issues. Ekelund & Hébert (2010), for example, found that whether a legislator represented a district that was outside of Confederate control influenced their support for severe trade legislation that regulated blockade-running in early 1864.

[13]Given the limited number of observations for the Confederate Senate, we confine our analysis to the Confederate House of Representatives.

district includes a slave index indicating the average slave holdings in a Congressman's county, a land value index indicating the average property value in the district, and a variable that indicates whether the district produced cotton or tobacco. Finally, we created a variable indicating whether the legislator represented a district located in a state that was no longer under Confederate control in early 1864 (AR, KY, LA, MO, MS, TN, TX), which we expect to be positively correlated with support for the currency reform. Moreover, we expect the importance of this variable to be larger for the initial vote than in the final one owing to the concessions made to those living in the Confederacy's interior. The results of this analysis are presented in Table 2.1.

Table 2.1: Logistic Analysis of Roll Call Voting for Currency Reform

	Logit Models	
	(1)	(2)
	Initial Vote	Final Vote
State Outside of Confederate Control	2.738*	2.337*
	(1.156)	(0.925)
Democrat	2.076	1.328
	(1.219)	(1.089)
Secession	0.419	0.715
	(0.745)	(0.968)
Lame Duck	0.605	0.183
	(0.874)	(0.760)
Slave Holdings	0.0186	0.0513**
	(0.0202)	(0.0183)
1860 Estate Value	-0.00000349	-0.0000233**
	(0.00000959)	(0.00000755)
Lawyer	2.038	-0.0310
	(1.189)	(1.100)
Agriculture	-0.667	0.819
	(1.218)	(1.155)
Slave Index	0.173	0.103
	(0.206)	(0.233)
Land Value Index	-0.102	-0.0532
	(0.0895)	(0.0959)
Cotton/Tobacco	1.009	-0.396
	(0.935)	(0.827)
Constant	-4.375	-2.739
	(2.393)	(1.851)
Observations	53	59
Psuedo R-Squared	0.386	0.286

Robust Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As predicted, the coefficient estimate for the Confederate control variable for both the initial and final reform vote is positive and statistically significant at the 95 percent level. Moreover, the magnitude of this variable decreased for the final reform, which is in line with our prediction that the concessions made to those in the Confederacy's interior would diminish the importance of geographical differences in representation.[14] The coefficient for State Outside of Confederate Control can be interpreted as the logarithmic odds ratio of voting for the currency reform. In other words, representing a district located in a state that was outside of Confederate control increased the probability that a legislator would support the initial reform by 94 percent. Likewise, in the case of the final vote, this factor increased the probability of supporting the reform by 91 percent.

Our findings suggest that congressional support for, or opposition to the final currency reform was politically motivated. Unlike Secretary Memminger, who was concerned with controlling inflation, Confederate lawmakers appear to have been concerned with pursuing policies that were consistent with their constituents' interests. Since there are no roll call voting records for the first two currency reforms, it is not possible to extent this analysis further. That said, by the time the first and second currency reforms were passed, between 37 and 39 percent of the Confederate House districts were either occupied or had been disrupted by the Union. When the final currency reform was adopted in February 1864, the fraction of Union-occupied or disrupted districts had only increased to 47 percent (Martis, 1994, 49). Based on the available evidence, therefore, we do not think that it is unreasonable to conclude that this factor could have contributed to the first two currency reforms as well.

[14]It should be noted that this result is merely suggestive given the differences between the two samples.

2.4 A Model of Inflationary Finance

In this section, we derive a steady-state relationship between seigniorage and the growth rate of the nominal money stock.[15] To do so, we begin with three assumptions.[16] First, we assume that money takes only one form, e.g. Confederate Treasury notes. Next, we assume that the public correctly anticipates the inflation rate. Lastly, we assume that the difference between the growth rates of velocity and real income is constant. In other words, we are assuming that the inflation rate moves one-for-one with the growth rate of the nominal money stock. These latter two assumptions imply that changes in the growth rate of the money stock are matched one-for-one by changes in the actual and expected rate of inflation. The higher the inflation rate, the greater is the cost of holding real money balances. Thus, increases in the growth rate of the money stock will cause the real quantity of money demanded to decrease.

Under these assumptions, the amount of real seigniorage collected by the monetary authority is equal to the product of the real money stock and the rate at which that stock depreciates. Since, under a fiat monetary system, the real money stock is determined entirely on the demand side via movements in the price level, and because we have assumed that changes in the growth rate of the money stock are matched exactly by changes in actual and expected inflation, we can express steady-state real seigniorage as:

$$s = \frac{M}{P} g_M \tag{2.1}$$

where s is real seigniorage, M/P is the real money stock, and g_M is the rate of monetary expansion.[17] To make this point more concrete, consider the following Cagan-style money

[15] For a detailed discussion of this approach, see Blanchard and Fischer (1989, 195-201) or Romer (**?**, 567-576).

[16] These assumptions are similar to those found in both Bailey's (1956) and Cagan's (1956) analysis of seigniorage maximization (as well as the aforementioned textbooks). While these assumptions are not necessarily realistic, they allow us to establish a steady-state relationship between the growth rate of Confederate Treasury notes and the flow of real seigniorage that we can use to derive a first approximation of the effect that changes in the growth rate of Confederate Treasury notes had on seigniorage.

[17] For our purposes, the fact that Confederate Treasury notes were a credit rather than a fiat money does

demand function:

$$(\frac{M}{P})^d = e^{-\alpha g_M - \gamma} \tag{2.2}$$

where e is the natural logarithmic base and α (which is necessarily positive) and γ are constants.[18] Since the real money stock accommodates itself to the real quantity of money demand, we can think of the real money stock as being equal to real money demand. Accordingly, we can substitute equation (2.2) into equation (2.1), which yields:

$$s = e^{-\alpha g_M - \gamma} g_M \tag{2.3}$$

To maximize seigniorage, the monetary authority must account for the negative effect that higher growth rates of the money stock have on real money demand. The seigniorage-maximizing growth rate of the money stock occurs where:

$$\frac{\partial s}{\partial g_M} = (1 - \alpha g_M) e^{-\alpha g_M - \gamma} g_M = 0 \tag{2.4}$$

and

$$\frac{\partial^2 s}{\partial g_M^2} = (\alpha^2 g_M - 2\alpha) e^{-\alpha g_M - \gamma} = 0 \tag{2.5}$$

These first- and second-order conditions are satisfied where:

$$g_M^* = \frac{1}{\alpha} \tag{2.6}$$

not alter the implications of the analysis. In both cases, the real money stock is determined entirely on the demand side.

[18] Under our assumptions, $-\alpha$ is the semi-elasticity of the money demand function with respect to the growth rate of the money stock, and γ is a scale parameter - the smaller γ becomes the greater is real money demand for any given growth rate of the money stock. Policies such as reserve requirements and legal tender laws can augment the values of these parameters thereby increasing or decreasing real seigniorage. We do not explore these factors in this paper. Instead, we take the Confederacy's policies vis-à-vis currency restrictions and reserve requirements as given to focus on the effect that the currency reforms had on real seigniorage.

In other words, the seigniorage-maximizing rate of monetary expansion occurs where the demand for real money balances is unit elastic.[19] Figure 2.6 is a graphical representation of equation (2.3). The curve, which was first derived by Bailey (1956), maps steady-state real seigniorage as a function of the growth rate of the nominal money stock. At low levels of monetary expansion, the corresponding flow of real seigniorage is also low. As the growth rate of the money stock increases, the note-issuing authority generates greater amounts of real seigniorage, but at a decreasing rate. Eventually, as real money demand becomes increasingly elastic, the additional revenue generated by further increases in the growth rate approaches zero as the elasticity of demand for real money balances approaches unity. After that point, the additional revenue generated by a continued depreciation of the real money stock becomes negative.

[19]The elasticity of the Equation (2.2) with respect to g_M is:

$$\eta = -\alpha e^{-\alpha g_M - \gamma}\left(\frac{g_M}{e^{-\alpha g_M - \gamma}}\right) = -\alpha g_M$$

Setting this equation equal to -1 yields the same result found in Equation (2.5):

$$-1 = \alpha g_M$$
$$g_M^* = \frac{1}{\alpha}$$

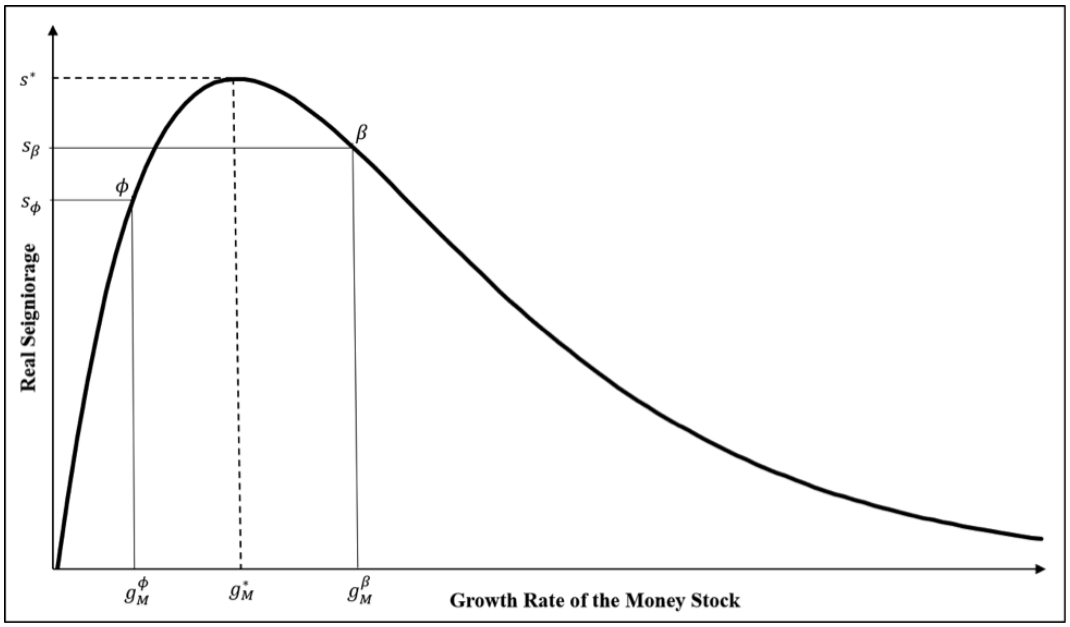

Figure 2.6: Real Seigniorage as a Function of the Growth Rate of the Money Stock

We can use this relationship to evaluate whether the rate of monetary expansion in the Confederacy was consistent with seigniorage maximization by observing how real seigniorage responded to the currency reforms. For instance, if, prior to the currency reforms, the growth rate of Confederate Treasury notes was to the right of g_M^* at g_M^β, then we expect that the currency reforms will cause seigniorage to increase. If, on the other hand, the growth rate of Confederate Treasury notes prior to the reform was to the left of g_M^* at g_M^ϕ, then we expect the opposite. Moreover, the model predicts that if the Confederacy was operating to the left s^*, then the subsequent increases in the rate of monetary expansion following the currency reforms should increase the flow of seigniorage and vice versa.

Before proceeding, three qualifications are in order. First, the monetary authority only earns seigniorage on the notes that it is issues. Thus, while the Confederate money stock consisted of more than Treasury notes, as we noted in Section 2, the Treasury only derived revenue from the notes it issued. Thus, our analysis in the next section focuses exclusively

on the relationship between the expansion of Confederate Treasury notes and its effects on seigniorage. Next, the relationship between the flow of seigniorage and the rate of monetary expansion that we have derived in this section assumes that the long-run demand for money is constant. Graphically, if the demand for real money balances was to shift, so too would the curve in Figure 2.6. In other words, a decrease in real money demand would shift the curve in Figure 2.6 downward, reducing the flow of seigniorage for any given rate of monetary expansion. In such a situation, therefore, the monetary authority would need to increase the rate of monetary expansion in order to maintain a constant flow of seigniorage. Accordingly, it will be necessary to control for factors that influenced the demand for Confederate Treasury notes, e.g., decreases in real output and noteholders expectations of Confederate success.

Finally, if we relax the second assumption that the money-holding public correctly anticipates the inflation rate and instead forms their inflation expectations based on the previous period's inflation, then it is possible for the note-issuing authority to be *temporarily* off the curve in Figure 2.6. Once people's inflation expectations adjust, however, seigniorage converges to the steady state equilibrium. Under the assumption of adaptive expectations, for example, a reduction in the growth rate of Confederate Treasury notes will initially cause seigniorage to fall below that indicated in Figure 2.7. Once inflation expectations, adjust, however, seigniorage will converge to the steady state, assuming that there are no further changes in the growth rate of Confederate Treasury notes, which, as discuss in the following section, was not the case.

2.5 Empirical Analysis of the Currency Reforms

Data on the quantity of Confederate Treasury notes is limited by the Confederacy's relatively short existence and the small number of Treasury reports that exist. Unfortunately, this limitation prevents us from estimating the demand for Confederate Treasury notes directly; however, we can use the existing data to evaluate how the flow of real seigniorage

responded to the currency reforms by using the theoretical framework developed in the previous section. Using Godfrey's (1978, 118-119) quarterly data on the quantity of Treasury notes in circulation along with Burdekin and Weidenmier's (2003, 431) and Lerner's (1955, 24) price indices, we generated two time series of real seigniorage, which are listed in Table 2.2.[20]

Here, we are defining real seigniorage as the ratio of the change in Confederate Treasury notes to the price level:

$$s = \frac{\Delta M}{P} \tag{2.7}$$

This definition follows directly from Equation (2.1).[21]

Because our assumptions in the previous section imply that changes in the growth rate of the money stock are matched one-for-one by changes in the actual and expected rate of inflation, it was unnecessary to distinguish between alternative definitions of seigniorage. That is, in the steady-state there would be no difference between defining seigniorage as the product of the real money stock and the rate of monetary expansion or as the product of the real money stock and the inflation rate. Such a distinction, however, is critical for empirical research.

There are two reasons that we defined seigniorage as the product of the real money stock and the rate of monetary expansion. First, as Honohan (1996) notes, defining seigniorage as the product of the real money stock and the rate of monetary expansion is most appropriate in situations wherein the government's deficit is being financed by issuing currency, as

[20]Based on the Augmented Dickey-Fuller test, we were unable to reject the null hypothesis that both series have a unit root, which we addressed by taking the first difference of each series. Details are available from the authors upon request.

[21]Since g_M can be written as $\frac{\Delta M}{M}$, Equation (2.1) can be expressed as:

$$s = (\frac{M}{P})(\frac{\Delta M}{M})$$

which simplifies to:

$$s = (\frac{\Delta M}{P})$$

was the case for the Confederacy. Second, recall that the value of the grayback was a function of both the quantity of notes in circulation and people's expectations of Confederate success. Inflation caused by people's diminished expectations of Confederate success would not have generated additional seigniorage revenues for the rebel government. Thus, defining seigniorage in this manner would overstate the amount of real revenue that the Confederacy collected by issuing Treasury notes.

Table 2.2: Quarterly Data for Confederate Monetary and Price Variables

Year	Quarter	(1) Confederate Currency (Millions of Greybacks)	(2) Growth Rate of Confederate Treasury Notes	(3) Burdekin/ Weidenmier Price Index	(4) Real Seigniorage (Burdekin/ Weidenmier Index)	(5) $\Delta Seigniorage$ $(Burdekin/ WeidenmierIndex)$	(6) Lerner Price Index	(7) Real Seigniorage (Lerner Index)	(8) $\Delta Seigniorage$ $(LernerIndex)$	(9) Casualties
1861	3	1		100	0.01	-	111	0.009	-	-
	4	20	1900.00%	115	0.165	0.155	136	0.14	0.131	0
1862	1	68	240.00%	130	0.369	0.204	193	0.249	0.109	0
	2	135	98.53%	176	0.381	0.011	281	0.238	-0.01	2.48
	3	214	58.52%	200	0.395	0.014	380	0.208	-0.031	0.41
	4	328	53.27%	240	0.475	0.08	526	0.217	0.009	0.23
1863	1	456	39.02%	310	0.413	-0.062	762	0.168	-0.049	0
	2	508	11.40%	550	0.095	-0.318	1178	0.044	-0.124	0.16
	3	576	13.39%	1000	0.068	-0.027	1326	0.051	0.007	0.22
	4	701	21.70%	1250	0.1	0.032	1879	0.067	0.015	0.21
1864	1	845	20.54%	2200	0.065	-0.035	2801	0.051	-0.015	0.01
	2	632	-25.21%	2300	0.036	-0.029	2947	0.027	-0.024	0.25
	3	644	1.90%	1700	-0.128	-0.164	4470	-0.066	-0.093	0.1
	4	690	7.14%	2300	0.007	0.135	4094	0.003	0.069	0.05
1865	1	781	13.19%	5000	0.02	0.013	4001	0.011	0.009	0.03

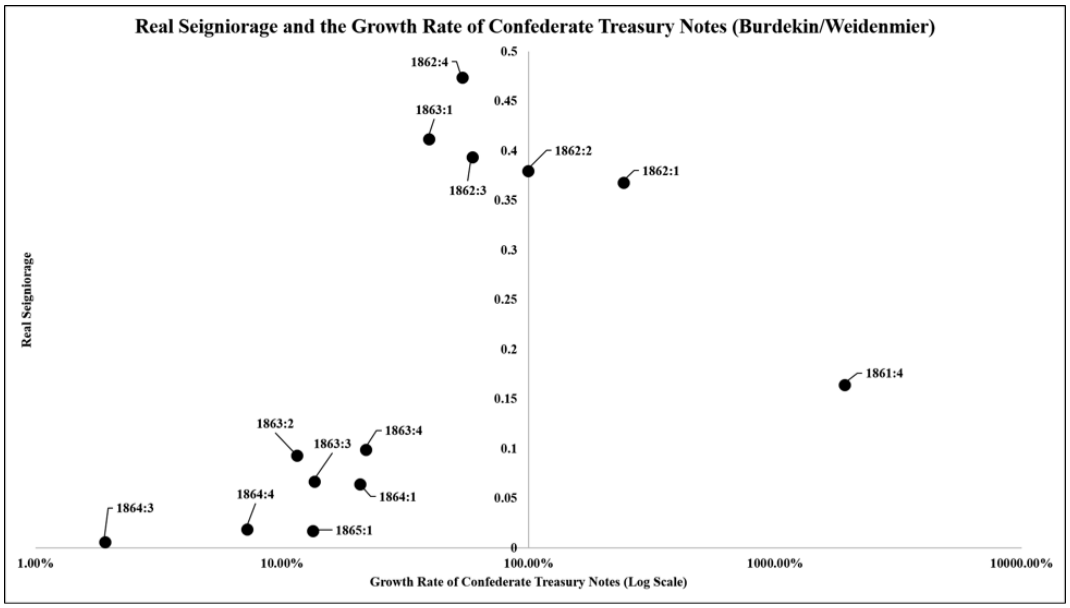

Figure 2.7: Real Seigniorage and the Growth Rate of Confederate Treasury Notes (Burdekin/Weidenmier) Source: Burdekin and Weidenmier (2003, 431), Godfrey (1978, 118–119)

Both real seigniorage series are plotted against the growth rate of Confederate Treasury notes in Figures 2.7 and 2.8.[22] Each series exhibits a pattern like that predicted by the model we derived in the previous section.[23] Real seigniorage was at its highest between the first quarters of 1862 and 1863, after which point it is clustered at lower rates of monetary expansion. It is worth noting that the majority of the observations, which occurred later in the war, are clustered at lower rates of monetary expansion, indicating that the South may have failed to maximize the revenue from seigniorage.

[22]In both figures, the growth rate of Confederate Treasury notes is displayed on a logarithmic scale owing to the wide variation in the rates of monetary expansion. Accordingly, it was necessary to omit the observation from the third quarter of 1864 when, due to the final currency reform, the growth rate of Confederate Treasury notes was negative.

[23]The correlation coefficient for two series is 0.961 and the correlation for the first difference of the two series is 0.932.

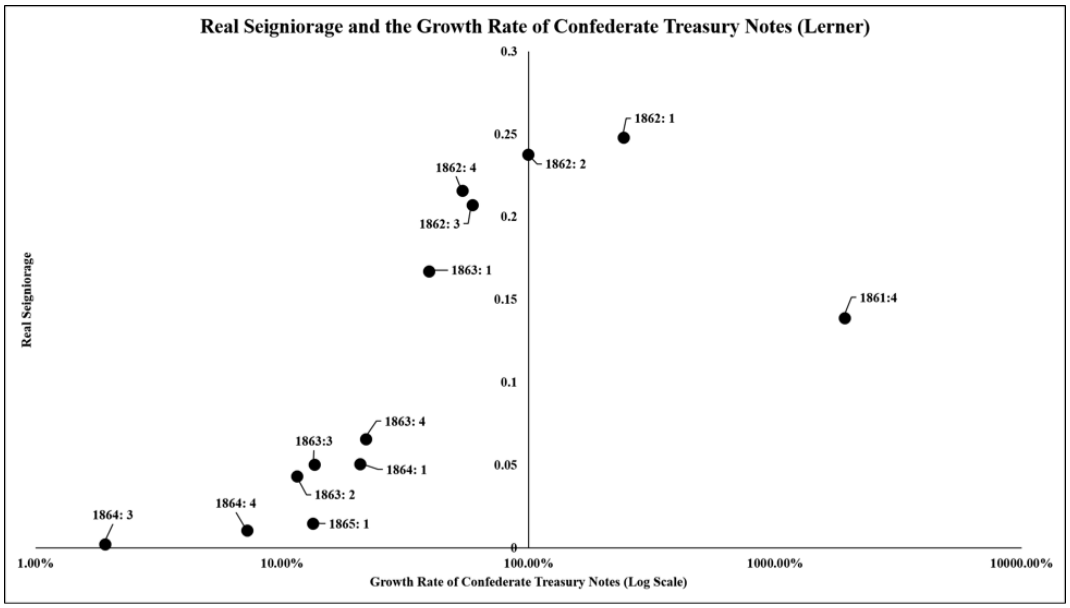

Figure 2.8: Real Seigniorage and the Growth Rate of Confederate Treasury Notes (Lerner)
Source: Godfrey (1978, 118–119), Lerner (1955, 24)

To capture the effect of the currency reforms on seigniorage, we first created three reform variables that were set to 1 for the quarters in which the reforms went into effect and 0 otherwise, i.e., Currency Reform 1 was set to 1 for 1863:2, Currency Reform 2 was set to 1 for 1863:3, and Currency Reform 3 was set to 1 for 1864:2. To estimate the joint effect of all three currency reforms, we created an additional dummy variable that was set to 1 for the quarters in which the reforms went into effect and 0 for all others. Since there was a gap in between the time the Confederate Congress passed the reforms and when their stipulations went into effect, consideration was also given to the response of real seigniorage to the passage of the reforms; however, these were not found to have had a statistically significant influence on seigniorage.[24] Next, to account for the effect that subsequent changes on the growth rate of Treasury notes would have had on seigniorage, we created a lagged reform dummy variable for each reform that was set to 1 for the quarter following the

[24]This finding is not altogether surprising since money-holders could exchange their notes without penalty up to the day prior to the reforms going into effect. Details are available from the authors upon request.

implementation of each reform and 0 for all other quarters, i.e., Lagged Currency Reform 1 was set to 1 for 1863:3, Lagged Currency Reform 2 was set to 1 for 1863:4, and Lagged Currency Reform 3 was set to 1 for 1864:3. Finally, to capture the lag on the joint reforms, we created a joint lagged reform variable that was set to 1 for the quarters following those in which the reforms went into effect and 0 for all others. Weidenmier's (2002) analysis of the value of the grayback indicates that the market responded quickly, i.e., often within weeks, to major events that affected people's expectations of Confederate success. Based on this finding and given that the currency reforms were each announced, not to mention debated in Congress, more than a month prior to their implementation, it seems reasonable to conclude that people's inflation expectations adjusted quickly enough in response to the currency reforms to ensure that deviations from the steady state would have been short-lived. Accordingly, it seems unlikely that people's inflation expectations would significantly bias the coefficient estimate on the initial reform variable. Also, recall from the previous section that if inflation expectations do not adjust instantaneously to reflect a decrease in the growth rate of the nominal money stock, that real seigniorage will initially fall and subsequently increase until the steady state is achieved, all else equal. While the currency reforms did temporarily reduce the growth rate of Confederate Treasury notes, these reductions were not permanent; that is, all else was not equal. In fact, as Table 2.3 illustrates, in the quarters following each of the three currency reforms, i.e., 1863:3, 1863:4, and 1864:3, the growth rates of Confederate Treasury notes increased by 2, 8, and 27 percentage points, respectively (Godfrey, 1978, 118–119). Thus, if the rate of monetary expansion was below that which would have maximized the revenue from seigniorage, then we expect the coefficient estimates on the initial and lagged reform variables to be negative and positive, respectively. On the other hand, if the Confederacy was operating to the right of the maximum in Figure 2.6, then we expect the coefficient estimates on the initial and lagged reform variables to be reversed.

Table 2.3: Effect of the Currency Reforms on the Rate of Monetary Expansion

	(1) Initial Effect of the Currency Reforms on the Growth Rate of Confederate Treasury Notes (in Percentage Points)	(2) Subsequent Change in the Growth Rate of Confederate Treasury Notes (in Percentage Points)
Currency Reform (1863:2) 1	-27.62	1.98
Currency Reform (1863:3) 2	1.98	8.31
Currency Reform (1864:2) 3	-45.75	27.10

Additional consideration was given to factors other than the currency reform that could have influenced the demand for Treasury notes. First, the empirical evidence from the war news literature indicates that the value of the Confederate currency responded to political and military events that influenced people's expectations of Confederate success (Burdekin & Langdana, 1993; Davis & Pecquet, 1990; McCandless, 1996; Pecquet et al., 2004; Weidenmier, 2002). To control for this factor, we constructed a war news variable that was set to 1 in the quarters following those turning points identified in Weidenmier's analysis of the grayback market, which were the Battles of Antietam (1863:1) and Gettysburg (1863:4) as well as the Union's finance and conscription bills (1863:2).[25] Here, we expect the coefficient estimate to be negative – bad news will cause the Confederate Treasury notes to depreciate thereby decreasing the demand for Confederate Treasury notes, which in turn will decrease real seigniorage.

Next, the steady-state relationship between the rate of monetary expansion and the flow of real seigniorage derived in the previous section assumed that the difference between the growth rates of velocity and real income was constant. Since real income in the South was

[25]We also constructed a war news variable based on Burdekin and Langdana's (1993, 367) war news variable, which, while statistically significant, lacked the same explanatory power as our variable. Details are available from the authors upon request.

likely declining over the course of the war, it is necessary to control for changes in income that may have influenced the demand for Treasury notes. While no reliable measure of output or production for the Confederacy exists, Burdekin and Langdana's (1993) findings suggest that casualty figures may serve as a proxy for lost productive potential. The intuition here is that an increase in the casualty rate may have effects that are like those of a supply shock, which would cause the price level to rise thereby reducing real seigniorage. To account for changes in real income, we used Burdekin and Langdana's casualty variable, which is equal to the logarithm of the ratio of the cumulative casualty total at the end of each quarter to the cumulative total of the preceding quarter.[26] Here, we also expect the coefficient estimate to be negative.

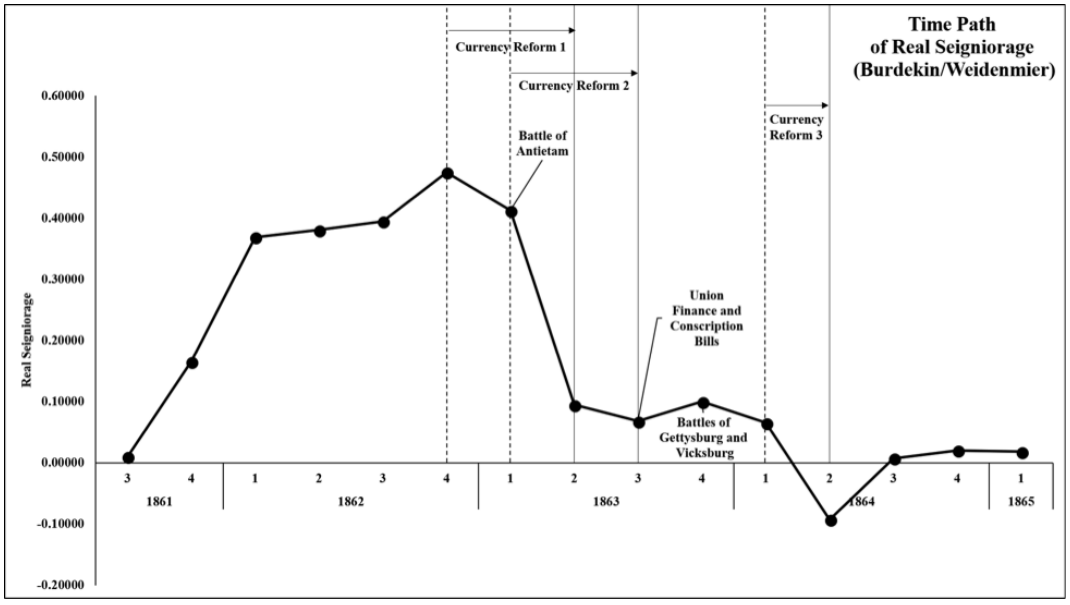

Figure 2.9: Time Path of Real Seigniorage (Burdekin/Weidenmier) Source: Burdekin and Weidenmier (2003, 431), Godfrey (1978, 118-119)

[26]Details of the battles included in the variable are available from the authors upon request. We thank Richard Burdekin for his assistance with recreating variable.

The time paths of each real seigniorage series are illustrated in Figures 2.9 and 2.10. The figures also include the dates of the currency reforms – the dashed lines indicate when the currency reform was passed by the Confederate Congress and the solid lines indicate when the currency reform went into effect. Also included in the figures are the dates included in the war news variable. Given the high degree of correlation between the two series, their time paths follow approximately the same pattern. Real seigniorage temporarily increases between the second and fourth quarters of 1863, declines again at the beginning of 1864, and increases slightly until the beginning of 1865.

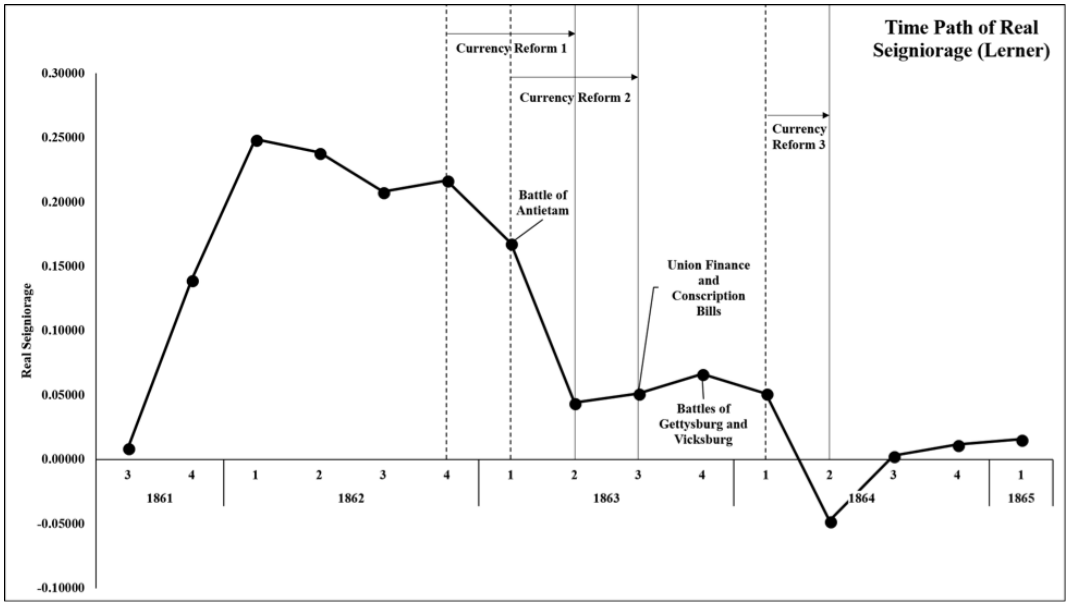

Figure 2.10: Time Path of Real Seigniorage (Lerner) Source: Godfrey (1978, 118-119), Lerner (1955, 24)

Our analysis of seigniorage in the Confederacy is limited to the sample period of 1861:3 – 1865:1 – 15 observations in total. As we noted, the sample is quite small, though the considerable variation in the data somewhat offsets this problem. The results reported in

Tables 2.4 and 2.5 have the change in real seigniorage regressed on the currency reform and lagged currency reform variables, the war news and casualties variables, and a lagged dependent variable.

Table 2.4: Change in Real Seigniorage (Burdekin/Weidenmier)

	(1)	(2)	(3)	(4)
	$\Delta Seigniorage$	$\Delta Seigniorage$	$\Delta Seigniorage$	$\Delta Seigniorage$
Currency Reform (Joint Effect)	-0.184***			
	(0.0317)			
Lagged Currency Reform (Joint Effect)	0.148***			
	(0.0258)			
Currency Reform 1		-0.299***		
		(0.0340)		
Lagged Currency Reform 1		-0.0737		
		(0.0400)		
Currency Reform 2			-0.0578	
			(0.0786)	
Lagged Currency Reform 2			0.234*	
			(0.0911)	
Currency Reform 3				-0.201*
				(0.0887)
Lagged Currency Reform 3				0.0925
				(0.0663)
War News	-0.127***	-0.0572	-0.237*	-0.148
	(0.0248)	(0.0535)	(0.103)	(0.205)
Casualties	-0.0458*	-0.0237	-0.0277	-0.0272
	(0.0192)	(0.0239)	(0.0266)	(0.0358)
Constant	0.0594	0.0474	0.0475	0.0488
	(0.0537)	(0.0418)	(0.0404)	(0.0362)
Lagged Dependent Variable	0.738**	0.125	0.0774	0.118
	(0.231)	(0.382)	(0.411)	(0.857)
Constant	0.0469***	0.0871***	0.0979***	0.0929***
	(0.00603)	(0.0170)	(0.0159)	(0.0199)
Observations	14	14	14	14
R-Squared‡	0.8470	0.5304	0.5304	0.4671

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
‡ A measure of the correlation coefficient that does not depend on a linear estimation is the squared correlation between observed and in-sample forecast values. This is the version of R-Squared in the table.

For the Burdekin and Weidenmier seigniorage series, the coefficient estimate for the joint currency reform variable is negative and statistically significant at the 99.9 percent

level, and the coefficient estimate for the lagged joint currency reform variable is positive and similarly significant, which indicates that the rate of monetary expansion in the South was below that which would have maximized the revenue from seigniorage. In other words, the reforms reduced the flow of seigniorage and the subsequent increases in the rate of monetary expansion generated additional seigniorage revenue, which is consistent with the Confederacy operating on the left-hand side of the curve in Figure 2.6. We also find that the coefficient estimates for the war news and casualty variables have the expected signs and are statistically significant at the 99.9 and 95 percent level, respectively.

Turning to the effects of the individual reforms, the initial effect of the first reform is negative and statistically significant at the 99.9 percent level; however, the lagged effect is not statistically significantly different than 0, which is likely explained by the relatively small increase in the growth rate of Treasury notes following the first reform. Likewise, the initial effect of the third reform was negative and statistically significant at the 95 percent level while the lagged effect was not statistically significantly different than 0, which is somewhat surprising since the growth rate of Treasury notes following the implementation of the final reform was relatively large. Thus, while we find that the effect of the first and third reforms was to reduce the flow of seigniorage, we did not find that the subsequent increases in the growth rate of Confederate Treasury notes affected the flow of seigniorage. In the case of the first and third reforms, we also find that neither the war news or casualties variables were statistically significant. Unlike the first and third reforms, however, we find that the lagged effect of the second reform is positive and statistically significant at the 95 percent level while the initial effect is not statistically significantly different than 0. We also find that in the case of the second reform, the coefficient estimate for the war news variable had the expected sign and is statistically significant at the 95 percent level. Like the first and third reforms, our findings indicate that the casualties variable is not statistically significant.

Table 2.5: Change in Real Seigniorage (Lerner)

	(1)	(2)	(3)	(4)
	$\Delta Seigniorage$	$\Delta Seigniorage$	$\Delta Seigniorage$	$\Delta Seigniorage$
Currency Reform (Joint Effect)	-0.0736***			
	(0.00548)			
Lagged Currency Reform (Joint Effect)	0.0782***			
	(0.00750)			
Currency Reform 1		-0.103***		
		(0.0171)		
Lagged Currency Reform 1		-0.0172		
		(0.0290)		
Currency Reform 2			0.00495	
			(0.0460)	
Lagged Currency Reform 2			0.115***	
			(0.0347)	
Currency Reform 3				-0.0913***
				(0.0117)
Lagged Currency Reform 3				0.0615***
				(0.0114)
War News	-0.0571***	-0.0310	-0.103*	-0.0468
	(0.00799)	(0.0349)	(0.0464)	(0.0329)
Casualties	-0.0248	-0.0213*	-0.0245*	-0.0238
	(0.0193)	(0.0104)	(0.00994)	(0.0132)
Constant	0.0432	0.0247	0.0240	0.0266
	(0.0735)	(0.0308)	(0.0300)	(0.0363)
Lagged Dependent Variable	0.865**	0.318	0.318	0.539
	(0.200)	(0.393)	(0.463)	(0.352)
Constant	0.0282***	0.0527***	0.0531***	0.0452***
	(0.00725)	(0.00915)	(0.00913)	(0.00751)
Observations	14	14	14	14
R-Squared‡	0.7370	0.3593	0.3520	0.4945

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
‡ A measure of the correlation coefficient that does not depend on a linear estimation is the squared correlation between observed and in-sample forecast values. This is the version of R-Squared in the table.

Like the Burdekin and Weidenmier series, the coefficient estimate for the joint currency reform variable for the Lerner series is negative and statistically significant at the 99.9 percent level, and the coefficient estimate for the lagged joint currency reform variable is positive and similarly significant, which again indicates that the rate of monetary expansion in the South was below that which would have maximized the revenue from seigniorage. Unlike the Burdekin and Weidenmier series, however, the casualties variable is not statistically significant for the joint specification. Another difference between the two series is that in the case of the third currency reform, both the initial and lagged effect are statistically significant at the 99.9 percent level. Finally, in the case of the first and second currency reforms, we find that the coefficient estimate for the casualties variable has the expected sign and is statistically significant at the 95 percent level. Overall, the analysis of the Lerner series is consistent with our previous findings and again suggests that the South was operating on the inelastic section of the money demand curve.

We also employed a Prais-Winsten (PW) procedure to remove the effect that the autocorrelation may have had on our estimates. This procedure is essentially a data transformation wherein each observation is multiplied by $\sqrt{1-\theta^2}$, where θ represents the fraction of autocorrelation. Subtracting from 1 combined with the monotonic square and root transformations captures the fraction of each observation unaffected by the prior period. In other words, we apply a weight to each variable to eliminate the deterministic process effect that may bias our results. Table 2.6 reports the results of the PW procedure.

Table 2.6: Change in Real Seigniorage

	(1)	(2)
	Δ Seigniorage (Burdekin/Weidenmier)	Δ Seigniorage (Lerner)
Currency Reform (Joint Effect)	-0.187***	-0.0785***
	(0.0337)	(0.0110)
Lagged Currency Reform (Joint Effect)	0.145***	0.0739***
	(0.0290)	(0.0124)
War News	-0.128**	-0.0606**
	(0.0284)	(0.0138)
Casualties	-0.0451*	-0.0247
	(0.0199)	(0.0180)
Constant	0.0582	0.0312
	(0.0546)	(0.0416)
Observations	14	14
R-Squared	0.880	0.787

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Using the PW procedure for both series, the initial and lagged joint effect of the currency reforms are statistically significant at the 99.9 percent level. For each series, the coefficient estimate for the initial joint reform variable is negative whereas the estimate for the lagged joint reform variable is positive. In other words, the results generated by the PW procedure confirm our previous results that the rate of monetary expansion in the Confederacy was below that which would have maximized the revenue from seigniorage. Finally, our findings also indicate that the coefficient estimate for the war news variable has the expected sign and was statistically significant at the 99 percent level for both series, while the casualties variable was only found to be statistically significant at the 95 percent level for the Burdekin and Weidenmier series.

What do our findings imply about the magnitude of the currency reforms' effect on seigniorage revenue? To answer this question, we performed a logarithmic transformation of each series both to address the issue of non-stationarity present in each series and estimate the size of the reduction in real seigniorage in percentage terms. Even after the transformation, the Burdekin & Weidenmier series still exhibited evidence of a non-stationary process, thus our analysis of the magnitude of the reforms' effect on the flow of seigniorage is limited to the Lerner series.[27] Moreover, because the observation for 1864:3 is negative, we were forced to drop that observation from our regression. Doing so biases our results significantly because this observation is associated with the final, and most substantial reform. Thus, the coefficient estimate will be biased upward (note that we expect the sign of the estimate to be negative), i.e., it will understate the magnitude of the reforms' effect on the flow of seigniorage.

Using the PW procedure, we regressed the natural logarithm of the Lerner series on the reform and lagged-reform variables as well as on the war news and casualties variables. The results are reported in Table 2.7. Our findings indicate that the currency reforms reduced the flow of seigniorage by approximately 57 percent.[28] Note, that in absolute value

[27]Details are available from the authors upon request.

[28]Because the estimated magnitude in Table 2.7 is greater in absolute terms than .1, the interpretation of the coefficient estimate is as follows:

terms this estimate is a lower-bound, or best-case assessment of the reforms' effect due to the missing observation discussed in the previous paragraph. Also note, that this finding refers to a reduction in the flow of seigniorage rather than the cumulative amount, which is equal to the summation of the flows. Because the effect of the currency reforms on the flow of seigniorage would have had a compounding effect on the total amount of seigniorage collected, the cumulative effect of the currency reforms was likely much larger than 57 percent, but it is impossible to say by precisely how much. What is clear, however, is that the currency reforms had an economically significant effect on the South's most effective source of revenue.

$$\%\Delta Seigniorage = 100x(e^{-.852} - 1)$$

Thus, the percent change is equal to 57.344 percent.

Table 2.7: Percent Change in Real Seigniorage

	(1)
	Δ Seigniorage (Lerner)
Currency Reform (Joint Effect)	-0.852*
	(0.271)
Lagged Currency Reform (Joint Effect)	-0.405
	(0.508)
War News	-0.163
	(0.320)
Casualties	-0.0231
	(0.0729)
Constant	-3.403*
	(1.205)
Observations	13
R-Squared	0.589

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.6 Conclusion

The political economy of the Confederacy has been a fertile source of scholarship for economic historians and political scientists alike. We have extended the scope of this literature by examining the political factors that influenced the rebel government's efforts to reform the currency and analyzing how the flow of seigniorage responded to these efforts. Our findings indicate that the primary determinant influencing a legislator's support for the final currency reform was whether he represented an area that was either occupied or disrupted by the advancing Union forces. We argue that this factor bifurcated the Confederate Congress into two groups – those that represented districts where graybacks were no longer circulating, and those that represented the interior of the Confederacy where graybacks were still in use. While the constituencies represented by both groups would benefit from a reduced rate of monetary expansion, those for whom graybacks remained part of their asset portfolios, i.e., those located in the Confederacy's interior, would suffer a loss from the partial repudiation of the outstanding currency. We also find that the rebel government's efforts to reform the currency reduced the flow of seigniorage by at least 57 percent, suggesting that despite being highly inflationary, the South was operating on the inelastic section of their money demand curve. In other words, our results suggest that the rate of monetary expansion in the Confederacy was below that which would have maximized the revenue from seigniorage, which lends support to Schwab's (1968, 69) and Godfrey's (1978, 37) claims about the South's mismanagement of the currency.

Our analysis in this paper does have several limitations, however. First, the lack of roll call voting records for the first two reforms prevents us from examining whether the political factors that influenced the final reform in 1864 were similarly influential in 1862 and 1863. Second, the limited amount of both monetary and voting data is insufficient to allow for any formal causality testing. Thus, our findings are only suggestive. Moreover, we cannot say with certainty that the reforms themselves were exogenous to changes in seigniorage; although, we think that the motivation behind the reforms was driven more by the political factors that we identified than it was by a concern with maximizing the revenue

from seigniorage. Indeed, while it is clear that Confederate policymakers understood the implications of the quantity theory of money, we were unable to find any evidence indicating that they possessed a theoretical understanding of seigniorage similar to that presented in this paper. Third, the extremely limited amount of monetary data prevents us from estimating a money demand function directly. We cannot rule out the possibility that the long-run demand for money shifted over the course of the war, nor can we be certain that the demand for Confederate Treasury notes would have remained invariant to increased rates of monetary expansion; however, the evidence from the literature on the demand for money indicates that even during periods of high and volatile inflation the long-run demand for money is stable.[29] Nonetheless, the demand for graybacks may have contracted significantly had the rebel government made no effort to control inflation. Consequently, there is no way to be sure that a more consistent effort to fund the war though inflation would not have caused the demand for Confederate Treasury notes to contract.

These limitations aside, our analysis has important implications for the study of the Confederacy. Prior to becoming President of the United States, Abraham Lincoln famously remarked that "A house divided against itself, cannot stand." Perhaps ironically, one of the implications of our research is that it was the bifurcation of the Congress into two groups brought on by the Union's advance into the Confederacy that contributed to the adoption of the disastrous currency reforms, which Secretary Trenholm (1864), Memminger's successor, described in the following way:

> However patriotically intended, it is not to be denied that the measures adopted by Congress for the reform of the currency had the unhappy effect of inspiring the public mind with feelings of fear and distrust as to the course that would ultimately be pursued in relation to that part of the public debt that is represented by the Treasury notes. Apprehensions of ultimate repudiation crept like an all-pervading poison into the minds of the people, and greatly circumscribed and diminished the purchasing power of the notes... it must now be universally

[29] See Choudhry (1995), who finds evidence of a stationary long-run money demand function during inflationary episodes in Argentina, Israel, and Mexico.

admitted that the policy was erroneous.

In 1865, General Robert E. Lee (War of the Rebellion: Armies, 1880, 1143) reported that "insufficient food and non-payment of the troops have more to do with the dissatisfaction than anything else." Echoing Lee's comments, Robert Kean, chief clerk of the Confederate Bureau of War, believed that the primary cause of the South's defeat was the lack of financial resources necessary to properly compensate and equip its soldiers, which in turn led to desertion and demoralization (1957, 243-244). Following the final currency reform in 1864, Confederate forces suffered critical losses including the fall of Atlanta, which likely contributed to Lincoln's reelection. Had the South won these battles and McClellan become President, history may have taken a drastically different course. It is impossible to say whether the South would have won these battles had the Confederate Congress not adopted the reforms. But, to the extent that these battles were lost due to a demoralized army, we do not consider it unreasonable to conclude that at the very least the conflict may have lasted longer than it did had the South pursued a more expansionary monetary policy.

Chapter 3: Assignats or Death[1]

3.1 Introduction

Time and again, governments which rely too much on the printing press to raise revenue face economy-wide skyrocketing prices.[2] There is a longstanding tradition in economics of using such episodes to gain a better understanding of the characteristics of inflationary finance. These episodes expose critical relationships that might otherwise be obscured during normal times (Friedman, 1952). Despite the richness of this tradition, however, there has been comparatively little analysis of inflationary finance from a constitutional perspective, by which we refer to a focus on the rules of the game that define the set of permissible actions and thereby anchor people's expectations of others' behavior (Brennan & Buchanan, 2000). This paper focuses on those rules that constrain the government's money-creation powers. How do these rules affect the public's demand for money, their inflation expectations, and ultimately the government's revenue?

We think that the final years of the French Revolution can shed some light on these questions. Between 1794 and 1796, France experienced an unprecedented period of hyperinflation.[3] Fueled by the need to cover the government's budget deficit, the quantity of paper money - known as *assignats* - exploded, causing the price level in France to increase by more than 18,000 percent. More importantly, government officials adopted a new constitution in the midst of this hyperinflation, one partially designed to address issues that had forced the government to rely on *assignats* in the first place. The coalescence of these two

[1]This chapter was written with fellow GMU students Bryan Cutsinger and Louis Rouanet. During the collaboration Dr. Cutsinger graduated and is now affiliated with Angelo State University.

[2]See Bernholz (2016) for a detailed analysis. See also, Sargent (1982).

[3]Indeed, as Peter Bernholz (2016, p. 15) notes, the French experience with the *assignat* is the only known case of hyperinflation to occur prior to the widespread adoption of discretionary fiat standards in the 20th century.

rare events, hyperinflation and constitutional reform, offers a unique opportunity to study the effects of constitutional change on inflationary finance.

Philip Cagan (1956) and Martin Bailey (1956) both pioneered the now traditional approach to inflationary finance. Their work's most significant contribution implies a limit to the amount of revenue that can be derived from the printing press. Their work, in subsequent years, not only spawned an extensive literature which teased out new theoretical and empirical insights from the original episodes studied by Cagan and Bailey (Barro, 1972; Engsted, 1994; Salemi & Sargent, 1979; Sargent, 1977; Taylor, 1991), but it also inspired examination of other well-known cases of hyperinflation (Bailey & Tavlas, 1985; Cutsinger & Ingber, 2019; Easterly et al., 1995; Frenkel & Taylor, 1993; Friedman, 1971a; Miller & Ndhlela, 2020; Mladenović & Petrović, 2010; Phylaktis & Taylor, 1993). In general, however, this literature has neglected to consider the influence that constitutions have on the effectiveness of inflationary finance.

A related body of research, constitutional political economy, incorporates such political factors into the analysis of money creation. Probably the most well-known work in this area is Brennan & Buchanan's (1981; 2000) analysis of fiscal constitutions. Their work considers the government an independent actor and analyzes how such an actor might behave under alternative sets of institutional constraints. Unlike the literature in the "Bailey-Cagan" tradition, there has been comparatively little empirical work assessing the "constitutional" approach to inflationary finance. The little empirical work that does take seriously the political economy issues associated with money creation generally finds that political instability plays an important role in determining the extent to which governments rely on the printing press for revenue. However, these studies do not analyze the effect of this instability on the public's demand for money (Aisen & Veiga, 2008; Cukierman et al., 1992).

Examining fiscal institutions through the lens of constitutional political economy sheds light on the rules versus discretion debate. We take an approach similar to advocates of monetary rules by exploring whether or not the future path of monetary policy influences the public's behavior in a way that makes it difficult to systematically exploit. In this

literature, the government's objective function reflects a trade off between employment and inflation - the former entering positively and the latter entering negatively. We, by contrast, assume that the government's objective is to extract as much revenue as possible from its monopoly franchise over the creation of money. Therefore while our approach shares a foundation with constitutional political economy (rules matter for setting expectations), it differs in that our revenue-maximizing Leviathan actively seeks to fool the public. In other words, the government can systematically fool people by making it difficult for the public to form expectations about its behavior.

Unsurprisingly, the *assignat*'s inflation has historically been a fertile source of scholarship for monetary economists and economic historians alike. We are not the first to estimate the demand for money during the French Revolution. Brezis & Crouzet (1995) estimated the demand for money and the revenue-maximizing rate of inflation for the entire revolutionary period. Their estimates are problematic for two reasons. First, they rely on an instrumental-approach to estimating the money demand function, which, as David Laidler (1993, pp. 112-133) argues, leads to identification problems. Second, Brezis & Crouzet (1995) consider a much longer period, beginning their analysis in 1792. As Sargent & Velde (1995) have argued, however, the "Bailey-Cagan" approach appears only to apply during periods of hyperinflation, while other periods are better described by other theories of the demand, e.g., legal restrictions and the Real-Bills doctrine. Sargent & Velde's analysis, while informative, did not estimate the demand for money during the hyperinflation nor does it account for the constitutional changes that occurred midway through the episode.

We contribute to work on political economy and hyperinflation in three ways. First, we derive a set of testable implications that can be used to assess the applicability of the "constitutional" approach to hyperinflation. Next, we use the different predictions of each approach in order to analyze the behavior of the public's demand for real money balances between 1794 and 1796. Using data from de Nogaret (1800) and Caron (1909), we find evidence in favor of the "constitutional" approach in the form of structural breaks in the time series of real money balances, breaks which coincide with political events pertaining

to the adoption of the new constitutional regime (known as the *Directoire* (1795-1799)). We also find evidence that the public's sensitivity to inflation shifted in response to these political events, a result best explained by the "constitutional" approach. Finally, our findings indicate that although Sargent & Velde were correct to describe the demand for money during this period as consistent with the "Bailey-Cagan" approach, the demand for money balances was not constant across the period.

As we explain in Section 3.3, the limited number of observations available prevents us from measuring how sensitive the public's demand for money was with respect to changes in the inflation rate using a standard Vector Error Correction Model (VECM) approach. The advantage of this approach is that it is robust to different assumptions about how the public forms their expectations by separating explained short-term variation from long-term variation. Instead, we test for cointegration between money demand and inflation, using several other approaches, for the sake of robustness. In fact, we have statistical evidence for cointegration, even before controlling for the structural breaks. Thus, while our cointegration results lack a high quantity of data, they do increase in precision when consideration for the regime changes are included. With this robustness, we attempt to estimate how sensitive the public's demand for money was with respect to inflation by using an ARMA model. Our estimates indicate that following the adoption of the new constitution the public's demand for money became less sensitive.

Our theory predicts that credible constitutional rules should influence the public's demand for money in straightforward ways. One channel through which rules will affect the public's demand for money is by changing the uncertainty surrounding future inflation. In other words, an effective monetary constitution may conceivably reduce or exacerbate the public's uncertainty surrounding future inflation, but the crucial point is that it will not remain constant. To test whether the constitution adopted in the midst of the *assignat* hyperinflation was a binding constraint on the government's ability to create money, we use a GARCH model to measure inflation uncertainty across the regimes. We find evidence

suggesting that the new constitution likely increased the variation in inflation, or inflation uncertainty, which is consistent with our observed change in how sensitive the public's demand for money was with respect to inflation.

We proceed as follows: Section 3.2 provides an overview of the "Bailey-Cagan" and constitutional approaches, before then deriving a set of testable implications that can be used to assess both. In Section 3.3, we provide a detailed history of this period in order to contextualize the empirical analysis presented in Section 3.4. The final section concludes.

3.2 Rules, Seigniorage, and the Demand for Money

Before proceeding to our empirical analysis, a brief overview of the two distinct "Bailey-Cagan" and "Brennan-Buchanan" approaches is in order. The former focuses on deriving the revenue-maximizing rate of money growth, whereas the latter focuses on the rules - both implicit and explicit - that constrain the government's money-creation powers. In our view, the two approaches are not necessarily at odds with one another. Rather, as we will attempt to demonstrate in this, and the remaining sections, the two approaches are complementary in that they yield a richer understanding of inflationary finance when utilized together.

To highlight the complementarity between these two approaches, we use a simple model of money that begins with three assumptions: (1) the government has a monopoly over money creation such that the supply of money consists solely of liabilities issued by the government; (2) the economy is closed and in stationary equilibrium; and (3) the government operates with an infinite time horizon. In the first period, the government creates a stock of money that it offers to the public in exchange for real resources. To induce the public to accept its offer, the government permits the public to use its liabilities to pay their taxes in subsequent periods, and then issues an amount of money equivalent to that just collected, ensuring that the price level remains constant over time.

If the public accepts this exchange, the government will receive an interest-free loan worth the real value of the money stock. To make this point more concrete, consider the following example. Let's say that the government exchanges $100 worth of newly-created

money for an equivalent amount of real resources from the public in the first period. Had the government borrowed via traditional means, it would have to return the principal plus interest. But, because the public gave up the $100 worth of real resources in exchange for the liquidity services that the government-issued money provides, the authority need only return the principal, $100. At an interest rate of 10%, the monopoly franchise confers a benefit to the government worth $10 per period in perpetuity, which is equal to $100 - the real value of the money stock. Thus, even with zero inflation, the government's money-creation powers have implications for raising revenue.

We now turn to the effect that inflation has on the value of the government's monopoly franchise. Consider the demand curve for real money balances depicted in Figure 3.1. The x-axis measures the quantity of real money balances (denominated in initial period dollars), m, and the y-axis measures the capitalized cost of holding different quantities of those balances in perpetuity. In the zero-inflation case, the price of a dollar's worth of liquidity services provided by a unit of real money balances is simply $1. The intuition here is straightforward: without inflation, a dollar's worth of real money balances must yield a dollar's worth of liquidity services, at the margin. Since the monopoly franchise entitles the government to the present value of those liquidity services, the value of its franchise is depicted in Figure 3.1 as either the area $0ABC$, or simply $0C$.

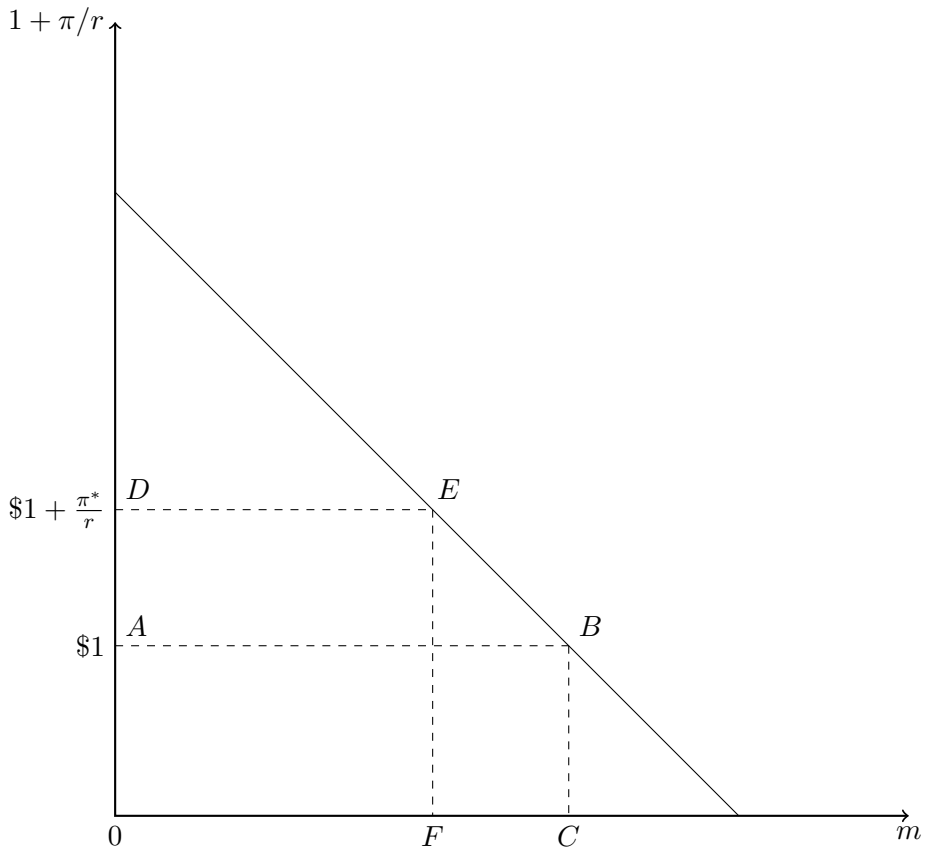

Figure 3.1: The Demand for Real Money Balances

With inflation, the matter is slightly more complicated. The price of holding a unit of real money balances in the positive-inflation case is higher than in the zero-inflation case because maintaining the same stock of real money balances requires additional resources. Assuming that the inflation rate, π, is constant and accurately predicted by the public, the present value of the additional cost that must be incurred to maintain a unit of real money balances in perpetuity is:

$$\frac{\pi}{1+(\pi+r)} + \frac{\pi(1+\pi)}{[1+(\pi+r)]^2} + \cdots + \frac{\pi(1+\pi)^{n-1}}{[1+(\pi+r)]^n} = \frac{\pi}{r} \tag{3.1}$$

Thus, the price of maintaining a dollar's worth of money balances in perpetuity in the positive-inflation regime is:

$$\$1 + \frac{\pi}{r} \tag{3.2}$$

Like the zero-inflation case, the present value of the government's monopoly franchise is equal to the quantity of real money balances that the public holds times the price the government charges the public for those balances. Unlike the zero-inflation case, however, this price now includes the capitalized cost of inflation:

$$m \cdot (\$1 + \frac{\pi}{r}) \tag{3.3}$$

To maximize the present value of its monopoly franchise, the government must select a rate of inflation as follows:

$$\frac{d(\$1 + i/r)m}{di} = 0 \tag{3.4}$$

which, assuming the government can costlessly produce money, occurs where the demand for real money balances is unit elastic. At this "optimal" rate of inflation, π^*, the capital value of the government's money-creation powers is the area $0DEF$ in Figure 1.

That there is a revenue-maximizing rate of inflation relies upon the assumption of perfect foresight, a the key component of the "Bailey-Cagan" approach to inflationary finance. The "Brennan-Buchanan" approach, by contrast, holds that this insight only applies to those cases where the government can credibly commit to π^*. Absent such a binding commitment, the government could always raise additional revenue by selecting an inflation rate in excess of π^* after the public has formed their expectations.

For instance, imagine that after committing to a monetary policy consistent with π^*, the monetary authorities announce a one-time increase in the growth rate of the money supply. Because they based their decision about the quantity of money to hold prior to the change in policy, the public experiences a capital loss. The government, on the other hand,

experiences a capital gain. If the public were to believe that each increase in the growth rate of the money supply in excess of the previously announced policy path was permanent, then the government could collect an amount of revenue approaching $0ABC$ in each period. Using the numbers from our previous example, such a scenario would increase the present value of the government's monopoly franchise from $100 to $1,000.

While the public is not likely to be this myopic, our example illustrates the relationship between the government's revenue from the inflation and the public's expectations of its future behavior. In the "Brennan-Buchanan" approach, the rules governing the government's money-creating power define the monetary regime, which in turn determines the public's expectations, and thereby the money demand function. That is, the revenue-maximizing rate of inflation is institutionally contingent.

This insight suggests several empirical implications. First, estimates of the revenue-maximizing rate of inflation will be biased (up or down) if the public's demand for money shifts during the periods under consideration. Second, because governments tend to rely on inflationary finance during periods of political instability, the rules that govern the creation of money are likely to be unstable, suggesting the existence of multiple monetary regimes during periods of said instability. Finally, the public's estimation of the predictability of the government's future behavior is likely to differ across regimes. Less credible regimes will exhibit a greater degree of inflation uncertainty, implying a higher revenue-maximizing rate of inflation.

$$Y^D = L(\pi_t; E[\pi_{t+1}]) \tag{3.5}$$

$$E[\pi_{t+1}] = \sum_i p_i E[\pi_{t+1}|i] \tag{3.6}$$

3.3 The Data

In order to compare the constitutional approach with that of "Bailey-Cagan", we use data from de Nogaret (1800) on the money supply from April 30, 1794 to June 9, 1796 and from Caron (1909) on the price level. We use the data copied from the Treasuries registers by de Nogaret (1800), who argues that the money supply can be derived from the difference between the number of *assignats* burnt and the number of *assignats* issued by the Treasury. Previous scholars have used the data given by Nogaret in monthly form (Sargent & Velde, 1995), even though his data are given are weekly.[4] As weekly data is better suited for identifying the effect of constitutional change on money demand, we use Nogaret's data in its original form.

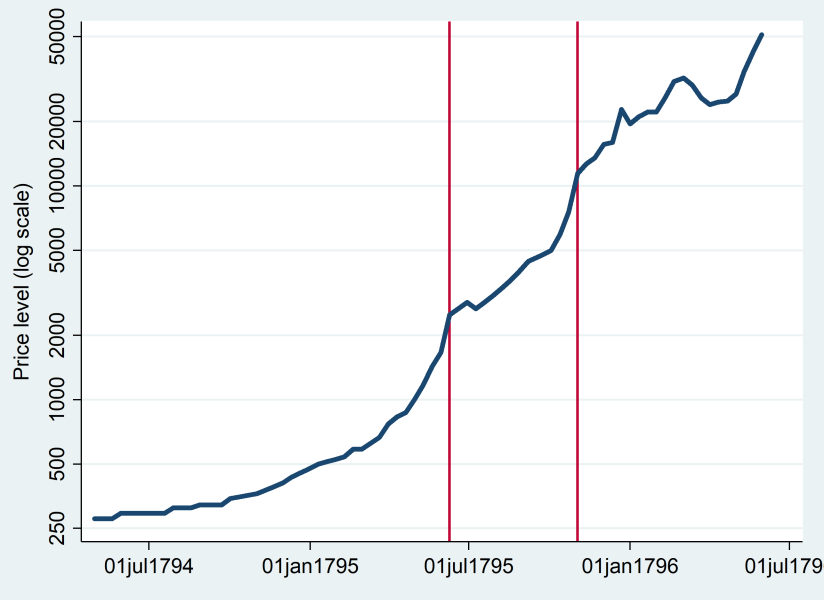

Figure 3.2: Log of the Price level, May 1794-June 1796.
The two red lines represent the two structural breaks identified in section 3.4.

[4]The revolutionary week is not exactly a week. The idiosyncrasies of the French revolutionary calendar means that each week is 10 days long.

Caron (1909)'s data gives the quantity of nuéraire that could be purchased with 100 livres of *assignats*. The data from *Tableaux de Dépréciation* was collected to enable debtors who contracted their debt in *assignat* to settle their debt. The law of June 23, 1797 ordered each department to produce a table accounting for the depreciation of the paper money, based on the price of: a) gold, b) foodstuff, c) real estate and d) other commodities. (E. N. White, 1991, 245) argues that those tables are "a fairly accurate measure of inflation [...], particularly during the last and most rapid phase of inflation."

Over our period of interest, which lasted slightly more than 2 years, prices increased by more than 18,000%. Prices increased by average 6.86% every 10 days in average between April 30, 1794 and June 9, 1796.[5] Although it is difficult to know to what extent departmental figures drawn by local authorities reflect the price of gold, gold and commodity prices do closely follow each other, giving more credibility to our measure of the price level. Although data about commodity prices is relatively scarce, we were able to acquire daily data about a few commodities published in *Le Moniteur* between August and December 1795.[6] Those price series confirm that commodity prices closely followed the price of gold (see Appendix).

In order to get a better picture of the state of public finances, we also draw from the *Archives Parlementaires* and the *Journal des Débats et des décrets* to reconstruct monthly public spending and revenue between 1791 and 1795 as well as data given by Braesch (1934) for the years 1790 and 1791.[7]

[5]The average inflation rate is a geometric mean. Thus, the price index is equal to 277.778,in the first period, and 51063.8 on the last. Hence, $51063.8 = 277.778e^{76x}$, where 76 is the number of periods and solving for x gives the geometrical average of the inflation rate per period.

[6]Those data are consistent and completed with the data published in the *Journal de Paris* during the same period.

[7]With respect to government revenue and spending, most studies (Stourm 1885; Gomel 1892-1905; Hawtrey 1923; Harris 1930) rely on parliamentary archives for a rather cursory view of government finance. Marion (1914) is too unsystematic in his methodology and mixes up ordinary and extraordinary government deficit. Braesch (1934) was the first one to use the original documents used by the committee of finances. Sadly, many relevant documents were burnt during the 1871 Paris commune. Harris (1930) graphs the data but does not systematically mentions his sources.

3.4 Money demand, seigniorage maximization and constitutional change during the French Revolution

3.4.1 *Assignats* or Death

The French Revolution began in May of 1789 as a result of disputes between the King and the parliament of Paris pertaining to issues of public finances. By 1788, government deficits were no longer sustainable: more than 20% of government revenue came from borrowing and nearly 50% of government spending consisted of debt repayments and the interest payments necessary to service the debt (Braesch, 1934). In a desperate attempt to rectify the situation, the King summoned the Estates Generals, but to no avail. Public finances continued to spiral out of control and by 1789 a member of the Committee of Finances Montesquiou (1791) declared that "loans, [the] fatal and last resource of our finances, had even become impossible."

Even though political institutions changed radically with the third-estate declaring themselves the National Assembly on June 17, 1789, the government's fiscal situation remained dire. Over the course of the next decade, successive governments tried to reduce the budget deficit using any means available to them: expropriations, new taxes, the looting of military occupied regions and, more significantly, inflation. The "unpleasant fiscal arithmetic" (Sargent & Velde, 1995) that gripped the *Ancien Régime*, combined with the changes in the tax system operated by the revolutionaries, led inevitably to inflation. Even inflation was not the only problem as an almost ten-fold increase in the deficit followed the declaration of war in April 1792 (Figure 3.3).

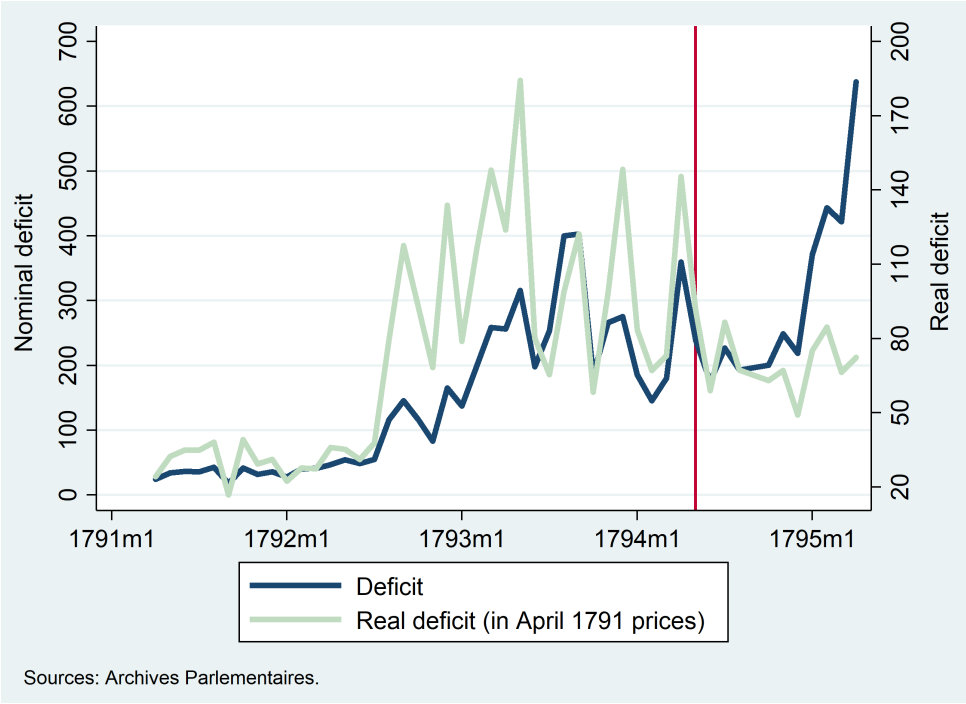

Figure 3.3: Monthly Government Deficit
The red line represents the beginning of our sample based of weekly data.

Hyperinflation started only after the Fall of Robespierre (June 28, 1794). As Sargent & Velde (1995) argue, the French Revolution can be usefully examined through the lens of three alternative monetary theories: (1) The Real-bills doctrine, (2) Legal Restriction Theory, (3) Classical hyperinflation *á la* Cagan. Only after the fall of Robespierre in 1794, Sargent and Velde argue, did the relationship between real money balances and inflation match the process described by Cagan (1956).

Our econometric work suggests that this hyperinflation period can be further disaggregated into three distinct periods, periods which align with important historical events and Constitutional changes. We find two structural breaks in the relationship between real money balances and inflation: the first around June 9, 1795 and the second around November 2, 1795. Both dates correspond to key moments in the establishment of the Constitution

of Year III which established the Directorial regime (1795-1799).

As a historical example of hyperinflation, ours is unique as it spans a constitutional change whose decision-making process lasted from the fall of Robespierre on the 10th of Thermidor Year II (June 28, 1794) through the final nomination of the Directors on the 10th of Brumaire Year IV (November 1, 1795). This regime change is characterized by a long struggle amongst different factions in the National Assembly and in particular the *Girondins* and *Jacobins*.

The *Girondins*, supported most by the countryside and some provincial cities, was expelled from the National Assembly on June 3, 1793 after losing their political battle against the *Jacobins*. They supported a stricter division of power and decentralization. The *Jacobins*, on the other hand, supported the supremacy of the National Assembly and became the architects of the Terror which consisted in *de facto* dictatorship by the Committee of Public Safety. The *Jacobins*, hoping to feed the army and cities, preferred using the coercive force of the State to expropriate resources from the countryside through price controls and forced sales.

The *Jacobins* declared that the goal of price controls, called the *Maximum* and introduced in May 1793, was to limit the depreciation of the *assignats*. The Convention had, progressively, started to control the price of an increasing amount of goods. The war, which required raising a significant amount of real resources, was partly financed through this system of forced requisitions paid at the official price set by the government. As long as the *Jacobins* and Robespierre remained in power, the political support in favor of price controls remained strong. Even after the fall of Robespierre and his faction on July 27, 1794, the so-called Thermidorians - the members of parliament involved in the coup against Robespierre - were reluctant to get rid of the *Maximum*. Despite its disastrous economic consequences, the Thermidorians feared that its suppression would further depreciate the value of the only reliable resource the State had access to: the *assignats* (Sciout, 1895, p.46).

The *Maximum* was associated with a wide array of coercive policies attempting to prop

up the demand for money. For example, the law of April 11, 1793 forbade the sale of metallic currency and double-pricing (i.e. publishing prices in terms of both gold and *assignats*). Severe punishments were established and the Convention even went so far as to punish, by death, people who would express opinions which tend to discredit the *assignats*. The Convention even rewarded informers of such opinions with 100 pounds (Sciout, 1895, p.195).

Historians and observers of the period often conclude that the end of the price controls (December 24, 1794) gave way to hyper-inflation. While the suppression of the *Maximum* does coincide with a rapid rise in the inflation rate and the nominal deficit on the one hand (Figure 3.3) and a fall in real tax revenue on the other (Figure 3.4), we find no evidence that major regulatory changes were associated with structural breaks in the relationship between real money balances and inflation. Neither do those structural breaks correspond to major battles or diplomatic events. Instead, those structural breaks correspond best with key historical events leading to the establishment of the Directorial Regime. Changes in expectations over the tax status of the *assignats* may also have played a role as well.

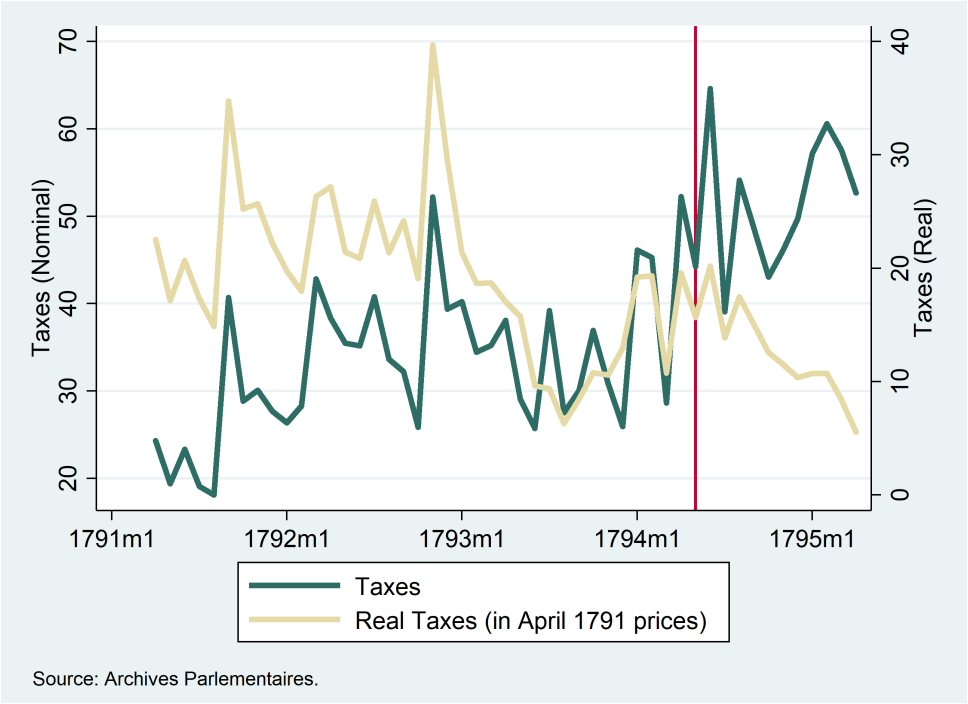

Figure 3.4: Monthly Government Tax Revenues
The red line represents the beginning of our sample based of weekly data.

Monetary "policy" did receive a significant amount of attention by politicians at the end of the Convention. By February 1795 Cambon proposed a plan to burn 3 to 4 billion pounds of *assignats*.[8] During the last weeks of the Convention, leading politicians worried that inflation might become uncontrollable, a coup would occur, and they would be killed. The president of the Committee of Public Safety, Cambacérès, declared during a session that if inflation continues "well, we run the risk of being hooked to the lantern."[9] "*Assignat* or death," was not a simple rhetorical quip, it was a grim possibility for politicians at the time. The Constitution of Year III specified the functions of the Treasury in order to avoid abuses that occurred during the Convention.

The idea that the public takes into account constitutional changes in its decision to hold

[8] *Le Messager du Soir*, n°921, February 26, 1795.
[9] Lamp posts served as an instrument to mobs to perform improvise lynchings and executions in Paris during the revolution.

money balances seems supported by both the quantitative and qualitative evidence of late 18th century France. Numerous police reports and newspaper articles refer to the impact of a change in the Constitution on the value of *assignats*. For instance on June 28, 1795, the *Courrier français* links constitutional change to inflation:

> We must believe that the hope of a new Constitution would bring consolation in the hearts and would reduce the price of commodities. Whatever the cause, the price of goods and particularly that of edibles has increased by almost a third. This circumstance should hasten the debates to which the new plan of Constitution will give rise, and above all determine the government to put a very prompt economy in its finances (Aulard, 1899, 42).

Similarly, a police report declared on June 20, 1795 that "organic laws occupy people's minds, as well as the restoration of finances" (**?**, 26) and on June 23, 1795, the police reported how Parisians in coffee shops, after speaking of the rise in the price of gold and silver, declared that "Courage and patience is needed; it is only gradually [...] that the Constitution will be organized, that the price of foodstuffs will decrease and abundance will be reborn with trust." (Aulard, 1899, 31). The concerns expressed about the Constitution and inflation in the second part of June 1795 correspond to the first structural break we identify econometrically in section 3.4.3.

3.4.2 Cointegration

Use of the Cagan model, which stipulates a stable money demand function during a hyperinflation, requires cointegration between demand for cash balances and the course of inflation. That is, for Cagan to apply, a linear combination of the integrated variables, money supply and changes in inflation, must have a long-run stationary distribution. Following Engle & Granger (1987), cointegration tests are applied using residual-based models

that test for unit-root.[10] Rejection of the null hypothesis in this context implies cointegration, while acceptance of the null hypothesis suggests a lack of cointegration. Similarly, Johansen (1988) developed a method to test for cointegration using a vector autoregressive model to tease out the possibility of a long run steady-state effect. Here again, rejection of the null offers evidence of cointegration. As seen in table 3.1, both methods suggest that a linear combination exists and therefore a long-run asymptotic relationship.

Table 3.1: Cointegration Tests Across the Entire Hyperinflation Period

Engle-Granger Test for Cointegration

	Test Statistic	1% Critical Value	5% Critical Value
Z_t	**4.36****	4.543	3.911

Johansen Test for Cointegration

Rank	Eigenvalue	Trace Statistic	5% Critical Value
0	-	15.793	15.410
1	0.192	**0.238***	3.760
2	0.003		

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Naturally, then, it follows that we ought to estimate Cagan's α.[11] Table 3.4, column 4, estimates Cagan's α at -0.525, implying that money holders are relatively insensitive to changes in inflation. This estimate of alpha suggests a 10-day seigniorage maximizing rate of 190.48% over an average 6.86% change in inflation.[12] The interpretation here would be

[10] According to Engle & Granger (1987) evidence of cointegration exists if u_t is integrated of degree zero, $u_t \sim I(0)$, provided that $y_t \sim I(1)$ and $x_t \sim I(1)$. Higher orders of cointegration for y_t and x_t are possible if they are of the same order of integration, and the linear combination is integration of one less order than y_t and x_t. The residuals are tested for unit roots, using bias-corrected first-order serial correlation test statistics: the three common test statistics are provided by the augmented Dickey–Fuller (ADF) test (suggested by Engle & Granger (1987)), and the Z_a and Z_t tests (suggested by Phillips 1987).

[11] For replication, an ARMA (4,2) model was selected according to its autocorrelation requirements. Ideally, a vector error correction model (VECM) would be used for its Johansen long-term estimation power. However, as we shall see, we will need to control for regime breaks, which will limit our sample size and thus, limit the underlying variation required in a VECM.

[12] The seigniorage maximizing rate is calculated as $-\alpha^{-1}$. The average inflation rate is a geometric mean.

that the government prints currency at a sub-optimal rate compared to that of their revenue maximizing rate.

3.4.3 Structural breaks in the Money-demand function

Zivot & Andrews (2002), Perron (1989, 1990), and Hansen (1992a,b) show that tests for cointegration have low power in the presence of structural breaks that are not considered. Thus, it would seem almost unnecessary to test for structural breaks. However, the confounding result described above and the visual analysis of the data, as seen in the figure 3.4.3, suggest such structural regime changes.

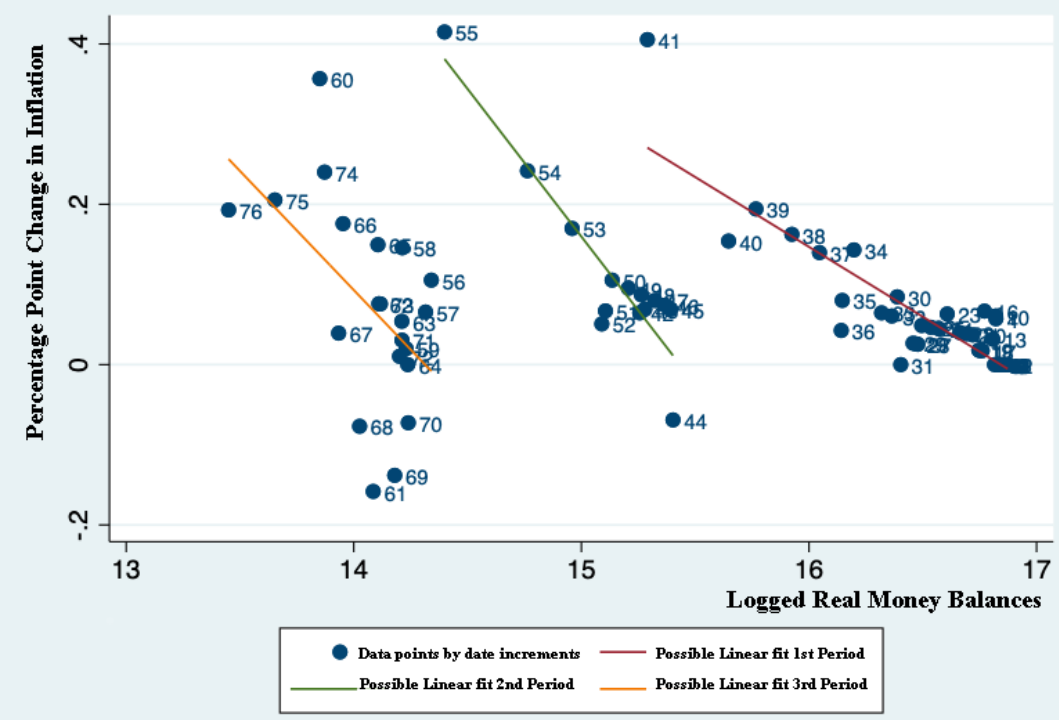

Figure 3.5: Possible Structural Break Plot

See footnote 5.

Following Quandt (1960), Kim & Siegmund (1989), and Andrews (1993), we test for structural breaks without imposing a known break date by combining the test statistics computed for each possible break date in the sample. We use the supremum Wald test. Once we can verify the existence of the first break, we continue to restrict the sample until no statistical evidence for breaks remain. We find two breaks in the data, described in the following table.

Table 3.2: Evidence for Two Structural Breaks
Wald Test for a Structural Break †

Sample Size†	75	53
Supremum Wald Statistic	**620.89*** **	**800.66*** **
P-value	0.000	0.000
Break Date††	November 2, 1795	June 9, 1795

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
†The sample size changes to test for additional structural breaks, after the first is removed from the sample.
††The table describes evidence of two regime breaks, one in June 1795 and the other in November 1795.

Equipped with evidence of structural breaks, the possibility of a better specified cointegration test (where the cointegrating vector can change during the sample period) emerges. Therefore, we conducted an additional cointegration test. Cointegration under regime change[13] is an extension of Engle & Granger (1987), a technique developed by Gregory & Hansen (1996) and then Hatemi-J (2008). In addition, it is worth noting that the Hatemi-J method serves as a robustness check on the periods selected in the structural break analysis. Here we find yet stronger evidence for a long-run stationary relationship between cash balances and the course of inflation. We turn next to the political economy associated with

[13]By a regime shift it is meant that there is a change in both the intercept and the slope parameters.

the two structural breaks.

Table 3.3: Cointegration Tests With Regime Changes

Gregory-Hansen Cointegration Test with Hatemi-J Modification

	Test Statistic	1% Critical Value	5% Critical Value
Z_t	**3.36*** **	3.549	2.912

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

First regime change: June 1795

The fall of Robespierre was an internal coup by members of Robespierre's own political group rather than a fundamental constitutional change. It was Tallien, Cambon, and other *Jacobins* who overthrew Robespierre and the Montagnards. It was only progressively that the coup of Thermidor led to the marginalisation of the *Jacobins* and the return of the *Girondins* who were previously expelled. The first step was the closing of the Parisian *Jacobin*'s club on November 11, 1794. The second was the reinstatement of 73 *Girondin*s in the assembly on March 5 of the same year. Among others, La Revellière came back to the Convention in March 1795, was appointed to the Committee of Public Safety during the last few weeks of the regime, and participated to the redaction of the Constitution of Year III establishing the political institutions of the Directory. Other members of the "eleven" - those in charge of writing the new Constitution - such as Daunou, Louvet de Couvray, Boissy d'Anglas, Lanjuinais or Lesage were all former *Girondins* or close to them.

Even after the reinstatement of the *Girondins*, however, it was still unclear whether or not a new Constitution would be drafted. The "Thermidorians" seemed likely to make marginal changes in the political institutions established by the Constitution of 1793 rather than create a new regime. Barére and Audoin had already proposed the formation of a

commission to draft a new Constitution on November 14, 1794 and a similar proposition was made by Fréron in March 1795. Both were rejected. As a rule, leading politicians in the Convention such as Sieyès or Cambacérès were scared that the Montagnards and Parisian *sans-culottes* would revolt against any attempts to change the constitution of 1793 and guillotine them. It is only after the failed revolt of the Sans-Culottes on the April 23, 1795 that the Convention decided to name a commission of eleven parliamentarians charged with transforming the Constitution of 1793 in favor of the Thermidorians. Hence, even after the revolt of April 23, it was by no means clear that a new Constitution would be drafted (de La Révellière-Lépeaux, 1895, 229). Fearing a Montagnards resurgence, influential politicians such as Sieyès refused to give any advice to the committee of the eleven (de La Révellière-Lépeaux, 1895, 242).

The adoption of a new Constitution became much more likely only after the Montagnards and *sans-culottes* opposition were crushed in an attempted coup in late May 1795, just before the first structural break we identify in section 3.4.3. As Larevillière, himself a member of the Committee drafting the new Constitution, writes in his memoirs, "We had to fear the fierce opposition of the anarchists in the Convention, still numerous, and furious of their upcoming nullity" (de La Révellière-Lépeaux, 1895, 236). This insurrection of Prairial 1 to 4 (May 20 to 23, 1795) was not benign. It almost succeeded. The Parisian *sans-culottes*, after killing a member of parliament, presented his head on the spike to the president of the National Assembly. The crowd invaded the Convention, yelling their slogan: "Bread and the Constitution of 1793."[14] It took the government 3 days to disarm the Parisian sections.[15] *Le Courrier républicain* reports that: "Never had such a thing been seen since the existence of this great city, neither on the 14th of July, nor on the 10th of August, nor on the 31st of May."[16] The General Menou, with 40,000 men, had to face 60,000 protestors, equipped with guns, canons and protected behind barricades.

[14]The 1793 Constitution was the one ratified when the National Assembly was still controlled by the Montagnard *Jacobin*s. Given the fall of Robespierre, this Constitution was never enforced.

[15]The Sections were subdivisions of Paris during the French Revolution which often organized political uprisings.

[16]*Le Courrier Républicain*, n°565, May 23, 1795.

After the obliteration of the Montagnard opposition and much political unrest, the public expected a new constitution and therefore changes in inflation. The Parisian police reports that on June 15 1795 people "would still see with the greatest satisfaction [...] the *assignats* take back a credit considerable enough to let go of anxiety. It has also been noted that what mainly occupies the minds, but without agitation, is the expectation of the new government, whose mode must be soon proposed." (Aulard, 1899, 15). That said, some worried that the government would "default" on the *assignats*. On June 17, 1795, we read in a police report: "Dufresnoy says he heard several individuals say they were not surprised at the loss the *assignats* felt, since during the course of next month France was to have a chief, and bankruptcy would be declared." (Aulard, 1899, 20).

On June 23, 1795, Boissy d'Anglas proposed the preliminary project for the Constitution of Year III in front of the Assembly. The probability that a new Constitution, whose principles were based on a) a strict separation of powers, and b) censitary suffrage, became much greater. This date corresponds approximately to the first structural break we find between real money balances and inflation. It also corresponds to a shift in people's expectations about what kind of political regime will prevail.

Second regime change: September 1795

While a new Constitution was proposed by the Committee of the Eleven to the Convention, it was by no means guaranteed that the formation of a new regime would occur. As political uncertainty increased, so did the unpredictability of inflation (Figures 3.7 and 3.8). Even though the Montagnards and *sans-culottes* were crushed during the *Journées de Prairial*, the new Constitution still faced powerful opponents. Rumors of insurgency against the Convention were not uncommon.[17] In addition, Sieyès, on the Thermidor 2 (July 20, 1795), proposed an alternative Constitution to that proposed by the Comittee of the Eleven. As for Cambacérès, he seemed to have tried to postpone indefinitely the adoption of the project proposed by the Committee (de La Révellière-Lépeaux, 1895, 236).

[17]For instance, a rumor that a revolt was planned for the 25 Prairial (June 13 1795) circulated widely for more than a week in Paris and is amply discussed in police reports compiled in **?**.

The new Constitution was nonetheless approved by plebiscite on September 6, 1795. It was followed by a series of attempted coups to avoid its enactment. On October 3, seven Parisian sections declared to be in a state of insurrection. On October 5, the monarchists attempted a coup which failed. With both the *Jacobin*s and the monarchists crushed, the Directory was now able to emerge. Faith in the new Constitution, however, remained uncertain until the very end. As Larevelliere (1895, p. 257-263) explains in his memoirs, the attempted coup by the monarchists gave some Thermidorians an excuse to stop the establishment of the Constitution of Year III and to reestablish the Revolutionary government. After much unrest, the Directorial regime officially started on October 26, less than a week before the second structural break we identify between real money balances and inflation (Section 3.4.3). The 30th the new Congress met for the first time and the first Director was nominated on November 1st. The establishment of the Directorial regime is associated with the second structural break we identify. This gives further credibility to the Constitutional approach to money demand.

The day before the new assembly was formed, a letter by Benjamin Constant suggests that the birth of the new directorial regime was uncertain. He writes in his correspondence:

> The big day has passed [...] the Convention has ceased to be, and the Legislative Body is installed. We have been threatened by many storms [...]. There are no maneuvers that have not been tried, vexatious laws that have not been proposed, attempts that were not made to delay the convening of the legislature and to plunge France back into anarchy. (Constant & Melegari, 1895, 246)

Similarly, the police report that on October 24, two days before the official start of the Directorial regime, some people in Paris "manifested the fear that the work of the Convention would continue beyond the 5th of this month [Brumaire], which would further delay the organization of the constitutional government." (Aulard, 1899, 335).

The structural break we identify also corresponds to a sudden and sharp increase in bond prices. Figure 3.4.3 shows the market price for a perpetual bond yielding an annuity

of 100 pounds. Those *inscriptions* refer to the consolidation of the public debt in 1792 which lead all contracts of the creditors of the state into an inscription in a great book, which should be called the "Great Book of the Public Debt." This reform transformed different claims into perpetual annuities yielding the same interest rate (Thiers, 1845, 320).

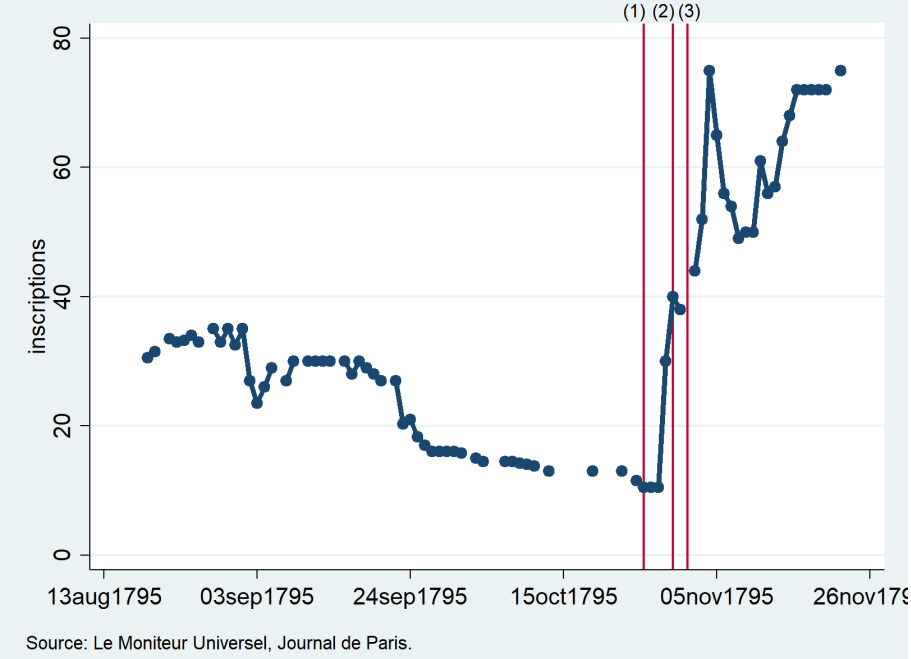

Figure 3.6: Perpetual bond prices during the second regime change.

Lines (1), (2) and (3) in Figure 3.4.3 represent respectively the official start of the Directorial regime (October 26), the beginning of the first session of the new Congress (October 30) and the formation of the executive branch with nomination of the first Director (November 1). The establishment of the new Constitution matches with a more than seven-fold increase in the price of perpetual bonds between October 28 and November 4. This suggests that the structural break in the demand for money we identified corresponds with a radical change in people's expectations vis-à-vis fiscal and monetary policy.

3.4.4 Estimating Cagan and Seigniorage

Having established cointegration under two regime changes, we construct ARMA models in Table 3.4 for each period to estimate Cagan's α, according to the autocorrelation requirements. Our findings for each period are displayed in columns 1 through 3, respectively.

Table 3.4: Estimating Money Demand Using Change in Inflation

	ARMA Models			
	(1)	(2)	(3)	(4)
	1st Period	2nd Period	3rd Period	Entire Period
Change in Inflation	-0.749***	-0.571***	-0.591***	-0.525***
	(0.0788)	(0.126)	(0.179)	(0.0345)
Intercept	16.22***	14.71***	14.04***	15.20***
	(0.643)	(0.668)	(0.237)	(1.490)
ARMA				
Autoregressive Process (AR)				
First AR Lag	0.994***	1.889***	0.927***	1.419*
	(0.0482)	(0.169)	(0.193)	(0.720)
Second AR Lag		-0.925***		-0.428
		(0.184)		(0.913)
Fourth AR Lag				0.00566
				(0.199)
Moving Average (MA)				
First MA Lag				0.669
				(0.741)
Second MA Lag	0.559***			0.209
	(0.107)			(0.585)
Error				
Standard Deviation	0.0451***	0.0488**	0.114***	0.0559***
	(0.00473)	(0.0183)	(0.0246)	(0.00401)
N	40	14	21	75
AIC	-118.3	-27.63	-21.70	-195.9
Seigniorage Weekly Maximum	133.51%	175.13%	173.91%	190.48%
Seigniorage Monthly Maximum	1,173.26%	1,982.67%	2,350.91%	2,450.93%

Robust Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In period 1, the period before the first structural break, we estimate Cagan's α at .749, suggesting that money holders are relatively more sensitive to changes in inflation than our estimate for the whole period. This sensitivity decreases in period 2, .571, and remains within a standard deviation for period 3, .591. These estimates of α are inverted to reveal weekly seigniorage maximizing rates of roughly 134%, 175%, and 174%, respectively. Again, they stand in stark contrast with each of the period's average inflation rates, 5.49%, 10.39%, 6.63%.[18]

We see that the first period demand curve is more elastic than that of the whole period.[19] The second period demand becomes more inelastic, relative to the first. Finally, the elasticity between periods two and three are within a standard deviation.

Despite the fact that the structural breaks divides the sample from 75 observations into periods with 40, 14, and 21 respectively, there is enough variation in the data to provide statistical explanatory at the 99.9% confidence interval for much of the variables. Note that the Akaike Information Criterion (AIC) tends to favor the entire period because of the higher sample size. That is, AIC's asymptotic result is inappropriate when the sample size is small. This is also true of the Bayesian Information Criterion (BIC). The corrected AIC (AICc) of Hurvich and Tsai (1989) modifies the standard AIC with a correction for small sample sizes. Using AICc, the benefits of controlling for the regime change are clear.

Two questions emerge from the empirical results. First, why isn't the regime maximizing the possible revenue from seigniorage? And second, are the estimates of Cagan's α indeed different between the entire period and the structural shifts? The former requires a qualitative political economy analysis since the supporting historical data is unavailable. The latter is an empirical question resolved by a Chow test.

The null hypothesis of the Chow test asserts that coefficients are equal, assuming that the model errors are independent and identically distributed from a normal distribution

[18] As with the entire period, the weekly seigniorage maximizing rate is calculated as $-\alpha^{-1}$. Note that the monthly rate is determined as $(1 + \alpha^{-1})^3 - 1)$. The average inflation rate is the geometric mean of the period.

[19] Here, we describe elasticity in economic terms, where inflation is on the y-axis and money demand on the x-axis. The axes are flipped in the ARMA models and must be interpreted accordingly.

with unknown variance. The results from the Chow test indicate a rejection of the null, that is, the estimates of Cagan's α and of the equation intercepts are uniform across the period. The slopes between first period and the whole are distinct at the 99% confidence level and the intercepts between the third period and the whole are disparate at the 95% level. Thus, the test demonstrates a statistical difference between regime changes.

With evidence of structural breaks, the data constrains Cagan's stability assumption to account for statistical regime changes. It is worth noting the magnitude difference between estimates of Cagan's α. For example, the difference between the estimate in the first period and that of the entire period is approximately 43%. This suggests an economic difference between coefficients beyond just a statistical difference. Thus, this study offers some empirical evidence in support of the constitutional argument.

3.4.5 Estimating The Variation in Inflation Uncertainty

As a robustness check, we consider the likelihood that inflation expectations would become more or less uncertain under a new constitution. Specifically, we do not make the case that uncertainty in inflation expectations increases or decreases. There are arguments for both. On the one hand, we could argue that under some regimes, one might expect additional uncertainty, as the price of holding money undergoes a new discovery process. On the other hand, a new regime could be sufficiently credible so as to make the price of holding money more stable. We avoid arguing either case. Instead, we simply argue that changes in the demand for money, due to regime change, likely changes the ability for demanders to predict inflation. Thus, in this section we use a GARCH model[20] to test the hypothesis that a regime change leads to changes in the uncertainty of inflation expectations.

There is a substantial literature that models the variation in prices, which they term as Relative Price Dispersion (RPD), according the part of inflation that is expected and that which is unexpected. According to Grier & Perry (1998), their application focuses

[20]GARCH stands for generalized, autoregressive conditional heteroskedasticity. Based on the work of Engle (1982) these models assume that the conditional error variance can be described by a time- series model. Moreover, the GARCH estimate of the conditional variance of inflation, allows us to capture uncertainty, as opposed to variability.

"on separating the effects of trend inflation from inflation uncertainty. Other examples include **?** and **?**. All are extensions of the work done by Bollerslev (1986) and Engel (1982). We borrow the aformentioned techniques used in modelling unexpected inflation while also controlling for the periods of regime change.

Before examining the model, it is worth visualizing the data. In Figure 3.7, we see the stationarity of inflation. However, we see volatility changing alongside the periods with statistical structural breaks. We see a similar timing correlation when graphing the variance in inflation, as seen in Figure 3.8.

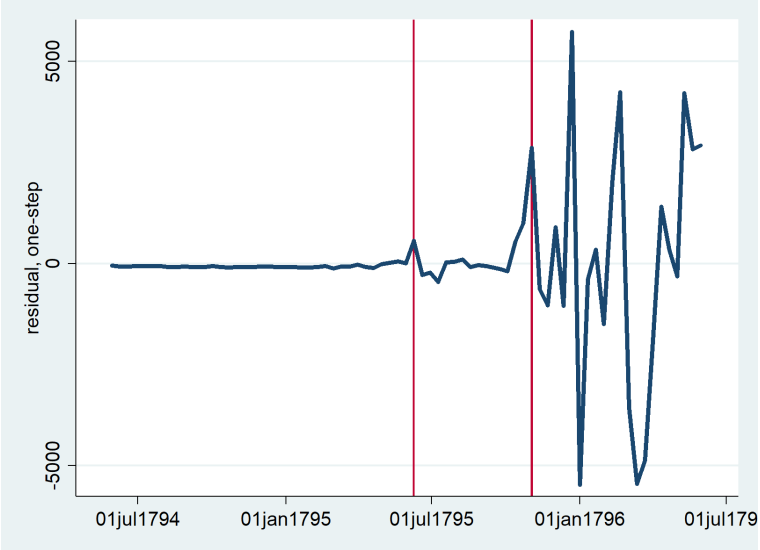

Figure 3.7: Residual Variation in Inflation Uncertainty
The two red lines represent the two structural breaks identified.

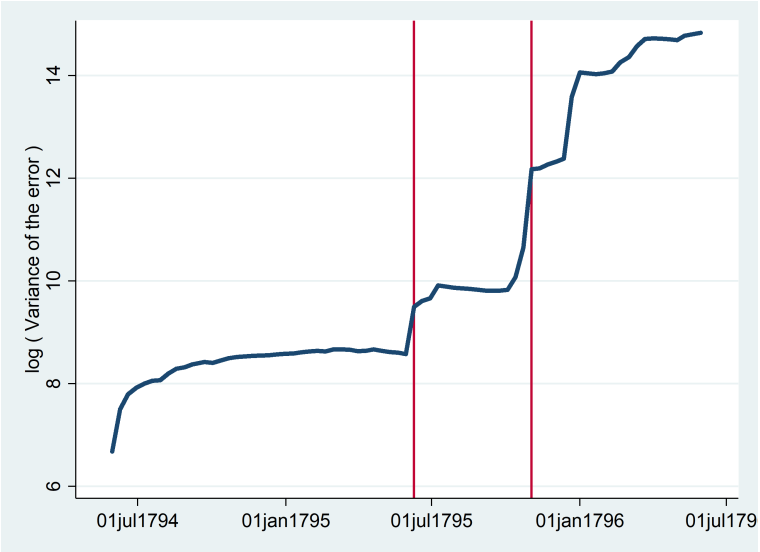

Figure 3.8: Log of the Variance in the Residual Inflation
Note: the two red lines represent the two structural breaks identified.

To model these graphical representations, we use two stages of modeling. In the first, we use an ARMA process to estimate the conditional variance of inflation and a residual component, which signifies the aspect of inflation unexplained by prior inflation knowledge. Then we use a GARCH model to estimate the variance of inflation uncertainty.

$$\pi_t = \beta_0 + \beta_1 \pi_{t-1} + \beta_2 \epsilon_{t-2} \tag{3.7}$$

$$\sigma^2_{\epsilon t} = \alpha_0 + \alpha_1 {\epsilon_{t-2}}^2 + \alpha_2 \sigma^2_{\epsilon_{t-1}} + \alpha_3 RegimeChange \tag{3.8}$$

Equation (3.7) describes the inflation rate as a function of the first lag of inflation and a second-order moving average term. This specification was determined using auto-correlation and partial auto-correlation tests. ϵ_t represents the part of inflation unexplained, or unexpected, by prior inflation. The intercept and autoregressive component is statistically

significant at the 99% level.[21] [22]

$$\pi_t = \underset{(.0260517)}{.0595812} + \underset{(.0899349)}{.2554001}\pi_{t-1} + \underset{(.1335981)}{.258373}\,\epsilon_{t-2}$$

Equation (3.8) is a GARCH model of the conditional variance of inflation uncertainty. The GARCH (2) specification implies that the conditional variance of inflation at time t depends on the prior period's conditional variance and the squared residual, or unexpected inflation from Equation (3.7). In accord with the literature, we use this estimated conditional variance as our time series measure of inflation uncertainty. Table 5 contains our results.

[21] The second-order moving average corresponds with a p-value of 0.054. While just below the 95th percentile threshold, its inclusion is substantiated with autocorrelation, Chi-squared, and AIC tests. Moreover, its usage becomes statistically significant in the forthcoming GARCH model. That is, slight unexplained persistence in inflation uncertainty contributes to relevant persistence in the conditional variance of inflation uncertainty.

[22] Standard Errors are in parenthesis. Robust variance estimates are not generally robust to ARMA components. See Hamilton (1994)

Table 3.5: Estimating Inflation Uncertainty

	GARCH Model Conditional Variance of Inflation Uncertainty
Inflation Uncertainty	
Regime	0.0637***
	(0.0120)
Intercept	0.0387***
	(0.00437)
1st-Order ARCH	1.440***
i.e., Lagged Inflation Uncertainty	(0.342)
2nd-Order GARCH	0.179*
i.e., 2nd Lag - Residual Inflation Variation	(0.0715)
Intercept	0.000201
	(0.000212)
N	75
AIC	-165.1

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results suggest that there are autoregressive and moving average components. In other words, inflation uncertainty is a function of both expected and unexpected priors. More importantly, we see that a regime change[23] likely increases the variation in inflation, or inflation uncertainty. We can imagine cases where the opposite effect is the case[24], but that there is any effect at all follows this important fact: a regime change effects the stability of the demand curve and inflation uncertainty.

3.5 Conclusion

The purpose of this paper was to determine how constitutional change affects the public's demand for money and the maximum amount of revenue the government can collect from

[23]Here regime represents a binary variable, 1 if the period is after the structural break and 0 otherwise. We did test results that separate the first break from the second. Those models show similar statistical results, albeit the model explains less variation in unexpected inflation overall. This is due to the few observations available between the first and second breaks.

[24]It is possible, and the subject of a follow-up paper, that dollarization in Ecuador represented a stabilizing effect on inflation expectations.

money creation. We found that the demand for money responded to political events that portended future changes in the monetary regime, and that the public's response was consistent with greater restrictions on the power to tax their money holdings. In other words, our findings indicate that monetary institutions matter.

We believe that our analysis has important implications for how economists study hyperinflation more generally. Many of the most well-known studies of such episodes neglect the influence that rules over the creation of money have on the public's demand for money. As we endeavored to show in this paper, the demand for money is not invariant to the rules governing its creation. Future research should reexamine the episodes of hyperinflation that have already received considerable attention. One of the consistent findings in the literature on inflationary finance is that governments fail to maximize the revenue seigniorage. We think that our analysis may help to explain why. Namely, the rules governing the creation of money influence the public's demand for money in a manner that makes the notion of a seigniorage maximizing rate of inflation contingent on a binding monetary rule. Absent such a rule, the public's demand for money will fluctuate in response to the government's behavior.

If our conjecture is correct, then the idea that the government faces a menu of seigniorage and inflation combinations is incorrect. Any attempt to exploit this relationship will cause the public's demand for money to shift in response to this exploitation. Thus, the notion of a Bailey Curve is similar to that of the Philip's Curve. That is, given a set of expectations, there is a short-run relationship between seigniorage and inflation of the sort predicted by Bailey. However, any attempt to exploit this relationship will cause it to breakdown. In other words, the public's demand for money is institutionally contingent. Different institutions are capable of producing different amounts of seigniorage revenue, but it would be inappropriate to discuss the seigniorage-maximizing rate of inflation independent of these rules.

Appendix A: Appendix

A.0.1 Chapter 1: Continuation of Model

Table A.1: Estimating Percent Change in Real GDP

	(1) ln_gdp_real	(2) ln_gdp_real
Canada	2.600***	2.599***
	(0.173)	(0.173)
Chad	0.915***	0.914***
	(0.152)	(0.152)
Chile	3.183***	3.182***
	(0.147)	(0.147)
Colombia	3.029***	3.028***
	(0.176)	(0.176)
Costa Rica	0	0
	(.)	(.)
Cyprus	3.727***	3.727***
	(0.144)	(0.144)
Denmark	0	0
	(.)	(.)
Dominican Republic	1.285***	1.283***
	(0.156)	(0.156)
Ecuador	1.570***	1.570***
	(0.150)	(0.150)
Egypt	3.188***	3.188***
	(0.160)	(0.161)
El Salvador	4.023***	4.023***
	(0.142)	(0.143)
Estonia	4.005***	4.005***
	(0.164)	(0.164)
Ethiopia	3.317***	3.316***
	(0.173)	(0.173)
Fiji	3.018***	3.018***
	(0.173)	(0.173)
Finland	0.631***	0.630***
	(0.144)	(0.144)
France	0	0
	(.)	(.)
Germany	0.354*	0.353*
	(0.142)	(0.142)
Ghana	2.068***	2.067***
	(0.176)	(0.176)
Greece	0	0
	(.)	(.)
Grenada	4.050***	4.050***
	(0.165)	(0.165)
Guatemala	4.793***	4.792***
	(0.170)	(0.170)
Guinea-Bissau	2.360***	2.360***
	(0.145)	(0.145)
Guyana	0	0
	(.)	(.)
Haiti	3.620***	3.620***
	(0.173)	(0.173)
Honduras	0	0
	(.)	(.)
Hungary	2.034***	2.034***
	(0.150)	(0.150)
Iceland	4.034***	4.033***
	(0.156)	(0.156)
India	1.020***	1.019***
	(0.176)	(0.176)
Indonesia	2.241***	2.240***
	(0.163)	(0.163)
Ireland	4.392***	4.392***
	(0.155)	(0.155)
Israel	1.510***	1.509***
	(0.139)	(0.139)
Italy	0	0
	(.)	(.)
Japan	5.457***	5.457***
	(0.171)	(0.171)
Jordan	1.722***	1.722***
	(0.160)	(0.160)
Kenya	0.538***	0.538***
	(0.162)	(0.162)
Kuwait	1.880***	1.880***
	(0.156)	(0.156)
N	603	603
R^2	0.994	0.994

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A.0.2 Chapter 3: Price of gold relative to commodity prices

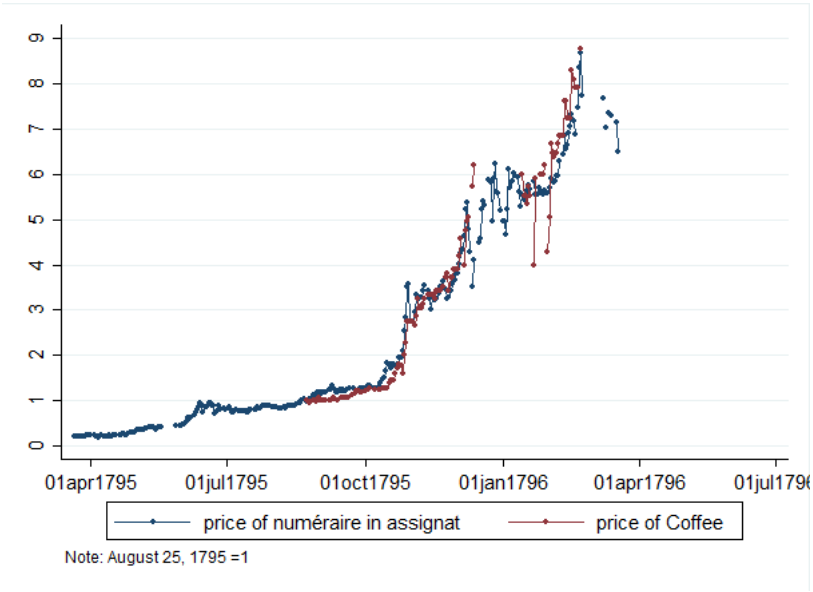

Figure A.1: Price of coffee and prive of gold during the hyperinflation period.

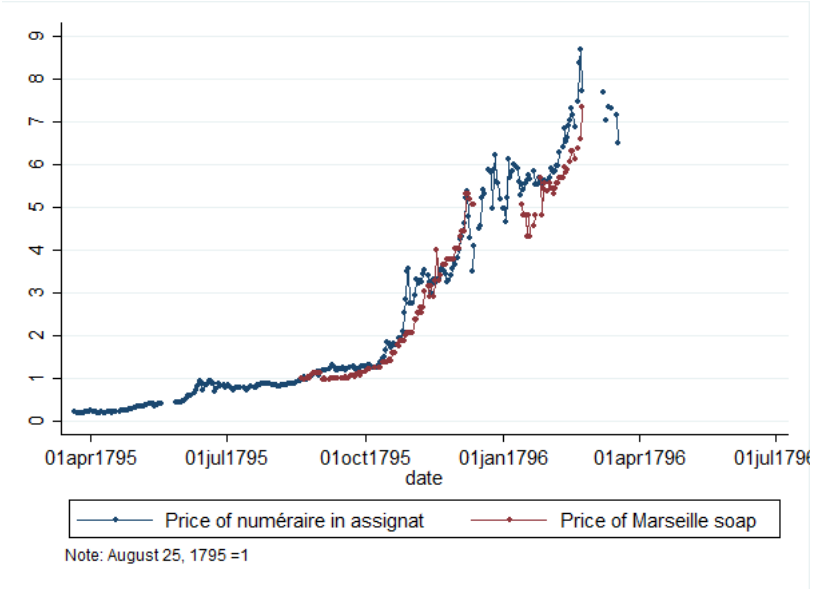

Figure A.2: Price of Marseilles soap and price of gold during the hyperinflation period.

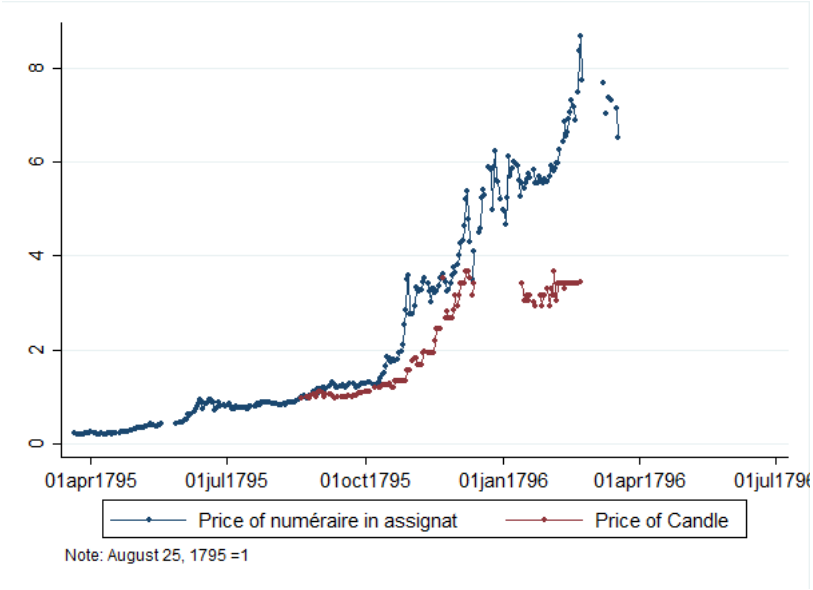

Figure A.3: Price of candles and price of gold during the hyperinflation period.

References

Aisen, A., & Veiga, F. J. (2005, September). *The Political Economy of Seigniorage* (IMF Working Papers No. 05/175). International Monetary Fund. Retrieved from `https://ideas.repec.org/p/imf/imfwpa/05-175.html`

Aisen, A., & Veiga, F. J. (2008). The political economy of seigniorage. *Journal of Development Economics*, *87*(1), 29–50. doi: 10.1016/j.jdeveco.2007.12.006

Aizenman, J. (1992, February). Competitive externalities and the optimal seigniorage. *Journal of Money, Credit & Banking*, *24*(1), 61+. (61)

Alexander, T. B., & Beringer, R. E. (1972). *The anatomy of the confederate congress: a study of the influences of member characteristics on legislative voting behavior, 1861-1865.* Vanderbilt University Press.

Andrews, D. W. K. (1993). Tests for Parameter Instability and Structural Change With Unknown Change Point. *Econometrica*, *61*(4), 821–856.

Auernheimer, L. (1974). The Honest Government's Guide to the Revenue from the Creation of Money. *Journal of Political Economy*, *82*(3), 598–606. Retrieved from `www.jstor.org/stable/1829849`

Aulard, F.-A. (1899). *Paris pendant la reaction thermidorienne et sous le directoire: recueil de documents pour l'histoire de l'esprit publique a Paris* (Vol. 2). Cerf.

Bailey, M. J. (1956). The Welfare Cost of Inflationary Finance. *Journal of Political Economy*, *64*(2), 93–110.

Bailey, M. J., & Tavlas, G. S. (1985). Inflation and the demand for money in Israel. *Economics Letters*, *18*(4), 339–343. doi: 10.1016/0165-1765(85)90049-7

Ball, D. B. (1991). *Financial Failure and Confederate Defeat*. Urbana: University of Illinois Press.

Barro, R. J. (1972). Inflationary Finance and the Welfare Cost of Inflation. *Journal of Political Economy*, *80*(5), 978–1001.

Barro, R. J. (1974). Are Government Bonds Net Wealth? *Journal of Political Economy*, *82*(6), 1095–1117.

Bernhard, M., Nordstrom, T., & Reenock, C. (2001). Economic performance, institutional intermediation, and democratic survival. *Journal of Politics*, *63*(3), 775–803. (Publisher: Wiley Online Library)

Bernholz, P. (2016). *Monetary Regimes and Inflation: History, Economic and Political Relationships, Second Edition* (Second Edition ed.). Northampton, MA: Edward Elgar Publishing, Inc.

Blanchard, O., & Fischer, S. (1989). *Lectures on macroeconomics*. Cambridge, Mass: MIT Press.

Bordo, M. D. (1986). Explorations in monetary history: A survey of the literature. *Explorations in Economic History*, *23*(4), 339–415. doi: 10.1016/0014-4983(86)90001-X

Braesch, F. (1934). *Les exercices budgétaires 1790 et 1791 d'après les comptes du trésor*.

Brender, A. (2003). The effect of fiscal performance on local government election results in Israel: 1989–1998. *Journal of Public Economics*, *87*(9-10), 2187–2205. (Publisher: Elsevier)

Brennan, G., & Buchanan, J. (1981). Revenue Implications of Money Creation under Leviathan. *The American Economic Review*, *71*(2), 347–351.

Brennan, G., & Buchanan, J. (2000). *The Power to Tax: Analytical Foundations of a Fiscal Constitution*. Indianapolis: Liberty Fund.

Brezis, E. S., & Crouzet, F. H. (1995). The Role of Assignats during the French Revolution: An Evil or A Rescuer? *The Journal of European Economic History*, *24*(1), 7–40.

Brown, W. O., & Burdekin, R. C. K. (2000). Turning Points in the U.S. Civil War: A British Perspective. *The Journal of Economic History*, *60*(1), 216–231.

Brunner, K., & Meltzer, A. H. (1971). The Uses of Money: Money in the Theory of an Exchange Economy. *The American Economic Review*, *61*(5), 784–805.

Burdekin, R. C. K., & Langdana, F. K. (1993). War Finance in the Southern Confederacy, 1861-1865. *Explorations in Economic History*, *30*(3), 352–376. doi: 10.1006/exeh.1993.1015

Burdekin, R. C. K., & Weidenmier, M. D. (2001). Inflation Is Always and Everywhere a Monetary Phenomenon: Richmond vs. Houston in 1864. *The American Economic Review*, *91*(5), 1621–1630.

Burdekin, R. C. K., & Weidenmier, M. D. (2003). Suppressing Asset Price Inflation: The Confederate Experience, 1861–1865. *Economic Inquiry*, *41*(3), 420–432. doi: 10.1093/ei/cbg018

Cagan, P. (1956). The Monetary Dynamics of Hyperinflation. In M. Friedman (Ed.), *Studies in the Quantity Theory of Money* (pp. 25–117). The University of Chicago Press.

Calvo, G. A. (1978, August). Optimal Seigniorage from Money Creation: An Analysis in Terms of the Optimum Balance of Payments Deficit Problem. *Journal of Monetary Economics*, 503–517.

Caron, P. (1909). *Tableaux de dépréciation du papier-monnaie*. Impr. nationale, É. Leroux, éditeur.

Chelliah, R. J., Baas, H. J., & Kelly, M. R. (1975, March). Tax Ratios and Tax Effort in Developing Countries, 1969-71 (Pression fiscale et effort fiscal dans les pays en developpement, 1969-71) (Coeficientes y esfuerzo tributarios en los paises en desarrollo, 1969-71). *Staff Papers - International Monetary Fund*, *22*(1), 187. Retrieved 2020-03-16, from http://www.palgrave-journals.com/doifinder/10.2307/3866592 doi: 10.2307/3866592

Choudhry, T. (1995). High inflation rates and the long-run money demand function: Evidence from cointegration tests. *Journal of Macroeconomics*, *17*(1), 77–91. doi: 10.1016/0164-0704(95)80004-2

Click, R. W. (1998). Seigniorage in a Cross-Section of Countries. *Journal of Money, Credit and Banking*, *30*(2), 154–171. Retrieved 2018-05-10, from http://www.jstor.org/stable/2601207 doi: 10.2307/2601207

Confederate States of America., & Memminger, C. G. (1863). *Report of the Secretary of the Treasury.* [Richmond. Retrieved from //catalog.hathitrust.org/Record/010943001

Confederate States of America., & United States. (1904). *Journal of the Congress of the Confederate States of America, 1861-1865.* (No. 7 v.). Washington: Government Printing Office. Retrieved from //catalog.hathitrust.org/Record/007686617

Constant, B., & Melegari, D. (1895). *Journal intime de Benjamin Constant et lettres à sa famille et ses amis.* Paul Ollendorff.

Cukierman, A., Edwards, S., & Tabellini, G. (1992). Seigniorage and Political Instability. *The American Economic Review*, *82*(3), 537–555.

Cutsinger, B. P., & Ingber, J. S. (2019). Seigniorage in the Civil War South. *Explorations in Economic History*, *72*, 74–92. doi: 10.1016/j.eeh.2018.11.001

Davis, G. K., & Pecquet, G. M. (1990). Interest Rates in the Civil War South. *The Journal of Economic History*, *50*(1), 133–148. doi: 10.2307/2123441

de La Révellière-Lépeaux, L.-M. (1895). *Mémoires de Larevellière-Lépeaux membre du Directoire exécutif de la République française...* Plon.

de Nogaret, D.-V. R. (1800). *Des finances de la République française en l'an IX.* Chez H. Agasse, imprimeur-libraire.

Dornbusch, R. (1988). The European Monetary System, the Dollar and the Yen. In F. Giavazzi, S. Micossi, & M. Miller (Eds.), *The European Monetary System,.* Cambridge University Press.

Easterly, W. R., Mauro, P., & Schmidt-Hebbel, K. (1995). Money Demand and Seigniorage-Maximizing Inflation. *Journal of Money, Credit and Banking*, *27*(2), 583–603. doi: 10.2307/2077885

Edwards, S., & Tabellini, G. (1991). Explaining fiscal policies and inflation in developing countries. *Journal of International Money and Finance*, *10*, S16–S48. doi: 10.1016/0261-5606(91)90045-L

Ekelund, R. B., & Hébert, R. F. (2010). Interest-Group Analysis in Economic History and the History of Economic Thought. *Public Choice*, *142*(3/4), 471–480.

Ekelund, R. B., Jackson, J. D., & Thornton, M. (2010). Desperation votes and private interests: an analysis of Confederate trade legislation. *Public Choice*, *144*, 199–214. doi: 10.1007/s11127-009-9511-2

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica: Journal of the Econometric Society*, 987–1007. (Publisher: JSTOR)

Engle, R. F., & Granger, C. W. J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, *55*(2), 251–276.

Engsted, T. (1994). The Classic European Hyperinflations Revisited: Testing the Cagan Model Using a Cointegrated VAR Approach. *Economica*, *61*(243), 331–343. doi: 10.2307/2554619

Fischer, S. (1982). Seigniorage and the Case for a National Money. *Journal of Political Economy*, *90*(2), 295–313. doi: 10.1086/261057

Frenkel, J. A., & Taylor, M. P. (1993). Money demand and inflation in Yugoslavia 1980–1989. *Journal of Macroeconomics*, *15*(3), 455–481. doi: 10.1016/0164-0704(93)90004-6

Friedman, M. (1952). Price, Income, and Monetary Changes in Three Wartime Periods. *The American Economic Review*, *42*(2), 612–625.

Friedman, M. (1953). Discussion of the Inflationary Gap. *Essays in Positive Economics (University of Chicago Press)*.

Friedman, M. (1971a). Government Revenue from Inflation. *Journal of Political Economy*, *79*(4), 846–856. Retrieved 2018-01-10, from `http://www.jstor.org/stable/1830832`

Friedman, M. (1971b). A Monetary Theory of Nominal Income. *Journal of Political Economy*, *79*(2), 323–337. Retrieved 2018-05-07, from `http://www.jstor.org/stable/1832113`

Gentry, J. F. (1970). A Confederate Success in Europe: The Erlanger Loan. *The Journal of Southern History*, *36*(2), 157–188. doi: 10.2307/2205869

Godfrey, J. M. (1978). *Monetary Expansion in the Confederacy*. Arno Press.

Gregory, A. W., & Hansen, B. E. (1996). Tests for Cointegration in Models with Regime and Trend Shifts. *Oxford Bulletin of Economics and Statistics*, *58*(3), 555–560.

Grier, K. B., & Perry, M. J. (1998). On inflation and inflation uncertainty in the G7 countries. *Journal of International Money and Finance*, *17*(4), 671–689. doi: 10.1016/S0261-5606(98)00023-0

Grilli, V. (1989). Seigniorage in Europe. In M. deCecco & A. Giovannini (Eds.), *European Central Bank? Perspectives on Monetary Unification after Ten Years of the EMS.* Cambridge University Press.

Grossman, H. I., & Han, T. (1996). War Debt, Moral Hazard, and the Financing of the Confederacy. *Journal of Money, Credit and Banking*, *28*(2), 200–215. doi: 10.2307/2078023

Hamilton, J. D. (1994). *Time Series Analysis*. Princeton, NJ: Princeton University Press.

Hansen, B. E. (1992a). Consistent Covariance Matrix Estimation for Dependent Heterogeneous Processes. *Econometrica*, *60*(4), 967–972.

Hansen, B. E. (1992b). Tests for Parameter Instability in Regressions with I(1) Processes. *Journal of Business & Economic Statistics*, *10*(3), 321–335.

Hatemi-J, A. (2008). Tests for cointegration with two unknown regime shifts with an application to financial market integration. *Empirical Economics*, *35*(3), 497–505.

Hayek, F. A. v. (1989). The Pretence of Knowledge. *The American Economic Review*, *79*(6), 3–7.

Honohan, P. (1996). Does It Matter How Seigniorage Is Measured. *Applied Financial Economics*, *6*(3), 293–300.

HURVICH, C. M., & TSAI, C.-L. (1989). Regression and time series model selection in small samples. *Biometrika*, *76*(2), 297–307. Retrieved from `https://doi.org/10.1093/biomet/76.2.297` (_eprint: https://academic.oup.com/biomet/article-pdf/76/2/297/737009/76-2-297.pdf) doi: 10.1093/biomet/76.2.297

Jenkins, J. A. (1999). Examining the Bonding Effects of Party: A Comparative Analysis of Roll-Call Voting in the U.S. and Confederate Houses. *American Journal of Political Science*, *43*(4), 1144–1165. doi: 10.2307/2991821

Jenkins, J. A. (2000). Examining the Robustness of Ideological Voting: Evidence from the Confederate House of Representatives. *American Journal of Political Science*, *44*(4), 811–822. doi: 10.2307/2669283

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, *12*(2), 231–254.

Johnson, H. G. (1969). A Note on Seigniorage and the Social Saving from Substituting Credit for Commodity Money. In R. A. Mundell & A. K. Swoboda (Eds.), *Monetary Problems of the International Economy.* University of Chicago Press.

Keynes, J. M. (1923). *A tract on monetary reform,*. London: Macmillan and Co., Limited.

Kim, H.-J., & Siegmund, D. (1989). The Likelihood Ratio Test for a Change-Point in Simple Linear Regression. *Biometrika*, *76*(3), 409–423.

Korosteleva, J. (2007). Maximizing Seigniorage and Inflation Tax: The Case of Belarus. *Eastern European Economics*, *45*(3), 33–50.

Laidler, D. (1993). *The Demand for Money: Theories, Evidence, and Problems* (4th ed.). New York, NY: HarperCollins College Publishers.

Lerner, E. M. (1954). The Monetary and Fiscal Programs of the Confederate Government, 1861-65. *Journal of Political Economy*, *62*(6), 506–522.

Lerner, E. M. (1955). Money, Prices, and Wages in the Confederacy, 1861-65. *Journal of Political Economy*, *63*(1), 20–40. Retrieved from `http://www.jstor.org/stable/1826773`

Lerner, E. M. (1956). Investment Uncertainty During the Civil War–A Note on the McCormick Brothers. *The Journal of Economic History*, *16*(1), 34–40. Retrieved from http://www.jstor.org/stable/2114317

Loviscek, A. L. (1996). Seigniorage and the Mexican financial crisis. *The Quarterly Review of Economics and Finance*, *36*(1), 55–64. doi: 10.1016/S1062-9769(96)90029-0

Mankiw, N. G. (1987). The optimal collection of seigniorage: Theory and evidence. *Journal of Monetary Economics*, *20*(2), 327–341. doi: 10.1016/0304-3932(87)90019-5

Martis, K. C. (1994). *The Historical Atlas of the Congresses of the Confederate States of America 1861-1865* (First Edition edition ed.). New York: Macmillan Library Reference.

McCandless, G. T. (1996). Money, Expectations, and the U.S. Civil War. *The American Economic Review*, *86*(3), 661–671.

McCormick, R. E., & Tollison, R. D. (1981). *Politicians, Legislation, and the Economy: An Inquiry into the Interest-Group Theory of Government*. Hingham, MA: Springer.

McGuire, R. A., & Van Cott, T. N. (2002). The Confederate constitution, tariffs, and the Laffer relationship. *Economic Inquiry*, *40*(3), 428–438.

McKitterick, T. E. M., & Younger, K. (1957). *Fabian international essays*. Praeger.

Memminger, C. G. (1863a). *Report of the Secretary of the Treasury, December 7, 1863*. Richmond, VA: Parrish & Willingham Confederate Imprints.

Memminger, C. G. (1863b). *Report of the Secretary of the Treasury, January 10, 1863*. Richmond, VA: Parrish & Willingham Confederate Imprints.

Menger, K. (1892). On the Origin of Money. *The Economic Journal*, *2*(6), 239–255. doi: 10.2307/2956146

Miller, S. M., & Ndhlela, T. (2020). Money demand and seignorage maximization before the end of the Zimbabwean dollar. *Journal of Macroeconomics*, *63*. doi: 10.1016/j.jmacro .2019.103186

Mises, L. v. (1981). *The Theory of Money and Credit* (5th edition ed.). Indianapolis: Liberty Fund Inc.

Mladenović, Z., & Petrović, P. (2010). Cagan's paradox and money demand in hyperinflation: Revisited at daily frequency. *Journal of International Money and Finance*, *29*(7), 1369–1384. doi: 10.1016/j.jimonfin.2010.05.005

Montesquiou, F. (1791). *Rapport sur les dépenses publiques fait à l'Assemblée nationale, au nom du comité de finances, par M. de Montesquiou, député de Paris, le 6 février 1791.* National Assembly.

Morgan, J. F. (1985). *Graybacks and Gold: Confederate Monetary Policy.* Pensacola, Fla: W S Coker.

Neumann, M. J. M. (1992). Seigniorage in the United States: how much does the U.S. government make from money production? *Review*(Mar), 29–40. Retrieved from `https://ideas.repec.org/a/fip/fedlrv/y1992imarp29-40.html`

Niemi, R. G., Stanley, H. W., & Vogel, R. J. (1995). State economies and state taxes: Do voters hold governors accountable? *American Journal of Political Science*, 936–957. (Publisher: JSTOR)

Pecquet, G. (1987). Money in the trans-Mississippi confederacy and the confederate currency reform act of 1864. *Explorations in Economic History*, *24*(2), 218–243. doi: 10.1016/0014-4983(87)90013-1

Pecquet, G., Davis, G., & Kanago, B. (2004). The Emancipation Proclamation, Confederate Expectations, and the Price of Southern Bank Notes. *Southern Economic Journal*, *70*(3), 616–630. doi: 10.2307/4135334

Perron, P. (1989). The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Econometrica*, *57*(6), 1361–1401.

Perron, P. (1990). Testing for a Unit Root in a Time Series with a Changing Mean. *Journal of Business & Economic Statistics*, *8*(2), 153–162.

Phelps, E. S. (1973). Inflation in the Theory of Public Finance. *The Swedish Journal of Economics*, *75*(1), 67–82.

Phylaktis, K., & Taylor, M. P. (1993). Money Demand, the Cagan Model and the Inflation Tax: Some Latin American Evidence. *The Review of Economics and Statistics*, *75*(1), 32–37. doi: 10.2307/2109623

Quandt, R. E. (1960). Tests of the Hypothesis that a Linear Regression System Obeys Two Separate Regimes. *Journal of the American Statistical Association*, *55*(290), 324–330.

Razaghian, R. (2004, December). Financing the Civil War: The Confederacy's Financial Strategy. *Yale ICF Working Paper*, *04-45*. Retrieved from `https://ssrn.com/abstract=621761`

Reich, J. (2017). *Seigniorage* (No. 978-3-319-63124-0). Springer. Retrieved from `https://ideas.repec.org/b/spr/sprbok/978-3-319-63124-0.html` doi: 10.1007/978-3-319-63124-0

Salemi, M. K., & Sargent, T. J. (1979). The Demand for Money During Hyperinflation under Rational Expectations: II. *International Economic Review*, *20*(3), 741–758. doi: 10.2307/2526270

Sargent, T. J. (1977). The Demand for Money during Hyperinflations under Rational Expectations: I. *International Economic Review*, *18*(1), 59–82. doi: 10.2307/2525769

Sargent, T. J. (1982). The End of Four Big Inflations. In R. E. Hall (Ed.), *Inflation: Causes and Effects* (pp. 41–98). University of Chicago Press.

Sargent, T. J., & Velde, F. R. (1995). Macroeconomic Features of the French Revolution. *Journal of Political Economy*, *103*(3), 474–518.

Schwab, J. (1968). *The Confederate States of America, 1861-1865: a financial and industrial history of the South during the Civil War*. B. Franklin. Retrieved from `https://books.google.com/books?id=_64rAQAAIAAJ`

Schwab, J. C. (1901). *The Confederate States of America, 1861-1865: A Financial and Industrial History of the Civil War*. New York/London: Schribner and Sons.

Sciout, L. (1895). *Le directoire.* Paris: Firmin-Didot & C.

Selgin, G. A., & White, L. H. (1999). A Fiscal Theory of Government's Role in Money. *Economic Inquiry*, *37*(1), 154–165. doi: 10.1111/j.1465-7295.1999.tb01422.x

Taylor, M. P. (1991). The Hyperinflation Model of Money Demand Revisited. *Journal of Money, Credit and Banking*, *23*(3), 327–351. doi: 10.2307/1992749

Thiers, L. A. (1845). *History of the French Revolution, Translated by J. Dixon*. G. Vickers.

Todd, R. C. (1954). *Confederate Finance*. Athens, GA.: University of George Press.

Turner, P., & Benavides, G. (2001). The Demand for Money and Inflation in Mexico 1980-1999: Implications for Stability and Real Seigniorage Revenues. *Applied Economics Letters*, *8*(12), 775–778.

Végh, C. A. (1995, October). Inflationary finance and currency substitution in a public finance framework. *Journal of International Money and Finance*, *14*(5), 679–693. Retrieved from `http://www.sciencedirect.com/science/article/pii/0261560695000216` doi: 10.1016/0261-5606(95)00021-6

Weidenmier, M. D. (2000). The Market for Confederate Cotton Bonds. *Explorations in Economic History*, *37*(1), 76–97. doi: 10.1006/exeh.2000.0732

Weidenmier, M. D. (2002). Turning Points in the U. S. Civil War: Views from the Grayback Market. *Southern Economic Journal*, *68*(4), 875–890. doi: 10.2307/1061497

White, E. N. (1991). Measuring the French Revolution's inflation: the Tableaux de dépréciation. *Histoire & Mesure*, 245–274.

White, L. H. (1999). *The Theory of Monetary Institutions*. Malden, MA: Wiley-Blackwell.

Wolfe, M. (Ed.). (1972). *The economic causes of imperialism*. New York: Wiley. (OCLC: 245962957)

Yearns, W. B. (2010). *The Confederate Congress*. Athens, Ga.: University of Georgia Press.

Zivot, E., & Andrews, D. W. K. (2002). Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis. *Journal of Business & Economic Statistics*, *20*(1), 25–44.

Curriculum Vitae

Joshua Ingber received his Ph.D. in Economics from George Mason University (GMU) in 2020. In addition, he earned a MSc. from Johns Hopkins University in Applied Economics in 2013. During his time at George Mason University, Joshua worked at the Bureau of Economic Analysis, as a regional research economist, and he received a Mercatus Fellowship from the Mercatus Center. His work has been published in *Explorations in Economic History*. In fall 2020, Joshua will begin an appointment as an assistant professor at Northern Michigan University.