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Colonial Pennsylvania Commodity Prices and the Quantity Theory of Money

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Abstract: The Quantity Theory of Money (QTM) has been one of the most long-standing and controversial ideas in economics. Economic historians have analyzed many different times and eras to see if it holds, with varying conclusions. One particular era has remained particularly contentious: colonial America. In the 1700s, the British North American colonies all had different monetary systems and currencies, and at times, issued very large amounts of money. And yet, some authors have found little to no response from prices to these changes in the money supply, an apparent direct violation of QTM. Others have contended strongly that colonial American history is perfectly consistent with QTM, and that conclusions otherwise simply come from mishandling of the data. This paper traces the history of the colonial monetary regimes and the debate about them to the present day, and offers a new approach to solving the puzzle. For the first time, instead of overall price indices, time series for many individual commodities in the colonial era are analyzed. The results show that domestically produced goods, and goods that are more expensive on average, are more likely to show a correlation than imported or cheap goods. These structural complexities are a clear issue for QTM, which appears to be too simple a theory to fully explain complex economies.

Keywords: quantity theory of money, economic history, colonial America, money supply, price level

JEL: C32, E31, E42, E51, N11

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1 Defining the Quantity Theory

In its most common form, the Quantity Theory of Money (QTM) states that the supply of money is correlated to, causal to, and exactly proportional to, the general price level. A 1% increase in the money supply will cause a 1% increase in prices.

Because a circulating medium of exchange does not necessarily have any inherent value on its own, it theoretically does not matter how much is in circulation, because its total worth will remain exactly the same regardless of quantity. If more money is created, people will spend more, driving up prices, and thus the relative value of each unit of money will decrease accordingly. Alternately, if money is destroyed, people will spend less, decreasing prices, and thus the relative value of each unit of money will increase accordingly. Knowing this mechanism, the adjustment period may even be skipped entirely by price setters anticipating the effects of a known change in money supply and changing prices in advance. At least in the long-run, the specific amount of money in the economy is completely irrelevant.

In the modern era, QTM is governed by the simple equation of exchange:

$$MV = PQ$$

Where:

- M is the money supply
- V is the velocity of money
- P is the price level
- Q is the real value of goods and services

Although it is widely acknowledged that V and Q are not always constant over time, a general implicit assumption of QTM is that changes in the money supply do not inherently affect money velocity or the real value of goods. Therefore, their inclusion in the formula does not affect the validity of the theory.

To the outside observer, QTM seems intuitive, even obvious. And yet, Gothenburg economist Hugo Hegeland's 1951 doctoral thesis, which was titled *The Quantity Theory of Money*, begin by saying "hardly any theory in economics has been so long debated".[1] Several successive waves of economic thought have repeatedly placed it into and removed it from mainstream acceptance. From the 1600s and 1700s, it slowly developed from the recognition that increases in the money supply will increase prices, into the idea that increases in the money supply are *exactly proportional* to an increase in prices, springing forth from the writings of such famous names in historical economics as John Locke, David Hume, Richard Cantillon, Jean-Baptiste Say, and David Ricardo. Its 'golden age' was the late 1800s and early 1900s, during the development of neoclassical economics.[2] It fell out of favor after 1929, at the onset of the Great Depression,[3] to be replaced by the scholarship of John Maynard Keynes, who noted that price adjustments could take so long as to render QTM irrelevant, and who instead emphasized the effects of aggregate demand and aggregate supply on the general price level. QTM was once again brought back to the forefront of economic thought in the 1960s by the monetarist school.[4] And now, as of this writing in the early 2020s, in the wake of the global financial crisis of 2008 and the COVID-19 recession of 2020, the pendulum has perhaps swung back once again towards doubt.

Nothing likely illustrates this better than a graph showing money supply and prices over the last two decades in the United States (see Figure 1). In the 21 century, the Federal Reserve has engaged in massive amounts of quantitative easing, and prices have not responded with equivalent increases. Between January 2000 and March 2022, the M2 money stock rose by 369.2%,[5] while the Consumer Price Index (CPI) only rose by 70.3%.[6] In other words, over the past 22 years, a 1% increase in the money supply has been associated on average with a 0.19% increase in prices, much smaller than the 1% predicted by QTM.

Whether or not this massive visible divergence between the money supply and price levels is unprecedented, a result of some factors specific to the modern economy, or just the most recent example in a history of QTM failures, has been yet another piece of controversy. Many economists have analyzed the historical record to see how well QTM applies to different places at different times. Such analyses have looked at a diverse range of places, including

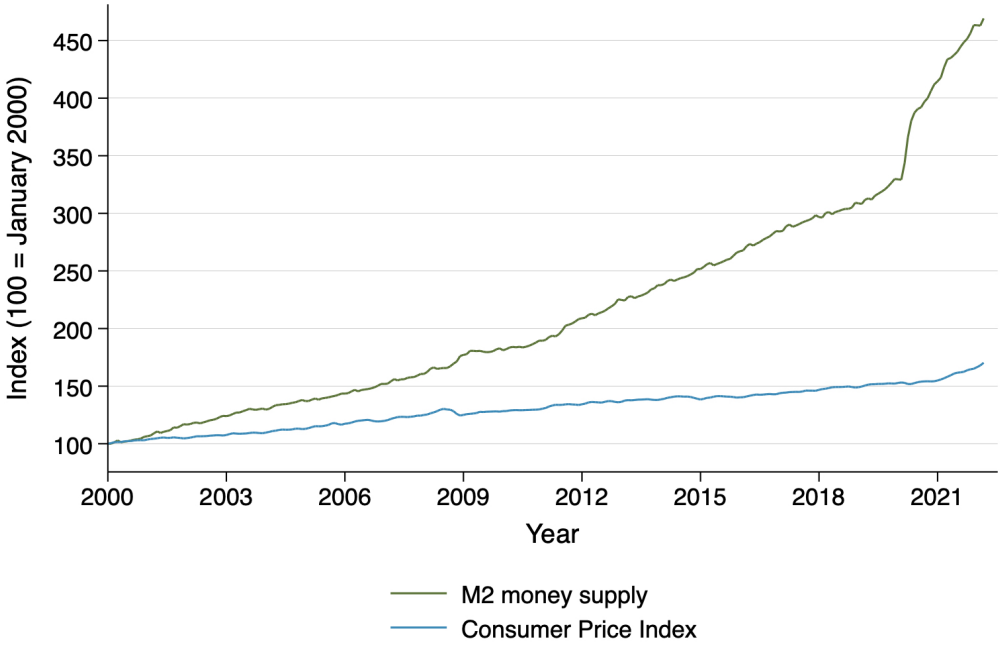

Figure 1 – a graph of the M2 money supply and the Consumer Price Index (CPI) in the United States from January 2000 to March 2022. The data are adjusted such that the values for both time series are equal to 100 at the start of the graph, in order to emphasize total percentage change. In the original source data, the CPI is an index where the average for 1967 is set to 100, and M2 is measured in billions of dollars; from January 2000 to March 2022, CPI spans 505.8 to 861.235, and M2 spans 4672.6 to 21926.1.

1400s Egypt,[7] 1600s India,[8] 1900s West Germany,[9] and 2010s Zimbabwe.[10] But one time and place has remained particularly controversial, simultaneously an extremely attractive case study and notoriously difficult to analyze: 1700s colonial America.

2 History of colonial paper money

2.1 Origins

Although nationally issued and circulating paper money had been used in China for centuries prior,[11] the first banknotes in the western world were produced in mid-1661 by the Stockholms Banco, the predecessor to the Riksbank (the central bank of Sweden).[12] It is often incorrectly assumed, and sometimes directly incorrectly stated,[13] that these notes were also the first *paper money* in the western world. In fact, there are at least three earlier

cases. The first is from 1483 to 1485, in the southern Spanish town of Alhama de Granada. While it was under siege by the Emirate of Granada, from whom it had been conquered the previous year, a shortage of money made it impossible to pay soldiers' wages. As a solution, Íñigo López de Mendoza, second count of Tendilla, issued paper money on his own credit, which circulated in the town.[14] These were apparently all redeemed and destroyed, since no examples of them survive to the present day.[15] The second case is the Dutch municipality of Leyden in 1574 which, while under revolt against Spanish authorities, temporarily issued cardboard coins made from recycled Catholic prayer books or parish registers.[16] Examples of these survive to the modern day, making these coins the oldest extant European paper money.

The third example, by far the most obscure, marks the origin of paper money in the North American colonies. A 1684 report to King Charles II of England regarding Massachusetts' banking system stated that "for some years paper bills passed for payments of debts" before the 1652 creation of a colonial central bank.[17] Nothing more is known about these bills outside of this one reference, and certainly no physical examples survive to this day. The best educated guess is that these were promissory notes "issued" by private individuals, which instead of always being held onto, sometimes traded hands like money in local communities out of an economic necessity that did not exist in mainland Europe.[18] The documented existence of extensive informal credit networks in certain parts of the colonies lends credence to this theory.[19] The fact paper "money" was apparently used in British Massachusetts before it was ever used in Sweden is a curious fact that today has been almost entirely forgotten to history.

The first sanctioned and institutionalized use of paper money in the North American colonies (and the first use in the western world after Sweden) came from the colony of New France (modern day Canada), and was the result of the Nine Years' War, or King William's War as the North American theatre was known. In 1685, New France had found itself completely out of funds to pay military troops returning from a failed expedition against the Iroquois, and provisions from mainland France were not due for several more months. Seeing no other options, on 8 June 1685, the governing intendant of the colony obtained

a pack of playing cards, divided them into quarters, and handwrote denominations on the back with his signature. These cards were simply declared to be legal tender, and it was made illegal to charge someone a higher price for payment in this form.[20] Although this first issue of money was short-lived and redeemed at face value just months later, further issues in 1686 and beyond increasingly made this 'card money' a staple of New France.

The colony of Massachusetts followed New France's example and proceeded to institutionalize the practice in 1690 for very similar reasons: when two thousand troops returned to Boston from a failed expedition to New France, the colony found itself unable to pay them. Normally, returning soldiers would be paid from a portion of the wealth they had stolen during the expedition, but this one being unsuccessful, the troops had returned empty-handed. To remedy this situation, on 10 December 1690, a court authorized Massachusetts to print £7,000 in paper currency, a limit that was removed in February 1691 and increased to £40,000 in May 1691.[21]

The Bank of England was created in 1694 in order to print paper money to fund England's war with France,[22] which was the first post-Sweden use of paper money in mainland Europe. This was soon followed by Scotland[23] and Norway[24] in 1695, and France itself in 1701.[25] This opened up the door for the North American colonies to also establish local paper currencies, and up through the 1720s, more than a dozen did so. Among the existing colonies that would become the original 13 states of the United States, by the end of 1723, only two had not established paper currencies: Maryland, which acquiesced in 1733, and Virginia, which acquiesced in 1755 (Georgia first used paper money in 1735, but was not founded as a colony until 1732). It strangely seems impossible to find anywhere in published literature a full accurate list of each colony's first paper money issue, complete with specific correct dates and reasons behind the currencies' creation; thus, one has been assembled here (see Table 1).

Table 1 – First Official Paper Money Issues of North American Colonies, to 1755

Colony	Date	Reason
New France	**8 June 1685** (cards signed)[26]	To pay troops returning from failed expedition against the Iroquois.
Massachusetts	**10 December 1690** (court authorization and bills dated)[27]	To pay troops returning from a failed occupation of New France.
South Carolina	**8 May 1703** (law passed)[28]	To pay war debts accrued in the Siege of St. Augustine, a part of Queen Anne's War.[29]
Barbados	**1705** (date unknown)[30]	To fix a shortage of circulating money.[31]
New York	**8 June 1709** (law passed)[32] **31 May 1709** (bills dated)[33]	To fund a (failed) military expedition to New France, jointly with Connecticut and New Jersey.[34]
Connecticut	**11 June 1709** (law passed)[35] **12 July 1709** (bills dated)[36]	To fund a (failed) military expedition to New France, jointly with New York and New Jersey.[37] Also to pay other debts and fix a shortage of circulating money.[38]
New Jersey	**30 June 1709** (law passed)[39] **1 July 1709** (bills dated)[40]	To fund a (failed) military expedition to New France, jointly with New York and Connecticut.[41]
New Hampshire	**5 December 1709** (law passed)[42] **6 December 1709** (bills dated)[43]	To pay debt from wars with Native Americans, as well as debt from the failed New France expedition,[44] for which New Hampshire had raised a separate force with Massachusetts and Rhode Island to attack from a different route.[45]
Rhode Island	**3 May 1710** (law passed)[46] **16 August 1710** (bills dated)[47]	To fund a military expedition against Port Royal, Nova Scotia, and to fix a shortage of circulating money.[48]
North Carolina	**1712** (date unknown)[49]	To fund war against the Tuscarora Native Americans, and to pay debts.[50]
Louisiana (part of New France)	**20 May 1722** (law passed)[51]	Local card money issued by the French East India Company to replace storehouse order slips that had been unofficially circulating as money starting in 1721.[52]
Pennsylvania	**2 March 1723** (law passed)[53] **2 April 1723** (bills dated)[54]	To fix a shortage of money, relieve an economic depression, and pay government debts.[55]
Delaware (part of Pennsylvania)[56]	**25 April 1723** (law passed)[57]	To fix a shortage of money and relieve an economic depression.[58]

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Table 1 – *Continued from previous page*

Colony	Date	Reason
Maryland	**12 April 1733** (law passed)[59] **29 September 1733** (bills circulated)[60]	To replace bills backed by tobacco ("tobacco money"), the colony's main money supply, which suffered from fluctuations in supply and value, uneven distribution, scarcity, and transport difficulties, and which caused agricultural inefficiencies.[61]
Georgia	**24 July 1735** (law passed and bills dated)[62]	To fix a shortage of funds to run government, and a shortage of circulating money.[63]
Virginia	**9 July 1755** (law passed)[64]	To fund campaigns in the French and Indian War.[65]

Notes – dates used are indicative of the calendar system being used in the area at that time. Therefore, all dates are in the Julian calendar, except for the ones for New France and Virginia, which are in the Gregorian calendar. Julian calendar dates are given assuming the modern standard of a 1 January new year, rather than 25 March. Dates are ordered by when law was passed, rather than when bills were dated or released, which only reverses the order of Connecticut and New Jersey.

The paper currencies of the British North American colonies took the form of "bills of credit," which were essentially certificates indicating that the colonial government owed a debt to the holder. They would be introduced to the economy either by the government's direct spending, or by being loaned out through "land-banks", so called because loans were taken on the security of real estate.[66] The bills would be redeemed by the government at a future date, either through accepting them in payment of taxes or repayment on loans, or by accumulating a sinking fund of silver with which to redeem the bills on a designated timeline.[67] Some bills of credit, mostly the ones issued in the later years of the 1750s and beyond, bore interest, but the majority of them did not.[68] In this way, colonial governments were essentially borrowing against their future selves.

Most of the early established colonial money systems were created on the occasion of war. Among the colonies that would later become the United States, the first eight to create independent paper currencies did so for immediate war funding. One single failed military campaign against New France contributed to four different colonies doing so in 1709. The first colony to establish a system of bills of credit during peacetime was Pennsylvania in 1723, which did so attempting to counteract an economic depression that had begun a couple years prior. They were apparently successful at this, and repeated it by issuing more paper money for a second economic downturn in 1729.[69] Even earlier, in 1718, the

legislature of New York had described an economic motivation in a prior 1715 issue of paper money, saying that trade had been languishing and that the new additional paper money had revived it.[70] As time went on, the reasons for colonies' further issues of paper money became increasingly divorced from the short-term funding of specific programs or the payment of specific debts, and instead became oriented towards the more abstract long-term goals of encouraging economic performance. As Elmer James Ferguson noted in 1961, "a modern economist finds the tactics of colonial governments analogous to those of the New Deal and in some ancestral relationship to present-day Keynesian doctrine."[71] Banks that loaned these bills out would increasingly become a central part of colonial economic life. And, just like there is vigorous debate today on the government's proper role in managing economic affairs, so too was there in the 1700s.

2.2 Specie scarcity

A major reason supplied in the 1700s for printing paper money was a lack of gold, silver, and copper coins, called specie, in circulation to facilitate trade. A lack of physical money was one of the colonists' most frequent and consistent complaints.[72] Although the laws regarding many of the very earliest paper money issues did not explicitly state this as a motivation, this quickly changed. A Massachusetts law emitting more paper money in 1702 cited "the extream Scarcity of Money" as its primary motivation.[73] A lack of circulating money and the need for economic stimulus soon began to be viewed by many as the same problem, a view exemplified by a statement made in 1725 by the Pennsylvania House of Representatives, in which they described the introduction of paper currency in the colony two years prior as arising from "not Cash enough to carry on our domestick Affairs and Commerce: And likewise the Value of Lands and Country Product, being brought so low by the Scarcity of Money, and Decay of Trade, that many Families were likely to be ruined."[74] Benjamin Franklin himself, a longtime ardent supporter of paper money, stated in 1767 that the colonies "cannot keep Gold and Silver among them sufficient for the Purposes of their internal Commerce."[75] These issues were reported in the French colonies as well as the British.[76]

A complaint about too little money on the macroeconomic scale is interesting in the abstract, because according to QTM and assumptions of classical economics, this is absurd and impossible. The specific amount of money in an economy is irrelevant, because no matter how little it is, prices should lower appropriately to balance it out, increasing the value of each piece of money. If the amount of circulating silver and gold becomes particularly low, then the associated low prices should attract foreign buyers, who will bring with them more silver and gold, thus raising the money supply again. Not only would "too little money" be a nonsensical claim, but amounts of circulating money should equalize between regions in the long run anyway.

This simple and logical analysis, when it comes to the 1700s North American colonies, is wrong. For one, it assumes money is infinitely physically divisible. This issue can be understood through a thought experiment: imagine a large economy that is given exactly one single copper coin with which to carry on transactions, with no ability to get more. In theory, this one single coin could be divided into millions of microscopic pieces and circulated widely, and prices could be denominated in millionths. In practice, this could never happen, and people would be forced to resort to barter or the use of inefficient alternative mediums of exchange. It is therefore conceivable, given the reasonable limits of the division of physical money, that there *could* be too little currency to support the aggregate amount of desired economic activity. This would never be a problem in a modern developed economy, but in certain places in the 1700s, this empirical limit to QTM could be quite real.

Secondly, there were barriers to prices falling lower, because the colonies were heavily dependent on imports from England. For any imports, or goods which relied on imports as an input, the colonists had to pay prices influenced by the size of a foreign specie supply, and not their own. This was exacerbated by the cost of importing, which was significant, given that the colonies were thousands of kilometers away from mainland Europe.

But even more important than sticky prices was the fact that England banned the direct exportation of specie to its colonies, and refused to open a branch of the Royal Mint overseas.[77] The English government also took direct steps to stop the colonies from opening up mints of their own. Massachusetts opened a mint in 1652, which the English

government attempted to forcibly shut down in 1665. The mint continued to operate, due to a combination of colonial defiance and the English government's inability to enforce the law due to distraction by other political crises, but in 1684, the entire Massachusetts colonial charter was revoked for several grievances, chief among them the mint.[78] Furthermore, although England had banned specie exportation, the colonies were at times stopped from themselves banning specie from leaving,[79] since England wanted as little of it as possible leaving the mainland and as much of it as possible coming in.

It would seem as if neither the physical limits of money's divisibility nor significant barriers to trade could alone account for the idea of "too little money." If only the former, a theoretically efficient free market imports more money; if only the latter, money gets divided as much as is needed; and ostensibly only both together are sufficient conditions to theoretically explain a lack of money. However, economist Farley Grubb has expanded the idea further, by proposing a model that apparently demonstrates too little specie is possible even under conditions of free trade. According to Grubb's (2012) model, in conditions where there are locally efficient barter systems and imports can only be purchased with specie, individuals may maximize their own welfare by exporting specie, but everyone doing so results in lower total social welfare. Thus specie scarcity comes about through an economy-wide prisoner's dilemma.

Unable to legally get any specie directly from England, the colonies had to trade with other countries to get it. The colonies' money supply was often made of coins from foreign nations, mostly the Spanish silver dollars known as the "pieces of eight". These largely came to the British colonies from Spanish mints in Mexico and Peru.[80] One observer in 1691 said that "there is largely only Spanish money in New England".[81] Other coinage besides Spanish dollars did make its way to the colonies too though, including Spanish pistoles and pistareens, Portuguese Joannes and moidores, British guineas and crowns re-exported from other nations or smuggled,[82] and apparently extremely rarely, Dutch groots.[83] Often, as soon as the specie arrived, it was immediately traded out to other countries for more goods, likely thanks to the wider trend of an uneven balance of trade.

In the absence of sufficient specie, the colonies through the 1600s resorted to making

various commodities legally valid for all public and private payments. Very early on, in 1631, Massachusetts made corn legal tender.[84] In various areas of colonial America at various times, other commodities used as money included wheat, beef, pork, tobacco, sugar, peas, barley, rye, rice, lumber, fish, flax, hemp, wool, pitch, tar, cattle, bullets, wampum beads, and beaver skins.[85] In 1649, a student at Harvard University paid his tuition with an old cow.[86] Making a commodity legal tender would hardly be a logical or prudent thing to do in an economy with no money scarcity. Such "commodity money" suffered from many problems, including difficult transportation, fluctuating value and supply, the commodities expiring, and agricultural inefficiencies where farmers would grow a specific crop not because it was needed but because it was used as a currency.

Despite all this, whether or not specie scarcity was even a genuine issue in the colonies has been fiercely debated. Of course there were many complaints about it, but through the 1720s onward, the idea of specie scarcity became increasingly politicized as emissions of paper money were linked to economic stimulus. Therefore, depending on their partisanship, writers of the time may be unreliable in their accounts of how readily specie was available. Those who wanted colonial governments to take measures to alleviate economic depression were naturally more likely to exaggerate specie scarcity, and those who opposed intervention in the economy were naturally more likely to exaggerate specie plenitude. Colonial governments often cited specie scarcity when passing acts emitting bills of credit, but of course governments always try to justify their actions. It has even been argued that a lack of specie was an apparently semi-fictional excuse used by colonists who wanted to avoid paying their debts.[87]

Some authors have reversed the causality entirely, saying that the issuance of paper money is what caused the scarcity of specie in the first place. In modern economic thought, this is usually conceptualized through Gresham's Law, which states that bad (overvalued) money drives out good (undervalued) money—in this case, the 'bad' paper money driving out the 'good' specie money. In 1752, David Hume wrote that "before the introduction of paper money into our colonies, they had gold and silver sufficient for their circulation. Since the introduction of that commodity, the least inconveniencies that has follow'd is the total

banishment of the precious metals."[88] The English Board of Trade certainly thought this is how it worked in 1764, in a letter to the King strongly advising the further regulation of the colonies' finances.[89] This became a rather dominant strain of thought in the 1800s. One writer stated in 1837 that "when the specie had been driven away by the increase in paper money, the 'scarcity of silver' was a fresh excuse for more emissions."[90] Likewise, in his 1893 work *A History of Currency in the British Colonies*, Richard Chalmers stated that "the North American colonies sought refuge in paper issues which speedily drove out coin."[91]

The idea that any specie scarcity was caused by paper money itself, or that there was no specie scarcity at all, still exists today. John McCusker and Russell Menard, in their 1985 book *The Economy of British America, 1607–1789*, wrote that "it appears...that the colonists' stock of money was adequate, at least insofar as quantity was concerned."[92] Angela Redish described specie scarcity as "inconsistent with economic theory."[93] Murray Rothbard, in a larger attempt to historically defend a radical right-wing libertarian agenda, flatly stated with no evidence supplied that "in reality, there was no such [specie] shortage."[94] More recently and more rigorously, economist Ronald Michener (1987) has represented paper money and specie as substitutes for one another in economic calculations, meaning the introduction of one drives out the other. Michener, along with historian Robert Wright, has described claims of colonial specie scarcity as "highly revisionist", saying that such positions "aim to rewrite the economic and political history of the United States in the second half of the eighteenth century."[95]

This claim of Michener's and Wright's should not be taken seriously. The only time there was maybe an academic consensus against specie scarcity was the 1800s, which was itself simplistic revisionism from the lively debate of the 1700s. Following a return of the debate in the 1900s, there has been no definitive consensus, and many writers can be found who believe that specie was in fact scarce in the colonies. Farley Grubb falls strongly on the side of specie scarcity,[96] as does Harvard Law professor Christine Desan[97] and economist Charles Calomiris.[98] Bruce D. Smith believed in specie scarcity as far as small change was concerned.[99] Among 20th century historians who have written about the colonial period, it is not difficult to find an additional ten examples of writers who took specie scarcity as fact,

just to thoroughly make the point.[100]

Perhaps nothing more expresses the contentiousness of the debate than what happened to an article written by economic historian Leslie Brock, posthumously published in 1992 after he died in 1985. The article, being in an unfinished state, required polishing by an editor before publication. Brock mentions specie scarcity as existing in Virginia, to which the editor, seemingly slightly disrespectfully, inserted a three paragraph endnote using and citing their own research, explaining why Brock was in fact wrong.[101] That editor was none other than Ronald Michener.

Ultimately, the best evidence that specie scarcity existed, and existed independent of paper money, is that there are analyzable trends in reported specie scarcity based on first-hand quotations which predate the introduction of paper currency. Certainly, reports of scarcity precede any paper money emissions—for example, an ordinance from the Council of Quebec dated 7 October 1661 discusses New France's failure in its attempts to retain a sizable domestic money supply[102]—but the existence of complaints does not inherently mean their legitimacy. What is more compelling is that, as identified by historian Curtis Nettels, complaints of specie scarcity were noticeably more common between 1700 and 1715 than they were between 1690 and 1700, even in colonies where there was not yet any paper money. In 1697, specie was reported as being plentiful in Pennsylvania, but by 1703 it was reported as being incredibly scarce. Pennsylvania would not introduce a paper currency until 20 years later, and the only British colony that had emitted bills of credit at this time was Massachusetts (which did not and does not border Pennsylvania). Nettels attributes this change around 1700 to the suppression of piracy, and also mentions the disruption of trade with the Spanish colonies due to war.[103] If complaints of specie scarcity were never legitimate, we would expect them to be more or less constant over time. This does not say anything about specie scarcity later on in the 1700s, but it should certainly be enough to dispel the idea that specie scarcity could not exist in theory and never did.

This also does not necessarily mean that specie was never driven out by paper money. The question of whether the two were substitutes or complements is a separate one. But it does mean that claims there was never any legitimate pre-existing specie scarcity, and thus

that paper money could never aid the colonial economy even in theory, seem ahistorical. Like any political issue, specie scarcity was surely at times exaggerated, lied about, or taken advantage of, and many firsthand accounts from the era are naturally tainted by the observer's political bias. But, dependent on location and time, it certainly seems like a physical lack of money was sometimes a genuine issue.

2.3 Interpretations of paper money's effects

There is no debate that many colonial governments issued very large amounts of paper money. In 1690, there was an estimated £200,000 in silver money circulating in New England.[104] With this knowledge, Massachusetts' authorization in 1691 to print £40,000 in bills can be understood to be quite large. Adding together unredeemed bills from Massachusetts, Rhode Island, Connecticut, and New Hampshire, there were already more than £200,000 worth of circulating bills in New England by 1712, which increased to over £400,000 by 1724, £888,000 by 1740, and £4,030,000 by 1750.[105] The exchange rate between London and local currency in most of New England was 1:1.33 in 1702, but by 1748 had inflated to 1:2.5 in Maryland, 1:7 in South Carolina, 1:10 in North Carolina, and 1:11 in Massachusetts. The majority of this inflation in Massachusetts happened in the 1740s during King George's War, with rates going from 1:5.5 to 1:11 between 1741 and 1748 alone.[106] The result was that, according to contemporary observer William Douglass, "every honest Man not in Debt lost about one half of his personal Estate" in Massachusetts during the 1740s.[107]

The most extreme case was Rhode Island, being small enough that its neighbors took the economic brunt of its inflationary policies. Reports indicate Rhode Island exchange rates against London as having further sunk to 1:23 by 1759,[108] 1:26 by 1760, and 1:32 by 1762.[109] In Spanish silver dollars, the legal value of Rhode Island bills went from 56 shillings to the dollar in 1751 to 140 shillings to the dollar in 1762.[110] A writer in February 1743 proclaimed, probably hyperbolically, that Rhode Island had "defrauded more in a few Years than any of the most wicked Administrations in the several Nations of Europe have done in several Centuries."[111] A parallel to this opinion comes from Adam Smith himself, who, in his famous and incredibly influential 1776 work *The Wealth of Nations*, described obligating

a creditor to accept colonial paper money as "an act of such violent injustice, as has scarce, perhaps, been attempted by the government of any other country which pretended to be free."[112]

The government of mainland England did not take kindly to the major inflationary episode of the 1740s. In 1751, Parliament passed a law banning Massachusetts, Rhode Island, Connecticut, and New Hampshire from issuing any further bills of credit beyond immediately funding yearly government expenses, or for "extraordinary emergencies of government, in case of war or invasion". The law also banned them from making their bills legal tender for private debts.[113] In practice, the exceptions were broad enough to still allow for some large currency emissions and further depreciation, especially if there was a state of war,[114] which there was after the French and Indian War started in 1754. The law apparently stopped Rhode Island from issuing further bills only until 1755.[115] Parliament passed an even further reaching law in 1764, forbidding bills of credit in *all* colonies from being legal tender for private *and* public debts,[116] with the Board of Trade calling legal tender paper money "manifestly fradulent", "destructive", and "absurd, unjust and impolitic."[117]

Historical opinion on this paper money was extremely negative throughout the 19th century, and it is very difficult to find a source during this time period that praises the colonial banking systems in any way. A history of the United States published in 1810 ended a chapter by calling the colonial paper money "a great injury to commerce, public credit, and the morals of the people, for years after the termination of the war."[118] Another textbook declared, "the effects of this kind of paper money on the public prosperity, by destroying the necessary confidence between man and man, as well as confidence in the public faith, were disastrous."[119] In an official 1865 report to the Massachusetts Secretary of the Commonwealth, colonial paper currency was called a "miserable substitute for money," and furthermore it was stated that "it is impossible to tell the exact proportions of fraud and delusion which entered into the concoction of this scheme, but without doubt there was much of both."[120] What had been an open political question in the 18th century, with debate on both sides of the issue, had seemingly become a settled economic question in the 19th.

This changed as the 19th century gave way to the 20th. Modern historical scholarship has fiercely reignited the debate. Very influential has been Leslie Brock, who has been rightly called "the father of modern thought regarding colonial currency."[121] Brock's 1941 PhD thesis at the University of Michigan, which was a comprehensive manuscript that examined the issue colony by colony between 1700 and 1764, concluded that the colonial monetary policies were very reasonable at the time and did more economic good than harm.[122] Specifically, previous writers had focused disproportionately on New England, the epicenter of the 1740s inflation, where depreciation had been at its worst. They relied too much on 1700s writers like William Douglass,[123] who rallied against paper money in a "ranting tone" because he had personally lost money in Massachusetts real estate.[124] According to the then-emerging 1900s scholarship, if one looks further south, there were many colonies who ran perfectly successful paper money economies with little to no inflation or depreciation. The old scholars took the experiences of the New England colonies and unfairly and inaccurately used them to form conclusions about the monetary systems of all the colonies.

Furthermore, and very importantly, the large majority of 1800s writers were only interested in describing colonial money schemes as a precursor to the economic history of the American Revolutionary War,[125] beginning in 1775, which would establish the United States of America as an independent country. Paper money issues during the Revolution were much more unambiguously widely damaging: the circulating money supply before the war was approximately $12 million,[126] and the new federal government issued $6,000,000 in paper money (the continental dollar) by the end of 1775, already a monetary increase of about 50%. It then issued a further $18.9 million during 1776, $13 million during 1777, $63.5 million during 1778, and about $98.5 million during 1779, for a total of around $200,000,000 in circulation at once, printed between 22 June 1775 and 29 November 1779.[127] The result was that by official exchange rates, the continental dollar's value against specie went from 1:1 in 1775 to 1:40 in 1780,[128] while unofficial market exchange rates continued to fall to 1:167.5 by 1781.[129] The colonies/states themselves additionally issued what probably amounted to over $200 million bills of credit and treasury notes through 1783.[130] Massachusetts' currency

officially fell to 1:100, Pennsylvania's to 1:225, North Carolina's to 1:725, and Virginia's to 1:1000.[131] If the colonial monetary systems are viewed exclusively as a precursor to the Revolutionary era monetary system, it becomes much easier to universally condemn the former. However, 20th century scholarship has separated the two, since the post-1775 era was under the structure of an entirely new government.

Both preceding and succeeding Brock's 1941 thesis defending the colonial monetary systems were other academics with narrower focuses, who were reaching similar conclusions on an individual colony level. Kathryn Behrens' 1921 PhD dissertation focused on Maryland's paper money; she observed that although initially Maryland's bills depreciated in value, renewed confidence in their redemption saw them once again rise to par against specie, and they stayed this way until the Revolution.[132] Behrens even declared that "Maryland had solved the problem of a paper currency."[133] Carl Lotus Becker's 1907 PhD dissertation on New York mostly focused on the late politics of the colony from 1760 to 1776, but Becker also touched upon the colony's monetary policies as a whole. He enumerated his belief in no uncertain terms that in New York, paper money was not only necessary to solve specie scarcity and encourage trade, but that the colony did an excellent job at keeping its currency on par with specie and preventing it from depreciating.[134] Richard Jellison's 1952 PhD dissertation was a spirited defense of South Carolina's paper money, in which he stated that "every emission of paper money appeared to be necessary and was utilized with a certain degree of efficiency", and that "only a very small group were in opposition to its use."[135] Jellison's overall attitude is encompassed very well by the title to a 1961 article he penned: *Paper Currency in Colonial South Carolina: A Reappraisal*. Jellison notes that although there was significant depreciation between 1703 and 1731, the currency remained stable from 1731 until the Revolution, and paper money from here on out was accepted as a necessity in the colony and caused very little fluctuation in exchange rates.

Special attention, perhaps, is due to the case of Pennsylvania, which has long since been particularly praised. Pennsylvania was not included in the colonies restricted from issuing bills of credit by the 1751 Currency Act because, according to the Board of Trade, the colony already came very close to following what external regulations would be without requiring

regulation in the first place.[136] Benjamin Franklin noted in 1767 that Pennsylvania and New York currency had never seemed to depreciate at any point in the previous 40 years;[137] indeed, looking at available monthly data, the low and high extremes of the Pennsylvania exchange rate for the period between 1720 and 1775 were 1:1.2875 and 1:1.8833, and the exchange never left the interval of 1:1.5 to 1:1.8 from 1750 to 1775.[138] Accordingly, as noted by Richard Lester in 1938, Pennsylvania's prices between 1723 and 1773 were more stable than general American price levels had been in any subsequent 50 year period.[139]

Paton Wesley Yoder wrote both his master's thesis in 1936 and his PhD dissertation in 1941 on Pennsylvania's colonial currency, and although he was at times cautious and nuanced with his conclusions, he stated that "we can say without question that Pennsylvania's system of emitting bills of credit on private loans was successful", and that Pennsylvania's attempt to establish a sound monetary system "was, if not the most successful, among the most successful" of the colonies.[140] A yet still far more glowing review comes from John Borden, who in 1995 also wrote his master's thesis on Pennsylvania colonial currency, and called it "a currency system far more advanced than any country in the world", attributing it to saving Pennsylvania from specie scarcity, economic depression, war, harsher colonial rule, a lack of trade, high taxes, underfunded government, and high transaction costs.[141] Rare pieces of praise from the 1800s can even be found, such as one writer in 1866 who wrote that "so far as concerns Pennsylvania and New Jersey, the weight of the argument was in favor of the friends of paper money."[142] New Jersey was included here perhaps because, at least between 1724 and 1765, the exchange rate between the Pennsylvania pound and the New Jersey pound was generally 1:1,[143] thus seemingly vindicating yet another colonial money system.

2.4 The Econometric Era

Before the advent of modern statistical methods, many or most writers simply assumed QTM held for the colonial era. The question of whether a colony issued large amounts of money, and whether or not prices rose significantly, were considered to be one and the same. Evidence against the latter was considered evidence against the former. Studies that did look

at the relationship between prices and money supply only did so casually, without making any attempt to formally establish a relationship mathematically. For example, Kemmerer (1956) determined that QTM held in colonial New Jersey, but only observed that falls in exchange rates existed after paper money emissions, without attempting to quantify their relative sizes against one another.[144] Even in this era though, some scholarship by the 1940s had begun to cast doubts. Yoder (1941) observed that although price responses to money supply increases in Pennsylvania seemed "fairly evident", the "amount of response usually defies measurement and is subject to no determinable rules."[145] On the other hand, after the first bills of credit in 1723, Brock (1941) found no observable relationship between money supply and prices in Pennsylvania at all.[146]

The first attempt at applying econometrics to QTM in the colonial era came in 1978 from Robert Craig West. West (1978) ran regressions for several colonies where the dependent variable is the price level and the independent variable is the stock of paper money. This included versions with zero, one, and two lags for the money supply (at a yearly level). Although West found a significant statistical correlation between prices and the money supply for Massachusetts, he found no statistical correlation for New York, South Carolina, or Pennsylvania. He cautioned that the data quality for New York and South Carolina was not high enough to disprove the existence of a correlation, but believed that Pennsylvania's was complete enough to draw definitive conclusions. One of West's regressions shows that, over a two year period, a 1% increase in the Pennsylvanian paper money supply would only be associated with a 0.13% increase in prices.[147] Although theories and interpretations would vary significantly in future papers, this point estimate would only end up being revised further downwards. Testing the same Pennsylvania regression specification, Grubb (2005) finds 0.17%,[148] Rousseau (2007) finds 0.07%,[149] and Grubb (2016b) finds 0.04%.[150]

West (1978) permanently changed the nature of the colonial American currency debate. Now, it was about the validity or lack thereof of QTM. As a response, in the 1980s, a new theory emerged, one specifically applied to the colonial American era: the backing theory. This theory suggests that more important to the price level than the quantity of money is how the money is backed, which can allow it to hold its value. For example: imagine a bank

has printed 100 pounds backed by 60 ounces of silver. If they issue an additional 50 pounds without increasing the amount of silver in their reserves, the value of each pound should fall by 50% against silver, because of the 50% increase in the money supply. However, if they issue an additional 50 pounds and back it by acquiring an additional 30 ounces of silver, then each pound should hold its value, even though the money supply has increased. The liability of the extra paper money is balanced out by the asset of the additional backing. However, the backing need not be physical additional silver: it might be IOUs the bank holds for 50 pounds from the already extant money supply.[151] In the case of the colonies, the backing asset would usually be the future pledge to accept the money in payment of taxes or in repayment of loans. Thus the liability of paper money is balanced out by the asset of the future pledge of redemption. The money would only depreciate against specie if faith wavered or collapsed in the government's ability to fully redeem all notes issued. This would be what happened in the 1740s in New England and the 1770s more generally, when the number of notes issued by governments far exceeded their ability to redeem them at the issued value.

Of course, money's value in exchange rates and its purchasing power in the economy are two related but separate issues, and one reason they can diverge is the existence of significant barriers or transaction costs for free trade between regions that would otherwise equalize prices, like there was in 1700s North America. In this case, even if money itself held its value in exchange rates, couldn't prices have still gone up denominated in any medium due to the increased spending caused by the new liquidity offered by paper bills? However, even this might not at all occur under a backing theory framework, because the velocity of money could be negatively correlated to the amount of paper money. Given that colonial paper money was backed by future pledges of redemption, an increase in its supply could cause people to hold onto it to a greater extent in order to be able to more easily pay the future taxes and loans that the money would be good for. Or, they might hold onto more cash anticipating lower prices once the money started to be redeemed.[152] This explanation would make no sense under a QTM framework, because in order for there to be no effect on prices, the drop in V would have to exactly equal the increase in M; in other words,

every single new piece of money would have to be hoarded and not spent. But under a backing theory, where a theoretical possible increase could be much more modest, this has applicability.

In the wake of West (1978), Smith (1985a, 1985b) supported the backing theory as the only one that matches the evidence for colonial America. Smith supplies several examples where QTM seems to break down. In his first paper, he notes that between 1755 and 1760, Virginia increased its per capita paper money by 749%, but only saw 9% depreciation; Pennsylvania from 1755 to 1760 increased its per capita paper money 271%, and actually saw appreciation rather than depreciation; and New York from 1760 to 1770 decreased its per capita paper money by 86%, but only saw a 2% decrease in prices.[153] He finds additional examples in his second paper, noting that South Carolina per capita paper money increased 228% from 1755 to 1760, yet prices only increased 7% and exchange rates remained constant.[154]

For those who back QTM, the response to this, as exemplified by Michener (1987) (a paper about which Smith once privately said "I think that virtually nothing in the Michener Carnegie-Rochester paper is correct"[155]), is simple and hard to falsify. Paper money and specie are perfect substitutes, and so an increase in paper money will drive out specie, thus leaving the total money supply unchanged and price levels intact. Of course, for this to be true, there must always have been enough pre-existing specie in the first place, which means that the idea of specie scarcity is directly at odds with the validity of QTM for the colonial time period. Thus, the specie scarcity debate was reignited in the 1980s in a new context.

Smith's scholarship has been criticized under such a framework. McCallum (1992) finds estimates of per capita paper money stock for times and places where it is agreed that little to no specie was circulating, and compares this to the times and places listed by Smith (1985a, 1985b) where amounts of paper money increased rapidly; he finds the former to be higher than the latter, concluding that the episodes Smith lists did not actually result in an excessive amount of circulating money.

There is criticism to be levied towards both sides. Smith (1985a) poorly motivates his belief that specie and paper money were complements and not substitutes, saying only there

is no evidence they were substitutes, and that during the French and Indian War they were almost surely complements (without providing data for this).[156] Additionally, as noted by McCallum (1992), a large percentage increase in paper money is not necessarily meaningful if there was little paper money to begin with. The 749% increase in paper money from 1755 to 1760 in Virginia mentioned by Smith (1985a) is misleading, because 1755 was the first year Virginia printed paper money in the first place. McCallum says that if one instead uses 1754 as the starting year, we would see an increase of ∞%.[157] On the other hand, McCallum's (1992) methodology is somewhat arbitrary and incomplete. For example, he notes that there was about £1.75 worth of paper money per capita in South Carolina between 1727 and 1730, at a time there was apparently negligible circulating specie, and compares this to about £1.10 in Virginia in 1760, around the peak of the large paper money expansion. Thus, McCallum concludes, QTM is supported over the backing theory, because the money supply expansions discussed by Smith (1985a, 1985b) were not actually that large. However, this says absolutely nothing about the actual total size of Virginia's money supply expansion or whether the paper money increase occurred alongside a decrease in specie or a steady supply. While claiming to show evidence strongly favoring QTM, McCallum actually only demonstrates that, without more complete info, the data could fit either theory.

The core problem, as explained by Elmus Wicker in 1985, is that the two theories "cannot be tested directly because there are no reliable estimates of the total money stock of the separate colonies."[158] Without an actual time series for amount of specie, much scholarship on QTM versus the backing theory in the colonial era has simply amounted to academic guesswork. The first scholarship that attempted to change this was Grubb (2004), which, for the first time, offered an estimate of the total money supply of Pennsylvania. This ended up being controversial and igniting a fierce argument, which brings us directly to an understudied modern chapter of the colonial money debate.

3 The Grubb-Michener debate

By far the most contentious chapter of the colonial paper money arguments in the 21st century has been the Grubb-Michener[159] debate, between previously cited economic historians Farley Grubb and Ronald Michener. As of this writing, it has gone through five back-and-forth volleys of published academic papers, spanning 19 papers total from 2003 to 2021, not counting a few manuscripts never formally published. However, it has never been independently analyzed in any detail.[160] It is the second series of papers that is most relevant to this paper, and thus the one that will be of focus here. Each series has always started with Grubb publishing an article, and Michener responding to it with criticism in an article of his own. In the first two series of papers, Michener was joined by Robert Wright. Grubb always responds to the criticism with his own reply papers.

3.1 The first round - a civil disagreement

The debate began with Grubb (2003). Here, Grubb proposes a revisionist and fascinating reason for why the United States switched from a monetary system of individual state currencies to a national one. The states were only prevented from issuing their own bills of credit in 1789, when the US Constitution came into force, which contains a clause reading "no State shall...emit Bills of Credit".[161] Conventional wisdom indicates that the switch occurred because state currencies were too volatile, and a national monetary system was needed for stability. Grubb contests this both econometrically and historically. He finds that one can reject the null hypothesis of a unit root in pre-1776 exchange rates, but not for exchange rates from 1797 to 1811, implying greater stability during the era of state currencies. He also notes increased volatility in prices for the second era. Historically, he traces the clause in the Constitution banning state bills of credit as being inserted by several bankers sent to the Constitutional Convention by Pennsylvania, who wanted to ban the Pennsylvania pound from circulating because it was successfully competing with their own banknotes and diminishing their profits. They succeeded in inserting the clause, thus, according to Grubb, transitioning the country to a worse monetary system for their own

personal rent-seeking reasons.

Michener and Wright (2005) disagree on several grounds, making the arguments (among others) that the Constitutional clause banning state bills of credit was espoused by several others not in the Pennsylvania delegation, and that bills of credit were not successfully competing with banknotes through the late 1780s and had largely already disappeared. One argument of theirs though is more relevant to this paper than the others: medium of exchange versus unit of account. Grubb (2003) observed that in Pennsylvania, market transactions before 1795 were almost always denominated in pounds. By 1797 however, they were usually denominated in dollars. This, Grubb concludes, represents the point at which enough Pennsylvania pounds had been removed from the economy that the US dollar took over, and the transition from a state to a national currency occurred (thus motivating his choice of 1797 as the beginning of the second period he econometrically analyzes). Michener and Wright (2005), who believe Pennsylvania pounds ceased to circulate before the 1790s, point out that just because a transaction was denominated in pounds does not actually mean that is the currency that changed hands, because pounds were both a currency and a general unit of account for recording standardized values in an economy with multiple circulating currencies. A transaction recorded as £5 could mean five pounds worth of Pennsylvania bills of credit, or of foreign specie, or a book account transfer, or even of agricultural products. As an example, Michener and Wright (2005) cite a 1794 transaction recorded as £37.75 that was paid in two Portuguese half Joannes (worth £6), an English guinea (worth £1.75), and $80 of banknotes (worth £30).

In his reply, Grubb (2005b) states that he is well aware of the difference between medium of exchange and unit of account, and that he knows this makes "merchant account books, bank records, government accounts, and statements about economy-wide aggregates" unreliable in determining medium of exchange. However, he states that he only relies on "unregulated one-off transactions between strangers",[162] which often record multiple currencies and are more reliable for determining actual medium of exchange.

3.2 The second round - anger and passive-aggression

This medium of exchange versus unit of account issue became the major focus of the second series of papers, which involve data that will be used in this paper. As previously mentioned, Grubb (2004) was the first attempt at estimating a time series of the *total* money supply of one of the colonies, and not just the amount of circulating money. Grubb used Pennsylvania as his case study, and his estimates were twofold: the amount of paper currency in circulation and the amount of specie in circulation, added together as the total money supply. Estimates of the former are generally unchallenged, and come from the 1992 posthumously published paper by Leslie Brock[163] that corrected some errors from his previous 1941 dissertation. The latter, on the other hand, came from new unique calculations Grubb introduced in the paper. Grubb analyzed what percentage of advertisements about runaway slaves in the *Pennsylvania Gazette* newspaper listed the rewards for capture in specie money, and what percentage listed the rewards in paper currency, from 1729 to 1775. Grubb used these amounts to determine the approximate ratio of paper currency to specie, and already knowing the amount of the former, calculated the amount of the latter. For the most part, Grubb finds specie very scarce, only becoming a large percentage of the money supply between 1770 and 1775. Grubb specifically motives these rewards as being listed in medium of exchange and not unit of account, because they are written in a variety of currencies, and it would have been unwise to "misrepresent" what the payment was.

Michener and Wright (2006a) disagree, and once again believe a significant number of these advertisements were in the unit of account. They are unequivocal about this, and harsh to a degree of questionable necessity, stating: "We question Grubb's research for the simple reason that it is wrong. Grubb has discovered the economic history equivalent of phlogiston, black bile, or geocentrism."[164] Part of this harshness is surely out of a partisan need to defend their greater ideology: they *must* oppose Grubb's time series, because the specie scarcity it shows is a direct issue for their defenses of QTM. This characterization is not entirely fair, however, because they offer a very convincing smoking gun for the inaccuracy of Grubb (2004): believing all advertisements represented medium of exchange, Grubb took anything denominated in generic pounds and shillings to mean Pennsylvania

pounds. These represent the majority of all advertisements. However, the majority of ads in 1720 were also listed in pounds, a full three years before Pennsylvania introduced its paper currency. These by definition cannot be the Pennsylvania pound, proving that ads listed in the unit of account did in fact exist. There would be no reason to believe that by the late 1720s, every single ad listed in generic pounds had come to specifically refer to the Pennsylvania pound.

In his reply paper, Grubb (2006a) shockingly does not respond to this point at all. Instead, he does some quick ad hoc calculations to determine that his time series is about 99.9% likely to be correct regardless. He notes that Benjamin Franklin said there was almost no specie in Pennsylvania in the late 1720s, and "Pelatiah Webster estimated...that 50 to 60 percent of the money in Pennsylvania in 1774 was paper money."[165] Grubb's time series reflects both of these points very accurately, showing 100% paper money in 1729 and 54.97% in 1774. If his time series were random with no reflection to actual real life monetary conditions, then the chances of it hitting the correct 10% intervals for these points, he contends, is 0.1*0.1 = 0.01, or 1%. Furthermore, historical sources are clear that specie flowed into the colonies during King George's War of the 1740s, and once again in the 1750 during the French and Indian War, and both of these events are reflected in his time series. He puts the chances of getting each of these correct by chance at 1 in 3 each, since the other two possibilities are showing specie staying steady or showing it decreasing. Extending the calculation, 0.1*0.1*(1/3)*(1/3) $\approx$ 0.0001, or about 0.1% of being correct entirely by accident.

This calculation is severely flawed in ways that Michener and Wright do not at all address in their follow-up response paper (2006b). For one, matching Benjamin Franklin's observation of almost no specie in the late 1720s should not indicate a 90% chance of being correct. Grubb's time series shows less than 10% specie in almost 2/3rds of the years it runs for, so for any quote indicating specie scarcity in any given year, there is a high chance of Grubb's time series matching it. The second point seems more persuasive at first: 54.97% is almost *exactly* halfway between 50% and 60%, ostensibly the upper and lower bounds estimated by Webster for the total money supply's fraction of paper money in 1774.

However, consulting the original source shows that Grubb has misquoted Webster. What Webster actually said was "not more than half, or at most three fifths, of the circulating cash in this State was paper in 1774."[166] In other words, Webster did not mean between 50% to 60%, but rather meant probably less than 50% and absolutely less than 60%. Grubb's time series would have better matched Webster's estimate if it showed under 50% paper money. This was a discrepancy that Michener and Wright failed to notice.

But in a more general sense, Grubb's time series matching specific estimates from the 1700s is not rigorous evidence in general, because one can pick and choose which quotes to match. As pointed out by Michener and Wright (2006a), Grubb's time series completely misses another estimate, namely a period of apparent specie plenitude during King George's War in the 1740s. As Leslie Brock wrote, "during King George's War the amount of specie in the province had increased until in 1749 there was more in circulation than at any previous time in the history of the province. There were at this time perhaps three or four pounds circulating in specie for every pound in paper."[167] While Grubb's estimates do show specie increasing as a percentage of money supply from 1744 to 1748, his estimate maxes out at 16.67% specie in 1748, before falling to 3.28% in 1749. This is a far cry from the 75% to 80% estimated by Brock. Grubb (2006a) dismisses this estimate as originally coming from "a single anecdotal quote"[168] in 1753, in which Richard Hockley, the quit-rents receiver for Pennsylvania, wrote that 80% of the money received was in gold and silver. While Grubb gives some very plausible arguments as to why this original quote is not representative of the general makeup of Pennsylvania's money supply at this time, there is no proof that this was the sole source for Brock's claim. Brock's statement that the specie-paper ratio in 1749 Pennsylvania was 3:1 or 4:1 is unsourced, but considering it gives two possible values and mentions an increase over time prior to this, it is safe to say it is built on more than a single source giving a single value at a single time. While Brock does use and cite the quote supplied by Grubb, it is 32 pages after his initial assertion on the 1749 Pennsylvania specie-paper ratio.[169] Indeed, Michener and Wright (2006a, 2006b) supply other quotes to bolster the assertion.

The second part of Grubb's flawed calculation is more interesting. He notes that his time

series properly reflects the established increases and decreases of specie through the 1740s and 1750s. He conflates correctly estimating the direction of flow of specie with correctly estimating the actual percentage of specie, but the fact that his time series does follow established historical trends is an important point. Even though many of the newspaper ads that were written only as a unit of account do seem to have been confused by Grubb as being medium of exchange, Grubb's time series of percentage specie does not seem entirely uncorrelated with actual economic indicators. The probable truth, one that neither Grubb nor Michener/Wright seemed to realize in their series of papers, is that although Grubb has not accurately measured the amount of specie in the economy over time, he has measured something correlated to it, and therefore his time series, while not to be taken literally, is not useless. The two sides almost, but do not quite, touch upon this: Michener and Wright (2006a) acknowledge that a change in the relative composition of the money supply can affect what units of account people decide to use,[170] to which Grubb (2006a) replies that Michener and Wright "cannot have it both ways",[171] since they have claimed that the ads have nothing at all to do with the medium of exchange. Given that Grubb's time series has logical flaws, but does indeed seem to match reality in some important ways, it seems that the writers of some newspaper ads intended to communicate their medium of exchange, others just the unit of account, and that both could be meaningfully influenced by changes in the money supply's composition.

Cutting through this academic debate to find such a middle ground is difficult because of the sheer contentiousness of the Grubb-Michener debate. In a stunning display of academic passive-aggressiveness, the Michener and Wright (2006b) paper's main section has a length of about a page and a half, the other twenty or so pages with all the actual arguments put under an Appendix header. Michener and Wright simply say they "relegate the details to an appendix because we believe that, for a general audience, the tone of Grubb's reply is the best evidence of the underlying weakness of his propositions."[172] Grubb (2006b) somewhat understandably responds with regular aggressiveness, characterizing Michener and Wright as "ideologues" and "curmudgeons", and comparing their academic tactics to "religious zealots" and "dictators."[173]

3.3 Further rounds - contempt and disdain

The debate has become even further charged through the past few years, when Michener began repeatedly taking on Grubb alone, without Wright. After Michener's (2019) 5th paper directly criticizing his work, Grubb (2019) notes that the majority of Michener's published articles in the past 20 years have just been these criticisms of him. He says that "there has not been an original research paper on colonial or Revolutionary era paper money that I have published in a scholarly journal over the last 20 years that Michener has not written and submitted a comment on – submissions that have been mostly rejected by editors." He characterizes Michener's "20-year obsession with me" as being "unseemly and weirdly personal."[174] Clearly, by now, Ronald Michener had established himself as the bane of Farley Grubb's academic existence.

Michener then proceeded to elevate the argument to a level of borderline paranoia, accusing Grubb of having "methodically exploited his standing in the profession to defame me."[175] Over a new argument about the exchange rate in New Jersey in 1741, Michener (2020) directly accuses Grubb of having violated the ethical standards of the journal, and implies a paper of his (Grubb 2016c) should be retracted. Robert Wright, who had long since left formally participating in the debate, went a bit further on his personal blog, directly calling for a retraction (and inexplicably mixing in a completely unrelated racist comment).[176] In response, Grubb (2021) says Michener does not understand basic microeconomic theory—literally writing in his abstract "Michener does not understand basic microeconomic theory" and then including a section header reading "Michener does not understand basic microeconomic theory".[177] The open hatred between the two is palpable.

Despite all the vitriol, Grubb seems to have accidentally ceded a small amount of ground to Michener in one notable way. Grubb (2016b), an updated and more comprehensive attempt at using econometrics to observe the relationship between the money supply and prices in colonial America, only uses the estimated amount of paper money in Pennsylvania and not the specie estimates from Grubb (2004). In fact, Grubb (2016b) says "reliable and direct quantitative data on specie monies do not currently exist."[178] Notice that Grubb has not disavowed his previous work; he says that reliable and *direct* data do not exist, and cites

Grubb (2004) as an example of an effort to "*indirectly* estimate the level and change in specie monies for Pennsylvania"[179] (emphasis mine). But, it is interesting that the Pennsylvania specie estimates have now seemingly been relegated to being a side project, not used in Grubb's largest econometric effort on this subject to date. And yet, in another bigger way, Grubb has diverged from Michener much further: while Grubb (2005a) is a defense of QTM, Grubb (2016b) describes QTM as failing on a wide scale.

The Grubb (2004) data will be used in this paper. But first, it is important to acknowledge the limitations for the other half of the data, the paper money estimates.

4 Other data limitations

The time series for the paper money supply in Pennsylvania has been comparatively relatively unchallenged. But it has some acknowledged limitations, which are worth enumerating here.

4.1 Data frequency

The unquestioned source for colonial Pennsylvania price time series is Bezanson, Gray, and Hussey (1935), a work entitled *Prices in Colonial Pennsylvania*. Bezanson and her team looked through numerous original 1700s newspapers to construct a monthly price index (with gaps given periods of missing data) for many commodities in Philadelphia, from January 1720 until December 1775, the eve of the American Revolution. Unsurprisingly, their scholarship shows it was not at all uncommon for commodity prices to display seasonal trends or exhibit shocks at a sub-yearly level.

Unfortunately, our money supply estimates are only yearly, not monthly, and given the types of original records we have it is extremely doubtful that a reliable monthly money supply index for the era could ever be constructed. This means that in regressions, we must use the yearly average of prices, which will naturally obscure shorter term price trends.

4.2 Counterfeit bills

When the first law was passed in 1723 establishing paper money in Pennsylvania, the legal penalty for counterfeiting was having both ears cut off, being flogged 31 times in public, and paying a fine of £100.[180] In 1739, this was upgraded to the death penalty.[181] Pennsylvania bills from then onwards usually had the words "To Counterfeit is Death" printed on them.[182]

And yet, this did not stop people. As early as 28 November 1723, the *American Weekly Mercury* newspaper reported that some notes for one and two shillings had been altered to say ten shillings.[183] Many cases followed of a larger scale, including a counterfeiting operation out of Ireland discovered in 1735 that had produced 1,840 fake Pennsylvania notes.[184] The law of 1739 noted that "great quantities of counterfeit bills in the likeness and imitation of genuine bills of credit of this province have been imported among us".[185] The quality of counterfeit Pennsylvania notes varied widely depending on the maker. Samuel Ford made such good fakes that he escaped the law for many years throughout the 1760s and 1770s.[186] On the other hand, some fakes were discovered immediately. One 1753 attempt misspelled the warning "To Counterfeit is Death" on the back, instead writing "Couuterfeit".[187] Another from 1750 spelled "JUSTICE" as "JNSRICE".[188]

Because the time series for amount of paper money in Pennsylvania was constructed by carefully analyzing the colonial laws that authorized various issues, counterfeit bills are inherently excluded. There is no reliable estimate for what role these played in the money supply or the economy in general. So far, the only study of counterfeiting's effect on the colonial economy is Grubb (2018), which looked at Virginia and not Pennsylvania. The study also did not produce any time series of amount of circulating counterfeit bills, which is probably impossible to determine.

4.3 Cross-colony bill circulation

Paper currency of one colony sometimes circulated as money in a different colony, another thing that the paper money time series does not account for. For example, in 1730, the *Pennsylvania Gazette* newspaper reported that "a considerable Part of [Delaware's paper

money] in the ordinary Course of Trade is daily brought into this Province", and listed 117 people who had agreed to receive up to one-fourth of payment for debts in Delaware currency, in order to work "towards abolishing all Distinctions between the said Currency, and that of this Province."[189] As previously noted, Pennsylvania and New Jersey money largely traded at par with one another for many decades, resulting in some sources reporting that New Jersey money circulated in Pennsylvania. William Douglass in 1740 noted that New York bills were not circulating in Pennsylvania, and Pennsylvania bills were not circulating in New York, but New Jersey bills were circulating in both, and so trade between the two provinces was conducted in New Jersey money.[190] It was apparently a tactic of counterfeiters to spend fake bills of one colony in a different colony, presumably to lessen their chances of getting caught. In 1747, the German language *Pensylvanische Berichte* newspaper reported counterfeiters wanting to spend fake New Jersey in bills in Pennsylvania and fake Pennsylvania bills in New Jersey.[191] Fake New York and Maryland bills are also reported as appearing in Pennsylvania.[192] Besides foreign bills circulating in Pennsylvania, the opposite could apparently sometimes occur: some reports from the 1750s and 1760s indicate Pennsylvania notes circulating in Maryland and New Jersey.[193]

There is unarguable proof that bills of one colony circulated in another *sometimes*. Whether this was very rarely or very commonly, though, has been another contentious facet of the Grubb-Michener debate. Grubb (2003, 2004, 2006a, 2006b, 2021) has repeatedly characterized bills of credit as normally only circulating within their respective colonies, and only crossing borders in specific unusual circumstances. Michener (1987, 2019, 2020) alone and Michener and Wright (2006a, 2006b) together have repeatedly characterized bills of credit as flowing freely across borders. Grubb describes quotes indicating cross-colony bill circulation as being mostly one-off comments from merchants dealing in inter-colony trade, whose experiences with money are not representative of the normal population.[194] He accuses Michener of failing to evaluate the context and biases behind anecdotal quotes.[195] Michener and Wright accuse Grubb of ignoring the collective weight of many pieces of evidence indicating cross-colony circulation.[196]

To an extent, both are probably correct. Michener is most certainly not above taking

quotes out of context to bolster his point. Stepping outside of the Grubb-Michener debate for a moment, Michener (1987) quotes a 1730 letter from the governor of New Jersey indicating that at that time, only one third of New Jersey's extant paper money was circulating inside the colony's borders, the other two thirds circulating in Pennsylvania and New York.[197] Consulting the original source reveals that this was only the case once the majority of New Jersey's bills had been redeemed and removed from circulation.[198] New Jersey bills could, of course, only be redeemed in New Jersey and not Pennsylvania or New York, so the only bills redeemed were the ones circulating within the colony. It makes perfect sense that because of this, a large *percentage* of New Jersey's bills would then be outside its borders, when the actual total amount had become small. Michener does not mention this at all. And yet, this quote, along with others describing the role in inter-colony trade that New Jersey bills had in the first half of the 1700s, does indicate that a notable amount of colonial currency circulated across borders at this place and time, which is something that cannot be ignored.

Ultimately, it might not even matter. In econometric testing of money supply versus prices, Grubb (2016b) tested both individual colonies and blocks of neighboring colonies as a unit, and still did not find correlations nearly of the size QTM would predict. Of course, neighboring colonies were certainly not one cohesive economic unit either. Although bills sometimes circulated across colonies, there were obviously real transaction and opportunity costs associated with using a different colony's money. As of now, there is no precise way of estimating or modeling to what specific extent inter-colony trade affected the money supply.

4.4 The nature of colonial money itself

Much of Grubb's (2016a, 2016b, 2016c, 2018; Celia and Grubb, 2016; Cutsail and Grubb, 2021) recent work has involved analyzing colonial currency as zero-coupon bonds, rather than fiat money. As a result, in Grubb's own words:

> Not only did the structure of paper money differ between colonies, it differed from emission to emission within a colony. These findings indicate that the face values of paper monies cannot be compared within, or summed across, emissions to measure the amount of value in circulation. This observation makes most past

> studies of colonial monetary performance meaningless – thus perhaps explaining the poor modeling performance in those studies.[199]

In Pennsylvania, the primary difference between paper currency emissions was the time until redemption, ranging from 3.58 years to 16 years. Later issues in the 1760s and 1770s were also not legal tender like old issues were.[200] According to a model that treats these bills like bonds, bills with a longer time until redemption would trade at lower values, due to time discounting. Of course, such a model has been contested—by whom, the reader should easily be able to guess by now.

This is an issue for econometric studies, including ones attempted by Grubb (2005a, 2016b) himself. In fact, there is a bit of a contradiction here. Grubb (2016a) claims that summing amounts of bills of credit across emissions is meaningless, yet Grubb (2016b) does exactly this to describe an apparent failure in QTM. Ultimately, the bills of credit as bonds view probably does not make the creation of paper money time series "meaningless", but it does present another important distortion to the data. After all, the face value of a bond is an extremely important part of its value; it is just not the only part.

5 A new approach

5.1 Shifting focus

Given these multiple serious data limitations and issues, a very reasonable conclusion is that calculating an accurate estimate for the effect on prices of a change in the money supply in colonial America is impossible. In fact, a very reasonable conclusion is that it will probably *always* be impossible. But even if calculating accurate absolute correlations is beyond our ability, there is one hope left.

To date, every single study applying econometrics to the colonial American era has used overall price indices, and not individual commodity prices. According to a strict QTM interpretation, an increase in the money supply should increase the price of all goods equally. This assumption has apparently found its way into all the applied econometric

literature on colonial America—even that which argues against QTM in the first place. For Massachusetts, West (1978) did do calculations using only the price of wheat, but *only* as a stand-in for an overall price index, because he did not have access to one like he did for the other colonies. West (1978) only had time series for the price of wheat in Boston from 1701 to 1749 and the price of molasses in Boston from 1720 to 1749. As such, he did calculations with both wheat alone and the average of wheat and molasses. Neglecting to try molasses alone is very telling of the greater approach: only overall prices, as best as can be reconstructed, are used.

Testing different commodities individually and comparing their relative effects is not just some trivial exercise; in fact, it might be the most worthwhile econometrics we can currently do for the colonial era. As previously discussed in detail, the data we have is very distorted and incomplete, to the point that it is very difficult to put any serious amount of faith in the accuracy of absolute measurements. But relative measurements are a different matter. Because we have reliable estimates for price time series in many cases, but only an unreliable estimate for the total money supply, distortions in the calculations should affect equally the effect size for all commodities. If we observe relative differences between these calculations, then we can still say something meaningful about how changes in the money supply affected prices in colonial America. According to QTM, we should observe no such differences; therefore, this serves as an indirect test for different theories of money's value.

5.2 The data and calculations

Pennsylvania is the colony for which the most complete data on colonial prices is available. As mentioned, the undisputed source for colonial Pennsylvania price time series is Bezanson, Gray, and Hussey (1935). Bezanson and her team constructed an overall price index using the prices of 29 different goods: corn, wheat, tobacco, rice, brown bread, middling bread, ship bread, white bread, flour, beef, pork, coarse salt, fine salt, molasses, muscovado sugar, London sugarloaf, Pennsylvania sugarloaf, New England rum, West Indies rum, Madeira wine, indigo, barrel staves, hogshead staves, pipe staves, pitch, tar, turpentine, cotton, and gunpowder. The prices for brown bread, middling bread, ship bread, and white bread were

averaged together to create a single time series for bread. Likewise, course salt and fine salt were averaged together to create an index for salt; London sugarloaf and Pennsylvania sugarloaf were averaged together to create an index for sugarloaf, which was then averaged with muscovado sugar to create an overall index for sugar; New England rum and West Indies rum were averaged together to create an index for rum; and barrel staves, hogshead staves, and pipe staves were averaged together to create an index for staves. The result was time series for 20 commodities, which were then averaged together to create the overall index.

These 20 commodities will be what are individually tested here. Bezanson, Gray, and Hussey (1935) aggregated data for some additional commodities, such as pepper, ginger, and hemp, but the data were considered too incomplete. Bezanson supplied both monthly and yearly indices, and due to previously discussed data constraints, it is the yearly data that are used here. Bezanson did not explicitly supply time series for the goods averaged together: for example, the data for New England rum and West Indies rum are both supplied individually, but not their average that was used in the creation of the overall index. As such, manually averaging the data was necessary here. The prices for each commodity were quoted in shillings, with four exceptions, which were quoted in pounds: Madeira wine, hogshead staves, pipe staves, and gunpowder. The data for these four goods were all multiplied by 20, so that all prices are listed in shillings. For Madeira wine and gunpowder, this does not matter. Multiplying a time series by a particular number only changes the size of the constant in log regressions, and has no effect on the size or standard errors of the coefficients. However, since the three types of staves must be averaged together, this affects the results slightly.

The money supply data comes from both Grubb (2004) and Grubb (2016b). The data Grubb (2004) used for Pennsylvania's paper money supply was taken directly from Brock (1992). In Grubb (2016b), he has presented some updated calculations for the Pennsylvania paper money time series. To create the most up-to-date time series, the paper money amounts from Grubb (2016b) have been combined with the yearly specie ratios in Grubb (2004). The Grubb (2004) money supply time series runs from 1729 to 1775, and the Grubb

(2016b) time series runs from 1723 to 1774. Although there are no specie ratios from Grubb (2004) to combine with the Grubb (2016b) data from 1723 to 1728, these six years from Grubb (2016b) have been left in as is. This is because the Grubb (2004) data shows 0% specie for the first 11 years, so it is reasonable to assume the same going a few extra years backwards.

The decision in Grubb (2016b) to leave out 1775 seems purposeful, and is likely because 1775 was the first year of the new national monetary system, even though the colonies did not declare independence until 1776. As such, 1775 has also been left out here. For 9 out of 20 commodities, there is no price data for 1775, meaning this decision has no effect on the results. For the other 11 goods, just in case, all regressions were reran including 1775. Coefficient sizes moved very little, and in no cases did a statistically significant result become statistically insignificant or vice versa, with one exception: including 1775 causes sugar to be significant at the 10% (but not 5%) level when it was not before. However, this is a spurious result. Sugarloaf data runs only until 1774, but muscovado sugar data runs until 1775. Muscovado is much more expensive than sugarloaf, so using the average of them causes an artificial large spike in the last year when the cheaper of the two is no longer available to drive down the index. This happens to coincide with a large influx of specie that Grubb (2004) records for 1775. Given the large price differential between muscovado sugar and sugarloaf, the different trends in their prices over time, and the fact that data for sugarloaf is more sparsely available than muscovado, averaging them together is questionable methodology for the original overall Bezanson Index. However, neither muscovado sugar nor sugarloaf prices individually exhibit any significant positive correlation to the money supply estimate after correction for serial correlation, so the point is moot for our purposes.

The regression specification is largely taken from West (1978), which Grubb (2016b) inherited. The natural log of prices are regressed on the natural log of money supply with zero, one, and two lags, to account for price changes over different time intervals. With two lags, the regression specification is:

$$ln(P_t) = \beta_0 + \beta_1 * ln(M_t) + \beta_2 * ln(M_{t-1}) + \beta_3 * ln(M_{t-2}) + \epsilon_t$$

Where P_t is price at time t and M_t is money supply at time t.

West (1978) corrected for serial correlation by applying the Cochrane-Orcutt procedure. This would not be an appropriate method here, because Cochrane-Orcutt only corrects for AR(1) serial correlation, and the presence of higher order serial correlation is evident in some of our regressions. Instead, the serial correlation correction method from Grubb (2016b) is used here: lags of the dependent variable (prices) are added to the regression until the null of no serial correlation cannot be rejected at the 5% level. In both Grubb (2016b) and this paper, this normally required anywhere from one to three lags depending on the equation. Appending the previous regression specification (which had two independent variable lags) with three dependent variable lags, the regression specification becomes:

$$\begin{aligned} ln(P_t) = \beta_0 + \beta_1 * ln(M_t) + \beta_2 * ln(M_{t-1}) + \beta_3 * ln(M_{t-2}) \\ + \beta_4 * ln(P_{t-1}) + \beta_5 * ln(P_{t-2}) + \beta_6 * ln(P_{t-3}) + \epsilon_t \end{aligned}$$

As per Grubb (2016b), six versions of each regression are reported in the appendix: results with zero, one, and two independent variable lags, each both uncorrected and corrected for serial correlation with dependent variable lags. In the main body of the paper, the results analyzed will primarily be those of the regressions with two money supply lags corrected for serial correlation.

However, the method of serial correlation detection used here is different from Grubb (2016b), which used Durbin's h test at each added dependent variable lag until the null of no serial correlation could not be rejected. In this paper, some regressions also displayed heteroskedasticity, which means a heteroskedasticity-robust method of serial correlation testing was needed. In this case, the Cumby-Huizinga test was used. Each regression was tested for heteroskedasticity using the Breusch-Pagan test. If the null of no heteroskedasticity was not rejected at the 5% level, then it was tested for serial correlation using the regular Cumby-Huizinga test. If the null of no heteroskedasticity *was* rejected, then the heteroskedasticity-robust Cumby-Huizinga test was used. If the version of Cumby-Huizinga

used rejected the null of no serial correlation at the 5% level for any of the first four lags, then a dependent variable lag was added to the regression, and the testing procedure started over again. This was repeated until enough dependent variable lags were added such that the nulls of no serial correlation for the first four lags could not be rejected at the 5% level. If the resulting final regression exhibited heteroskedasticity at the 5% level, then robust standard errors using the HC3 estimator are used.

Due to the inherent arbitrariness of the traditionally used 5% level of significance, strict adherence to the previously described method caused a potential issue with one commodity: tobacco. The tobacco regression with two independent variable lags and one dependent variable lag exhibits heteroskedasticity at the 5% level, and has AR(1) serial correlation at the 5% level when using the regular Cumby-Huizinga test, but only at the 10% level when using the robust Cumby-Huizinga test. According to the described method, no additional lags should be added after this. However, the tobacco regression with two independent variable lags and two dependent variable lags has no heteroskedasticity, but also still has AR(1) serial correlation. This is a strong sign that one lag is not enough. We cannot be certain that serial correlation has been properly removed until we reach three lags. Because of this, two versions of the tobacco regression with two independent variable lags have been reported in the appendix: one version with one dependent variable lag and HC3 standard errors, and one version with three dependent variable lags and normal OLS standard errors. It is the latter version that is analyzed in the main body of this paper, although some level of subjective analysis was required to make the choice between the two.

A smaller issue is that for the staves regression with two independent variable lags and no dependent variable lags, the Breusch-Pagan test returned a p-value of 0.0516. However, the two versions with OLS and HC3 standard errors were almost identical, so only the version with OLS standard errors is reported.

To find the cumulative associated effect of an increase in money supply on prices given multiple lags of money supply in regressions, the coefficients are added together. This results in what is herein referred to as the long-run propensity (LRP). In the previous regression specifications with two independent variable lags, the formula for this is simply:

$$\beta_1 + \beta_2 + \beta_3$$

And the standard error is:

$$\sqrt{\begin{array}{l} SE(\beta_1)^2 + SE(\beta_2)^2 + SE(\beta_3)^2 + 2 * Cov(\beta_1, \beta_2) \\ + 2 * Cov(\beta_1, \beta_3) + 2 * Cov(\beta_2, \beta_3) \end{array}}$$

The percentage change associated with the log regression, herein referred to as the long-run elasticity (LRE), is:

$$e^{(\beta_1+\beta_2+\beta_3)} - 1$$

6 Results

6.1 Overview

A short summary of the results for the regressions with two independent variable lags, corrected for serial correlation, can be seen below (Table 2). The complete regression results can be seen in the appendix (Table 7).

Table 2 – Regression results with two independent variable lags, corrected for serial correlation

Commodity	**LRP**	**N**	**P-value**
Corn	0.1089***	50	0.0068
Wheat	0.0791**	50	0.038
Tobacco	0.0662**	37	0.023
Rice	0.0089	37	0.817
Bread	0.0516	50	0.108
Flour	0.0805**	50	0.033
Beef	0.0849***	41	0.0035
Pork	0.0802**	50	0.013

Continued on next page

Table 2 – *Continued from previous page*

Commodity	LRP	N	P-value
Salt	-0.0059	50	0.841
Molasses	0.0121	50	0.58
Sugar	0.0229	50	0.3
Rum	0.0185	50	0.378
Wine	0.0857*	39	0.068
Indigo	-0.0221	31	0.675
Staves	0.1452***	39	0.0071
Pitch	0.0059	50	0.771
Tar	0.0350	46	0.109
Turpentine	-0.0154	41	0.61
Cotton	0.0206	39	0.511
Gunpowder	0.1158**	27	0.044

*** p < 0.01; ** p < 0.05; * p < 0.1

Out of 20 commodity prices, there are 8 which have a statistically significant relationship to the money supply at the 5% level. These are: corn, wheat, tobacco, flour, beef, pork, staves, and gunpowder. The remaining ones not correlated at the 5% level are rice, bread, salt, molasses, sugar, rum, wine, indigo, pitch, tar, turpentine, and cotton. The only commodity correlated at the 10% level but not the 5% level is wine. However, wine is correlated at the 5% level for both the zero and one independent variable lag regressions corrected for serial correlation, which means it should certainly be counted as one of the goods with a demonstrated correlation. The most likely explanation is that wine only dipped below 5% significance with an additional independent variable lag because of the larger standard errors from a more complex model with limited data. With this is mind, wine will be counted as being correlated.

When testing many regressions at the same time, it is common and usually well-advised to calculate and report p-values adjusted with a Bonferroni correction. If we were to do that here, no commodities would be statistically significant. However, due to the very short time span of the data, a Bonferroni correction is probably not appropriate, and there is no convenient solution to the multiple comparisons problem. This can be illustrated by the fact that, if the true number of goods correlated at the 5% level is zero, then the probability of seeing 8 (not counting wine in order to be conservative with the estimate) or more correlated by chance is:

$$\sum_{n=8}^{20} \frac{20!}{(20-x)! * x!} * 0.05^{x} * 0.95^{(20-x)} \approx 0.00000286 \rightleftharpoons 1 \text{ in } 350{,}000$$

This would be an upper bound, since it assumes the price series are themselves uncorrelated with one another, which is not the case; however, the point remains that a Bonferroni correction is unlikely to yield accurate results. Of course, by the same general formula, if the true number were 7 out of 20, the chances of at least one of the remaining 13 being a false positive would be approximately 48.67%. Like any econometrics applied to the colonial American era, we must proceed with caution.

In line with previous literature, the absolute size of the coefficients is rather small, ranging from -0.0154 (turpentine) on the low end to 0.1452 (staves) on the high end. The latter represents an approximately 0.1563% increase in price given a 1% increase in the money supply, about one-sixth the size as predicted by the quantity theory of money. However, as previously discussed, of more interest is the relative comparisons between the commodities' coefficients, rather than their absolute values.

In one case, a lack of statistical significance seems to be the result of averaging different types of the commodities together. As seen in Table 2, the p-value for bread is 0.108, not significant at any commonly accepted level. However, if we individually test the four types of bread that were averaged to create the bread time series, the story changes somewhat. A short summary of these results, once again with two independent variable lags corrected for serial correlation, can be seen below (Table 3). The complete results are in the appendix (Table 8).

Table 3 – Regression results for bread with two independent variable lags, corrected for serial correlation

Commodity	**LRP**	**N**	**P-value**
Bread (brown)	-0.1233	21	0.415
Bread (middling)	0.0756**	50	0.041
Bread (ship)	0.0672	40	0.111
Bread (white)	0.2706***	31	0.0052

*** p < 0.01; ** p < 0.05; * p < 0.1

Two types of bread, white and middling, are correlated at the 5% level. In fact, white

bread has the largest correlation of any tested good, with an LRP of 0.2706 and thus an LRE of 0.3108%. Before being corrected for serial correlation, the white bread regression with two independent variable lags has an LRP of 0.6579 and an LRE of 0.9308%, which would be the only result that comes within reasonable bounds of QTM's predictions. A third type of bread, ship, flirts with significance: the version with only one independent variable lag, corrected for serial correlation with two dependent variable lags, is actually significant at the 5% level. However, in this regression specification, the null of no serial correlation is not rejected at the 5% level, but is still rejected at the 10% level. Adding a third dependent variable lag removes the correlation. The last type of bread, brown, shows no significance, but has by a notable margin the lowest number of observations of any commodity tested here, at only 21, so nothing definitive can be said.[201]

6.2 Expensive and cheap goods

Of the 20 commodities, 13 are edible, and 7 are not. Of the 13 edible commodities, at least 7 have statistically significant correlations. This is 8 out of 13 if we count bread. Of the 7 non-edible commodities, only 2 are correlated. An interesting observation can be made when we take the average price of each non-edible commodity across the time series and compare this to the effect sizes:

Table 4 – Non-edible commodity effect sizes and average prices

Commodity	**Average price**	**LRP**	**P-value**
Cotton	1.444	0.0206	0.511
Indigo	8.133	-0.0221	0.675
Tar	10.979	0.0350	0.109
Pitch	14.730	0.0059	0.771
Turpentine	17.658	-0.0154	0.61
Staves	100.954	0.1452***	0.0071
Gunpowder	199.406	0.1158**	0.044

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Prices listed in shillings.

Only the two most expensive goods show a correlation. These goods are *significantly* more expensive than the rest, implying that this is not a coincidence. Assuming this is a

meaningful result, there are two explanations for this. The first is that perhaps correlations are harder to detect with less expensive goods, because price movements are comparatively smaller and get drowned out by either short term movements and shocks or measurement and rounding errors. This would imply that differences we see between the goods are not necessarily reflective of reality, and are an artifact of the data. This conclusion would be somewhat supportive of QTM. The second explanation is that more expensive (non-edible) commodities were more sensitive to changes in the money supply than cheaper ones. This would help explain why, as Elisha Potter said in his 1837 account of Rhode Island bills, "the emissions of paper money were generally opposed by the merchants and businessmen".[202] Those dealing in the trade of more expensive commodities were more likely to notice paper money's effect on prices, whereas those who mostly bought items for personal consumption would not.

If we break down staves by the three types, we see even more evidence for this. A summary of the stave regressions, once again with two independent variable lags corrected for serial correlation, along with the average prices, can be seen below (Table 5). Full regression results are in the appendix (Table 9). For hogshead staves at one and two independent variable lags, the Cumby-Huizinga p-values for AR(2) serial correlation were about 0.06 and 0.055 respectively when at one dependent variable lag. Serial correlation did not definitively disappear until two dependent variable lags. Both one and two lag versions are reported in the appendix, but the two lag version is used below.

Table 5 – Regression results for staves with two independent variable lags, corrected for serial correlation

Commodity	**Average price**	**LRP**	**N**	**P-value**
Staves (barrel)	54.726	0.1413***	39	0.0050
Staves (hogshead)	95.464	0.1928***	38	0.0027
Staves (pipe)	152.673	0.1856***	39	0.0022

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Prices listed in shillings.

All three show a significant correlation, but the cheapest type of stave has a noticeably lower coefficient than the other two. If we use the one dependent variable lag regression

for hogshead staves, the coefficient is 0.1638, possibly offering even further evidence for the relationship between average price and observed effect, at least for non-edible commodities.

Prices versus observed effects for edible commodities can be seen below:

Table 6 – Edible commodity effect sizes and average prices

Commodity	**Average price**	**LRP**	**P-value**
Molasses	1.838	0.0121	0.58
Salt	2.130	-0.0059	0.841
Corn	2.384	0.1089***	0.0068
Rum	2.844	0.0185	0.378
Wheat	4.304	0.0791**	0.038
Flour	12.522	0.0805**	0.033
Rice	16.214	0.0089	0.817
Bread	17.994	0.0516	0.108
Tobacco	18.406	0.0662**	0.023
Sugar	25.433	0.0229	0.3
Beef	44.324	0.0849***	0.0035
Pork	61.352	0.0802**	0.013
Wine	716.636	0.0857*	0.068

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$
Prices listed in shillings.

The association is significantly less straightforward for edible goods. However, a few things should be noted. The three most expensive edible goods are all correlated, which means the five most expensive goods overall are all correlated. Oppositely, the two least expensive edible goods are not, which means the three least expensive goods overall are all uncorrelated. Likewise, if we look at all four types of bread, the pattern holds exactly. White bread, the most expensive (average price 23.968 shillings), has the largest correlation. Middling bread, the second most expensive (19.385), has the second largest correlation. Ship bread, the commodity that nears significance, is the third most expensive (13.584). And lastly, brown bread, for which there was no detectable correlation, is the cheapest (10.258).

It is in the middle of the table for edible goods sorted by average price that things are significantly mixed. Cheaper edible commodities that do exhibit correlation are corn, wheat, and flour. In describing the price trends of corn and wheat, Bezanson says that "both were subject to very frequent short price movements."[203] In this case, if the prices of these goods

were more sensitive, it makes sense they would have notable correlations. This is a blow to the previous theory that cheaper goods may simply be harder to measure the correlation for, and implies that in fact there *are* structural differences between commodities in how they responded to changes in the money supply.

6.3 Imports and domestic goods

There is another mechanism that can explain why some goods show a correlation and others do not. In general, it seems like goods that were produced domestically in Pennsylvania are much more likely to display a statistical correlation, and goods imported from other colonies or other countries are less likely. It can be reasoned that goods produced locally were more sensitive to local economic conditions. Among the cheaper goods, this has an excellent track record at explaining which goods show a correlation and which do not. The three cheap correlated commodities, flour, wheat, and corn, were all produced widely in Pennsylvania, and were extremely important to the economy as exports.[204] On the other hand, for the four cheapest uncorrelated edible products, salt was imported from Europe,[205] molasses and rum were imported from New England and the Caribbean,[206] and rice was largely an import from North and South Carolina.[207] For our more expensive goods, results are more mixed. Tobacco, only slightly more expensive than rice, was largely imported from Maryland and Virginia,[208] but still shows a correlation. Sugar, which is uncorrelated, follows our pattern: some sugarloaf was refined in Pennsylvania, but made from imported ingredients, and competed with sugarloaf from London and muscovado sugar from the Caribbean.[209] Beef and pork don't seem to necessarily have had a specific origin, with Pennsylvania being both a producer of it and a midway point for trade of it between the Carolinas and Connecticut.[210] Wine, the most expensive good, was an import from Portugal.[211]

The non-edible commodities show the exact same pattern. For the five cheaper uncorrelated goods, cotton came from the Caribbean;[212] tar, pitch, and turpentine were imported from the southern colonies like the Carolinas;[213] and some indigo came from the Carolinas, but most came from the Caribbean.[214] The two expensive correlated commodities are, unsurprisingly, mixed. Staves were a staple domestic product in Pennsylvania and a key

export,[215] whereas gunpowder was imported from Europe.[216]

It is worth noting that even among the more expensive goods, it appears there might be more of a demonstrable effect for those goods which were produced domestically. Though both staves and gunpowder are expensive correlated goods, it is staves, the domestic good, that has a larger correlation. Although wine, the imported good, has about the same effect size as pork and beef, the standard errors are larger, and it straddles both sides of the 5% significance level. This is not seen with pork and beef, the latter of which is easily correlated at the 1% level.

It seems that these two mechanisms—more expensive goods are more likely to show a correlation, and imported goods less likely—can explain the large majority of variation for which commodity prices show responses to money supply changes and which do not. In fact, out of 20 commodities, this theory seems to be reflected in 19 out of 20. The only notable exception is tobacco, but even this might not be an exception: as previously described, there are two versions of the final tobacco regression, and some subjective analysis was required to decide which one was more appropriate. The one chosen is significant at the 5% level, but the other one is not. However, even if tobacco is an exception, the almost completely successful explanatory power of these two factors in tandem is hard to ignore.

This is a problem for a strict interpretation of the Quantity Theory. If QTM holds, we should see approximately the same response in all prices from a change in the money supply. Instead, we see complex trends and sizable differences.

7 Conclusions, and why it might matter

Previous scholars analyzing QTM in the context of the colonial American era, even the ones attempting to disprove that it applies, have accidentally tacitly accepted one of its main assumptions. Only overall price indices have ever been used, rather than individual commodity prices. The unstated assumption has been that different commodities must react the same way to changes in the money supply, and that monetary policy has a uniform effect on all aspects of the economy. This lack of rigor in previous econometric scholarship has

hid the true complexities behind the historical colonial monetary systems.

The colonial American economy, we know, was very complex and dynamic. Multiple currencies from multiple countries circulated at once, such that sometimes even a single transaction was made with more than one type of money. Complex systems of local barter and credit coexisted with trade routes spanning thousands of kilometers. Each colony had its own separately functioning monetary system, and free movements of goods and people across borders meant people often had to convert between currencies, and it was possible for one colony's currency to circulate in another. Systems of 'commodity money' blurred the line between barter and money. At times, gold and silver were plentiful, and at other times, there was barely any with which to carry on trade. In some years and places, a flood of paper money inundated the economy, and in different years, most of the paper money supply had been redeemed and retired by the government. Different circulating issues of paper money in different years, even those by the same government, could be issued differently in ways that impacted people's beliefs about its worth and subjective valuation. In many ways, the nature of everyday economic transactions in 1700s America was more complex and diverse than our own today.

Given all these complexities, it is no surprise that we can now recognize yet another one for colonial America, which has somehow escaped realization: changes in the money supply could have disproportional effects on some parts of the economy over others. And, given that the money supply estimate used here is a direct measurement of paper money stocks with only an indirect, incomplete, distorted measurement of the specie stock added to it, we can probably go a step further: changes in *one specific aspect* of the money supply could have disproportional effects on some parts of the economy. It is almost surprising that this has escaped mathematical analysis up to now.

Specifically, using Pennsylvania as a case study, changes in the money supply were more likely to affect the prices of commodities manufactured domestically. Prices of imported goods, which necessarily came from an economy operating on an entirely different monetary system, were less impacted. For cheaper goods, whether a good was produced within the colony or imported from elsewhere seems to be a strong predictor of whether or not there

was an observed correlation, and possibly even for what the size of the correlation was. On the other hand, this could be overridden by the second observed mechanism, that more expensive goods were also more likely to exhibit a correlation.

This can help explain why the debate about paper money was often very divided in colonial America, with some hailing paper money as the savior of commerce and others decrying it as a source of ruin. If the introduction of paper money changed relative prices, it also must have, to some extent, changed the structure of the economy, to the benefit of some at the expense of others. Different people, who had different preferences and worked in different professions, would have different spending patterns, and thus reaped the benefits or bore the costs of paper money unevenly. In a colony like Pennsylvania, which kept its monetary policy cautious and reasonable and was able to mitigate the issue of specie scarcity without causing considerable depreciation, any relative negative effects on certain sectors of the economy were probably balanced out by the general encouragement of trade, and thus this translated to some people being benefited overall more than others. In a colony like Massachusetts in the 1740s, which experienced a large amount of inflation, any negative effects were probably only exacerbated, and thus this translated to some people being harmed more overall than others. For colonies whose monetary track record was somewhere in between, it is not hard to imagine that some experienced a net benefit and others net harm.

This is all a problem for the Quantity Theory of Money. If the theory strictly holds, we should not be seeing various mechanisms behind which goods respond to money supply changes in what ways. Some previous scholars have concluded that the paucity of the data for the colonial American era means that we cannot use it to say anything certain about QTM. In some ways, this is still true: the exact sizes of correlations elude us, and likely always will. However, what we *can* observe about relative differences is telling. Ultimately, the problem seems to be that QTM is quite a simple theory. Too simple. Despite its intuitive nature, it does not seem to fully hold in complex economies.

QTM should not be considered a fully dead theory. The existence of modern periods of hyperinflation for some currencies unequivocally shows that it is sometimes reflective of

reality. QTM is a great starting point for understanding the general relationships between money supply, money velocity, price levels, and real value of goods for many (but not all) economic structures. It can be used to reasonably analyze many economic events, and this can possibly even include those from colonial America (albeit with relaxed assumptions): for example, maybe during times of specie scarcity, increases in the paper money supply did not cause large increases of prices because, given $MV/Q = P$, the mitigation of specie scarcity encouraged economic activity, thus raising both M and Q. However, the existence of structural differences in how different types of goods are impacted by an increase in the money supply shows that QTM is not enough. Although it can be useful, it is a clear oversimplification, and strict adherence to it limits and harms our understanding of the economy.

A natural question one might ask is, why does this matter? Data from the 1700s has been used here to form conclusions about the modern day, but the specific conditions of the economy in the 1700s have no bearing on what happens today. Is entering this niche historical debate not just an exercise in academic futility?

Over time, economic theory and modelling has grown increasingly complex. Today, students of economics learn an entire overview of classical economics in a couple introductory classes, before moving on and learning all the intricate ways in which these simple logical models fail us. Economic thought over a couple centuries has grown from generalized statements and clean graphs to deeply mathematical models, some of which are so complex that only a small handful of experts truly understand them. At the same time, the economy itself seems to have grown more complicated. Stock trading happens at the millisecond level. Financial instruments of a complexity undreamed of a century ago have both made some into billionaires and ruined entire economies. Important indicators can take huge dives and recover all in the matter of hours or minutes. Perhaps the old theories were fine for an old world, but we live in a more complex one now.

But, embracing this complexity has meant leaving behind an entirely different type of complexity. With technology and globalization comes standardization and integration. Singular currencies controlled by singular central banks are used by hundreds of millions.

On a day-to-day basis, there is little need to worry about the specific method to use for transactions. In 1700s America though, a transaction could occur in paper money, silver or gold from various countries, traded commodities, accounting book transfers, or complex systems of barter. Multiple forms might even be used at the same time.

There is a pernicious and frequent tendency to think of history as a constant upward slope. Technology, general knowledge, and the intricacies of everyday life are all often thought of as only increasing. But this is not true. Things can be both gained and lost. People in the past had lives that were just as rich and complex as ours, just sometimes in different ways. It is fallacious to think of a simple theory like QTM as having been fine and good when it emerged hundreds of years ago, but being outdated for a modern economy. According to the best evidence we have, it was *always* an oversimplification.

Viewing the past as inherently simpler than the present makes us both bad economists and bad historians. This is, in fact, true no matter what economic theories we subscribe to. We should never balk at analyzing even the distant past as a method of understanding the present.

8 Appendix

Table 7 – Full regression results (general commodities)

ln(Commodity)	**Constant** (SE)	**ln(M_t)** (SE)	**ln(M_{t-1})** (SE)	**ln(M_{t-2})** (SE)	**Lags**	**N**	**LRP** (SE)	**LRE** (p-value)	**HC3?**
Corn	-1.2926***	0.1830***			0	52	0.1830***	0.2008%	No
	(0.3958)	(0.0337)					(0.0337)	$(1.7 * 10^{-6})$	
Corn	-0.5075	0.0706*			3	52	0.0706*	0.0731%	No
	(0.3522)	(0.0359)					(0.0359)	(0.055)	
Corn	-1.3941***	-0.0256	0.2183*		0	51	0.1926***	0.2124%	No
	(0.4164)	(0.1253)	(0.1197)				(0.0354)	$(1.7 * 10^{-6})$	
Corn	-0.6337*	-0.0398	0.1244		3	51	0.0847**	0.0883%	No
	(0.3766)	(0.1013)	(0.0981)				(0.0380)	(0.031)	
Corn	-1.5664***	-0.1849	0.2006	0.1925	0	50	0.2083***	0.2316%	No
	(0.4034)	(0.1489)	(0.2061)	(0.1174)			(0.0343)	$(2.2 * 10^{-7})$	
Corn	-0.8558**	-0.1712	0.1857	0.0944	3	50	0.1089***	0.1150%	No
	(0.3770)	(0.1247)	(0.1716)	(0.1009)			(0.0383)	(0.0068)	
Wheat	-1.4878***	0.2490***			0	52	0.2490***	0.2828%	No
	(0.4236)	(0.0361)					(0.0361)	$(8.7 * 10^{-9})$	
Wheat	-0.4732	0.0706**			3	51	0.0706**	0.0732%	No
	(0.3004)	(0.0336)					(0.0336)	(0.041)	
Wheat	-1.5457***	0.0584	0.1965		0	51	0.2549***	0.2903%	No
	(0.4522)	(0.1361)	(0.1300)				(0.0384)	$(2.7 * 10^{-8})$	
Wheat	-0.4500	0.0418	0.0271		3	51	0.0690*	0.0714%	No
	(0.3331)	(0.0912)	(0.0871)				(0.0368)	(0.068)	
Wheat	-1.6840***	-0.0706	0.2336	0.1042	0	50	0.2673***	0.3064%	No
	(0.4605)	(0.1700)	(0.2353)	(0.1340)			(0.0391)	$(1.6 * 10^{-8})$	
Wheat	-0.5800*	-0.0955	0.2098	-0.0352	3	50	0.0791**	0.0823%	No
	(0.3334)	(0.1122)	(0.1543)	(0.0902)			(0.0370)	(0.038)	
Tobacco	1.3910***	0.1292***			0	45	0.1292***	0.1379%	No
	(0.4726)	(0.0401)					(0.0401)	(0.0024)	
Tobacco	-0.0917	0.0978*			1	42	0.0978*	0.1027%	Yes
	(0.3187)	(0.0523)					(0.0523)	(0.069)	
Tobacco	1.3317***	-0.2903*	0.4258**		0	45	0.1355***	0.1451%	No
	(0.4433)	(0.1630)	(0.1610)				(0.0376)	(0.0008)	
Tobacco	-0.0248	-0.0183	0.1205		1	42	0.1022*	0.1076%	Yes
	(0.3792)	(0.0681)	(0.1008)				(0.0540)	(0.066)	
Tobacco	1.3230***	-0.3722**	0.8261***	-0.3194**	0	45	0.1345***	0.1440%	No
	(0.4168)	(0.1565)	(0.2178)	(0.1250)			(0.0354)	(0.0005)	
Tobacco	-0.0135	-0.0317	0.1656	-0.0342	1	42	0.0997*	0.1048%	Yes
	(0.3843)	(0.0872)	(0.1746)	(0.1186)			(0.0580)	(0.094)	
Tobacco	-0.1776	0.0715	-0.0266	0.0213	3	37	0.0662**	0.0684%	No
	(0.3300)	(0.0985)	(0.1750)	(0.1141)			(0.0275)	(0.023)	
Rice	2.4090***	0.0304			0	43	0.0304	0.0309%	No
	(0.4976)	(0.0422)					(0.0422)	(0.475)	
Rice	1.0669	-0.0053			1	39	-0.0053	-0.0053%	Yes
	(0.6574)	(0.0273)					(0.0373)	(0.888)	
Rice	2.5570***	-0.1030	0.1217		0	42	0.0186	0.0188%	No
	(0.5676)	(0.1556)	(0.1409)				(0.0478)	(0.699)	

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Table 7 – *Continued from previous page*

ln(Commodity)	**Constant** (SE)	**ln(M_t)** (SE)	**ln(M_{t-1})** (SE)	**ln(M_{t-2})** (SE)	**Lags**	**N**	**LRP** (SE)	**LRE** (p-value)	**HC3?**
Rice	1.2404	-1.1881	0.1695		1	38	-0.0186	-0.0184%	Yes
	(0.7498)	(0.1526)	(0.1549)				(0.0362)	(0.661)	
Rice	2.4740***	-0.1440	0.2337	-0.0642	0	41	0.0255	0.258%	No
	(0.6027)	(0.1957)	(0.2623)	(0.1642)			(0.0507)	(0.618)	
Rice	0.8083	-0.3333**	0.5292**	-0.1870*	1	37	0.0089	0.0089%	Yes
	(0.8512)	(0.1546)	(0.2347)	(0.1095)			(0.0381)	(0.817)	
Bread	-0.1888	0.2596***			0	52	0.2596***	0.2965%	Yes
	(0.4881)	(0.0428)					(0.0428)	$(1.7 * 10^{-7})$	
Bread	-0.1835	0.0467			1	52	0.0467	0.0478%	No
	(0.2500)	(0.0280)					(0.0280)	(0.101)	
Bread	-0.3235	0.0892	0.1826		0	51	0.2718***	0.3123%	Yes
	(0.5454)	(0.1553)	(0.1436)				(0.0475)	$(6.8 * 10^{-7})$	
Bread	-0.1652	-0.0394	0.0869		1	51	0.0476	0.0487%	No
	(0.2707)	(0.0821)	(0.0782)				(0.0303)	(0.123)	
Bread	-0.3638	0.0555	0.0142	0.2064	0	50	0.2762***	0.3181%	No
	(0.5315)	(0.1957)	(0.2716)	(0.1547)			(0.0451)	$(1.9 * 10^{-7})$	
Bread	-0.2307	-0.1042	0.1897	-0.0338	1	50	0.0516	0.0530%	No
	(0.2811)	(0.1044)	(0.1444)	(0.0846)			(0.0314)	(0.108)	
Flour	0.2026	0.1970***			0	52	0.1970***	0.2178%	No
	(0.3865)	(0.0329)					(0.0329)	$(2.4 * 10^{-7})$	
Flour	-0.0146	0.0711**			3	52	0.0711**	0.0737%	No
	(0.2772)	(0.0335)					(0.0335)	(0.039)	
Flour	0.1568	0.0390	0.1627		0	51	0.2017***	0.2234%	No
	(0.4145)	(0.1247)	(0.1192)				(0.0352)	$(6.4 * 10^{-7})$	
Flour	-0.0173	0.0601	0.0121		3	51	0.0721*	0.0748%	No
	(0.3022)	(0.0938)	(0.0897)				(0.0365)	(0.054)	
Flour	-0.0021	-0.1109	0.2838	0.0427	0	50	0.2156***	0.2406%	No
	(0.4210)	(0.1550)	(0.2151)	(0.1225)			(0.0358)	$(2.6 * 10^{-7})$	
Flour	-0.1572	-0.0814	0.2069	-0.0451	3	50	0.0805**	0.0838%	No
	(0.3057)	(0.1182)	(0.1631)	(0.0928)			(0.0364)	(0.033)	
Beef	1.2201***	0.2173***			0	46	0.2173***	0.2428%	No
	(0.2352)	(0.0200)					(0.0200)	$(4.0 * 10^{-14})$	
Beef	0.4064*	0.0647**			1	43	0.0647**	0.0668%	No
	(0.2035)	(0.0254)					(0.0254)	(0.015)	
Beef	1.1187***	0.0966	0.1297*		0	45	0.2263***	0.2540%	No
	(0.2493)	(0.0724)	(0.0691)				(0.0210)	$(1.1 * 10^{-13})$	
Beef	0.4329*	0.0216	0.0519		1	42	0.0736**	0.0763%	No
	(0.2174)	(0.0518)	(0.0496)				(0.0283)	(0.013)	
Beef	1.1585***	0.1324	-0.0881	0.1794*	0	44	0.2237***	0.2507%	Yes
	(0.2583)	(0.1114)	(0.1846)	(0.1021)			(0.0210)	$(3.2 * 10^{-13})$	
Beef	0.5371**	0.0498	-0.0523	0.0874**	1	41	0.0849***	0.0886%	Yes
	(0.2328)	(0.0576)	(0.0759)	(0.0385)			(0.0272)	(0.0035)	
Pork	1.5570***	0.2176***			0	52	0.2176***	0.2431%	No
	(0.3012)	(0.0257)					(0.0257)	$(3.1 * 10^{-11})$	
Pork	0.5146*	0.0644**			1	52	0.0644**	0.0665%	No
	(0.2677)	(0.0294)					(0.0294)	(0.033)	
Pork	1.5454***	-0.0512	0.2712***		0	51	0.2200***	0.2461%	No
	(0.3000)	(0.0903)	(0.0862)				(0.0255)	$(2.5 * 10^{-11})$	

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Table 7 – *Continued from previous page*

ln(Commodity)	**Constant** (SE)	**ln(M_t)** (SE)	**ln(M_{t-1})** (SE)	**ln(M_{t-2})** (SE)	**Lags**	**N**	**LRP** (SE)	**LRE** (p-value)	**HC3?**
Pork	0.7235***	-0.1259*	0.2059***		2	51	0.0800**	0.0833%	No
	(0.2578)	(0.0659)	(0.0624)				(0.0302)	(0.011)	
Pork	1.6132***	0.0190	-0.0665	0.2628***	0	50	0.2153***	0.2402%	No
	(0.2855)	(0.1051)	(0.1459)	(0.0831)			(0.0243)	$(1.6 * 10^{-11})$	
Pork	0.7338**	-0.1155	0.1108	0.0849	1	50	0.0802**	0.0835%	No
	(0.2753)	(0.0859)	(0.1188)	(0.0727)			(0.0311)	(0.013)	
Salt	1.0245**	-0.0254			0	52	-0.0254	-0.0250%	No
	(0.4836)	(0.0412)					(0.0412)	(0.541)	
Salt	0.6345*	-0.0285			2	52	-0.0285	-0.0281%	No
	(0.3411)	(0.0284)					(0.0284)	(0.32)	
Salt	0.9159*	0.1621	-0.1794		0	0	-0.0173	-0.0171%	No
	(0.5207)	(0.1567)	(0.1497)				(0.0442)	(0.698)	
Salt	0.1685	0.1964*	-0.1963*		1	51	0.0002	0.0002%	No
	(0.3617)	(0.1050)	(0.1002)				(0.0297)	(0.996)	
Salt	0.8013	0.0451	0.3123	-0.3663**	0	50	-0.0089	0.0089%	No
	(0.5140)	(0.1893)	(0.2626)	(0.1496)			(0.0437)	(0.838)	
Salt	0.3077	0.1600	-0.0151	-0.1508	2	50	-0.0059	-0.0059%	No
	(0.3551)	(0.1275)	(0.1794)	(0.1045)			(0.0291)	(0.841)	
Molasses	-0.9821***	0.1358***			0	52	0.1358***	0.1455%	No
	(0.3328)	(0.0284)					(0.0284)	$(1.5 * 10^{-5})$	
Molasses	-0.0598	0.0158			1	52	0.0158	0.0159%	Yes
	(0.2436)	(0.0253)					(0.0253)	(0.535)	
Molasses	-0.9327**	0.1449	-0.0133		0	51	0.1317***	0.1407%	No
	(0.3639)	(0.1095)	(0.1046)				(0.0309)	$(9.5 * 10^{-5})$	
Molasses	-0.0394	0.1332**	-0.1213**		1	51	0.0118	0.0119%	Yes
	(0.2525)	(0.0568)	(0.0469)				(0.0255)	(0.645)	
Molasses	-0.8959**	0.1772	0.0712	-0.1205	0	50	0.1280***	0.1365%	No
	(0.3753)	(0.1382)	(0.1917)	(0.1092)			(0.0319)	(0.0002)	
Molasses	-0.0409	0.1390*	-0.0352	-0.0918	1	50	0.0121	0.0121%	No
	(0.2304)	(0.0787)	(0.1096)	(0.0622)			(0.0216)	(0.58)	
Sugar	3.0672***	0.0093			0	52	0.0093	0.0093%	Yes
	(0.5502)	(0.0450)					(0.0450)	(0.838)	
Sugar	0.5857	0.0051			1	52	0.0051	0.0052%	Yes
	(0.3530)	(0.0240)					(0.0240)	(0.831)	
Sugar	2.6913***	0.0753	-0.0350		0	51	0.0403	0.0412%	Yes
	(0.5267)	(0.1701)	(0.1675)				(0.0428)	(0.351)	
Sugar	0.3777	-0.1460	0.1649		1	51	0.0189	0.0191%	Yes
	(0.2989)	(0.1038)	(0.1072)				(0.0224)	(0.404)	
Sugar	2.5345***	-0.0748	0.1866	-0.0582	0	50	0.05361	0.0551%	Yes
	(0.5724)	(0.1960)	(0.4691)	(0.3169)			(0.0467)	(0.257)	
Sugar	0.3594	-0.1889*	0.2710**	-0.0593	1	50	0.0229	0.0232%	No
	(0.3444)	(0.0945)	(0.1304)	(0.0741)			(0.0219)	(0.3)	
Rum	0.2409	0.0679***			0	52	0.0679***	0.0702%	No
	(0.2920)	(0.0249)					(0.0249)	(0.0088)	
Rum	0.0119	0.0279			1	52	0.0279	0.0283%	No
	(0.2188)	(0.0194)					(0.0194)	(0.156)	
Rum	0.2101	-0.0236	0.0945		0	51	0.0709**	0.0735%	No
	(0.3158)	(0.0950)	(0.0908)				(0.0268)	(0.011)	

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Table 7 – *Continued from previous page*

ln(Commodity)	**Constant**	**ln(M_t)**	**ln(M_{t-1})**	**ln(M_{t-2})**	**Lags**	**N**	**LRP**	**LRE**	**HC3?**
	(SE)	(SE)	(SE)	(SE)			(SE)	(p-value)	
Rum	0.0629	0.0032	0.0201		1	51	0.0233	0.0236%	No
	(0.2367)	(0.0710)	(0.0687)				(0.0214)	(0.281)	
Rum	0.1907	-0.0450	0.2495	-0.1325	0	50	0.0720**	0.0747%	No
	(0.3249)	(0.1196)	(0.1660)	(0.0946)			(0.0276)	(0.012)	
Rum	0.0695	0.0152	0.1816	-0.17823**	1	50	0.0185	0.0187%	No
	(0.2286)	(0.0844)	(0.1169)	(0.0666)			(0.0208)	(0.378)	
Wine	1.1484***	0.4494***			0	40	0.4494***	0.5674%	No
	(0.3646)	(0.0304)					(0.0304)	$(2.4 * 10^{-17})$	
Wine	0.1568	0.0884**			1	39	0.0884**	0.0924%	No
	(0.1910)	(0.0330)					(0.0330)	(0.011)	
Wine	1.0396***	0.1950*	0.2645**		0	40	0.4595***	0.5833%	No
	(0.3488)	(0.1142)	(0.1149)				(0.0291)	$(5.3 * 10^{-18})$	
Wine	0.1527	0.1003*	-0.0162		1	39	0.0841**	0.0877%	No
	(0.1942)	(0.0565)	(0.0618)				(0.0372)	(0.03)	
Wine	0.8778***	0.3838***	-0.3156**	0.4053***	0	40	0.4735***	0.6056%	No
	(0.3141)	(0.1167)	(0.2039)	(0.1233)			(0.0263)	$(1.3 * 10^{-19})$	
Wine	0.1541	0.1030	-0.0224	0.0051	1	39	0.0857*	0.0894%	No
	(0.1984)	(0.0721)	(0.1183)	(0.0820)			(0.0455)	(0.068)	
Indigo	1.2038	0.0734			0	32	0.0734	0.0762%	No
	(0.8796)	(0.0755)					(0.0755)	(0.339)	
Indigo	0.8857*	-0.0446			1	31	-0.0446	-0.0437%	No
	(0.4971)	(0.0443)					(0.0443)	(0.322)	
Indigo	1.5744*	0.4401	-0.4004		0	32	0.0397	0.0405%	No
	(0.9115)	(0.2844)	(0.2997)				(0.0787)	(0.618)	
Indigo	0.7179	-0.1937	0.1574		1	31	-0.0363	-0.0356%	No
	(0.5368)	(0.1800)	(0.1843)				(0.0455)	(0.433)	
Indigo	1.3161	0.5546	-0.7091	0.2172	0	32	0.0626	0.0646%	No
	(1.0373)	(0.3563)	(0.6424)	(0.3983)			(0.0900)	(0.493)	
Indigo	0.5634	-0.1220	-0.0321	0.1320	1	31	-0.0221	-0.0218%	No
	(0.6040)	(0.2195)	(0.3734)	(0.2252)			(0.0521)	(0.675)	
Staves	0.7614	0.3228***			0	41	0.3228***	0.3810%	No
	(0.4525)	(0.0379)					(0.0379)	$(1.9 * 10^{-10})$	
Staves	0.1145	0.1185***			1	40	0.1185***	0.1258%	No
	(0.3168)	(0.0373)					(0.0373)	(0.0030)	
Staves	0.6540	-0.3286**	0.6630***		0	40	0.3344***	0.3971%	Yes
	(0.4175)	(0.1431)	(0.1323)				(0.0339)	$(6.4 * 10^{-12})$	
Staves	0.2157	-0.1734	0.3450***		1	39	0.1716***	0.1872%	No
	(0.3379)	(0.1080)	(0.1213)				(0.0406)	(0.0002)	
Staves	0.5311	-0.1853	0.2227	0.3077*	0	40	0.3451***	0.4121%	No
	(0.4009)	(0.1489)	(0.2604)	(0.1575)			(0.0335)	$(2.8 * 10^{-12})$	
Staves	0.1960	-0.2156*	0.5010**	-0.1402	1	39	0.1452***	0.1563%	No
	(0.3398)	(0.1186)	(0.2156)	(0.1599)			(0.0507)	(0.0071)	
Pitch	2.7152***	-0.0027			0	52	-0.0027	-0.0027%	No
	(0.3107)	(0.0265)					(0.0265)	(0.919)	
Pitch	1.1424***	0.0051			2	52	0.0051	0.0052%	No
	(0.3723)	(0.0191)					(0.0191)	(0.789)	
Pitch	2.8489***	-0.0793	0.0658		0	51	-0.0135	-0.0134%	No
	(0.3349)	(0.1008)	(0.0963)				(0.0284)	(0.638)	

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Table 7 – *Continued from previous page*

ln(Commodity)	**Constant**	**ln(M_t)**	**ln(M_{t-1})**	**ln(M_{t-2})**	**Lags**	**N**	**LRP**	**LRE**	**HC3?**
	(SE)	(SE)	(SE)	(SE)			(SE)	(p-value)	
Pitch	1.2922***	0.0263	-0.0300		2	51	-0.0038	-0.0038%	No
	(0.3963)	(0.0741)	(0.0707)				(0.0205)	(0.855)	
Pitch	2.7513***	-0.1747	0.2969*	-0.1278	0	50	-0.0056	-0.0056%	No
	(0.3427)	(0.1262)	(0.1751)	(0.0997)			(0.0291)	(0.848)	
Pitch	1.0369**	-0.0881	0.2439*	-0.1499**	2	50	0.0059	0.0059%	No
	(0.3896)	(0.0883)	(0.1231)	(0.0693)			(0.0200)	(0.771)	
Tar	1.9369***	0.0391*			0	49	0.0391*	0.0399%	No
	(0.2486)	(0.0211)					(0.0211)	(0.07)	
Tar	0.7455**	0.0210			1	48	0.0210	0.0212%	No
	(0.3204)	(0.0185)					(0.0185)	(0.264)	
Tar	1.8290***	0.0145	0.0337		0	48	0.0482**	0.0494%	No
	(0.2734)	(0.0780)	(0.0730)				(0.0231)	(0.042)	
Tar	0.6238*	-0.0296	0.0594		1	47	0.0298	0.0302%	No
	(0.3290)	(0.0652)	(0.0600)				(0.0201)	(0.146)	
Tar	1.7479***	0.0333	-0.1314	0.1536	0	47	0.0554**	0.0570%	No
	(0.2800)	(0.1024)	(0.1701)	(0.1058)			(0.0237)	(0.024)	
Tar	0.6217*	-0.0360	0.0180	0.0529	1	46	0.0350	0.0356%	No
	(0.3387)	(0.0874)	(0.1458)	(0.0911)			(0.0214)	(0.109)	
Turpentine	3.5590***	-0.0627			0	43	-0.0627	-0.0607%	Yes
	(0.5855)	(0.0472)					(0.0472)	(0.192)	
Turpentine	1.4340***	-0.0139			2	41	-0.0139	-0.0138%	No
	(0.4967)	(0.0287)					(0.0287)	(0.631)	
Turpentine	3.5204***	-0.1492	0.0901		0	43	-0.0591	-0.0574%	Yes
	(0.6009)	(0.1657)	(0.1637)				(0.0487)	(0.232)	
Turpentine	1.4343***	-0.0097	-0.0044		2	41	-0.0140	0.0139%	No
	(0.5036)	(0.1130)	(0.1128)				(0.0293)	(0.635)	
Turpentine	3.5396***	-0.1726	0.1621	-0.0504	0	43	-0.0608	-0.0590%	Yes
	(0.6189)	(0.2088)	(0.3200)	(0.1583)			(0.0504)	(0.235)	
Turpentine	1.4422***	-0.0315	0.0641	-0.0480	2	41	-0.0154	-0.0153%	No
	(0.5104)	(0.1303)	(0.2270)	(0.1376)			(0.0299)	(0.61)	
Cotton	-0.8692	0.1024**			0	41	0.1024**	0.1078%	No
	(0.5516)	(0.0465)					(0.0465)	(0.034)	
Cotton	-0.1045	0.0148			1	39	0.0148	0.0149%	No
	(0.3363)	(0.0290)					(0.0290)	(0.613)	
Cotton	-0.9095	0.0298	0.0763		0	41	0.1061**	0.1119%	No
	(0.5670)	(0.1902)	(0.1937)				(0.0479)	(0.033)	
Cotton	-0.0792	0.0530	-0.0406		1	39	0.0124	0.0125%	No
	(0.3478)	(0.1108)	(0.1135)				(0.0301)	(0.683)	
Cotton	-1.0101*	0.1341	-0.2270	0.2078	0	41	0.1149**	0.1217%	No
	(0.5820)	(0.2286)	(0.4139)	(0.2503)			(0.0493)	(0.025)	
Cotton	-0.1728	0.1347	-0.2781	0.1639	1	39	0.0206	0.0208%	No
	(0.3567)	(0.1327)	(0.2420)	(0.1477)			(0.0309)	(0.511)	
Gunpowder	3.8073***	0.1285***			0	30	0.1285***	0.1371%	No
	(0.4587)	(0.0395)					(0.0395)	(0.0030)	
Gunpowder	1.4593	0.0801*			1	29	0.0801*	0.0834%	No
	(0.9517)	(0.0406)					(0.0406)	(0.059)	
Gunpowder	3.8296***	0.0272	0.1002		0	29	0.1274***	0.1359%	No
	(0.5380)	(0.1291)	(0.1211)				(0.0460)	(0.01)	

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Table 7 – *Continued from previous page*

ln(Commodity)	**Constant** (SE)	**ln(M_t)** (SE)	**ln(M_{t-1})** (SE)	**ln(M_{t-2})** (SE)	**Lags**	**N**	**LRP** (SE)	**LRE** (p-value)	**HC3?**
Gunpowder	1.4983	0.0314	0.0522		1	28	0.0836*	0.0872%	No
	(1.0407)	(0.1200)	(0.1135)				(0.0467)	(0.086)	
Gunpowder	3.6214***	0.2023	-0.2983	0.2419	0	28	0.1459**	0.1571%	No
	(0.6654)	(0.2214)	(0.3972)	(0.2462)			(0.0574)	(0.018)	
Gunpowder	0.9543	0.1854	-0.3769	0.3073	1	27	0.1158**	0.1228%	No
	(1.1769)	(0.2021)	(0.3627)	(0.2253)			(0.0543)	(0.044)	

*** p < 0.01; ** p < 0.05; * p < 0.1
Lags refers to number of dependent variable lags added to remove serial correlation.
P-values refer to both the LRP and LRE, which are just different ways of representing the coefficient.

Table 8 – Full regression results (types of bread)

ln(Commodity)	**Constant** (SE)	**ln(M_t)** (SE)	**ln(M_{t-1})** (SE)	**ln(M_{t-2})** (SE)	**Lags**	**N**	**LRP** (SE)	**LRE** (p-value)	**HC3?**
Bread (brown)	2.8897***	-0.0525			0	23	-0.0525	-0.0511%	No
	(0.7910)	(0.0718)					(0.0718)	(0.472)	
Bread (brown)	–	–			–	–	–	–	–
	(–)	(–)					(–)	(–)	
Bread (brown)	4.0336***	-0.1949	0.0398		0	22	-0.1551	-0.1437%	No
	(1.2244)	(0.1719)	(0.1161)				(0.1104)	(0.176)	
Bread (brown)	3.2219***	-0.1566	0.0276		1	22	-0.1289	-0.1209%	Yes
	(1.0271)	(0.1150)	(0.0784)				(0.0870)	(0.155)	
Bread (brown)	4.0573***	-0.1450	0.0105	-0.0230	0	21	-0.1575	-0.1457%	No
	(1.4088)	(0.2656)	(0.2565)	(0.1297)			(0.1269)	(0.231)	
Bread (brown)	3.1428*	-0.1134	0.0272	-0.0370	1	21	-0.1233	-0.1160%	Yes
	(1.6607)	(1.2117)	(1.2092)	(0.2754)			(0.1472)	(0.415)	
Bread (middling)	-0.7274*	0.3129***			0	52	0.3129***	0.3673%	No
	(0.3688)	(0.0314)					(0.0314)	$(1.9 * 10^{-13})$	
Bread (middling)	-0.2117	0.0726**			1	52	0.0726**	0.0753%	No
	(0.2275)	(0.0326)					(0.0326)	(0.031)	
Bread (middling)	-0.8467**	0.0966	0.2274**		0	51	0.3240***	0.3826%	No
	(0.3830)	(0.1153)	(0.1101)				(0.0325)	$(2.9 * 10^{-13})$	
Bread (middling)	-0.1974	-0.0250	0.1005		1	51	0.07545**	0.0784%	No
	(0.2447)	(0.0717)	(0.0687)				(0.0339)	(0.031)	
Bread (middling)	-0.8778**	0.0711	0.0751	0.1812	0	50	0.3274***	0.3874%	No
	(0.3893)	(0.1433)	(0.1989)	(0.1133)			(0.0331)	$(5.5 * 10^{-13})$	
Bread (middling)	-0.2442	-0.0847	0.2023	-0.0420	1	50	0.0756**	0.0786%	No
	(0.2538)	(0.0912)	(0.1249)	(0.0753)			(0.0359)	(0.041)	
Bread (ship)	0.8577*	0.1451***			0	42	0.1451***	0.1561%	No
	(0.4556)	(0.0381)					(0.0381)	(0.0005)	
Bread (ship)	0.3437	0.0532			3	39	0.0532	0.0546%	No
	(0.4133)	(0.0414)					(0.0414)	(0.207)	
Bread (ship)	0.7363	-0.1308	0.2871*		0	42	0.1562***	0.1691%	No
	(0.4463)	(0.1507)	(0.1520)				(0.0374)	(0.0002)	
Bread (ship)	0.4366	-0.1523	0.2341*		2	40	0.0819**	0.0853%	No
	(0.3944)	(0.1310)	(0.1274)				(0.0384)	(0.04)	
Bread (ship)	0.6844	-0.0684	0.0946	0.1345	0	42	0.1608***	0.1744%	No
	(0.4547)	(0.1742)	(0.3054)	(0.1847)			(0.0381)	(0.0001)	

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Table 8 – *Continued from previous page*

ln(Commodity)	Constant	ln(M_t)	ln(M_{t-1})	ln(M_{t-2})	Lags	N	LRP	LRE	HC3?
	(SE)	(SE)	(SE)	(SE)			(SE)	(p-value)	
Bread (ship)	0.4517	-0.2386	0.4721*	-0.1663	2	40	0.0672	0.0695%	No
	(0.3945)	(0.1563)	(0.2675)	(0.1644)			(0.0410)	(0.111)	
Bread (white)	-3.1733***	0.5512***			0	36	0.5512***	0.7353%	No
	(0.7517)	(0.0661)					(0.0661)	$(9.7 * 10^{-10})$	
Bread (white)	-1.2130**	0.1634**			1	33	0.1634**	0.1775%	No
	(0.5562)	(0.0694)					(0.0694)	(0.025)	
Bread (white)	-4.1180***	0.5463***	0.0866		0	35	0.6330***	0.8832%	No
	(0.7827)	(0.1986)	(0.1833)				(0.0685)	$(1.5 * 10^{-10})$	
Bread (white)	-1.8323**	0.1703	0.0689		1	32	0.2393***	0.2703%	No
	(0.6929)	(0.1414)	(0.1154)				(0.0853)	(0.0090)	
Bread (white)	-4.4038***	0.3300	0.4054	-0.0774	0	34	0.6579***	0.9308%	No
	(0.8428)	(0.3148)	(0.3617)	(0.2194)			(0.0736)	$(5.9 * 10^{-10})$	
Bread (white)	-2.1542***	0.0476	0.3489	-0.1258	1	31	0.2706***	0.3108%	No
	(0.7309)	(0.1993)	(0.2257)	(0.1365)			(0.0887)	(0.0052)	

*** p < 0.01; ** p < 0.05; * p < 0.1

Lags refers to number of dependent variable lags added to remove serial correlation.

P-values refer to both the LRP and LRE, which are just different ways of representing the coefficient.

A version of the brown bread regression with zero independent variable lags corrected for serial correlation cannot be given. Serial correlation continues to be detected no matter how many dependent variable lags are added, until so many have been added that the regression becomes impossible to run due to limited data.

Table 9 – Full regression results (types of staves)

ln(Commodity)	Constant	ln(M_t)	ln(M_{t-1})	ln(M_{t-2})	Lags	N	LRP	LRE	HC3?
	(SE)	(SE)	(SE)	(SE)			(SE)	(p-value)	
Staves (barrel)	0.6308	0.2834***			0	41	0.2834***	0.3276%	No
	(0.4048)	(0.033)					(0.033)	$(3.1 * 10^{-10})$	
Staves (barrel)	0.2715	0.1280***			2	39	0.1280***	0.1366%	No
	(0.3188)	(0.0374)					(0.0374)	(0.0016)	
Staves (barrel)	0.7622*	-0.2471*	0.5219***		0	40	0.2748***	0.3163%	No
	(0.3775)	(0.1236)	(0.1243)				(0.0315)	$(1.7 * 10^{-10})$	
Staves (barrel)	0.4062	-0.1344	0.2913**		1	39	0.1569***	0.1699%	No
	(0.3486)	(0.1093)	(0.1221)				(0.0398)	(0.0004)	
Staves (barrel)	0.6873*	-0.1598	0.2534	0.1876	0	40	0.2813***	0.3248%	No
	(0.3792)	(0.1409)	(0.2463)	(0.1490)			(0.0317)	$(1.4 * 10^{-10})$	
Staves (barrel)	0.3908	-0.1652	0.4029*	-0.0964	1	39	0.1413***	0.1518%	No
	(0.3524)	(0.1204)	(0.2141)	(0.1514)			(0.0471)	(0.0050)	
Staves (hogshead)	0.6242	0.3287***			0	41	0.3287***	0.3891%	No
	(0.5304)	(0.0444)					(0.0444)	$(6.1 * 10^{-9})$	
Staves (hogshead)	0.2237	0.1236**			3	38	0.1236**	0.1316%	No
	(0.4109)	(0.0466)					(0.0466)	(0.012)	
Staves (hogshead)	0.3296	-0.2839	0.6395***		0	40	0.3556***	0.4270%	No
	(0.5339)	(0.1748)	(0.1758)				(0.0446)	$(1.5 * 10^{-9})$	
Staves (hogshead)	0.1610	-0.1623	0.3436**		1	39	0.1813***	0.1988%	No
	(0.4387)	(0.1423)	(0.1554)				(0.0514)	(0.0012)	
Staves (hogshead)	0.4263	-0.1733	0.3687**		2	38	0.1954***	0.2157%	No
	(0.4340)	(0.1390)	(0.1506)				(0.0496)	(0.0004)	

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Table 9 – *Continued from previous page*

ln(Commodity)	**Constant** (SE)	**ln(M_t)** (SE)	**ln(M_{t-1})** (SE)	**ln(M_{t-2})** (SE)	**Lags**	**N**	**LRP** (SE)	**LRE** (p-value)	**HC3?**
Staves (hogshead)	0.2109	-0.1455	0.2143	0.2971	0	40	0.3658***	0.4417%	No
	(0.5333)	(0.1981)	(0.3463)	(0.2095)			(0.0446)	$(9.2 * 10^{-10})$	
Staves (hogshead)	0.1782	-0.2053	0.4866*	-0.1175	1	39	0.1638***	0.1780%	No
	(0.4438)	(0.1609)	(0.2879)	(0.1984)			(0.0597)	(0.0096)	
Staves (hogshead)	0.4266	-0.1793	0.3881	-0.0160	2	38	0.1928***	0.2127%	No
	(0.4408)	(0.1596)	(0.2848)	(0.1971)			(0.0593)	(0.0027)	
Staves (pipe)	1.0468**	0.3334***			0	41	0.3334***	0.3957%	No
	(0.4748)	(0.0398)					(0.0398)	$(2.9 * 10^{-10})$	
Staves (pipe)	0.5894	0.1321**			6	34	0.1321**	0.1412%	No
	(0.5333)	(0.0483)					(0.0483)	(0.011)	
Staves (pipe)	0.9735**	-0.3852**	0.7277***		0	40	0.3425***	0.4085%	Yes
	(0.3941)	(0.1832)	(0.1750)				(0.0319)	$(6.4 * 10^{-13})$	
Staves (pipe)	0.3615	-0.2220*	0.4159***		1	39	0.1940***	0.2140%	No
	(0.3771)	(0.1174)	(0.1320)				(0.0434)	$(7.8 * 10^{-5})$	
Staves (pipe)	0.8275**	-0.2149	0.2044	0.3657**	0	40	0.3551***	0.4264%	No
	(0.3962)	(0.1472)	(0.2573)	(0.1556)			(0.0331)	$(9.3 * 10^{-13})$	
Staves (pipe)	0.3471	-0.2342*	0.4635*	-0.0436	1	39	0.1856***	0.2039%	No
	(0.3868)	(0.1294)	(0.2374)	(0.1800)			(0.0559)	(0.0022)	

*** p < 0.01; ** p < 0.05; * p < 0.1

Lags refers to number of dependent variable lags added to remove serial correlation.

P-values refer to both the LRP and LRE, which are just different ways of representing the coefficient.

$8\frac{1}{2}$ An econometric love poem

At first I thought I proved our love through linear regression,
Statistical significance displaying my obsession.
The logarithmic series indexed through the time we dated,
Did show the love regressand quite increasingly elated.

But then you pointed out the plot was heteroskedastic,
The second order variation's rise was very drastic.
Correcting with HCCM decreased the correlation,
And intervals of confidence towards H-naught seemed to hasten.

But nonetheless the loveless null was thankfully rejected,
Disheartened by the lower strength, I yet stayed undejected.
I still had not a reason for lamenting with my bourbon,
Until, of course, you used the test by Watson and by Durbin.

I always thought my love for you would never be abated,
Because I didn't realize it was autocorrelated.
I only loved the thought of love, which soon became apparent,
Since when you Cochrane-Orcutt'd, the numbers all turned errant.

When faced, it's true, with Newey-West's adjusted standard error,
My heart was struck with something I can only call sheer terror.
I learned a piece of wisdom from our dyad's abolition,
And that is one should never date a better statistician.

9 Notes

1. Hugo Hegeland, "The Quantity Theory of Money: A Critical Study of Its Historical Development and Interpretation and a Restatement" (PhD diss., University of Gothenburg, 1951), ix.

2. David E. Laider, *The Golden Age of the Quantity Theory* (Princeton: Princeton University Press, 1991).

3. Milton Friedman, "The Quantity Theory of Money—a Restatement," in *Studies in the Quantity Theory of Money*, ed. Milton Friedman (Chicago: University of Chicago Press, 1956), 3.

4. Maria Cristina Marcuzzo, "The Demise of the Quantity Theory of Money," *History of Economic Ideas* 10, no. 1 (2002): 49-62.

5. Board of Governors of the Federal Reserve System, "M1, M2 and Other Release Data, Monthly -in Billions," H.6 Statistical Release, April 26, 2022, https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H6.

6. U.S. Bureau of Labor Statistics, "CPI for All Urban Consumers (CPI-U) 1967=100 (Unadjusted) - CUUR0000AA0," May 11, 2022, https://data.bls.gov/timeseries/CUUR0000AA0.

7. Boaz Shoshan, "Money Supply and Grain Prices in Fifteenth-Century Egypt," *Economic History Review*, n.s., 36, no. 1 (1983): 47-67.

8. Shireen Moosvi, "The Silver Influx, Money Supply, Prices and Revenue-Extraction in Mughal India," *Journal of the Economic and Social History of the Orient* 30, no. 1 (1987): 47-94.

9. Kanhaya L. Gupta and Bakhtiar Moazzami, "On Some Predictions of the Quantity Theory of Money," *Southern Economic Journal* 57, no. 4 (1991): 1085-1091.

10. Sunge Regret and Makamba Biatrice Simbisai, "Testing the Quantity Theory of Money in Zimbabwe under the Multiple Currency Regime: An ARDL Bound Testing Approach," *African Journal of Economic Review* 8, no. 1 (2020): 65-88.

11. Yang Liansheng, *Money and Credit in China: A Short History* (Cambridge, MA: Harvard University Press, 1952), 51-62.

12. George S. Cuhaj, *Standard Catalog of World Paper Money. General Issues, 1368-1960*, 15th ed. (Iola, WI: Krause Publications, 2014), 1287; Gunnar Wetterberg, *Money and Power—the History of Sveriges Riksbank* (Stockholm: Sveriges Riksbank and Atlantis, 2009), 37-39.

13. As examples, see: Jeffrey F. Beatty, Susan S. Samuelson, and Patricia Sánchez Abril, *Business Law and the Legal Evironment, Standard Edition*, 7th ed. (Australia: Cengage Learning, 2021), 627; Gerald Hobermann,

The Art of Coins and Their Photography: An Illustrated Photographic Treatise with an Introduction to Numismatics (London: Spink and Son, 1982), 33; Dieter Kuhn, *The Age of Confucian Rule: The Song Transformation of China* (Cambridge, MA: Belknap Press of Harvard University Press, 2011), 234.

14. Thomas J. Sargent and François R. Velde, *The Big Problem of Small Change* (Princeton: Princeton University Press, 2014), 219-220.

15. Cuhaj, *Standard Catalog*, 1286.

16. Ibid.; Sargent and Velde, *Big Problem*, 221.

17. Joseph Barlow Felt, *An Historical Account of Massachusetts Currency* (Boston: Perkins and Marvin, 1839), 33.

18. Andrew McFarland Davis, *Currency and Banking in the Province of the Massachusetts-Bay*, vol. 2, *Banking* (New York: Macmillan, 1901), 61-62.

19. T. H. Breen, *Tobacco Culture: The Mentality of the Great Tidewater Planters on the Eve of Revolution* (Princeton: Princeton University Press, 1987), 94-97, 101-102.

20. Herbert Heaton, "The Playing Card Currency of French Canada," *American Economic Review* 18, no. 4 (1928): 649-662.

21. Andrew McFarland Davis, *Currency and Banking in the Province of the Massachusetts-Bay*, vol. 1, *Currency* (New York: Macmillan, 1901), 8-15; Dror Goldberg, "The Massachusetts Paper Money of 1690," *Journal of Economic History* 69, no. 4 (2009): 1092-1106.

22. Henry Warren, *The Story of the Bank of England (a History of English Banking, and a Sketch of the Money Market)* (London: Jordan and Sons, 1903), 6.

23. Cuhaj, *Standard Catalog*, 1062.

24. Ibid., 920

25. Ibid., 483

26. Adam Shortt, ed., *Documents Relating to Canadian Currency, Exchange and Finance during the French Period*, vol. 1 (Ottawa: F. A. Acland, 1925), xlix.

27. A court authorized the issue 10 December, the Governor approved the law 23 December, and the Assembly of Deputies approved the law 24 December (Davis, *Currency and Banking*, 1:10-12). For this reason, the date has sometimes been given as 24 December instead (Goldberg, *Massachusetts Paper Money*, 1094). The

date has also sometimes mistakenly been given as 3 February 1690, due to the existence of Massachusetts bills bearing this date. These actually come from the second issue of bills, authorized by a law of 3 February 1691 (Davis, *Currency and Banking*, 1:12-13, 1:307). The year discrepancy comes from the fact that before the British Empire's switch from the Julian to the Gregorian calendar in 1752, the start of the year was considered to be 25 March and not 1 January. See: Danby Pickering, ed., *The Statutes at Large, from the 23d to the 26th Year of King George II. To Which is Prefixed, a Table Containing the Titles of All the Statutes during That Period*, vol. 20 (Cambridge: Joseph Bentham, 1765), 186-211.

28. Thomas Cooper, ed., *The Statutes at Large of South Carolina; Edited, under Authority of the Legislature*, vol. 2, *Containing the Acts from 1682 to 1716, Inclusive. Arranged Chronologically* (Columbia, SC: A. S. Johnston, 1837), 206-212. Note that while earlier sources are cited for exact dates of first issue (reprints of firsthand documents when possible), they have all been checked against the mostly accurate modern reference work of: Eric P. Newman, *The Early Paper Money of America*, 5th ed. (Iola, WI: Krause Publications, 2008).

29. Richard M. Jellison, "Paper Currency in Colonial South Carolina: A Reappraisal," *South Carolina Historical Magazine* 62, no. 3 (1961): 134-147.

30. Robert Chalmers, *A History of Currency in the British Colonies* (London: Eyre and Spottiswoode, 1893), 51-52. Better known and described is a second law passed authorizing additional paper money on 18 June 1706.

31. Ibid., 46-52; Russell R. Menard, *Sweet Negotiations: Sugar, Slavery, and Plantation Agriculture in Early Barbados* (Charlottesville: University of Virginia Press, 2006), 56.

32. *The Colonial Laws of New York from the Year 1664 to the Revolution, including the Charters to the Duke of York, the Commissions and Instructions to Colonial Governors, the Duke's Laws, the Laws of the Dongan and Leisler Assemblies, the Charters of Albany and New York and the Acts of the Colonial Legislatures from 1691 to 1775 Inclusive*, vol. 1 (Albany: James B. Lyon, 1894), 666-668.

33. Ibid.; Newman, *Early Paper Money*, 270.

34. [William Douglass], *A Discourse Concerning the Currencies of the British Plantations in America. Especially with Regard to Their Paper Money: More Particularly in Relation to the Province of the Massachusetts-Bay, in New England* (London: Printed for T. Cooper, R. Amey, and Mrs. Nutt, 1740), 14; John H. Hickcox, *A History of the Bills of Credit or Paper Money Issued by New York, from 1709 to 1789: With a Description of the Bills, and Catalogue of the Various Issues* (Albany: J. H. Hickcox, 1866), 12-13.

35. Charles J. Hoadly, ed., *The Public Records of the Colony of Connecticut, from October, 1706, to October,*

1716, with the Council Journal from October, 1710, to February, 1717. Transcribed and Edited, in Accordance with a Resolution of the General Assembly (Hartford: Press of Case, Lockwood and Brainard, 1870), 111-113.

36. Ibid.

37. G. H. Hollister, *The History of Connecticut, from the First Settlement of the Colony to the Adoption of the Present Constitution*, vol. 1 (New Haven: Durrie and Peck, 1855), 372-373.

38. Hoadly, *Public Records*, 111.

39. Samuel Allinson, ed., *Acts of the General Assembly of the Province of New-Jersey, from the Surrender of the Government to Queen Anne, on the 17th Day of April, in the Year of Our Lord 1702, to the 14th Day of January 1776. To Which is Annexed, the Ordinance for Regulating and Establishing the Fees of the Court of Chancery of the Said Province. With Three Alphabetical Tables, and an Index* (Burlington, NJ: Isaac Collins, 1776), 9.

40. Edward Armstrong, notes to *Good Order Established in Pennsylvania and New-Jersey in America, Being a True Account of the Country; with Its Produce and Commodities There Made in the Year 1685*, by Thomas Budd, Gowans' Bibliotheca Americana, vol. 4 ([Philadelphia: William Bradford], 1685; repr., New York: William Gowans, 1865), 106. This publication has two simultaneous sets of page numbers, one enumerated from the beginning of the book and one enumerated from the beginning of the multivolume series of republications it belongs to. The former page numbers are used here. Page 106 is also labelled 402.

41. [Douglass], *A Discourse*, 16; Donald L. Kemmerer, *Path to Freedom: The Struggle for Self-Government in Colonial New Jersey 1703–1776* (Princeton: Princeton University Press; London: Humphrey Milford, Oxford University Press, 1940), 83-86. Note that Douglass (1740) has a mispagination issue where there are two page 9s and two page 10s. In a reprint (London, 1751) with corrected pagination, the mention of the reason behind New Jersey's first paper money issue is instead on page 15.

42. Nathaniel Bouton, ed., *Provincial Papers. Documents and Records Relating to the Province of New-Hampshire, from 1692 to 1722: Being Part II. of Papers Relating to That Period*, vol. 3 (Manchester, NH: John B. Clarke, 1869), 410-411.

43. Newman, *Early Paper Money*, 224.

44. C. E. Potter, *The History of Manchester, Formerly Derryfield, in New-Hampshire; including That of Ancient Amoskeag, or the Middle Merrimack Valley; Together with the Address, Poem, and Other Proceedings, of the Centennial Celebration, of the Incorporation of Derryfield; at Manchester, October 22, 1851* (Manchester, NH: C. E. Potter, 1856), 272-273.

45. E. Hoyt, *Antiquarian Researches: Comprising a History of the Indian Wars in the Country Bordering Connecticut River and Parts Adjacent, and Other Interesting Events, from the First Landing of the Pilgrims, to the Conquest of Canada by the English, in 1760: With Notices of Indian Depredations in the Neighboring Country: And of the First Planting and Progress of Settlements in New England, New York and Canada* (Greenfield, MA: Ansel Phelps, 1824), 199; James M. Volo and Dorothy Denneen Volo, *Daily Life on the Old Colonial Frontier* (Westport, CT: Greenwood Press, 2002), 276.

46. Sydney S. Rider, ed., *The Charter and the Acts and Laws of His Majesties Colony of Rhode-Island, and Providence-Plantations in America, 1719: A Fac-Simile Reprint with a Bibliographical and Historical Introduction* (Boston: John Allen, 1719; repr., Providence: Sydney S. Rider and Burnett Rider, 1895), 60-61.

47. Ibid.; Newman, *Early Paper Money*, 372.

48. Edward Field, *State of Rhode Island and Providence Plantations at the End of the Century: A History*, vol. 3 (Boston: Mason, 1902), 197-201.

49. Although it seems that the exact date of North Carolina's first issue has been lost to history, based on a reading of the published colonial records, it seems to have been no later than the 8th of May. See: William L. Saunders, ed., *The Colonial Records of North Carolina: Published under the Supervision of the Trustees of the Public Libraries, by Order of the General Assembly*, vol. 1, *1662 to 1712* (Raleigh: P. M. Hale, 1886), 839.

50. Edwin Wexler Kennedy, "Quit-Rents and Currency in North Carolina 1663--1776" (PhD diss., Johns Hopkins University, 1897; Baltimore: J. W. Bond, 1902), 22-23.

51. Newman, *Early Paper Money*, 159.

52. Ibid.

53. James T. Mitchell and Henry Flanders, eds., *The Statutes at Large of Pennsylvania from 1682 to 1801*, vol. 3, *1712 to 1724* (Pennsylvania: Clarence M Busch, 1896), 324-338.

54. Newman, *Early Paper Money*, 332. Newman has mistakenly written that the original law passed 23 March, rather than 2 March.

55. Richard A. Lester, "Currency Issues to Overcome Depressions in Pennsylvania, 1723 and 1729," *Journal of Political Economy* 46, no. 3 (1938): 324-375; Mitchell and Flanders, *Statutes at Large*, 3:324.

56. Richard S. Rodney, "Early Relations of Delaware and Pennsylvania," *Pennsylvania Magazine of History and Biography* 54, no. 3 (1930): 209-240. At this time, Delaware was not an independent colony, and in fact

was a semi-autonomous part of the Colony of Pennsylvania until Delaware declared independence in 1776. Although Delaware and Pennsylvania had separate legislative assemblies starting in 1704, they continued to have the same governor. It is through these separate legislatures that Delaware was able to issue its own separate currency.

57. Richard A. Lester, "Currency Issues to Overcome Depressions in Delaware, New Jersey, New York and Maryland, 1715–37," *Journal of Political Economy* 47, no. 2 (1939): 183; Richard S. Rodney, *Colonial Finances in Delaware* (Wilmington: Wilmington Trust, 1928), 17. Here, Newman (2008, 120) has apparently mistakenly given the date of 23 April, and on the same page mistakenly referred to the law which authorized the first Pennsylvania issue as being from 2 April instead of 2 March.

58. Lester, *Currency Issues to Overcome Depressions in Delaware*, 183-184; Rodney, *Colonial Finances*, 17-18.

59. Thomas Bacon, ed., *Laws of Maryland at Large, with Proper Indexes. Now First Collected into One Compleat Body, and Published from the Original Acts and Records, Remaining in the Secretary's Office of the Said Province. Together with Notes and Other Matters, Relative to the Constitution Thereof, Extracted from the Provincial Records. To Which is Prefixed, the Charter, with an English Translation* (Annapolis: Jonas Green, 1765), Ddd3r-Ddd3v; Bernard Christian Steiner, ed., *Archives of Maryland*, vol. 39, *Proceedings and Acts of the General Assembly of Maryland 1733–1736* (Baltimore: Lord Baltimore Press, 1919), 41, 84, 90. A reading of the original Lower House and Upper House journals shows that the bill was endorsed in its final form on 6 April. The colony's Proprietary Governor then agreed to it, along with all other bills of the legislative session, on 12 April. Grubb (2016a, 218) incorrectly gives the date as 13 March 1733, which was the first day of the legislative session.

60. Bacon, *Laws of Maryland*, Ddd3v; Steiner, *Archives of Maryland*, 105.

61. Clarence P. Gould, *Money and Transportation in Maryland 1720–1765*, Johns Hopkins University Studies in Historical and Political Science, series 33, no. 1 (Baltimore: Johns Hopkins Press, 1915), 78-83; Steiner, *Archives of Maryland*, 92.

62. Allen D. Candler, ed., *The Colonial Records of the State of Georgia: Compiled and Published under Authority of the Legislature*, vol. 2 (Atlanta: Franklin Printing and Publishing, 1904), 113-115.

63. William Estill Heath, "The Early Colonial Money System of Georgia," *Georgia Historical Quarterly* 19, no. 2 (1935): 145-160.

64. William Waller Hening, ed., *The Statutes at Large; Being a Collection of All the Laws of Virginia, from the First Session of the Legislature, in the Year 1619*, vol. 6 (Richmond: Franklin Press—W. W. Gray, 1819), 461-468; H. R. McIlwaine, ed., *Journals of the House of Burgesses of Virginia, 1752–1755, 1756–1758*

(Williamsburg: William Hunter, 1755; repr., Richmond: [Colonial Press, E. Waddey], 1909), 292-293.

65. "Paper Money in Colonial Virginia," *William and Mary Quarterly*, 1st ser., 20, no. 4 (1912): 227-262.

66. Theodore Thayer, "The Land-Bank System in the American Colonies," *Journal of Economic History* 13, no. 2 (1953): 145-159.

67. Farley Grubb, "Is Paper Money Just Paper Money? Experimentation and Variation in the Paper Monies Issued by the American Colonies from 1690 to 1775," *Research in Economic History* 32 (2016a): 149-150.

68. Ibid., 156, 159-160, 209-221.

69. Lester, *Currency Issues to Overcome Depressions in Pennsylvania*, 344, 361-367.

70. *Journal of the Legislative Council of the Colony of New-York: Began the 9th Day of April, 1691; Ended the 27 of September, 1743* (Albany: Weed, Parsons, 1861), 433-436.

71. E. James Ferguson, *The Power of the Purse: A History of American Public Finance, 1776–1790* (Williamsburg: University of North Carolina Press, 1961), 5.

72. Farley Grubb, "Chronic Specie Scarcity and Efficient Barter: The Problem of Maintaining an Outside Money Supply in British Colonial America" (NBER Working Paper No. 18099, National Bureau of Economic Research, Cambridge, MA, 2012), 1, 56.

73. *Acts and Laws, of His Majesty's Province of the Massachusetts-Bay in New-England* (Boston: B. Green, 1718; repr., 1726), Y2v-Y3r.

74. Leslie V. Brock, *The Currency of the American Colonies, 1700–1764: A Study in Colonial Finance and Imperial Relations* (PhD diss., University of Michigan, 1941; New York: Arno Press, 1975), 65; *Votes and Proceedings of the House of Representatives of the Province of Pennsylvania. Beginning the Fourteenth Day of October, 1707*, vol. 2 (Philadelphia: B. Franklin and D. Hall, 1753), 483.

75. Grubb, *Is Paper Money Just Paper Money?*, 148.

76. Vincent Geloso and Gabriel Mathy, "Monetary Famine, Paper Money, and International Constraints on Economic Growth: The Case of Colonial Quebec" (Working Paper No. 21-46, George Mason University Department of Economics, [Fairfax County, VA], 2021).

77. Edwin J. Perkins, *American Public Finance and Financial Services, 1700–1815* (Columbus: Ohio State University Press, 1994), 13.

78. Ibid., 377; Jonathan Edward Barth, "'A Peculiar Stampe of Our Owne': The Massachusetts Mint and the

Battle over Sovereignty, 1652–1691," *New England Quarterly* 87, no. 3 (2014): 490-525.

79. Curtis P. Nettels, *The Money Supply of the American Colonies before 1720* (Madison: University of Wisconsin, 1934; repr., New York: Sentry Press, 1964), 231-232.

80. Ibid., 232.

81. Ibid., 204.

82. Ronald Michener, "Fixed Exchange Rates and the Quantity Theory in Colonial America," *Carnegie-Rochester Conference Series on Public Policy* 27 (1987), 261.

83. Farley Grubb, "The Circulating Medium of Exchange in Colonial Pennsylvania, 1729–1775: New Estimates of Monetary Composition, Performance, and Economic Growth," *Explorations in Economic History* 41, no. 4 (2004): 336.

84. Felt, *An Historical Account*, 15-16.

85. Davis, *Currency and Banking*, 2:59; Nettels, *Money Supply*, 208-211.

86. Davis, *Currency and Banking*, 2:58

87. Roger W. Weiss, "The Issue of Paper Money in the American Colonies, 1720–1774," *Journal of Economic History* 30, no. 4 (1970): 773-774.

88. David Hume, *Political Discourses*, 2nd ed. (Edinburgh: R. Fleming, 1752), 92.

89. Frederick W. Ricord and Wm. Nelson, eds., *Documents Relating to the Colonial History of the State of New Jersey*, 1st ser., vol. 9, *1757–1767* (Newark, NJ: Daily Advertiser Printing House, 1885), 407, 412.

90. Elisha R. Potter, *A Brief Account of Emissions of Paper Money, Made by the Colony of Rhode-Island* (Providence: John E. Brown, 1837), 8.

91. Chalmers, *A History of Currency*, 15.

92. John J. McCusker and Russel R. Menard, *The Economy of British America, 1607–1789* (Chapel Hill, NC: University of North Carolina Press, 1985), 338.

93. Angela Redish, "Why Was Specie Scarce in Colonial Economies? An Analysis of the Canadian Currency, 1796–1830," *Journal of Economic History* 44, no. 3 (1984): 727.

94. Murray N. Rothbard, *A History of Money and Banking in the United States: The Colonial Era to World War*

II (Auburn, AL: Ludwig von Mises Institute, 2002), 50; U.S. Gold Commission, *Report to the Congress of the Commission on the Role of Gold in the Domestic and International Monetary Systems*, vol. 2, *Annexes* ([Washington, DC: United States Government Printing Office], 1982), 40. Rothbard also believed it should be legally permissible for a parent to let their child starve to death, and that laws preventing this were immoral, so perhaps we shouldn't put too much stock in his views.

95. Ronald W. Michener and Robert E. Wright, "Miscounting Money of Colonial America," *Econ Journal Watch* 3, no. 1 (2006): 4. In the paragraph they appear in, these quotes specifically refer to a few other points apparently made by Farley Grubb, such as a general success of colonial monetary systems and the unpopularity of the Constitution's clause banning state bills of credit. However, the very next paragraph declares Grubb's data in favor of specie scarcity as going against a nonexistence consensus, thus applying the claim of revisionism to specie scarcity as well.

96. Farley Grubb, "Theory, Evidence, and Belief—the Colonial Money Puzzle Revisited: Reply to Michener and Wright," *Econ Journal Watch* 3, no. 1 (2006a): 45-72.

97. Ibid., 47; Christine Dean, *Making Money: Coin, Currency, and the Coming of Capitalism* (Oxford: Oxford University Press, 2014), 45, 179, 254-265.

98. Charles W. Calomiris, "Institutional Failure, Monetary Scarcity, and the Depreciation of the Continental," *Journal of Economic History* 48, no. 1 (1988): 47-68.

99. Bruce D. Smith, "American Colonial Monetary Regimes: The Failure of the Quantity Theory and Some Evidence in Favour of an Alternate View," *Canadian Journal of Economics* 18, no. 3 (1985a): 541.

100. John F. Borden, *The Maturest Deliberation: Colonial Pennsylvania Currency in Depression and War* (master's thesis, Oregon State University, 1995), 5, 12, 16, 20, 111-112, 137-138; Breen, *Tobacco Culture*, 95-96; Ferguson, *Power of the Purse*, 4; Richard M. Jellison, "Paper Currency in Colonial South Carolina 1703–1764" (PhD diss., Indiana University, 1953), 6-7, 29; Lester, *Currency Issues to Overcome Depressions in Pennsylvania*, 326-328; Edmund S. Morgan and Helen M. Morgan, *The Stamp Act Crisis: Prologue to Revolution* (Chapel Hill, NC: North Carolina University Press, 1953), 30; Nettels, *Money Supply*, 202-208, 216, 230-231; Herbert L. Osgood, *The American Colonies in the Eighteenth Century*, vol. 2 (New York: Columbia University Press, 1924; repr., Gloucester, MA: Peter Smith, 1958), 371-373; Max Savelle, *The Foundations of American Civilization: A History of Colonial America* (New York: Henry Holt, 1942; repr., 1949), 345; Paton Wesley Yoder, "Paper Currency in Colonial Pennsylvania" (master's thesis, Indiana University, 1936), 1. Even more authors who believed in specie scarcity are cited throughout this paper.

101. Leslie V. Brock, "The Colonial Currency, Prices, and Exchange Rates," *Essays in History* 34 (1992): 97, 130-131.

102. Adam Shortt, "Canadian Currency and Exchange under French Rule," *Journal of the Canadian Bankers' Association* 5, no. 3 (1898): 278.

103. Nettels, *Money Supply*, 205-207.

104. Andrew McFarland Davis, ed., *Colonial Currency Reprints: 1682–1751*, vol. 1, Publications of the Prince Society (Boston: John Wilson and Son, 1910), 34.

105. Brock, *Colonial Currency*, 107

106. William Douglass, *A Summary, Historical and Political, of the First Planting, Progressive Improvements, and Present State of the British Settlements in North-America*, vol. 1 (Boston: Rogers and Fowle, 1749), 494.

107. William Douglass, *A Summary, Historical and Political, of the First Planting, Progressive Improvements, and Present State of the British Settlements in North-America*, vol. 2, bk. 1 (Boston: Daniel Fowle, 1751), 14.

108. J. Wright, *The American Negotiator: Or the Various Currencies of the British Colonies in America; as Well the Islands, as the Continent* (London: J. Everingham, 1761), v.

109. Edward Channing, *A History of the United States*, vol. 2, *A Century of Colonial History: 1660–1760* (New York: Macmillan, 1908; repr., 1918), 503.

110. Potter, *A Brief Account*, 15.

111. Andrew McFarland Davis, ed., *Colonial Currency Reprints: 1682–1751*, vol. 4, Publications of the Prince Society (Boston: John Wilson and Son, 1911), 222.

112. Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, vol. 1 (London: Printed for W. Strahan; and T. Cadell, 1776), 396.

113. Pickering, *Statutes at Large*, 20:306-309.

114. Channing, *A History*, 501.

115. Grubb, *Is Paper Money Just Paper Money?*, 214.

116. Danby Pickering, ed., *The Statutes at Large, from Magna Charta to the End of the Eleventh Parliament of Great Britain, Anno 1761. Continued*, vol. 26 (Cambridge: Joseph Bentham, 1764), 103-105.

117. Ricord and Nelson, *Documents*, 407, 410.

118. Benjamin Trumbull, *A General History of the United States of America; from the Discovery in 1492, to 1792: Or, Sketches of the Divine Agency, in Their Settlement, Growth, and Protection; and Especially in the Late Memorable Revolution*, vol. 1, *Exhibiting a General View of the Principal Events, from the Discovery of North America, to the Year 1795* (Boston: Farrand, Mallory, 1810), 338

119. Andrew W. Young, *Introduction to the Science of Government, and Compend of the Constitutional and Civil Jurisprudence of the United States; with a Brief Treatise on Political Economy*, 3rd ed. (Albany: W. C. Little; Buffalo: Steele and Peck, 1839), 153. This quotation does not appear in the first edition (Warsaw: Spencer and Lewis, 1835) or second edition (Warsaw: published by the author, 1836), but shows up in the third and all subsequent editions.

120. *Public Documents of Massachusetts: Being the Annual Reports of Various Public Officers and Institutions, for the Year 1865*, vol. 3 (Boston: Wright and Potter, 1866), 41.

121. Borden, *Maturest Deliberation*, preface, para. 5.

122. Brock, *Currency of the American Colonies*.

123. E. James Ferguson, "Currency Finance: An Interpretation of Colonial Monetary Practices," *William and Mary Quarterly*, 3rd ser., 10, no. 2 (1953): 153.

124. Raymond Phineas Stearns, *Science in the British Colonies of America* (Urbana, IL: University of Illinois Press, 1970), 483.

125. Ferguson, *Currency Finance*, 153-154.

126. Ron Michener, "Backing Theories and the Currencies of Eighteenth-Century America: A Comment," *Journal of Economic History* 48, no. 3 (1988): 687; Pelatiah Webster, *Political Essays on the Nature and Operation of Money, Public Finances, and Other Subjects: Published during the American War, and Continued Up to the Present Year, 1791* (Philadelphia: Joseph Crukshank, 1791), 6, 142.

127. Farley Grubb, "The Continental Dollar: How Much Was Really Issued?", *Journal of Economic History* 68, no. 1 (2008): 283-291.

128. John J. McCusker, "How Much Is That in Real Money? A Historical Price Index for Use as a Deflator of Money Values in the Economy of the United States," *Proceedings of the American Antiquarian Society* 101, pt. 2 (1991): 351-355; Webster, *Political Essays*, 501-502.

129. Ferguson, *Power of the Purse*, 32

130. Agnes F. Dodd, *History of Money in the British Empire & the United States* (London: Longmans, Green,

1911), 253; John Jay Knox, *United States Notes: A History of the Various Issues of Paper Money by the Government of the United States*, 2nd ed. (New York: Charles Scribner's Sons, 1885), 10; Michener, *Backing Theories*, 690; J. W. Schuckers, *A Brief Account of the Finances and Paper Money of the Revolutionary War* (Philadelphia: John Campbell and Son, 1874), 127. Dodd (1911) lists the amount authorized by the states as about $200,000,000, although points out the actual circulating amount would have been higher due to widespread counterfeiting. Schuckers (1874) lists the very specific amount of $209,524,776, although Schuckers states that his list of state authorizations is incomplete, presumably meaning the true figure is higher. Rounded amounts of both $209,000,000 and $210,000,000 appear in several subsequent publications. Knox (1885) lists $209,000,000, but says this figure is "probably too high", without giving an alternate estimate. Michener (1988) lists a larger amount of $246,366,940. However, the accuracy of all these figures is suspect, because all listed sources also use an outdated incorrect figure for the amount issued of the continental dollar. Dodd lists $241,562,775 in continental currency. Schuckers lists $241,552,780, which he subsequently miswrites as $241,552,380. Knox lists both $241,552,780 and an alternate estimate of $242,100,176. Michener lists a more round $241,500,000. An amount around $241 million was the academic consensus before Grubb (2008), which fixed and revised downward the amount of continental currency issued to $199,990,000. There seems to be no existing study of equal carefulness for how much the states issued. Amidst this uncertainty, a conservative approach has been taken, and the amount issued by the states has been stated to simply be probably more than $200,000,000.

131. McCusker, *How Much Is That*, 354-358.

132. Kathryn L. Behrens, "Paper Money in Maryland 1727–1789" (PhD diss., Johns Hopkins University, 1921; Baltimore: Johns Hopkins Press, 1923), 44-45, 55-59.

133. Ibid., 58.

134. Carl Lotus Becker, "The History of Political Parties in the Province of New York, 1760–1776" (PhD diss., University of Wisconsin, 1907; *Bulletin of the University of Wisconsin: History Series* 2, no. 1 (1909)), 66-67, 69-71.

135. Jellison, *Paper Currency in Colonial South Carolina 1703–1764*, 279.

136. Grubb, *Is Paper Money Just Paper Money?*, 193.

137. Albert Henry Smyth, ed., *The Writings of Benjamin Franklin: Collected and Edited with a Life and Introduction*, vol. 5, *1767–1772* (New York: Macmillan, 1906), 10-11.

138. Anne Bezanson, Robert D. Gray, and Miriam Hussey, *Prices in Colonial Pennsylvania* (Philadelphia: University of Pennsylvania Press, 1935), 431.

139. Lester, *Currency Issues to Overcome Depressions in Pennsylvania*, 373.

140. Yoder, *Paper Currency*, master's thesis, 105, 108.

141. Borden, *Maturest Deliberation*, 137-140.

142. Armstrong, notes to *Good Order*, 106.

143. Lester, *Currency Issues to Overcome Depressions in Delaware*, 192.

144. Donald L. Kemmerer, "A History of Paper Money in Colonial New Jersey, 1668–1775," *Proceedings of the New Jersey Historical Society*, n.s., 74, no. 2 (1956): 107-144. Donald Kemmerer's father, Edwin Kemmerer, was himself an economist who defended QTM. See: Hegeland, *Quantity Theory*, 83-85.

145. Yoder, *Paper Currency*, PhD diss., 344-345.

146. Brock, *Currency of the American Colonies*, 81.

147. Robert Craig West, "Money in the Colonial American Economy," *Economic Inquiry* 16, no. 1 (1978): 4.

148. Farley Grubb, "Two Theories of Money Reconciled: The Colonial Puzzle Revisited with New Evidence" (NBER Working Paper No. 11784, National Bureau of Economic Research, Cambridge, MA, 2005a), 27.

149. Peter L. Rousseau, "Backing, the Quantity Theory, and the Transition to the US Dollar, 1723–1850," *American Economic Review* 97, no. 2 (2007): 267.

150. Farley Grubb, "Colonial American Paper Money and the Quantity Theory of Money: An Extension" (NBER Working Paper No. 22192, National Bureau of Economic Research, Cambridge, MA, 2016b), 29.

151. A similar example is given in: Michael F. Sproul, "The Quantity Theory versus the Backing Theory in Colonial America" (unpublished manuscript, October 24, 2000), PDF file, 5-6.

152. Grubb, *Two Theories of Money*, 8-9.

153. Smith, *American Colonial Monetary Regimes*, 533.

154. Bruce D. Smith, "Some Colonial Evidence on Two Theories of Money: Maryland and the Carolinas," *Journal of Political Economy* 93, no. 6 (1985b): 1180, 1190-1191.

155. Farley Grubb, "Benjamin Franklin and Colonial Money: A Reply to Michener and Wright—Yet Again," *Econ Journal Watch* 3, no. 3 (2006b): 486-487.

156. Smith, *American Colonial Monetary Regimes*, 538-539.

157. Bennett T. McCallum, "Money and Prices in Colonial America: A New Test of Competing Theories," *Journal of Political Economy* 100, no. 1 (1992): 146, 154. This is technically a mathematical mistake on McCallum's part. Because division by zero is undefined, a percentage change of 0 to any number is undefined, and not infinity. However, this is a pedantic criticism that does not actually impact any argument.

158. Elmus Wicker, "Colonial Monetary Standards Contrasted: Evidence from the Seven Years' War," *Journal of Economic History* 45, no. 4 (1985): 871.

159. The debate has never been named before in academic literature, which leaves me with the obligation and privilege to name it. I originally called it the Michener-Grubb debate, since this is more fun to say out loud than Grubb-Michener. Two stressed syllables in a row don't flow together as nicely. However, at the last moment, I changed it to Grubb-Michener. Because Grubb always publishes first and Michener always attacks him second, this order seems more academically accurate and honest, at the slight expense of melodiousness.

    It is also worth explaining why I have left out Robert Wright's name. In the 2010s, Gavin Wright taught a graduate class in American Economic History at Stanford University where he called it the Grubb-Michener-Wright Debate. However, now, more papers in the debate have been written by Michener alone than by both Michener and Wright.

160. One paragraph is dedicated to it in: Robert McGuire, "The US Constitution in American Economic History," in *The Oxford Handbook of: American Economic History*, vol. 2, ed. Cain, Louis P., Price V. Fishback, and Paul W. Rhode (New York: Oxford University Press, 2018), 161-162.

161. U.S. Const. art. I, § 10, cl. 1.

162. Farley W. Grubb, "State 'Currencies' and the Transition to the U.S. Dollar: Reply—including a New View from Canada," *American Economic Review* 95, no. 4 (2005b): 1341.

163. Brock, *Colonial Currency*.

164. Michener and Wright, *Miscounting Money*, 6.

165. Grubb, *Theory, Evidence, and Belief*, 53-54.

166. Webster, *Political Essays*, 142.

167. Brock, *Currency of the American Colonies*, 354.

168. Grubb, *Theory, Evidence, and Belief*, 57.

169. Brock, *Currency of the American Colonies*, 382.

170. Michener and Wright, *Miscounting Money*, 33-34.

171. Grubb, *Theory, Evidence, and Belief*, 65.

172. Ronald W. Michener and Robert E. Wright, "Farley Grubb's Noisy Evasions on Colonial Money: A Rejoinder," *Econ Journal Watch* 3, no. 2 (2006b): 252-253.

173. Farley Grubb, *Benjamin Franklin*, 485, 507.

174. Farley Grubb, "Colonial Virginia's Paper Money, 1755–1774: A Reply to Michener," *Financial History Review* 26, no. 3 (2019): 407.

175. Ronald W. Michener, "Re-examination of the Theoretical and Historical Evidence Concerning Colonial New Jersey's Paper Money, 1709–1775: A Further Comment on Grubb," *Econ Journal Watch* 17, no. 2 (2020): 306.

176. Robert E. Wright, "Has Ron Michener Finally Gotten the Better of Farley Grubb?", *Finance: History and Policy* (blog), October 6, 2020, https://web.archive.org/web/20210111061851/http://financehistoryandpolicy.blogspot.com/2020/10/has-ron-michener-finally-gotten-better.html. At the bottom of his blog, Wright writes "One of the best blogs you'll read!" I politely, yet firmly, disagree.

177. Farley Grubb, "Colonial New Jersey's Paper Money: A Reply to Michener Again, and Again, and Again," *Econ Journal Watch* 18, no. 1 (2021): 79-80.

178. Farley Grubb, "Colonial American Paper Money and the Quantity Theory of Money: An Extension" (NBER Working Paper No. 22192, National Bureau of Economic Research, Cambridge, MA, 2016b), 16.

179. Ibid.

180. Mitchell and Flanders, *Statutes at Large*, 3:331.

181. James T. Mitchell and Henry Flanders, eds., *The Statutes at Large of Pennsylvania from 1682 to 1801*, vol. 4, *1724 to 1744* (Pennsylvania: Clarence M Busch, 1897), 358.

182. Newman, *Early Paper Money*, 334-363.

183. Kenneth Scott, *Counterfeiting in Colonial Pennsylvania*, Numismatic Notes and Monographs no. 132 (New York: American Numismatic Society, 1955), 15-16.

184. Ibid., 30.

185. Mitchell and Flanders, *Statutes at Large*, 4:345.

186. Scott, *Counterfeiting*, 111-132.

187. Ibid., 80.

188. Ibid., 77.

189. *Pennsylvania Gazette*, April 2, 1730.

190. [Douglass], *A Discourse*, 17. In the 1751 reprint where the pagination issue was fixed, this is page 16.

191. Scott, *Counterfeiting*, 65-66.

192. Ibid., 90-91, 107.

193. Michener and Wright, *Miscounting Money*, 25-27; Smith, *American Colonial Monetary Regimes*, 539.

194. Grubb, *Circulating Medium of Exchange*, 333, 336-337, 339.

195. Grubb, *Theory, Evidence, and Belief*, 60-64.

196. Michener and Wright, *Miscounting Money*, 12-13.

197. Michener, *Fixed Exchange Rates*, 236.

198. William A. Whitehead, ed., *Documents Relating to the Colonial History of the State of New Jersey*, 1st ser., vol. 5, *1720–1737* (Newark, NJ: Daily Advertiser Printing House, 1882), 289.

199. Grubb, *Is Paper Money Just Paper Money?*, 149.

200. Ibid., 217

201. For more academic lessons in nothing, see: Nicolas Reithner, Hannes Mähr, and Mario Frick, *Liechtenstein Maritime Law: The World's Most Useful Law Book* ([Schaan], Liechtenstein: Seeger, Frick and Partner, [2022]).

202. Potter, *A Brief Account*, 8.

203. Bezanson, *Prices in Colonial Pennsylvania*, 56.

204. Ibid., 9, 56.

205. Ibid., 237

206. Ibid., 186

207. Ibid., 56, 84

208. Ibid. 56, 79

209. Ibid., 163.

210. Ibid., 96-97.

211. Ibid., 230.

212. Ibid., 215, 226.

213. Ibid., 132.

214. Ibid., 219.

215. Ibid., 117

216. Ibid., 230, 249.

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