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Re-examination of the Empirical Evidence Concerning Colonial New Jersey's Paper Money, 1709–1775: A Comment on Farley Grubb

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LINK TO ABSTRACT

This is my sixth refereed article contesting papers authored or co-authored by Farley Grubb concerning money in early America, and that does not include three publications contesting the views of Bruce Smith, Elmus Wicker, and Charles Calomiris, who anticipated some of Grubb's arguments, nor two working papers.[2] Curiosity and speculation about my motives for this persistent assault have sometimes overshadowed the substance of my critique, so I preface this comment by addressing that issue.

Grubb in particular has grounded his analysis in econometrics. A casual reader of my previous papers may infer that I am a disgruntled antiquarian championing the traditional tools of literary history, one skeptical of sophisticated econometric tools. That skepticism, however, is borne of too much training in statistics, not too little: I have a hammer, but I can also recognize a nail.[3] Reliable data for colonial America remain remarkably scant, limiting the light that cliometrics can shed on early America's monetary history.

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2. The five previous journal articles are Michener and Wright 2005; Michener and Wright 2006a; b; Michener 2018b; and Michener 2019a (forthcoming). The two working papers are Michener 2018a; 2019b. The others are Michener 1987; 1988; 2015.

3. See https://en.wikipedia.org/wiki/Law_of_the_instrument (**link**).

Misapplied econometrics distorts our view of the colonial American economy

What can be said about interest rates? Usury laws tell us colonial legislatures considered interest rates of about 6 to 8 percent 'fair,' but the ubiquity of usury laws suggests market rates must have often exceeded these limits. Nobody has proffered monthly, quarterly, or even annual data on any meaningful market interest rate for any colony (Homer and Sylla 1991: Wright 1998). Literary evidence strongly suggests that colonial real estate prices collapsed dramatically during liquidity crises. Notwithstanding this, the absence of data forces econometricians investigating the behavior of colonial prices, exchange rates, and the demand for money to pretend fluctuations in interest rates were inconsequential. Many do so implicitly by neglecting the issue entirely. Bruce Smith (1985b, 1198–1199) did so explicitly: "the opportunity cost of holding money cannot have varied too substantially." Smith seems to presume freely floating exchange rates between sterling and colonial bills of credit, because he reasons that interest-rate fluctuations would manifest themselves in exchange-rate fluctuations. The wild fluctuations in asset prices and credit availability widely discussed by the colonials themselves, however, strongly suggest this data shortcut is untrue.

What can we say about the money supply? Each colony, at some time or another, issued its own paper money known as 'bills of credit.' The quantities issued by each colony outstanding in any given year are tolerably well known, though even here precision is sometimes wanting. The quantity of bills of credit issued by a colony and still outstanding, however, does not measure the quantity of paper money in use within that colony (even abstracting from counterfeits, yet another problem). The paper currencies of neighboring colonies frequently circulated promiscuously without respect to colony borders. This was notoriously true of the New England colonies before 1750, but Pennsylvania bills of credit circulated in Maryland and West Jersey; New Jersey bills passed in New York, Pennsylvania and Maryland; Maryland bills passed in Pennsylvania and West Jersey; Delaware bills passed in Pennsylvania (and perhaps elsewhere); New York bills passed in East Jersey; South Carolina bills exchanged hands in North Carolina and Georgia; Virginia bills circulated in northeastern North Carolina, and so on. Moreover, in most colonies, much of the time, foreign specie coins circulated as money with paper money serving as a supplement. How much specie circulated has been hotly contested, but evidence indicates that specie in circulation sometimes exceeded the amount of paper money in circulation, occasionally by a wide margin

(Michener and Wright 2006a; b; Ernst 1973, 106, 200).

Primary sources rarely reveal even imprecise estimates of how much specie circulated, or how many bills of credit circulated over colonial borders. Only spotty and uncertain information exists on the quantities of each type of money, the terms on which they exchanged for one another, and where they circulated. In the face of these data deficiencies, cliometricians eager to investigate the monetary history of early America have resorted to assuming that the quantity of bills of credit issued and still outstanding accurately measure any given colony's money supply. To sustain that assumption an econometrician would need to dismiss extensive contrary literary evidence that shows the significant presence of both specie and bills of other colonies.

Anne Bezanson, Robert D. Gray, and Miriam Hussey (1935, 315) were exactly correct when they wrote that "the amount of Pennsylvania currency that was paid for £100 sterling rested fundamentally on the arbitrarily increased rating given to the Spanish dollar by the Pennsylvanians." I believe the same to be true of many other American colonies, including New Jersey (Michener 1987; 2011; 2015; 2018a; b; Michener and Wright 2006c). Accepting this truth about colonial America, however, focuses attention on specie stocks and colonial coin ratings, where the dearth of data regarding specie limits one's ability to apply econometric methods. Accepting that bills of credit often circulated freely outside the colony that issued them presents similar issues.

Some cliometricians have chosen to ignore or deny that which stands in the way of their investigations. Bruce Smith (1985a, 538–539) argues that using money-supply data that omits specie is of scant consequence because specie was a modest fraction of the money supply, but his evidence does not hold up to scrutiny (Michener and Wright 2006a, 15; Michener and Wright 2006b, 265–267; Michener 2011). Smith does not deny that bills of credit from one colony often circulated in adjoining colonies, but he dismisses that concern as irrelevant to his own model (Smith 1985a, 534). Smith's empirical work, however, uses money-supply data omitting specie and the circulation of the bills of neighboring colonies to dismiss alternative theories in which both those components would be relevant. Peter Rousseau (2007) performs regressions relating the Pennsylvania price level to the quantity of Pennsylvania bills of credit outstanding. Rousseau acknowledges the neglect of specie, but proceeds as if this is only a minor obstacle. Rousseau seems unaware that many of Pennsylvania's bills of credit circulated outside the colony and that many Delaware, New Jersey, and (after 1767) Maryland bills circulated in Pennsylvania. Farley Grubb goes even further. By interpreting Pennsylvania pounds mentioned in newspaper ads not simply as a unit of account but as a specific reference to Pennsylvania bills of credit, Grubb purports to show that neither specie nor bills of adjacent colonies had any appreciable circulation in

Pennsylvania (Grubb 2004). This contention led to a spirited debate in this journal (Michener and Wright 2006a; b; Grubb 2006a; b). Grubb (2015, 17–18) continues to deny that either specie or bills of adjacent colonies played a significant role in colonial money supplies.

What about income? We have the haziest notions about the level and growth rate of per-capita real output in the American colonies. The available evidence suggests that American's real per-capita income increased over the colonial period, but that the average rate of increase was small, perhaps negligible, but almost certainly not more than 0.6% per annum (McCusker and Menard 1985, 55–57, 267–268; Lindert and Williamson 2016, 13–76). Absent better data, some econometricians have proxied income with per-capita imports or exports, and some have simply abstracted from changes in per-capita income. Bruce Smith (1985a, 561) and William Letwin (1981, 467) address this lack of data by using a working hypothesis that per-capita income in the colonies was essentially constant. Peter Rousseau (2007) uses Pennsylvania's exports to England to proxy Pennsylvania's income, a proxy that is difficult to rationalize. Pennsylvania's export staples consisted of wheat and flour, products the colony sold chiefly to the West Indies and southern Europe. Hardly any of Pennsylvania's exports went directly to England. Between 1768 and 1772 Great Britain purchased only about 4 percent of the grain products exported by the middle colonies, and Pennsylvania routinely imported five to thirty times as much from England as the colony exported to England (McCusker 2006, 710–711 series Eg 432 and Eg 439; McCusker and Menard 1985, 194–199). Great Britain's Corn Laws imposed duties on the importation of wheat and wheat products that effectively prohibited imports in all but the times of greatest scarcity, during which Parliament would sometimes waive the duties entirely (A. Smith 1976/1776, vol. 1 536; *Statutes*, 5 Geo. III c. 31).

The American colonies, however, faced wild gyrations in the terms of trade and the availability of foreign exchange. In the *patois* of open-economy Keynesian macroeconomics, large exogenous shocks buffeted their foreign balance schedules.[4] Most of the American colonies relied on one or two staple products for most of their foreign exchange earnings: tobacco in the Chesapeake, wheat and flour in the Middle Colonies, rice in South Carolina and Georgia, and (to a lesser extent) fish in New England. Market conditions abroad for these staples fluctuated, as did access to foreign markets, particularly during wartime (Lindert and Williamson 2016, 49–52). Other shocks to the availability of foreign exchange also roiled colonial economies. When pirates or privateers were prowling, it made all the

4. So much of the Keynesian apparatus has fallen into disuse that this phrase may be meaningless to many readers. I am referring to the balance of payments equilibrium locus described, for example, by Rivera-Batiz and Rivera-Batiz (1985, ch. 7).

difference in the world whether your colony was predator or prey (Lydon 1970). The ebb and flow of British military spending in North America also greatly influenced foreign exchange availability (Gwyn 1980a; b).[5] In colonies that relied on specie as a portion of their money supply, negative shocks to the foreign balance schedule decreased the domestic money supply, precipitating sporadic liquidity crises that exacerbated moral hazard and adverse selection problems in credit markets, causing them to freeze up. As credit disappeared, asset prices plummeted, destroying wealth and reducing consumption (Mishkin 2007, 596–605). Proprietors, particularly the ubiquitous agricultural ones, did not fear unemployment so much as an inability to pay or roll over even small debts, which could lead to lawsuits, foreclosure, the forced sale of assets in thin and depressed markets, and imprisonment. Econometricians' assumptions about per-capita income before independence mask these important year-to-year fluctuations in economic well-being.

And what do we know about prices and exchange rates? Price indices for colonial America remain primitive. For example, only wheat, codfish, and silver comprise the annual price series available for Massachusetts from 1711 (Rousseau and Stroup 2011, 606; Brock 1975, Table III). Even the best colonial price indices are based on prices for a small number of traded goods, and literary evidence suggests that these prices were not always an accurate representation of the aggregate price level (Brock 1975, preface). For some colonies, including colonial New Jersey, no price index exists. Consequently, economic historians often rely on more widely available exchange rates to measure the value of colonial currencies.

Although economists can measure modern exchange rates with extraordinary precision, colonial exchange rates remain subject to considerable measurement error. John McCusker compiled and published tables for each colony by tabulating prices of bills of exchange that he encountered in his research. McCusker (1978; 2006) remains the accepted source for sterling exchange rates in colonial America. McCusker (1978, 172–173 Table 3.4) presents data for New Jersey 1703–1775.[6] These data are so scarce that McCusker has observations from only 29 of the 73 years. Of the 29 years for which McCusker does report an exchange rate, 19 of those annual 'averages' are based on a single observation, an observation that might not be representative of the average price of bills of exchange over the year.

5. Gottfried (1936) and Hemphill (1985) are two historical accounts that investigate how the colonial economy responded to sudden exogenous shifts in the availability of foreign exchange and demonstrate the importance of the factor.

6. New Jersey's annual exchange rates in McCusker (2006) are identical to those in McCusker (1978). The New Jersey exchange rates in McCusker (1978) did not undergo any revision in McCusker's subsequent work.

The market for bills of exchange was thin, especially outside commercial centers such as Boston, Philadelphia, and New York. As Thomas Fitch, a Boston merchant, once explained to a correspondent: "there allways are persons that for a small matter to suit their necessitys will without regard to the current exchange purchase [bills of exchange] at wild rates, which ought not to state the exchange, and indeed its not everybody doth know the Currency of exchange but by hearsay may guess at it" (quoted in Michener 1987, n.29).

Even where the market was active and data plentiful, as in Pennsylvania after 1740, the price of a bill of exchange is at best a useful proxy for the spot exchange rate. A sterling bill of exchange was like an I.O.U. drawn on a person or organization in Great Britain, payable in pounds sterling, used by individuals in America to remit money to the mother country. The drawer's agent in Great Britain had to present the bill to the person or organization on whom it was drawn to receive payment, but payment could not be demanded on the spot. The person or organization commonly had 30, 60, or 90 days in which to make payment, depending on the bill's 'sight period.' To complicate matters further, sellers of bills of exchange sometimes exacted payment in advance of delivery. Bills of exchange, therefore, combined foreign exchange transactions and loans and consequently were inherently heterogeneous. Buyers preferred bills drawn on London, so bills drawn on another city generally sold for 'half or one p. ct.' less. Sight periods differed between bills, and the longer the sight period, other things equal, the more cheaply the bill could be purchased in America.[7] John Van Cortland, a New York merchant, reported selling a bill on London at £177½ New York money for £100 sterling and commented, "Merchants here make two & half difference between thirty & Sixty Days sight" (Van Cortland 1762–1769, October 30, 1766, 157 (facing)). This meant that 30-day bills were then selling at £180 and 60-day bills at £177½, (or that 30-day bills were selling at £177½ and 60-day bills at £175). Note that the price difference attributable to sight periods was small but not negligible, which implies that the deviation of the price of a bill of exchange from the spot exchange rate because of the implicit loan was also small but not negligible. Note also that New York merchants at that time paid about a 1.4 percent premium to deliver money 30 days earlier, which works out to an annual interest rate in excess of 18 percent, suggesting a considerably higher opportunity cost of capital than is implied by interest rates found in colonial usury laws. Surviving records seldom record a bill's sight period or the city on which it was drawn, forcing McCusker to abstract from these considerations in compiling his data.

Bills of exchange carried a positive, non-trivial default risk that varied with

7. *See* Michener 1987, 267–274; Jensen 1963, 24–26; Soltow 1965, 157–161; McCusker 1978, 19–22; Nettels 1934, 180–181; Officer 1996, 68–72.

the credibility of the bill's drawer/maker, its drawee/acceptor, its payee, and any endorsers. If the person on whom the bill was drawn failed to pay, the possessor could sue, but doing so was troublesome and costly, so bills of exchange involving reputable merchants were more valuable. In 1740 Thomas Hancock forwarded a bill of exchange with the comment that it was "undoubtedly as Good as a Bank Bill" and that he therefore "gave 20 per cent extra for it." Before 1750 these risk considerations were particularly important in any exchange transaction involving bills drawn on agencies of the British government ("public bills"). Such bills were typically sold in America to obtain funds for military supplies, but they were notoriously risky because the agencies often reviewed transactions and refused payment if they spotted any irregularity. Even the bills eventually honored were often paid only after a costly delay. Public bills accordingly sold at a discount. In 1710, Fitch purchased over a dozen private bills of exchange. Except for one dubious bill, he bought private bills at prices ranging from 150 to 160, but he simultaneously purchased many public bills, all at 140. On numerous occasions, Fitch encouraged his London correspondents to offer a "gratuity" if it would expedite payment of his public bills. In 1740 Thomas Hancock reported that although the prevailing exchange rate was 550, public bills were being offered at 500, and he feared that even at that they were overpriced.[8] William Douglass (1972, vol. II 255–256) reported even larger discounts. From time to time other species of bills of exchange would fall into disrepute and sell at a discount. Bills drawn in the tobacco colonies on tobacco merchants in London in the 1740s and bills drawn in Jamaica in the 1760s suffered this fate (Jensen 1963, 15–16). Unfortunately, surviving records rarely record how much default risk buyers perceived, forcing McCusker to abstract from these considerations too in compiling his unavoidably deficient data.

The price of bills of exchange can also present misleading evidence of the purchasing power of a colony's bills of credit when bills of exchange weren't being purchased with that colony's paper money. For example, in Connecticut between 1752 and 1755, because Connecticut bills were being hoarded in anticipation of a redemption profitable to bill holders, the medium of exchange consisted of Rhode Island and New Hampshire bills of credit. The price of a bill of exchange sold in Connecticut during these years reflects the value of these other media of exchange, not Connecticut's bills of credit, which were more valuable (Sherman 1752). At the beginning of Pennsylvania's paper money era, roughly 1723–1730, Pennsylvania merchants shunned the colony's bills of credit. Those who possessed bills of exchange refused to sell them for bills of credit, demanding gold instead, forcing

8. These examples are drawn from Michener 1987, 273–274; see also Nettels 1934, 181 n.6; Soltow 1965, 159–160.

people who had bills of credit and wished to purchase a bill of exchange to first convert their paper money to gold. During these years Pennsylvania's gold currency commanded a premium on the order of 10–20 percent that had to be paid by anyone converting bills of credit to gold. McCusker's Pennsylvania exchange rates do not distinguish between the exchange rate for gold and the exchange rate for paper, but because sellers often demanded gold, many of McCusker's citations must reflect the purchasing power of Pennsylvania's gold and not its paper (McCusker 1978, 176 n.134; MacKinney 1931–1935, vol II 1490, vol. III 1830–1831; Anon 1725, 1; Norris 1716–1731, 398, 403, 443, 490, 492). In the last 40 years several economic historians have published empirical articles investigating Pennsylvania's colonial bills of credit, yet none recognize that the exchange data in the early years does not accurately measure the value of those bills. A similar problem arises in Grubb's New Jersey paper, as we shall see.

Econometricians regularly employ data that imperfectly measure a variable they wish to include in a regression, but only when they can convince themselves and their audience that such discrepancies are inconsequential. When every variable is poorly measured, however, and some variables can scarcely be said to be measured at all, researchers should think first to do no harm. But the field of economic history increasingly rewards and selects for cliometrics, and allocation of research topics has left the investigation of colonial America's monetary history disproportionately in the hands of economic historians who lack such scruple. It seems to me that the conditions have generated a set of practitioners reluctant to question one another's rationalizations of the data. Like all generalizations, exceptions exist: Robert C. West (1978) appropriately used econometrics to debunk pre-existing nonsense, and Lawrence Officer (2005) made a commendable effort to mitigate data deficiencies to the extent currently possible. By contrast, Professor Grubb has rewritten the history of colonial money with a series of interlocking and mutually reinforcing papers that threaten to subjugate reality to myth.

The economy and the Revolution

Colleagues who wonder why I continue to criticize Grubb's work need to understand that the steady accumulation of published articles embracing data shortcuts make it likely that Grubb's errors will become self-perpetuating. Moreover, I believe the matter is of prime importance for understanding the causes of the discontent that led to the American Revolution. Most American colonies—all of them, by the eve of the Revolution—had monetary systems based on specie; colonial currencies played an important but subsidiary role. A modern analogy would be Disney dollars. Until recently, Disney parks created and circulated Disney

dollars featuring the likenesses of Disney's classic characters. Visitors used Disney dollars for purchases within the park just like Federal Reserve Notes. To use the colonial jargon, Disney dollars were 'current money' within the park. The key to the value of Disney dollars is that they could be exchanged one-for-one for U.S. dollars. Explanations of the value of Disney dollars that focused on their value on the day they were retired from service, discounted to the present, would seem laughable. The value of Disney dollars, and monetary and macroeconomic conditions prevailing within a Disney park, depended almost entirely on the supply of Federal Reserve notes and on the conversion rule linking Disney dollars and Federal Reserve Notes. In colonial times, merchant agreements linked the value of each colony's currency to specie by detailing the rate of conversion (Michener 1987; 2011; Michener and Wright 2006c). For the most part (and in particular, in New Jersey) these rates remained constant for decades. The supply of colonial currency played a role in influencing monetary and macroeconomic conditions within a colony, but so too did imperial trade policy, colonial access to foreign markets, privateering, British military spending, and the like, all of which influenced the availability of specie. Most modern econometric research into colonial currencies focuses exclusively on paper money to the neglect of specie, because we lack data on specie stocks. For lack of data, researchers also commonly treat interest rate fluctuations, changes in asset prices, and changes in national income, such as might arise from variations in the foreign balance schedule, as negligible. Neglect of these has led people to discount the legitimacy and gravity of grievances like those expressed by the "facts…submitted to a candid world" in the Declaration of Independence, such as cutting off trade, ravaging "our coasts," sending officers to harass "our people," imposing taxes without consent, and refusing laws necessary for the public good.

The mainstream opinion of economic historians is that the British Empire imposed only an inconsiderable burden on the colonists before the American Revolution. The principal cost, most believe, is the deadweight loss imposed by the Navigation Acts, which required certain enumerated goods, such as tobacco, to be routed through London. That cost, relative to national income, appears to have been a few percent at most. The taxes Parliament imposed on the colonies—the Sugar Act, the Stamp Act, and the Townshend duties—raised only a trickle of revenue for Great Britain. If realized burdens were small and offset largely, if not entirely, by the benefits of membership in the Empire, the colonists' motives could be only ideological (taxation without representation was 'slavery') or prospective (acquiescence was a slippery slope to more substantial burdens) (Atack and Passell 1994, 54–69).[9] Convinced that the current burden on the colonists was immaterial,

9. A referee objected quite sensibly that, even insofar as economic historians discount the role of shared

historians have spent decades investigating the colonial mind, trying to understand how the mother country's actions, by modern estimation clumsy and tone-deaf but well-intentioned, piqued such paranoid and ultimately violent opposition (Wood 1982). Historians' efforts to better understand the colonial mind have yielded valuable insights, and I am not trying to dismiss them. Indeed, my interpretation might enhance theirs. But much of the scholarship has proceeded on a false premise because British economic mismanagement imposed substantial costs on the North American colonies (Wright 2010a, 32–48).

During the French and Indian War, 1754–1763, the colonial economy expanded rapidly. To fund the war effort, colonial legislatures emitted large quantities of bills of credit. Meanwhile, unprecedented sums of gold, silver, and sterling bills of exchange entered the colonial economy in support of the British armed forces. Simultaneously, colonial privateers seized numerous French ships and cargoes. An extensive trade through neutral ports with the French West Indies proved extraordinarily profitable, as the French West Indies, largely cut off from foreign markets by privateers and the British navy, willingly traded their produce for provisions and British manufactures on very favorable terms to those who could reach them. Merchants also used flags of truce and falsified papers to carry on direct trade with enemy islands. The legal status of much of this trade was debatable, but only in the last few years of the French and Indian War did the British attempt to suppress it. After the fall to British forces of Guadeloupe in 1759 and Martinique in 1762, the American colonies briefly enjoyed an unencumbered legal trade with these islands, which helped compensate for the suppression of the more questionable branches of their commerce in the waning years of the war (Pares 1963).

By 1757 the colonial economy, hobbled in ordinary times by a lack of liquidity, suddenly found itself awash in cash of all kinds as bills of credit, foreign exchange, and specie temporarily became plentiful. The price of bills of exchange on London fell so low that merchants no longer needed to ship specie to London to pay their balances there and even began exporting specie to the French West Indies. Credit conditions eased, and real estate prices surged two or threefold. Business conditions in the colonies began to deteriorate, however, before the war ended. After the fall of Quebec in 1759 and Montreal in 1760, the theater of operations shifted to the Caribbean, and many British soldiers were reassigned there. As the

economic discontent, they do recognize the importance of discontented factions. For example, the East India Company's plan to market their tea in America, had it succeeded, might have benefitted consumers, but it would have stripped that profitable business from the merchants who had formerly engaged in the trade, a group that included many smugglers. Smugglers played a prominent role in opposing the landing of tea. That the opposition arose solely or principally from this quarter, however, is difficult to reconcile with the campaign that followed to discourage tea drinking and to boycott tea (Carp 2011, 161–181).

military forces assigned to the continent dwindled in number, Britain sent fewer coins and bills of exchange to support them. Privateering manna likewise disappeared, as the richest prizes were gathered in the early years of the war. Meanwhile, the British Navy began to suppress the colonists' lucrative trade with the foreign West Indies. Coin and foreign exchange, plentiful during the halcyon days of 1757–1760, began to diminish under the influence of this unfortunate confluence of events.

Shortly after the French and Indian War ended in 1763 the colonial economy stood on the brink of collapse. A financial crisis originating in Amsterdam spread to Great Britain (Schnabel and Shin 2004; Ashton 1959, 125–127). Much of the specie that had circulated in the colonies disappeared as British merchants pressed their American customers for repayment of the large sums advanced to them during the wartime boom. Bills of credit originally issued to pay colonial military expenses were in the process of being called in and burned. A liquidity crisis, the worst in living memory according to one Philadelphia merchant, gripped North America (Pollard 1764–1768, 19–20). Amid waves of bankruptcies, credit markets froze, and real estate prices plummeted to half or a third of their wartime peak. William Alexander of New York (Lord Stirling) wrote of "the Sudden Change that took place in the Sale of Lands…after the last War render'd lands almost unsaleable" (Franklin 1976, 191–192). Real estate markets recovered slowly. In 1771, Stephen Crane of New Jersey reminisced, "the landed Property of this Province, is reduced to near one half, the Value it was, seven or eight Years past" (Franklin 1974, 134–136). The fall in real estate prices, so far as can be ascertained, wiped out colonial wealth roughly equivalent to two years' national income.

What role did British policy play in this? The ministry decided in 1763 to curtail the illicit commerce of the North American colonies and dispatched a British fleet to cruise the coast and enforce trade laws. Naval commanders, incentivized by the prospect of a share in all captures, were deputized as customs officers although few of them had more than a rudimentary understanding of the laws they were sent to enforce. Onerous new requirements for certified shipping documents proving the payment of duties ('cockets') and bonds were introduced, creating a costly paperwork burden for the fair trader, particularly those who might have to travel hundreds of miles to the nearest customs house for the necessary paperwork before commencing a voyage. Proceeding on an otherwise lawful voyage without the proper paperwork was grounds for seizure. During the few years in which the British Navy aggressively policed North American coasts they succeeded all too well in disrupting colonial commerce, at just the moment that the colonies were desperate for any market, licit or illicit, where they could exchange their products for specie or bills of exchange (Barrow 1967, 160–212; Dickerson 1951, 208–265; Knollenberg 1960, 165–173; Stout 1973, 25–90). The Currency Act

of 1764, which declared that existing legal tender issues in the colonies were to be retired as they came due, and that after September 1764 any new emissions of legal tender bills, or extensions of the periods of existing bills, would be declared null and void, closed the door on escaping the liquidity vise by issuing paper money. It was "as if," David MacPherson (1805, 398) mused, "the government had intended to prevent the colonists having even the shadow of money." A newspaper wag put it in earthier terms: "As for their Money, Mr. Grenville *robbed* them of their Gold and Silver, and Lord Hillsborough blew away their Paper" (*Public Advertiser*, London, 9 January 1770). The colonists understood how policy impacted them and deeply resented it (Wright 2010b). The resentment boiled into rage when Parliament enacted the Stamp Act. The violence of the mobs protesting the Stamp Act and the implied threat of rebellion led Parliament, narrowly, to repeal the Stamp Act, but it also convinced many Englishmen that the rebellious colonists would eventually require sterner treatment.

Grenville's empowering of naval commanders also inadvertently disrupted Jamaica's illicit trade with the Spanish Main. Jamaica funneled British manufactures and North American agricultural commodities to the Spanish Main in return for Spanish bullion. Before Grenville's blunder, Jamaica's illicit trade with the Spanish Main helped provide both North America and Great Britain with hard money. Bungled efforts to restore Jamaica's trade failed, with long-lasting consequences for the colonial specie supply (Langford 1973, 112–117; Edwards 1793, vol. 1 225–229). Although the Rockingham ministry repealed the Stamp Act and loosened the death grip the Navy had imposed on North American commerce, the burdensome paperwork remained in place. The liquidity crisis in North America remained acute into the beginning of the next decade, powered by the persistent disruption of the Spanish trade and the continued reductions in bills of credit mandated by the Currency Act of 1764 (Egnal 1988, 126–149; Harrington 1935, 316–343). The colonial push for home manufactures, non-consumption agreements, and non-importation agreements had a political motive but not coincidentally also addressed the liquidity crisis. The intertwining of political and economic motives is evident in a 1767 almanac celebrating a non-consumption agreement recently approved in Boston:

> Boston, has set a noble Example for the Encouragement of Frugality and our own Manufactures, by the Agreement *unanimously* come into; and may it be followed by all the other Towns: nay, let them go further, by agreeing not to sip that *poisonous Herb*, called Bohea Tea, as also not to purchase any sort of Woolen goods made abroad, for 12 or 18 months to come, but to wear their old patch'd Cloaths till our own Manufacture can be bought, as many in New-York, Connecticut and Philadelphia, are now doing. – If this Savings is not made, interest must rise, Mortgages cannot be cleared, Lands

> will fall, or be possess'd by *Foreigners*; Families impoverish'd, and our Gaols filled with unhappy Objects – If these wise Measures should be come into, a whole Province will be saved from Slavery, and this dreadful Ruin. (Ames 1767)

The sketch here (as well as in Wright 2010a; b) portends a fuller story, one that cannot be told if scholars dismiss fluctuations in interest rates, asset prices, and income as inconsiderable and deny the importance of specie and cross-colony paper money circulation.

Grubb's analysis of colonial New Jersey

I shift my focus to narrower matters. Farley Grubb's recent paper on colonial New Jersey's paper money likens colonial currencies to "zero-coupon bonds" that "traded below face value due to time-discounting, not depreciation" (Grubb 2016a). Grubb's analysis proceeds by introducing two measures. One, MEV, measures the market exchange value of paper money as derived from exchange rate data, expressed as a percentage of its redemption value; e.g., MEV = 80 would mean that paper money was valued at 80 percent of its redemption value. The second, APV, measures the average present value of paper money: its discounted value expressed as a percentage of its value when received by the colonial Treasury in payment of taxes. Grubb argues that MEV can be almost entirely accounted for by APV or, in other words, that fluctuations in APV explain most of the fluctuations in MEV. The heart of his paper lies in using econometrics to establish that his approach provides a "statistically successful method" (Grubb 2016a, 1230) to explain the value of New Jersey's currency.

There is much I find objectionable in Grubb's theory and history (see, respectively, Michener 2018a, 29–39 and 9–19). Briefly, Grubb bases his measure of paper money's discounted value, APV, on its average utility rather than its marginal utility, putting his theory on the wrong side of the marginalist revolution. Computing APV from paper money's *average utility* inflates its value, just as the average utility of a glass of water greatly exceeds its marginal utility. A value based on its marginal utility would be a trivial fraction of MEV.[10] Moreover, Grubb computes MEV from exchange rate data by adjusting the par of exchange to cover

10. Even if correctly computed, a New Jersey bill's commodity value as a discount bond would not influence its market value in the way Grubb maintains. The commodity value of a bill establishes a floor for its market value, but so long as a bill's value as a medium of exchange exceeds that floor, its value would be insensitive to the precise position of the floor. Federal Reserve notes have commodity value as toilet paper, but they do not fluctuate in value as the price of toilet paper changes.

the cost of importing specie from England. This would make sense if exchange rates in colonial America hovered about the specie import point, but it is notorious that colonial America was much more likely to export specie to England than to import it, so his adjustment improperly deflates MEV. Moreover, although New Jersey styled its paper money as 'proclamation money,' the New Jersey treasury did not pay and receive it at the Crown's definition of proclamation money, as Grubb maintains, but at a lesser value.[11] Exaggerating the value at which New Jersey's treasurer accepted its paper money further deflates MEV. By inflating APV and deflating MEV Grubb's methodology brings the two measures into a fictitious alignment, an alignment that endows his econometric exercise with an air of plausibility.

Choosing between two discordant but plausible historical narratives is a task most economic historians find challenging. When one narrative is buttressed by modern econometric analysis, authored by someone with the imprimatur of the National Bureau of Economic Research, the Cliometric Society, and the *Journal of Economic History*, the easiest path is to accept the analysis supported by econometric evidence. Grubb's empirics, however, are deeply flawed. He adopts contradictory models of the data-generating mechanism, omits important variables, pads his sample with interpolated values of the dependent variable, relies upon MEV values from years in which no bills of credit remained in circulation, presents spurious correlations as if they were meaningful, and fails in the rudimentary matter of interpreting the sources of his data. Grubb constructs 'observations' that are simply false and that are crucial to his results. In this comment, therefore, I highlight the numerous errors in Grubb's econometric analysis, with the expectation that this will lead to an appropriately more critical reading of his historical narrative.

Preliminaries

Neither Grubb's estimates in his *JEH* paper nor any of the corresponding estimates in Grubb (2014; 2016b) can be precisely reproduced using the data Grubb provided. The discrepancies between Grubb's results and my replication, although disquieting, are relatively inconsequential. My Table 1 replicates Grubb's Table 2; my Table 7 replicates Grubb's Table 3.

11. Grubb's par is based on the specie value printed on the face of the bills, which Grubb considers definitive. Francis Bernard, who served as the Royal Governor of New Jersey, explicitly denied that the colony honored the provision. "In vain therefore did the possessor of bills read upon the face of them that he was entitled to a certain quantity of silver" (Bernard 2013, 388–389). Further discussion may be found in Michener 2018a.

Inconsistent claims about the data-generating mechanism

Table 2 of Grubb's *JEH* article (2016a, 1227) is based on Table 3 in Grubb's NBER working paper (2014, 33). The published article omits the discussion of the univariate time series properties of MEV and APV found in the working paper, a discussion in which Grubb (2014, 32) concludes that MEV is a trend stationary process, APV contains a unit root, and MEV and APV are cointegrated! It is impossible for a trend stationary process and a unit root process to be cointegrated, and the only way to reconcile these results is to recognize that one or more of the tests must be yielding either a Type I or Type II error. If the outcome of the cointegration test is a Type I error, then the regressions reproduced in Table 1 are spurious. Even if the error terms in the Table 1 regressions are free of unit roots, however, the discussion in Grubb's working paper highlights the curious omission of a trend term.

Deterministic trends have been a staple in Grubb's other regressions explaining the same data. Grubb (2014, 33) concludes that MEV in colonial New Jersey contains a deterministic trend not present in APV. Grubb (2016b, 182) likewise concludes that New Jersey's MEV has a deterministic trend. Finally, Grubb (2016a, 1229 Table 3) fits a regression to explain the difference between MEV and APV and includes both a trend term and a structural break term for the colony's land-bank years. The difference between MEV and APV could not contain these deterministic elements if they were absent in both MEV and APV. Hence, it is striking that the regressions reported in Table 1, where MEV is regressed on APV, contain neither a trend term nor a structural break for the colony's land bank years. When those variables are included, they are often statistically significant. Including a trend term or a trend in conjunction with a structural break, terms Grubb's own research calls for, renders APV statistically insignificant, undercutting Grubb's principal thesis. For details, see my Table 2.[12]

Interpolation and properties of the error term

An unrelated econometric problem arises because Grubb fleshed out his data for MEV, the dependent variable in his regressions reproduced in Table 1 and one of two components of the dependent variable in his regressions reproduced in Table 7, using "linear interpolations between years with missing values of MEV"

12. A caveat applies, namely, that I am abstracting from other errors. The statement about statistical significance abstracts from the issues caused by using interpolated data discussed in the next section as well as the data errors. The object is to demonstrate Grubb's conclusions are so frail that they can be overturned by a single change.

(Grubb 2016a, 1227). This is far from innocuous; 37 of the 65 observations in Table 1 and 45 of the 63 observations in Table 7 use interpolated values for either the current or lagged values of the dependent variable. (In a previous draft of this comment, my objections to the use of interpolated values of the dependent variable led an anonymous referee to defend the practice. Using only the original observations, the referee argued, would not allow one to model the dynamics. Apparently, the consequences of interpolating in this way are misunderstood.)

Suppose the true data generating mechanism is $y = XB + \varepsilon$, but some observations on y are missing at random, and one fills in the missing values using linear interpolation, as Grubb does. The implication is that the observed y vector, which I will call $\tilde{y}$, is given by $\tilde{y} = Ay$, where A is an n x n block diagonal matrix. If the observation y_i exists, then $a_{ii} = 1$ and $a_{ji} = a_{ij} = 0, j \neq i$. Suppose observation y_i doesn't exist, but observations y_{i-1} and observations y_{i+1} do exist. Then at the missing observation, A contains a 3 x 3 matrix on the diagonal, anchored by observations y_{i-1} and y_{i+1}, of this form: $\begin{matrix} 1 & 0 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} \\ 0 & 0 & 1 \end{matrix}$. A gap of two consecutive missing observations would be covered by a 4 x 4 matrix on the diagonal, anchored by the two adjacent extant observations, of the form: $\begin{matrix} 1 & 0 & 0 & 0 \\ \frac{2}{3} & 0 & 0 & \frac{1}{3} \\ \frac{1}{3} & 0 & 0 & \frac{2}{3} \\ 0 & 0 & 0 & 1 \end{matrix}$, and so on for longer gaps of missing observations. If one performs OLS treating the $\tilde{y}$ observations as legitimate, the resulting OLS coefficient estimator is biased, because $\hat{\beta} = (X'X)^{-1}X'Ay$ and $E\left(\hat{\beta}\right) = (X'X)^{-1}X'AX\beta \neq \beta$. OLS produces a biased estimator unless $X = AX$, which is only true if interpolating X values using the same rule as the observations on y leaves them unchanged. Even if one could abstract from that difficulty, the true data-generating process for $\tilde{y}$ is $\tilde{y} = AX\beta + A\varepsilon \equiv AX\beta + \tilde{\varepsilon}$, which means the variance-covariance matrix of the error in the $\tilde{y}$ regression, $\tilde{\varepsilon}$, is not Ω, the variance-covariance matrix of the original disturbances, but $A\Omega A'$. Even if the original disturbances were i.i.d., so $\Omega = \sigma^2 I$, the disturbances in a regression using interpolated values of y would be serially correlated and heteroscedastic.

This demonstrates that heteroscedastic and serially correlated errors are a

predictable artifact of using interpolated values of the dependent variable, even if the genuine error terms are perfectly behaved. Grubb infers the *existence* of dynamics from serial correlation in the residuals and uses that to justify including a lagged dependent variable. Interpolated dependent variables, however, are correlated with their own leads and lags *by construction*; hence, a lagged dependent variable is guaranteed to have spurious explanatory power.[13] If one omits interpolated values, there is no discernible evidence of serial correlation in residuals. If one bases the need for lagged dependent variables on discernible serial correlation in the residuals, as Grubb does, there is no rationale for including lagged dependent variables.

When and how one ought to utilize incomplete observations, i.e., those with missing values, has been investigated by careful statisticians, a literature surveyed by Roderick Little and Donald Rubin (2019). In cases where Little and Rubin recommend incorporating the incomplete observations, they recommend methods that, unlike Grubb's, exploit the joint distributions implied by the data-generating mechanism, methods that also appropriately account for the difference between complete and incomplete observations in the calculation of coefficient standard errors. Little and Rubin (2019, 264–265) also discuss circumstances in which incomplete observations add nothing to the analysis. In particular, they note that if Y is regressed on $X_1 \ldots X_p$, observations are missing at random, and missing values are confined to Y, then the incomplete observations contain no information about the model's parameters. Because the evidence of discernible serial correlation is spurious—an artifact of interpolating the dependent variable—there is no statistical rationale for including lagged dependent variables. If there are no lagged dependent variables then Grubb's missing values are confined to Y, and Little and Rubin's conditions are met, implying that there is no justification for using *any* imputed values of MEV.

Table 3 reports the results from regressing MEV on APV and a trend, both with and without a structural break term for the land-bank years, while omitting interpolated data. The residuals in these regressions exhibit no discernible serial correlation, despite the fact that there are no lagged dependent variables in any of these regressions. The coefficient of APV is uniformly statistically insignificant,

13. If one adds MEV_{t+1}, *a future value*, as an explanatory variable to either of Grubb's regressions reproduced in Table 1, its coefficient is statistically significant and scarcely different from the coefficient on MEV_{t-1}. Real world dynamics respect the arrow of time; this nearly symmetric dependence of MEV on both past and future values can only be explained as an artifact of interpolation. In Grubb's regressions reproduced in Table 1, the manufactured correlation between MEV and its lagged value artificially inflates the adjusted R-squared and the overall F statistic. Estimating the two regressions reported in Table 1 without using interpolated data, but abstracting from other errors, the adjusted R-squared values fall from 0.30 to 0.07 and 0.08 respectively and the F statistic, purportedly statistically significant at the 0.01 level in Grubb's regressions, is insignificant at the 10-percent level.

once again undermining Grubb's thesis that APV determines MEV.

TABLE 1. Replication of Grubb's Table 2: MEV's statistical relationship to APV, 1709–1774

			N	Adjusted R^2	F
MEV_t =	34.9950^{***}	$+ 0.09812(APV8_t)^{**} + z_t$	65	0.31	15.12^{***}
	(7.8214)	(0.0484)			
Co-integration test: $[z_t - z_{t-1}]$ =	−0.0992	$- 0.5682(z_{t-1})^{***}$	65	0.28	25.31^{***}
	(0.5795)	(0.1130)			
MEV_t =	32.9734^{***}	$+ 0.1156(APV6_t)^{*} + z_t$	65	0.3	15.03^{***}
	(7.9315)	(0.0578)			
Co-integration test: $[z_t - z_{t-1}]$ =	−0.0990	$- 0.5647(z_{t-1})^{***}$	65	0.27	25.08^{***}
	(0.5793)	(0.1128)			

Notes: The regressions of MEV on APV were done including one lag of MEV among the right-hand-side variables—something Grubb did in an attempt to eliminate serial correlation. The coefficients of the lagged dependent variables have been omitted. Because it is appropriate to do cointegration tests without prewhitening the residuals the cointegration tests performed here were done on residuals obtained from regressing MEV on APV with no lags of MEV. Grubb (2016a, 1227) did likewise, although his notation misleadingly suggests that the cointegration test is being performed on the prewhitened residuals (see Grubb 2014, 33 n.). Grubb tests for cointegration using critical values for the Dickey-Fuller test, but the correct critical values are those for the Engle-Granger test (Enders 2010, 490). The stars signifying statistical significance and the reported standard errors should be taken with a grain of salt, because, as discussed in the paper, heteroscedasticity and serial correlation are still present. ***Statistically significant at the 0.01 level. **Statistically significant at the 0.05 level. *Statistically significant at the 0.10 level.

TABLE 2. Including a time trend with/without a Land Bank dummy: MEV's statistical relationship to APV, 1709–1774

					N	Adjusted R^2	F
MEV_t =	158.765^{**}	$+ 0.05665(APV8_t)$	$- 0.0662(YEAR_t)^{*}$	$+ z_t$	65	0.33	11.32^{***}
	(74.161)	(0.05369)	(0.0394)				
MEV_t =	158.834^{**}	$+ 0.06595(APV6_t)$	$- 0.0668(YEAR_t)^{*}$	$+ z_t$	65	0.33	11.29^{***}
	(74.547)	(0.06404)	(0.0394)				
MEV_t =	224.798^{***}	$+ 0.02466(APV8_t)$	$- 0.0991(YEAR_t)^{**}$	$- 2.264(LandBank_t)^{*} + z_t$	65	0.35	9.55^{***}
	(82.045)	(0.05585)	(0.0431)	(1.289)			
MEV_t =	224.415^{***}	$+ 0.02976(APV6_t)$	$- 0.0992(YEAR_t)^{**}$	$- 2.272(LandBank_t)^{*} + z_t$	65	0.35	9.55^{***}
	(82.068)	(0.06617)	(0.0428)	(1.281)			

Notes: These regressions were done including one lag of the dependent variable, which is what Grubb did in order to eliminate serial correlation. The coefficients of the lagged dependent variables have been omitted. Stars signifying statistical significance and standard errors should be taken with a grain of salt, because, as explained in the text, heteroscedasticity and serial correlation are still present. ***Statistically significant at the 0.01 level. **Statistically significant at the 0.05 level. *Statistically significant at the 0.10 level.

TABLE 3. Omitting interpolated data: MEV's statistical relationship to APV, 1709–1774

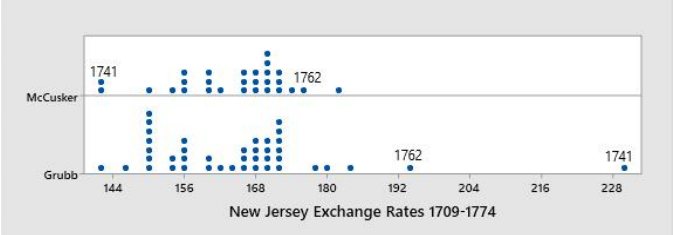
					N	Adjusted R^2	F
MEV_t =	290.836^{***}	$+ 0.09024(APV8_t)$	$- 0.12741(YEAR_t)^{**}$	$+ z_t$	41	0.24	7.15^{***}
	(96.217)	(0.07698)	(0.05350)				
MEV_t =	289.652^{***}	$+ 0.10679(APV6_t)$	$- 0.12776(YEAR_t)^{**}$	$+ z_t$	41	0.23	7.13^{***}
	(97.132)	(0.09192)	(0.05350)				
MEV_t =	334.912^{***}	$+ 0.03802(APV8_t)$	$- 0.14982(YEAR_t)^{***}$	$- 3.3134(LandBank)^{*} + z_t$	41	0.28	6.19^{***}
	(96.372)	(0.07990)	(0.05332)	(1.8028)			
MEV_t =	333.303^{***}	$+ 0.04677(APV6_t)$	$- 0.14941(YEAR_t)^{***}$	$- 3.3160(LandBank)^{*} + z_t$	41	0.28	6.20^{***}
	(97.090)	(0.09484)	(0.05317)	(1.7927)			

Notes: These regressions were done with no lags of the dependent variable because there was no evidence of serial correlation. ***Statistically significant at the 0.01 level. **Statistically significant at the 0.05 level. *Statistically significant at the 0.10 level.

New Jersey's exchange rates in 1741 and 1762

Grubb's MEV is a function of New Jersey exchange rates. For the most part, Grubb uses prices of bills of exchange as reported by McCusker (1978) to measure exchange rates, but Grubb saw fit to alter a few values.[14] Grubb's change in the 1741 observation is truly dramatic and creates a large outlier in his data series; his change in the 1762 observation is also exceptional but less extreme. The anomalous nature of the revisions is striking in Figure 1, a dot plot showing the marginal distribution of New Jersey's exchange rates.

Figure 1. The marginal distribution of exchange rates in Grubb and McCusker



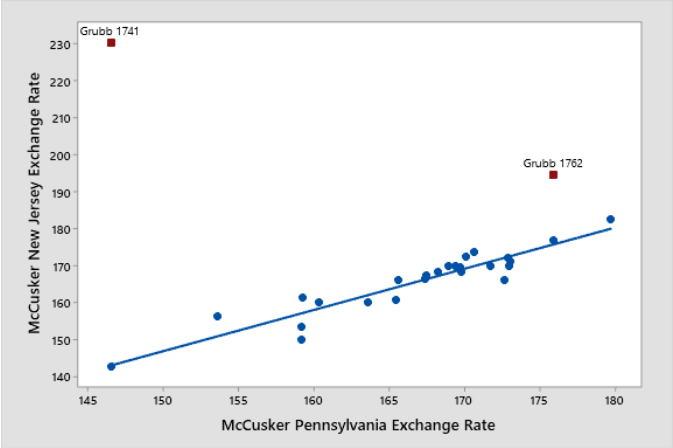
Sources: Grubb 2016a, 1220–1221; McCusker 1978, 172–174 Table 3.6.

Grubb's revisions to the 1741 and 1762 exchange rates are wrongheaded. Before pinpointing the defects in his revisions, let me present some general considerations that should have dissuaded him from ever proposing them.

14. Grubb cites exchange rates in New Jersey pounds *per pound sterling*; McCusker cites them in New Jersey pounds *per hundred pounds sterling*. I use McCusker's scale.

Colonial New Jersey engaged in scarcely any direct international trade. East Jersey served as a hinterland of New York City, while West Jersey served as a hinterland of Philadelphia. Merchants in New York and Philadelphia handled the bulk of New Jersey's international commerce. New Jersey residents generally acquired bills of exchange through either New York or Philadelphia, a process simplified by the fact that New Jersey's paper money usually passed one-for-one with Pennsylvania's paper money (see *NJ Archives*[15], vol. 5 417).[16] It was because New Jersey bills were usually accepted on equal terms with Pennsylvania bills in Philadelphia that "the West Jersey exchange," as Governor Shirley testified, "is constantly regulated by that of Philadelphia" (*NJ Archives*, vol. 7 398). In 1764, when the British imperial authorities demanded that each colony inform it of the annual prices of bills of exchange since 1749, New Jersey reported "Rates of Exchange at Philadelphia" (CO 323/19, fol. 38r). The tendency of New Jersey's exchange rates to conform to Pennsylvania's is illustrated in Figure 2. Figure 2 shows that Grubb's change in the 1741 and 1762 exchange rates also makes them outliers in the historical bivariate relationship between New Jersey and Pennsylvania exchange rates as reported by McCusker.

Figure 2. McCusker's New Jersey and Pennsylvania exchange rates



Notes: Data points in the scatterplot are from McCusker (2006, vol. 5 698), Series Eg317 and Eg318, 1737–1774. The only pre-1737 New Jersey exchange rate data McCusker possesses are from dates before 1722. Before 1724 New Jersey used what it termed '8 s. an ounce money,' a unit of account not comparable with that in Pennsylvania.

15. New Jersey Historical Society (1880–1928) is cited throughout this article as "*NJ Archives*."
16. Numerous examples of Pennsylvania bills being tendered and accepted in New Jersey at precisely the same value as New Jersey's own bills may be found in Stevens's colonial-era daybooks and account books (Stevens 1968). See also Michener and Wright (2006a, 27–29).

TABLE 4. The importance of the 1741 observation: MEV's statistical relationship to APV, 1709–1774

						N	Adjusted R^2	F
How large an outlier is 1741 in Grubb's regressions?: Including dummy variables for 1741 and 1742 in his regressions								
MEV_t =	19.6262***	+ 0.04885($APV8_t$)	− 20.103($Dummy41_t$)	+ 20.798($Dummy42_t$)	+ z_t	65	0.67	33.34***
	(6.2403)	(0.0339)	(3.271)	(3.768)				
MEV_t =	18.6394***	+ 0.05665($APV6_t$)	− 20.133($Dummy41_t$)	+ 20.801($Dummy42_t$)	+ z_t	65	0.67	33.24***
	(6.2634)	(0.0406)	(3.273)	(3.774)				
Regressions below substitute a value of MEV derived from McCusker's 1741 exchange rate								
MEV_t =	22.1591***	+ 0.03872($APV8_t$)	+ z_t			65	0.50	33.03***
	(6.6798)	(0.0368)						
MEV_t =	21.3871***	+ 0.04506($APV6_t$)	+ z_t			65	0.50	32.97***
	(6.7314)	(0.0440)						
MEV_t =	347.304***	+ 0.01442($APV8_t$)	− 0.1563($YEAR_t$)***	+ z_t		41	0.29	9.27***
	(80.559)	(0.06445)	(0.0448)					
MEV_t =	345.862***	+ 0.01907($APV6_t$)	− 0.1557($YEAR_t$)***	+ z_t		41	0.29	9.28***
	(81.288)	(0.0769)	(0.0448)					
MEV_t =	371.007***	− 0.01367($APV8_t$)	− 0.1684($YEAR_t$)***	− 1.782($LandBank_t$)	+ z_t	41	0.30	6.68***
	(82.824)	(0.06867)	(0.0458)	(1.549)				
MEV_t =	368.954***	− 0.01269($APV6_t$)	− 0.1672($YEAR_t$)***	− 1.754($LandBank_t$)	+ z_t	41	0.30	6.67***
	(83.477)	(0.0815)	(0.0457)	(1.541)				

Notes: The first four regressions were done including one lag of the dependent variable, mimicking what Grubb did to eliminate serial correlation. The coefficients of the lagged dependent variable have been omitted. Stars signifying statistical significance in these regressions should be taken with a grain of salt, because, as explained in the text, using interpolated MEV data guarantees that serial correlation and heteroscedasticity are still present. The final four regressions omit interpolated observations and do not exhibit any signs of serial correlation and therefore do not contain any lagged dependent variables. Consequently, estimated standard errors and t-statistics are no longer suspect in these four regressions. ***Statistically significant at the 0.01 level. **Statistically significant at the 0.05 level. *Statistically significant at the 0.10 level.

Grubb's 1741 value is also an extreme outlier in Grubb's regressions, the regressions reproduced in Table 1. The first two rows of Table 4 show just how extreme an outlier it is. The 1741 exchange rate appears in two observations—in 1741 as the value of the dependent variable and in 1742 as the value of the lagged dependent variable. The first two Table 4 regressions therefore add dummy variables for the 1741 and 1742 observations. The 1741 dummy has a t-statistic of −6.15 in both regressions; the 1742 dummy has a t-statistic of 5.51 in the first regression and 5.52 in the second. The probability of seeing a t-statistic as large as 6.15 by chance is 0.00000007, confirming that these observations are striking outliers.[17]

17. A caveat applies, namely, that I am abstracting from other errors. This p-value given here abstracts

Remarkably, Grubb did not document any basis for his changes. Grubb's revisions of these exchange rates first appear in the working paper where he notes:

> rates listed in McCusker (1978, 172–4) for 1739, 1741, and 1762 that could not be verified in the original sources cited were dropped, and those that were at odds with the original sources cited were changed to be consistent with those sources. (Grubb 2014, 17 Table 1 n.c)

In the *JEH* article, Grubb notifies readers of the changes as follows: "I corrected the errors (typos) in the McCusker data for the years 1739, 1741, and 1762 based on what was found in these original sources. I also added a few exchange rates found in other primary sources not originally included in the McCusker data" (2016a, 1219). Nowhere in the working paper nor the published article does Grubb specify McCusker's "errors (typos)," how the purported errors were "corrected," which observations are new, or where the new observations can be found. He merely provides one huge list of "Sources" for the table in each of the papers (Grubb 2014, 16; 2016a, 1221), covering the sourcing of all data.

How does Grubb account for the extraordinarily high 1741 exchange rate? All he writes about it is: "War panic is associated with a brief collapse in MEV in 1741" (2016a, 1226).[18] That's it! That a war panic caused the exchange rate to spike is implausible on two grounds. First, exchange rates in both New York and Pennsylvania were exceptionally low, and it is difficult to imagine a "war panic" that confined itself to New Jersey. Second, wars brought the American colonies unprecedented opportunities for privateering, trading with the enemy, and the provisioning of British land and sea forces, all of which made bills of exchange uncharacteristically plentiful. Anticipation of war would be as likely to depress exchange rates as to raise them (Harrington 1935, 289–315).

Bezanson, Gray, and Hussey (1935, 324–325) specifically discussed the unusually low exchange rate Pennsylvania enjoyed in 1741, attributing it to "the financing by the British government of the expedition against the Spanish in the West Indies." The British purchased foodstuffs and sent them to the West Indies for the use of the Royal Navy, she explained, injecting "a large volume of bills on London" into the market. Because foodstuffs were New Jersey's principal export, and because Philadelphia and New York were the ultimate wellspring of New Jersey's bills of exchange, we would naturally conjecture that New Jersey's

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from the issues caused by omitted variables and using interpolated data. Inserting these dummy variables is equivalent to dropping the 1741 observation from the sample. Hence, the first two Table 4 regressions reveal that simply dropping the 1741 observation deflates the t statistics on APV.

18. MEV is an inverse function of the exchange rate, so a high exchange rate corresponds to a low value of MEV.

exchange rate fell for the same reasons.

I worked through Grubb's list of "Sources" for the data in his tables and found no basis for his alterations. My reading of the data for 1741 is exactly in accord with McCusker's. McCusker (1978, 172 Table 3.6) reports New Jersey's exchange rate was 150 in January and April 1741, fell to 125 in June of that year, and rose to 140 in August. These values can be confirmed in the *NJ Archives*: the January value at vol. 15 p. 187; the April value at vol. 15 p. 196 and vol. 6 p. 132; the June value at vol. 6 p. 133; and the August value at vol. 6 p. 134.[19]

Grubb (2014, 17 Table 1), on the other hand, reported having five exchange citations for 1741, ranging in value from 142.86 to a high of 400 with an average of 230.57. As large and implausible as 230.57 is as an outlier, 400 would dwarf it. An email exchange between Grubb and Daniel Klein, the editor of this journal, has pinpointed the source of the disagreement. In a key letter Lewis Morris, New Jersey's governor, mentioned "the falling of exchange from 70 to 50 and after that so low as even to 25 per cent in 2 or 3 Months time and its rise again to 40" (*NJ Archives*, vol. 6 133–134). When Morris says exchange fell to "25 per cent," to focus on the most important example, what does "25 per cent" say about the number of pounds of New Jersey currency required to purchase a hundred pounds sterling? McCusker and I agree that it means 125 pounds of New Jersey currency were required to purchase a bill of exchange for 100 pounds sterling. Grubb's interpretation is that Morris means New Jersey's currency was worth only 25 percent as much as sterling, so that 400 pounds of New Jersey's currency were required to purchase a bill of exchange for 100 pounds sterling. How one ought to interpret Morris's statement about exchange having been 70, 50, 25, and 40 per cent is the crucial disagreement. This explains why Grubb finds an extraordinarily high exchange rate in 1741 while McCusker and I find a very low rate similar to that of Pennsylvania.

In his correspondence with Klein, Grubb (2019) explained why he thought that McCusker's interpretation was wrong. The New Jersey treasury, Grubb argued, received the colony's bills of credit in tax payments on terms that effectively redeemed them at a par of 133⅓.[20] Because a discount bond could not be worth

19. McCusker reports the annual average as 142.5, but the reader may notice the numbers average to 141.5. The reason, McCusker (1978, 23–24) explains, is that data were first gathered and averaged by quarter and then the quarterly data were averaged. McCusker does not specifically cite *NJ Archives*, vol. 15 p. 187, but discovering it was not hard. Although a glance at this page finds a date of 1 January 1740, the event predates the 1752 calendar reform; in this era the new year started on 25 March (McCusker 1978, 26). The editors of *NJ Archives* recognize the old-style date, and if one examines the header of page 187, one can see the editors give the date as 1740–41. Turn back to page 183, and one discovers that the records are for a session of the Council commencing on 31 December 1740. I have located one independent New Jersey exchange rate citation for 1741—Douglass 1972, vol. 2 pp. 255–256—but it is also broadly consistent with McCusker.
20. I would dispute the par value, but it is not germane to this discussion.

more than its face value before its redemption date, an exchange rate of 125, or any other number below the par value of 133⅓, had to be a mistake. Because the data (not his theory!) must be at fault, he was justified in correcting the data.

His reasoning here goes contrary to his own published work. Grubb recently analyzed colonial Virginia's experience in a paper paralleling his analysis of New Jersey. Grubb states that the Virginia treasury received that colony's bills in tax payments on terms that effectively redeemed them at a par of 125 (Grubb 2018a, 128). Yet between 1769 and 1772 there is scarcely a month in which the Virginia exchange rate was not below 125; annual averages stayed below 125 from 1768 to 1772. Indeed, Virginia's exchange rate bottomed out at 111.25 in February 1770 (McCusker 1978, 201–212 Table 3.10). Yet Grubb used McCusker's Virginia data, all of it, without comment. Either the Virginia exchange rate data contradict Grubb's contention that bills of credit were essentially discount bonds, or they do not. If they discredit the theory, a New Jersey exchange rate of 125 is credible; if they do not discredit the theory, any justification Grubb uses to rationalize Virginia's exchange rates can likewise justify a New Jersey exchange rate of 125.

Interpreting the sources for the New Jersey 1741 exchange rate comes down to the matter of how one ought to interpret "exchange is at 25 per cent." McCusker correctly explains colonial conventions for expressing rates of exchange:

> The expression of the commercial rate of exchange followed similar patterns. Sometimes one spoke of the sum necessary to buy a hundred units of the motherland's money. Henry Laurens of Charleston once wrote that exchange was "at 721 per cent"; he meant that he had to pay £721 South Carolina currency to buy a bill for £100 sterling. But sometimes, using the same phrases, the colonists spoke in terms of the percentage *increase* in local currency necessary to buy a bill on the metropolis. When Thomas Hancock of Boston spoke of bills that "go off at 800 per cent," he meant that it took £900 Massachusetts currency to buy a bill worth £100 sterling. Hancock's was, in fact, the more usual style, but in several English colonies both were occasionally used interchangeably. (McCusker 1978, 120, my emphasis)

This interpretation did not originate with McCusker. Before McCusker, Bezanson and her colleagues were the acknowledged experts on colonial exchange. In their 1935 book, they signaled their interpretation of such exchange rate citations using an editorial insertion to a quoted letter written by a Philadelphia merchant. "A great many people have been obliged to ship dollars…but it does not appear to me that they will make a better remittance than bills at 72½ per cent *[£172½ Pennsylvania currency for £100 sterling]* when the freight and insurance and all charges are paid" (Bezanson et al. 1935, 317, my emphasis). They go on to interpret exchange citations of 50 percent, 60 percent, 70 percent, 75 percent, etc., in a similar fashion

(ibid., 325–327).[21]

Briefly consider what it would mean if Bezanson and McCusker were wrong. As McCusker (1978, 120) notes, quoting exchange rates in this way was the "more usual style," and the interpretation of countless exchange rates tabulated by Bezanson and McCusker doubtless hinge on the correctness of their interpretation. If they were wrong, as Grubb asserts, the error would not be limited to New Jersey's 1741 exchange rate. The error would infect all Bezanson and McCusker's published exchange rate series and with it every bit of colonial economic history written since 1935 that has relied on those exchange rates, including many of Grubb's own papers.[22]

How did Bezanson and McCusker conclude that theirs was the correct interpretation? As McCusker (1978, 120 n.14) explains, one can verify it by checking arithmetic. Some exchange rate citations contain detailed information. A transaction for a bill of exchange in September 1762, preserved at the New York Historical Society, records the conversion of £2236..0..4 sterling to £3968..18..7 in Jersey Proclamation money with the annotation "Exchange @ 77½ p. C^{t}." "Exchange @ 77½ p. C^{t}." can only mean that it took £177.5 New Jersey Proclamation money to purchase a bill for £100 Sterling (see the account dated 9 September 1762, in Alexander Papers 1668–1818, Box 7 folder 5).

How can we be certain that Governor Morris, whose letter lies at the heart of the disagreement, quoted exchange rates as McCusker says he did? A clinching piece of evidence lies in a letter from Governor Morris to the Board of Trade in June 1743. "The Exchange is now at 60 per Cent for the reasons just mentioned," Morris wrote, "that is £160 in Jersey bills now will purchase £100 Sterling" (Morris 1993, 262).

Two comparatively inconsequential disagreements, relating to the dating of observations, explain the residual divergence between Grubb and McCusker's 1741 exchange rates. I have relegated that discussion to a footnote.[23]

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21. Regarding the proper interpretation of exchange rates in colonial documents, see also Baxter 1945, 99 n.30; Foster 1962, 45; Soltow 1965, 164–167; Mair 1752, 238. Douglass (1740, 10–12, 19–20), says of New England currency that "*Exchange with Great Britain* 4.50 *per cent Advance*, or five and an half *New England* for one Sterl." At another point, he says "by repeated large Emissions, Exchange becomes at present in *North-Carolina* 10 for 1 Sterl." and a few pages later says "*Exchange with* Great Britain *being at this Time*…*in North Carolina* 900 *per Cent*."

22. The havoc Grubb's current interpretation of "exchange is at 25 per cent" would wreak on Grubb (2018a) is evident from comparing the Virginia exchange rates derived from original sources in Soltow (1965, 166–167) and CO 323/19, fol. 51r. to the McCusker (1978, Table 3.10) Virginia exchange rates that Grubb relied upon.

23. Grubb did not discover *NJ Archives*, vol. 15 p. 187, where it is reported that on 1 January 1741 the exchange rate was 150. Therefore, when Morris said exchange fell from 70 to 50 to 25 and then rebounded to 40, Grubb attributes the "70" (100/0.70 = 142.86 in his estimation) to 1741, although Morris himself never said that these gyrations had all occurred since January. McCusker (1978, 172) shows the exchange

Grubb's (2016a) econometric results all hinge on the 1741 exchange rate. Reverting to McCusker's 1741 exchange rate deflates the t-statistic on APV6 and APV8 in Grubb's original regressions, even if one uses interpolated data and omits time trends and structural breaks (see the third and fourth equations in Table 4). If one discards the interpolated data (the only way to eliminate bias, heteroscedasticity, and serial correlation) and includes a deterministic time trend and/or a structural dummy for the land-bank era (the only approach consistent with Grubb's specification of other equations) one concludes that neither APV6 nor APV8 had a perceptible effect on MEV. These regressions, the most sensible of the several reported, are the final four equations in Table 4. Although it is a truism that accepting the null of zero does not prove the coefficient of APV is zero, zero is not the only parameter value of interest. If Grubb's theory is correct, an increase in APV should boost MEV approximately one-to-one. Not one of the estimated coefficients of APV in these 4 regressions is bigger than 0.02, and all of them are twelve or more standard deviations below 1.

What of the bizarre average exchange rate that Grubb reports for 1762? McCusker relied upon three observations for 1762. Two of them, 175 and 177.5, are for March 1762. These citations, derived from a report New Jersey submitted to Parliament in compliance with a Parliamentary request for information (CO 323/19, fol. 38r), are not in dispute. Perhaps because he could not easily verify it, Grubb discarded McCusker's third observation, 177.5, an observation from a manuscript account dated September 1762. I have this account; indeed, it is the very Alexander account used to illustrate how arithmetic could pin down the meaning of "Exchange @ 77½ per Cent." I also located two additional 1762 exchange rates buttressing McCusker's numbers for 1762. Stevens (1968, reel 4 image 198) records a March 1762 exchange rate of 175; Lurie and Walroth (1985, 132) record an August 1762 exchange transaction converting 298..6..0 sterling to 527..14..2 in Jersey's pounds, an exchange rate of 177.

Grubb (2014, 16 Table 1) replaced McCusker's third observation with his own third observation of 231.75—again, completely unaccounted for in sourcing and documentation—thereby raising the average exchange rate to 194.75. The

rate at 170 in 1739, and the January 1 citation suggests it had fallen as low as 150 by the beginning of 1741, so neither McCusker nor I believe that 70 is a number pertaining to 1741. Grubb (2019), in his communication with Klein, pointed to a citation McCusker overlooked, a table in the *Boston Evening Post*, 12 January 1741, showing the "Value of Paper Money or Bills of Credit in the Plantations." The exchange rate for "The Jersey's" given in the table is 160. Had McCusker included 160 as a January citation, his average January exchange rate would have been 155 instead of 150, a negligible change. Examining the article in the *Boston Evening Post*, however, reveals that the dateline on the article is "New York, December 15, 1740." In fact, the March 1740 issue of *Gentleman's Magazine* contains this precise table, and the information ricocheted between colonial newspapers for almost a year afterwards (*Boston Weekly News-Letter*, 5 June 1740, p. 4). This exchange rate does not pertain to 1741, although it is easy to understand why Grubb thought it did.

average, 194.75, is a notable outlier in the marginal distribution of New Jersey exchange rates and the bivariate distribution of New Jersey and Pennsylvania exchange rates; the rogue observation of 231.75 is a huge outlier.

In response to queries from Klein, Grubb (2019) revealed that his source for the peculiar 1762 exchange rate was a letter written by Joseph Sherwood, New Jersey's agent in London, a letter that he had neglected to cite. Here is what Sherwood's letter, dated 17 August 1762, says:

> The Favour of 5th, 6th. Mo. I received with Bills – Jacob Spicer Esqr by his letter to me dated 5th December 1760 writes that the sum of £287-6-10¼ Currency was the money allowed by the Assembly to be due to us as Executors of [former agent Richard Partridge] and we have rendered an Account in Chancery of the sum £152-9-2d. Sterling being due from the Province to the Estate of [Richard Partridge] and think that the Assembly should have paid the money Neat in London; so great a deduction as £66 will Occasion much Trouble to us. We had rather have waited longer than be paid thus. (Sherwood 1851, 137)

It is clear enough that Sherwood believes the colony shortchanged Partridge's executors by about £66 (£66 Sterling? £66 New Jersey currency?), but there is no self-evident exchange rate here. Grubb believes the assembly should have provided £287-6-10¼ plus £66 = £353-6-10¼ in New Jersey currency to cover the £152-9-2d. Sterling. The exchange rate that equates these values is 231.76. That this number would be an outlier did not give Grubb pause. Nor did Grubb ask how Sherwood, residing in London, would know the price of bills of exchange being drawn on the other side of the Atlantic, or why the assembly would earmark £287-6-10¼ currency in 1760 to pay £152-9-2d Sterling, a sum that in 1760 would have been worth more than £187 sterling.

Digging deeper provides some clues to Sherwood's meaning. In March 1762, the Governor and Council approved a warrant for £152-9-2 in *New Jersey currency* for the use of Richard Partridge's executors (*NJ Archives*, vol. 17 280). It is likely Sherwood had just learned of this, prompting him to object that Chancery was demanding the executors to pay £152-9-2 *sterling*. At McCusker's 1762 exchange rate, which is 176.88, £152-9-2 in New Jersey currency amounts to £86.19 sterling, almost exactly £66 pounds sterling less than the amount demanded of the executors. That the sum the colony provided was precisely the same number of pounds, shillings, and pence (albeit in a different currency) as the executors were being asked to pay on the colony's behalf seems too extraordinary to be a coincidence. Did someone confound a sum in New Jersey pounds with a sum in pounds sterling?

New Jersey settled on that sum shortly after Partridge's death. A committee

of the New Jersey Assembly appointed to adjust the former agent's accounts at the time of his death submitted its report on 25 November 1760, at which time the Assembly voted to insert a payment for £152-9-2 in Jersey proclamation money into the support bill to settle the colony's account with Partridge (New Jersey 1760, 39–40). Final approval for the payment occurred only in the spring of 1762, as previously noted.

What about the "£287-6-10¼ Currency" that Sherwood says the Assembly allocated to the executors? The 1760 Committee report mentions that the colony had previously approved paying Partridge £134-17-8¼ New Jersey Proclamation money, money that, although approved, was waiting to be remitted. Adding this to the additional £152-9-2 the Assembly recommended paying to close out Partridge's account gives £287-6-10¼, exactly the sum to which Sherwood alludes. The £134-17-8¼, much further along in the approval process than the £152-9-2, probably reached London considerably in advance of the second payment. It appears Sherwood mistakenly thought the executors still had the equivalent of £287-6-10¼ currency coming from the colony, and he was distraught to realize that they'd only receive the equivalent of £152-9-2 currency.

The oddball 1762 observation plays a supporting role in Grubb's empirical work, nudging t-values in crucial regressions across the symbolic threshold that divides coefficients significant at the 5-percent level from those that are not. In Grubb (2016a, 1227) the regressions reproduced in Table 1, purportedly demonstrating "a strong statistically significant positive association between MEV and APV," are the heart of the paper. The contribution of the revised 1762 exchange rate is evident in Table 5.[24]

TABLE 5. The incremental effect of the 1741 and 1762 observations in Grubb (2016a)

	Coefficient of APV8 in Table 1	Coefficient of APV6 in Table 1
Grubb data 1741 and 1762	t = 2.03, p-value = .047	t = 2.00, p-value = .050
McCusker 1741, Grubb 1762	t = 1.05, p-value = .296	t = 1.02, p-value = .310
Grubb 1741, McCusker 1762	t = 1.93, p-value = .059	t = 1.89, p-value = .063
McCusker data 1741 and 1762	t = 0.92, p-value = .363	t = 0.88, p-value = .380

In a *Research in Economic History* article, Grubb (2016b) estimates the time series properties of MEV for several colonies, including New Jersey, and reports statistically significant structural breaks in MEV in 1764 or 1765, corresponding to the end of the French and Indian War and passage of the Currency Act of 1764. New Jersey's bills of credit, by these estimates, became discernibly more valuable after 1764. One obvious problem is that the structural break in Grubb (2016b) does

24. Tables 5 and 6 abstract from errors arising from omitted variables and interpolation.

not appear in Grubb (2016a) and vice versa. It is odd, to put it mildly, to have a different data-generating mechanism in two different papers published in the same year, both explaining the same data set. But in both papers the oddball 1741 and 1762 observations have important effects with regard to statistical significance. Their effects on the results in Grubb (2016b) can be seen in Table 6.

TABLE 6. The incremental effect of the 1741 and 1762 observations in Grubb (2016b)

	Coefficient of the dummy for years after 1764
Grubb data 1741 and 1762	t = 2.05, p-value = .045
McCusker 1741, Grubb 1762	t = 1.58, p-value = .119
Grubb 1741, McCusker 1762	t = 1.88, p-value = .065
McCusker data 1741 and 1762	t = 1.42, p-value = .160

Other problems with exchange rates

Earlier I pointed out that exchange rates do not reflect the value of a colony's bills of credit when bills of exchange are purchased with some other medium of exchange. In 1717, New Jersey made what at the time was designed to be its last paper-money emission. The colony decreed the bills would remain current "between man and man" only until 1 December 1718, although the Treasurer was allowed to accept them until 1 April 1719. (*NJ Laws*, vol. 5 386–388). Predictably, when the term expired some bills remained outstanding. Grubb (2015, 33) estimates that the surviving remnant came to just £79.29, although the true number is certainly larger.[25] To deal with the remaining bills the New Jersey assembly resolved on 5 March 1719 to permit tax collectors and the treasurer to receive them until all arrears of taxes had been paid in but confirmed their earlier edict that *the bills were no longer to pass current between man and man* (CO 5/1019). Between 1719 and 1723 New Jersey's medium of exchange in ordinary transactions consisted exclusively of specie and the bills of credit of neighboring colonies, £20,000 of which were said to be circulating in New Jersey in 1723 (*NJ Archives*, vol. 5 87, 96). New Jersey bill-of-exchange transactions recorded during this period (in 1719 and 1721) shed no light on the value of the orphaned remnant of New Jersey's bills of credit, because New Jersey bills of credit could not have been used in these transactions. Nevertheless Grubb relies upon the integrity of these exchange rates. The 1719 and 1721 values of MEV based on these exchange rates and the interpolated 1718, 1720, 1722, and 1723 values that incorporate them are crucial to Grubb's empirical results. The coefficients of APV8 and APV6 become statistically insignificant at the 10-percent

25. In 1724 the colony permitted bill holders to exchange the old bills they still possessed for newly issued bills and redeemed £656.66 in this fashion. (*NJ Archives*, vol. 14 304–305).

level in the Table 1 regressions if one drops these observations from MEV. This is true whether one fills in the 1718–1723 observations by interpolating from the 1717 and 1724 observations or whether one simply drops 1718–1723 from the data set.

Parenthetically, when New Jersey resumed issuing bills of credit in 1724, its bills passed in Philadelphia at the value of Pennsylvania's own bills, and like Pennsylvania's bills circulated for a number of years at a discount with respect to the gold currency of both colonies (*NJ Archives*, vol. 5 154). During this period the exchange rate in gold and that in bills of credit were distinct, making it difficult to assess whether an exchange rate citation actually reflects the value of the paper currency.

Table 7: Spurious correlations and unjustified lag lengths

Grubb intended for his regressions reproduced in Table 7 to build on the results reproduced in Table 1. Grubb used the Table 1 regressions to argue that MEV was mostly determined by APV; he used the Table 7 regressions to investigate the deviations of MEV from APV, the residue left unexplained by APV, a residue related to the liquidity services bills of credit provided. Table 4 shows that if one omits interpolated data and reverts to McCusker's exchange rates, MEV is not influenced in any meaningful way by APV, which destroys the motivation for exploring the residue, MEV minus APV. Nevertheless, Table 7 appears to identify some suggestive correlations. What accounts for them?

TABLE 7. Replication of Grubb's Table 3: Determinants of the transaction premium, 1709–1774

Dependent variable	Constant	Per-capita M_t	Year	Land Bank Emission	N	Adjusted R^2	F
$TP8_t - RD_t$	188.3046^{++}	10.2158^{***}	-0.1131^{+++}	3.950^{**}	63	0.67	22.22^{***}
	(120.935)	(2.1661)	(0.0700)	(1.9080)			
$TP6_t - RD_t$	203.8079^{*}	8.9614^{***}	-0.1232^{*}	2.7788^{++}	63	0.63	18.78^{***}
	(108.9415)	(1.9400)	(0.0631)	(1.6733)			

Notes: These regressions were done including three lags of the dependent variable. The coefficients of the lagged dependent variables have been omitted. Grubb (2016a, 1229) did likewise. The lagged dependent variables fail to eliminate the serial correlation according to Grubb's preferred criterion. See the text for details. Stars signifying statistical significance should be taken with a grain of salt because of unresolved serial correlation and heteroscedasticity. ***Statistically significant at the 0.01 level. **Statistically significant at the 0.05 level. *Statistically significant at the 0.10 level. $^{++}$Statistically significant at the 0.11 level. $^{+++}$Statistically significant at the 0.12 level.

Grubb argues that the positive and statistically significant coefficients of the per-capita money supply in Table 7 demonstrate that the transactions premium (TP), the excess of the paper money's value over its present value in tax collections,

increases with an increase in the per-capita money supply. "More paper money in circulation per capita" Grubb concludes, "increased its ubiquity and familiarity of usage, which in turn led the public increasingly to treat this money as fiat-like currency" (2016a, 1230). It therefore displaced less efficient transactions media, such as barter, book credit, tobacco, and specie.

As Karl Pearson noted in 1902, spurious correlation often arises "due solely to the particular manipulation of the observations" (quoted in Aldrich 1995, 367). The transactions premium (TP, or more precisely, TP minus RD), can't be independently observed; Grubb infers it from MEV minus APV, which is actually the dependent variable in the Table 7 regressions. Grubb (2016b, 1224), however, *defines* APV using a formula that includes the current money supply in the denominator, effectively building in a strong negative correlation between APV and the money supply and hence the money supply per capita. The correlation between APV6 (APV8) and the per-capita money supply in the New Jersey data set is −0.7922 (−0.7873)! This correlation tells us nothing about the evolution of the colonial economy—both variables are nothing more than transformations of the money supply data. When Grubb computes MEV minus APV to create the dependent variable in the Table 7 regressions, this particular manipulation of the data injects the current money supply directly into the dependent variable. The statistical significance of the per-capita money supply in the Table 7 regression, therefore, is entirely unremarkable and entirely uninformative.

One can verify the overwhelming importance of the spurious correlation of APV and the per-capita money supply in Table 7 by noting that if one drops APV from the dependent variable, the money supply per capita has no statistically discernible effect on MEV. The per-capita money supply only appears to be significant when APV is part of the dependent variable—see Table 8. Grubb reports regressions exploiting the same spurious correlation in other articles (Grubb 2018a, 136–137; 2018b, 171–172).

TABLE 8. Grubb's Table 3 without APV in dependent variable: Determinants of the transaction premium, 1709–1774

Dependent variable	Constant	Per-capita M_t	Year	Land Bank Emission	N	Adjusted R^2	F
MEV_t	373.767***	0.5536	−0.1707***	−3.3418**	63	0.24	4.19***
	(84.853)	(1.5198)	(0.0491)	(1.3387)			
MEV_t	371.701***	0.3641	−0.1694***	−3.415**	63	0.24	4.22***
	(85.211)	(1.5174)	(0.0494)	(1.309)			

Notes: The first regression was performed with three lags of $MEV_t - APV8_t$ among the right-hand-side variables; the second with three lags of $MEV_t - APV6_t$ among the right-hand-side variables; in other words, three lags of Grubb's dependent variable, the dependent variable from which APV has been removed in this regression. The coefficients of these lagged variables have been omitted. Stars signifying statistical significance should be taken with a grain of salt because of unresolved serial correlation and heteroscedasticity. ***Statistically significant at the 0.01 level. **Statistically significant at the 0.05 level.

The final inference Grubb draws from the regressions in Table 7 is that emitting currency via a land bank increased the transaction premium, a conclusion derived from positive coefficients on the land bank dummy variable, one coefficient reported to be statistically significant at the 5-percent level, the other reported to be almost significant at the 10-percent level. Table 8 shows that the positive coefficient on the Land Bank dummy in this regression arises from the correlation between the Land Bank dummy and APV: dropping APV from the dependent variable flips the sign of the Land Bank variable from positive to negative. The Land Bank dummy is correlated −0.202 (−0.191) with APV8 (APV6), which accounts for its positive sign when APV is subtracted from MEV in the dependent variable. How quickly a colony called in its paper money partly determines APV, and one can explain the correlation of APV and the Land Bank dummy by observing that New Jersey's land banks were politically popular, and the government consequently allowed their bills to remain in circulation for a relatively long time.

The Table 7 regressions are important mostly for what they reveal about the quality of the empirics. Grubb (2016a, 1229 Table 3 notes) explains that he decided to use three lags of the dependent variable to eliminate serial correlation after testing for autocorrelation with Durbin's Alternative Test and accepting the null of no autocorrelation at a 10-percent significance level. I discovered, however, that discernible serial correlation remains in both the regressions reported in Table 7.[26] The p-values for Durbin's Alternative Test are 0.073 and 0.042 respectively with three lags. One lag—the specification Grubb used in the Table 1 regressions—delivered better p-values for Durbin's Alternative Test, namely 0.104 and 0.065. Experimenting with one to ten lags revealed that when one shortens or extends the lag length in Table 7 until Durbin's Alternative Test fails to detect serial correlation at a 10% level, the Land Bank dummy variables become statistically insignificant at the 10-percent level. Indeed, no other lag length tested produces smaller reported p-values on the structural break dummies than three lags did.

Conclusion

Grubb's (2016a, 1227) contention is that he has established a "strong statistically significant association between MEV and APV," thereby verifying his theo-

26. As previously noted, the regressions in Table 7 use many interpolated values of the dependent variable. Interpolating unavoidably creates complicated serial correlations that lagged dependent variables cannot possibly eliminate. The focus here is on *replicating* Grubb's regressions and determining whether the lagged dependent variables make the serial correlation *indiscernible*, which is what Grubb asserts to be true.

retical assertion that the value of colonial currencies in general, and New Jersey's in particular, is best explained by their resemblance to discount bonds. But Grubb omits variables, most crucially time trends, that he himself includes elsewhere in analyzing the same data, variables whose inclusion would overturn his result. Grubb also relies heavily on interpolated values of the dependent variable, thereby exaggerating the precision of his estimates, introducing bias, serial correlation, and heteroscedasticity in his regressions, and invalidating his statistical tests. He relies upon MEV values from 1719 and 1721, *years when New Jersey bills of credit were not circulating as money*, and uses those values to interpolate values for 1718, 1720, 1722, and 1723. Finally, Grubb makes specious alterations in McCusker's 1741 and 1762 exchange rates, creating outliers in the data set, outliers that are crucial to his empirical results. Correcting these issues reduces the coefficient of APV in Grubb's key regression to approximately 0.02, a value not statistically significantly different from zero, and more than 12 standard deviations below the value of one, the value suggested by Grubb's theory.

Grubb's investigation of the "transaction premium" reproduced in Table 7 is likewise flawed. The chief result, that an increase in the per-capita money supply increases the transaction premium, arises from a spurious correlation between the per-capita money supply and APV. The slow pace at which New Jersey liquidated its land banks can explain a secondary result, weak evidence that the transactions premium was greater during the land-bank era. The purported statistical significance of this last result can't be replicated.

All of my lines of argument against Grubb's work on colonial New Jersey are designed to demolish a beam holding up a vast structure that needs to come down. That bad structure is a mistaken reading of colonial monetary history, economic history, and political history. A different understanding is called for and is sketched out in the lengthy explanation of my motivations, given at the start of the present paper.

Data and code

Data and code for this research may be downloaded **here**.

References

Aldrich, John. 1995. Correlations Genuine and Spurious in Pearson and Yule. *Statistical Science* 10(4): 364–376.

Alexander Papers. 1668–1818. MS 8. New-York Historical Society, New York.

Ames, Nathaniel. 1767. *An Astronomical Diary or Almanack for the Year…1768*. Newport, R.I.: Samuel Hall.

Anon. 1725. *A Dialogue between Mr. Robert Rich, and Roger Plowman*. Philadelphia: Samuel Keimer.

Ashton, Thomas. 1959. *Economic Fluctuations in England, 1700–1800*. Oxford: Clarendon Press.

Atack, Jeremy, and Peter Passell. 1994. *A New Economic View of American History from Colonial Times to 1940*. New York: W. W. Norton & Company.

Barrow, Thomas C. 1967. *Trade and Empire: the British Customs Service in Colonial America 1660–1775*. Cambridge, Mass.: Harvard University Press.

Baxter, W. T. 1945. *The House of Hancock: Business in Boston 1724–1775*. Cambridge, Mass.: Harvard University Press.

Bernard, Francis. 2013. *The Papers of Francis Bernard, Governor of Colonial Massachusetts, 1760–69*, ed. Colin Nicolson, vol. 3. Boston: Colonial Society of Massachusetts.

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

Boston Evening Post. 1735–1775. Boston: T. Fleet.

Boston Weekly News-Letter. 1730–1757. Boston: B Green.

Brock, Leslie V. 1975. *The Currency of the American Colonies 1700–1764: A Study in Colonial Finance and Imperial Relations*. New York: Arno Press.

Carp, Benjamin L. 2011. *Defiance of the Patriots*. New Haven, Conn.: Yale University Press.

Colonial Office. 1703–1719 (CO 5/1019). Council; Assembly. National Archives, Kew, London. **Link**

Colonial Office. 1764–1766 (CO 323/19). S. No. 88. Annual Expenses of the Colonies. National Archives, Kew, London. **Link**

Dickerson, Oliver M. 1951. *The Navigation Acts and the American Revolution*. Philadelphia: University of Pennsylvania Press.

Douglass, William. 1740. *A Discourse concerning the Currencies of the British Plantations in America: Especially, with Regard to their Paper Money*. Boston: Kneeland and Green.

Douglass, William. 1972. *Summary, Historical and Political, of the First Planting, Progressive Improvements, and Present State of the British Settlements in North America*. New York: Arno Press.

Edwards, Bryan. 1793. *The History, Civil and Commercial, of the British Colonies in the West Indies: In Two Volumes*. Dublin: Luke White.

Egnal, Marc. 1988. *A Mighty Empire: The Origins of the American Revolution*. Ithaca, N.Y.: Cornell University Press.

Ernst, Joseph. 1973. *Money and Politics in America 1755–1775*. Chapel Hill, N.C.: University of North Carolina Press.

Foster, Margery Somers. 1962. *"Out of Small Beginnings…" An Economic History of Harvard College in the Puritan Period (1636 to 1712)*. Cambridge, Mass.: Harvard University Press.

Franklin, Benjamin. 1974. *The Papers of Benjamin Franklin, vol. 18: January 1 through December 31, 1771*, ed. William Bradford Willcox. New Haven, Conn.: Yale University Press.

Franklin, Benjamin. 1976. *The Papers of Benjamin Franklin, vol. 19: January 1 through December 31, 1772*, ed. William Bradford Willcox. New Haven, Conn.: Yale University Press.

Gottfried, Marion H. 1936. The First Depression in Massachusetts. *New England Quarterly* 9(4): 655–678.

Great Britain. Parliament. 1768–1800 (*Statutes*). *The Statutes at Large, from the Magna Charta to the End of the Last Parliament, 1761 [continued to 1800]*, ed. O. Rugghead. 18 vols. London: Market Basket.

Grubb, Farley. 2004. The Circulating Medium of Exchange in Colonial Pennsylvania, 1729–1775: New Estimates of Monetary Composition, Performance, and Economic Growth. *Explorations in Economic History* 41: 329–360.

Grubb, Farley. 2006a. Theory, Evidence, and Belief—The Colonial Money Puzzle Revisited: Reply to Michener and Wright. *Econ Journal Watch* 3(1): 45–72. **Link**

Grubb, Farley. 2006b. Benjamin Franklin and Colonial Money: A Reply to Michener and Wright—Yet Again. *Econ Journal Watch* 3(3): 484–510. **Link**

Grubb, Farley. 2014. A New Approach to Solving the Colonial Monetary Puzzle: Evidence from New Jersey, 1709–1775. *NBER Working Paper* 19903. National Bureau of Economic Research (Cambridge, Mass.). **Link**

Grubb, Farley. 2015. Colonial New Jersey's Paper Money Regime, 1709–1775: A Forensic Accounting Reconstruction of the Data. *Historical Methods* 48(1): 13–34.

Grubb, Farley. 2016a. Colonial New Jersey Paper Money, 1709–1775: Value Decomposition and Performance. *Journal of Economic History* 76(4): 1216–1232.

Grubb, Farley. 2016b. 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: 147–224.

Grubb, Farley. 2018a. Colonial Virginia's Paper Money, 1755–1774: Value Decomposition and Performance. *Financial History Review* 25(2): 113–140.

Grubb, Farley. 2018b. Colonial Maryland's Post-1764 Paper Money: A Reply to Ron Michener. *Econ Journal Watch* 15(2): 168–178. **Link**

Grubb, Farley. 2019. Email correspondence with Daniel B. Klein.

Gwyn, Julian. 1980a. The Impact of British Military Spending on the Colonial American Money Markets, 1760–1783. *Historical Papers* 15(1): 77–99.

Gwyn, Julian. 1980b. British Government Spending and the North American Colonies, 1740–1775. *Journal of Imperial and Commonwealth History* 8: 74–84.

Harrington, Virginia D. 1935. *The New York Merchant on the Eve of the Revolution*. New York: Columbia University Press.

Hemphill, John M. II. 1985. *Virginia and the English Commercial System, 1689–1733: Studies in the Development and Fluctuations of a Colonial Economy under Imperial Control*. New York: Garland Pubs.

Homer, Sydney, and Richard Sylla. 1991. *A History of Interest Rates*. New Brunswick, N.J.: Rutgers University Press.

Jensen, Arthur L. 1963. *The Maritime Commerce of Colonial Philadelphia*. Madison, Wis.: State Historical Society of Wisconsin.

Knollenberg, Bernhard. 1960. *Origin of the American Revolution: 1759–1766*. Indianapolis: Liberty Fund.

Langford, Paul. 1973. *The First Rockingham Administration 1765–1766*. London: Oxford University Press.

Letwin, William. 1981. Monetary Practices and Theory of the North American Colonies During the 17th and 18th Centuries. In *La Moneta Nell' Economia Europea*, ed. Vera

Barbagli-Bagnoli, 439–469. Rome: Le Monnier.

Lindert, Peter H., and Jeffrey G. Williamson. 2016. *Unequal Gains: American Growth and Inequality Since 1700*. Princeton, N.J.: Princeton University Press.

Little, Roderick J. A., and Donald B. Rubin. 2019. *Statistical Analysis with Missing Data*, 3rd ed. Hoboken, N.J.: John Wiley & Sons.

Lurie, Maxine N., and Joanne R. Walroth, eds. 1985. *The Minutes of the Board of Proprietors of the Eastern Division of New Jersey from 1764 to 1794*. Newark, N.J.: New Jersey Historical Society.

Lydon, James G. 1970. *Pirates, Privateers, and Profits*. Upper Saddle River, N.J.: Gregg Press.

MacKinney, Gertrude, et al., eds. 1931–1935. *Pennsylvania Archives*, 8th series. 8 vols. Harrisburg, Pa.: Wm. Stanley Ray.

Macpherson, David. 1805. *Annals of Commerce, Manufactures, Fisheries, and Navigation, with Brief Notices of the Arts and Sciences Connected with Them*. London: Nicholas and Son.

Mair, John. 1752. *Book-keeping Methodiz'd, or, a Methodical Treatise of Merchant-Accompts, According to the Italian Form*. Edinburgh: W. Sands, A. Murray, and J. Cochran.

McCusker, John J. 1978. *Money and Exchange in Europe and America, 1600–1775: A Handbook*. Chapel Hill, N.C.: University of North Carolina Press.

McCusker, John J. 2006. Colonial Statistics. In *Historical Statistics of the United States*, 4th ed., eds. Susan Carter et al., vol. V, 627–772. Cambridge, UK: Cambridge University Press.

McCusker, John J., and Russell R. Menard. 1985. *The Economy of British America, 1607–1789*. Chapel Hill, N.C.: University of North Carolina Press.

Michener, Ronald W. 1987. Fixed Exchange Rates and the Quantity Theory in Colonial America. *Carnegie-Rochester Conference Series* 27: 233–308.

Michener, Ronald W. 1988. Backing Theories and the Currencies of Eighteenth Century America: A Comment. *Journal of Economic History* 48(3): 682–692.

Michener, Ronald W. 2011. Money in the American Colonies. In *EH.Net Encyclopedia*, ed. Robert Whaples. Economic History Association (La Crosse, Wis.). **Link**

Michener, Ronald W. 2015. Redemption Theories and the Value of American Colonial Paper Money. *Financial History Review* 22(3): 1–21.

Michener, Ronald W. 2018a. The Case of Colonial New Jersey's Paper Money: The Redemption Theory's Resurrection or Its Death Rattle. Working paper, January 12. **Link**

Michener, Ronald W. 2018b. Reconsidering Colonial Maryland's Bills of Credit 1767–1775. *Econ Journal Watch* 15(2): 158–167. **Link**

Michener, Ronald W. 2019a (forthcoming). A Re-examination of the Empirical Evidence Concerning Colonial Virginia's Paper Money, 1755–1774: A Comment on Grubb. *Financial History Review*.

Michener, Ronald W. 2019b. Colonial North Carolina's Paper Money Regime, 1712–1774: A Comment on Cutsail and Grubb. Working paper, June 26. **Link**

Michener, Ronald W., and Robert E. Wright. 2005. State "Currencies" and the Transition to the U.S. Dollar: Clarifying Some Confusions. *American Economic Review* 95(3): 682–703.

Michener, Ronald W., and Robert E. Wright. 2006a. Miscounting Money of Colonial

America. *Econ Journal Watch* 3(1): 4–41. **Link**

Michener, Ronald W., and Robert E. Wright. 2006b. Farley Grubb's Noisy Evasions on Colonial Money: A Rejoinder. *Econ Journal Watch* 3(2): 251–274. **Link**

Michener, Ronald W., and Robert E. Wright. 2006c. Development of the US Monetary Union. *Financial History Review* 13(1): 19–41.

Mishkin, Frederick S. 2007. *The Economics of Money, Banking, and Financial Markets*. Boston: Addison-Wesley.

Morris, Lewis. 1993. *The Papers of Lewis Morris*, ed. Eugene R. Simmons. Newark, N.J.: New Jersey Historical Society.

Nettels, Curtis P. 1934. *The Money Supply of the American Colonies before 1720*. Madison, Wis.: University of Wisconsin Press.

New Jersey. 1760. *Votes and Proceedings of the General Assembly of the Province of New-Jersey, At a Session Held at Burlington; Began October 29th 1760*…. Woodbridge, N.J.: James Parker.

New Jersey. 1986 (*NJ Laws*). *Laws of the Royal Colony of New Jersey 1770–1775, with Addenda and Index*. In *New Jersey Archives*, ed. B. Bush, 3rd series, vol. 5. Trenton, N.J.: New Jersey State Library.

New Jersey Historical Society. 1880–1928 (*NJ Archives*). *Documents Relating to the Colonial History of the State of New Jersey*. 33 vols. Trenton, N.J.: New Jersey Historical Society.

Norris, Isaac. 1716–1731. Letterbook. Norris Family Papers, Historical Society of Pennsylvania, Philadelphia.

Officer, Lawrence H. 1996. *Between the Dollar-Sterling Gold Points: Exchange Rates, Parity, and Market Behavior*. Cambridge, UK: Cambridge University Press.

Officer, Lawrence H. 2005. The Quantity Theory in New England, 1703–1749: New Data to Analyze an Old Question. *Explorations in Economic History* 42(1): 101–121.

Pares, Richard. 1963. *War and Trade in the West Indies, 1739–1763*. London: F. Cass.

Pollard, William. 1764–1768. William Pollard letter book. MSS. Butler Library, Columbia University, New York.

Rivera-Batiz, Francisco L., and Luis Rivera-Batiz. 1985. *International Finance and Open Economy Macroeconomics*. New York: Macmillan Publishers.

Rousseau, Peter. 2007. Backing, the Quantity Theory, and the Transition to the U.S. Dollar, 1723–1850. *American Economic Review Papers and Proceedings* 97(2): 266–270.

Rousseau, Peter, and Caleb Stroup. 2011. Monetization and Growth in Colonial New England, 1703–1749. *Explorations in Economic History* 48(4): 600–613.

Schnabel, Isabel, and Hyun Song Shin. 2004. Liquidity and Contagion: The Crisis of 1763. *Journal of the European Economic Association* 2: 929–968.

Sherman, Roger. 1752. *A Caveat Against Injustice*. New York: Henry DeForest.

Sherwood, Joseph. 1851. Letters of Joseph Sherwood (Agent for New Jersey in Britain, 1761–1766). *Proceedings of the New Jersey Historical Society*, 1st series, vol. 5: 131–156.

Smith, Adam. 1976 [1776]. *An Inquiry into the Nature and Causes of the Wealth of Nations*, eds. R. H. Campbell and A. S. Skinner. Oxford: Oxford University Press.

Smith, Bruce. 1985a. American Colonial Monetary Regimes: The Failure of the Quantity Theory and Some Evidence in Favor of an Alternate View. *Canadian Journal of Economics* 18: 531–564.

Smith, Bruce. 1985b. Some Colonial Evidence on Two Theories of Money: Maryland and

the Carolinas. *Journal of Political Economy* 93: 1178–1211.
Soltow, James H. 1965. *The Economic Role of Williamsburg*. Charlottesville, Va.: University of Virginia Press.
Stevens. 1968. *Stevens family papers, 1666–1959*. Microfilm ed. Newark, N.J.: New Jersey Historical Society.
Stout, Neil R. 1973. *The Royal Navy in America, 1760–1775*. Annapolis, Md.: Naval Institute Press.
Van Cortland, John. 1762–1769. Letter book, MSS. New York Public Library, New York.
West, Robert C. 1978. Money in the Colonial American Economy. *Economic Inquiry* 16(1): 1–15.
Wood, Gordon S. 1982. Conspiracy and Paranoid Style: Causality and Deceit in the Eighteenth Century. *William and Mary Quarterly* 39(3): 401–441.
Wright, Robert E. 1998. Ground Rents Against Populist Historiography: Mid-Atlantic Land Tenure, 1750–1820. *Journal of Interdisciplinary History* 29(1): 23–42.
Wright, Robert E. 2010a. *Fubarnomics: A Lighthearted, Serious Look at America's Economic Ills*. Amherst, N.Y.: Prometheus Books.
Wright, Robert E. 2010b. How Throwing People Out of Their Homes Created a Revolution(ary). Presented at the John Morton Conference (Helsinki, Finland), June 15.

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Editors' note: Professor Grubb received Professor Michener's comment too late to allow for concurrent reply, but he will reply in the next issue of this journal.

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