

**The Circulating Medium of Exchange in Colonial Pennsylvania, 1729-1775:**

**New Estimates of Monetary Composition and Economic Growth\***

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## **The Circulating Medium of Exchange in Colonial Pennsylvania, 1729-1775:**

### **New Estimates of Monetary Composition and Economic Growth\***

Market transaction data are used to estimate the composition and quantity of specie in circulation. This estimate is used to provide the first comprehensive measure of the colony's money supply. This estimate, along with data on population and prices, is used to measure the growth in output using the quantity theory of money. Output growth is found to depend on periodization and the extent to which rising commercialization increased the velocity of circulation. Specie was scarce but becoming less so as the Revolution approached, and specie and paper currency were both substitutes and complements depending on the period of analysis.

Nobody knows the amount of specie in circulation in colonial America. The absence of this one piece of information has left unanswered a number of important questions about how colonial economies worked. One such question is whether specie was scarce in colonial America. Some writers believe it was scarce (Brock 1975, pp. 86, 267, 386; Bouton 1996; Lester 1938; Walton and Shepard 1979, pp. 100-105), while other disagree (Perkins 1988, pp. 163-66; Redish 1984; Michener 1987, 1988). A second question is whether Gresham's Law (bad money drives out good money) applies to colonial America. Did paper money drive out specie? In other words, were paper and specie substitutes or complements? Again scholars disagree, some believing they were substitutes (McCallum 1992; Michener 1987, 1988), other believing they were complements (Hanson 1979; Lester 1938; Smith 1985a, 1985b). A third question involves whether one colony's paper money circulated freely as a medium of exchange in other colonies. Did colonies compete to collect seigniorage from one another? While some scholars say yes (Michener 1987, pp. 236, 244; Rolnick, Smith, and Weber 1993), quantitative evidence for such an effect is lacking. Another question is whether the simple version of the quantity theory of money holds in the colonial economy, namely, is there a tight relationship between changes in the price level and changes in the total money supply? All tests of this proposition have related prices only to the paper money supply. Based on these tests some scholars conclude that this simple version of the quantity theory of money does not hold in colonial America (Calomiris 1988a, 1988b; Smith 1985a, 1985b; West 1978; Wicker 1985), while other scholars argue that, because we do not know the specie component of the total money supply, such tests prove nothing (McCallum 1992; Michener 1987, 1988; West 1978).<sup>1</sup> A final question is whether real growth was likely in colonial economies. Some scholars argue that real

growth was unlikely (Mancall and Weiss 1999), while others say real growth was likely (Atack and Passell 1994, pp. 2-14; Jones 1980, pp. 72-9; McCusker and Menard 1985, pp. 51-70). These disagreements about how the colonial macro-economy performed have a common cause: our absence of knowledge about the amount of specie in circulation.

In this study I provide the first estimate based on quantitative market-transaction data of the amount and composition of specie in circulation per year in colonial Pennsylvania between 1729 and 1775. The method does not directly measure the quantity of specie, which is rightly considered an impossible task, but instead indirectly measures the quantity of specie and, as a bonus, the composition of that specie by measuring the ratio of specie to paper currency used in a large sample of market transactions. Multiplying this ratio by the known quantity of paper currency in circulation (Brock 1975, 1992) yields the total quantity of specie in circulation. The total money supply is derived by adding the total quantities of paper and specie.<sup>2</sup> Dividing these currency totals by Pennsylvania's population yields cash balances per capita per year by currency type. These data will be used to determine whether specie was scarce, whether paper currency circulated as a medium of exchange outside the colony of issue, how the composition of specie changed, whether paper and specie currencies were substitutes or complements, and whether real output grew over time.

### **THE RATIO OF SPECIE TO PAPER CURRENCY IN MARKET TRANSACTIONS**

For a sample of market transactions to yield a ratio of specie to paper currency in use, that can be taken as representative of the true ratio in the economy, it should exhibit several ideal features. For obvious reasons, the sample should be large, geographically and occupationally diverse, reasonably continuous over time, and confined to the trading of a reasonably uniform product. To make sure that the transactions involve the actual exchange of currency rather than just debt/credit accounting units, the sample should also have few repeat participants and involve arm's-length, one-off exchanges. Parties that engage in repeat transactions with familiar and nearby parties are more likely to resort to book credit which could be cleared later through means other than the exchange of the

currencies denominated in the transaction record.

The sample used here consists of all the advertisements for runaway servants, convicts, and apprentices placed in the *Pennsylvania Gazette* between 1729 and 1775. With very few exceptions, these advertisements offered a separate extra-cash reward in addition to any reward required by law for the capture and/or return of the runaway. This sample of extra-cash rewards possesses all the ideal features described in the above paragraph. Grubb (1992, 1999) provides a transcription of these advertisements and cross-tabulations of the characteristics of the data.<sup>3</sup> The rewards offered in these advertisements should reflect what was actually exchanged. If advertisers routinely lied or misrepresented their offers by renegeing or insisting on an alternative reward to that advertised, then advertisers should have routinely offered rewards in specie, the most desired currency. Yet, the typical reward offered was in Pennsylvania pounds.<sup>4</sup> Considering that county sheriffs were frequently the parties claiming the rewards, lying about or misrepresenting rewards would have been unwise. Finally, because courts enforced the payment of a uniform reward set out in statutory law for capturing and/or returning runaways, little additional cost would be incurred for enforcing at the same time any advertised offer of extra-statutory cash rewards.

Table 1 reports the frequency of currencies offered as rewards for the entire sample, for the subsample of Pennsylvania residents only, and for the subsample of Philadelphia residents only. All samples indicate that local paper currency (Pennsylvania-issued bills of credit) dominated exchange, averaging just over 80% of the transactions. Only two types of specie coins show up with any frequency, Spanish silver dollars at 13% and Spanish gold pistoles at 3 to 5% of the transactions, respectively. There was also little difference in the composition of specie, gold versus silver, between rural and urban residents in Pennsylvania. This evidence indicates that specie as a circulating medium of exchange within the general populace (as distinct from the narrow circulation among merchants engaged in cross-colony and overseas trade) was relatively scarce, and that this scarcity was not just a rural versus urban phenomenon, but a general condition. The use of Pennsylvania-issued paper money within the colony was so extent that the colony's legislature had to pass, and frequently renew, an act authorizing the colony to exchange "torn or ragged" bills for new bills (*Statutes at Large*, vol. 4, pp. 203, 414; vol. 5, pp. 48, 60, 192; vol. 7, p. 204).

[Place Table 1 Here]

The pattern of paper currency use indicates infrequent cross-colony circulation of paper money as a medium of exchange. If paper currencies of the various colonies circulated freely in Pennsylvania, then some goodly percentage of Maryland, New York, New Jersey, and Virginia pounds, whatever advertisers currently had on hand, should have been offered as rewards by Pennsylvania residents. But absolutely none of these other-colony currencies were so offered.<sup>5</sup> Exchange across colonies was more like exchange between foreign countries, than exchange within a given country. It was transacted in specie or in the local paper currency where the physical exchange took place after the out-of-colony party had swapped their colony's paper currency with a merchant money-changer for the paper currency of the colony where the exchange was to take place.<sup>6</sup> Pennsylvania and Maryland runaway-advertisers routinely offered their own local paper currency to subjects from their own colony, respectively, but specie to subjects from other colonies. For example, William Spear of Lancaster County, Pennsylvania, when advertising for his runaway servants, Valentine Strong and Batholomew Logan, in the *Pennsylvania Gazette*, June 21, 1750, stated, "Whoever takes up and secures said servants, so as they may be had again, if in this province five pounds reward, or in any other province six pistoles..." Likewise, John Bordley and Kinvin Webb of Chester-town, Maryland, when advertising for their runaway servants, Richard Barrett and William Silvene, in the *Pennsylvania Gazette*, August 27, 1752, stated, "Whoever shall take up the said fellows in Maryland, and bring them to the subscribers...shall have four pounds reward, besides what the law allows; and if taken out of Maryland, shall have five pistoles..."

Over twenty years later, this behavior still had not changed. For example, Henry Baker of Frederick County, Maryland, when advertising for his runaway servant, John Martingle, in the *Pennsylvania Gazette*, January 5, 1774, stated, "Whoever takes up the said servant, ten miles from home, shall have twenty shillings, and if 20 miles forty shillings, and if out of the province twenty dollars reward..." Likewise, George Eberly of Lancaster County, Pennsylvania, when advertising for his runaway servant, Jared Ervin, in the *Pennsylvania Gazette*, December 28, 1774, stated, "Whoever takes up the said servant, and secures him, so that his master may get him again, shall have, if 20 miles from home, thirty shillings; if 40 miles from home, forty shillings; if out of the province, the above [eight

dollar] reward..."

After 1723, when Pennsylvania residents stated "pounds" without any qualification they meant, by law and custom within the jurisdiction of the colony, paper Pennsylvania pounds.<sup>7</sup> Pennsylvania residents who lived near the Maryland border, however, were more likely to explicitly specify payment in "Pennsylvania" pounds or in pounds "of the currency where taken", indicating that they would exchange Pennsylvania pounds for Maryland pounds if they had to travel to Maryland to retrieve the captured runaway. Likewise, non-Pennsylvania residents advertising in the *Pennsylvania Gazette* were more likely to specify payment in pounds "of the currency where taken" or to explicitly specify payment in pounds of their colony of residence if the runaway were delivered to the master's home. For example, Stephen Onion of Baltimore County, Maryland, when advertising for his runaway servant, John Wilson, in the *Pennsylvania Gazette*, June 20, 1745, stated, "Whoever secures the said servant so that he may be had again, if taken in Baltimore County, shall receive forty shillings, and if in any other county, five pounds, of the currency where taken..."

Still, non-Pennsylvania residents stated the vast majority of rewards they offered as just "pounds". Given that they were advertising in the *Pennsylvania Gazette* and so expecting their runaways to be captured in Pennsylvania, and most likely in Philadelphia which was the great runaway haven, the legal and customary implication was that they would exchange their local currencies and pay the reward in Pennsylvania pounds. This pattern can be seen in several advertisements by Virginia and New Jersey residents that listed the reward as so many "pounds", but which also explicitly stated that the reward would be paid by the advertiser's merchant correspondent in Philadelphia. For example, Daniel Campbell of Rappahannock River, Virginia, when advertising for his runaway servants, John Dennison and Hannah Dennison, in the *Pennsylvania Gazette*, May 24, 1753, stated, "Whoever apprehends and secures said runaways, may apply to Mr. William McIlvaine, in Philadelphia, who will pay them six pounds for the two..."<sup>8</sup>

This evidence indicates that paper currency transactions were denominated in the currency of the colony where the exchange physically took place. Little evidence of cross-colony circulation of paper money as a medium of exchange among the general populace (distinct from the narrow circulation among merchants engaged in cross-

colony trade), and thus little evidence of seigniorage competition among colonies, can be found here. The same conclusion was reached by Jones (1980, pp. 131-32) based on financial claims found in probated inventories. Likewise, Philip Mazzei in his 1782 *History of the Beginning, Progress, and End of Paper Money in the United States* (Marchione 1983, vol. 1, p. 326) concluded, "...state [colony] paper money circulated freely only within it, and the ease or difficulty with which it circulated in other states [colonies] depended on the distance and trade between the state where it was spent and the state issuing it."<sup>9</sup> This finding is important because it indicates that the proper geographic unit for monetary analysis is the individual colony, and that concerns over seigniorage competition among the states could not have been the overriding reason why the clause banning state-issued paper money in the U.S. Constitution was adopted (Grubb 2001; Rolnick, Smith, and Weber 1993). Because the geographic unit of study here is Pennsylvania, all subsequent analysis will use the sample in Table 1 of Pennsylvania residents only.

### **THE CHANGING COMPOSITION OF CURRENCY OVER TIME**

Figure 1 shows what percentage of the total money supply in Pennsylvania was comprised of specie, and in what form--dollars or pistoles--by year from 1729 and 1775 (see also Appendix Table A). The Seven Year's War was the pivotal turning point for specie composition. Before the war, specie was almost exclusively Spanish gold pistoles. After the war, it was almost exclusively Spanish silver dollars. This pattern is consistent with the movements of New World specie production and export into the Atlantic economy. From the late 17th-century, with the rise of gold mining in Minas Gerais, Brazil, until approximately 1760, New World gold exports boomed, while that of silver contracted. After 1760, this pattern reversed with a dramatic drop in New World and West African gold exports and an equally dramatic increase in New World silver exports (Attman 1986, pp. 20, 26, 30; Chaudhuri 1986, p. 72; Cross 1983, p. 405; Curtin 1983, p. 250; Flynn 1986, pp. 41-42; TePaske 1983, p. 442). Between 1721-1760 and 1761-1780, the ratio of the value of silver produced in all of Spanish America to that of gold produced in Brazil rose by 75%, from 0.64 to 1.12, respectively (derived from Attman 1986, pp. 21, 26). Specie use in

Pennsylvania, gold versus silver, reflected the pattern of relative availability in the larger Atlantic economy.

[Place Figure 1 Here]

The Seven Year's War also marked a turning point in the relative use of specie versus paper currency in Pennsylvania. Before the Seven Year's War, specie never exceeded 15% of total currency in circulation, reaching those peaks only in mid-war years. Between wars, specie returned to around 5% or less of total currency in circulation. Post-Seven Year's War, however, and in concurrence with the ascendance of silver over gold, specie skyrocketed from under 10% to almost 50% of total currency in circulation. Most of this rise was packed into the years 1770-1775 where specie rose from just under 20% to almost 50% of total currency in circulation. Given that paper currency per capita increased between 1771 and 1775, the post-1770 rise in the percentage of specie in total currency was not just the result of currency substitution, but represented an absolute rise--approximately 125%--in specie per capita (see Figure 2 below and Appendix Table A). This evidence is consistent with the opinion offer in 1780 by Pelatiah Webster (1969, p. 142) that "...not more than half, or at most three fifths, of the circulating cash in this State [Pennsylvania] was paper in 1774..."<sup>10</sup>

The evidence in Figure 1 showing a dramatic rise in the ratio of specie to paper currency after 1767 is also consistent with the evidence showing a relative lessening of the continental colonies' current-account trade deficit with England between the early 1750s and the early 1770s (Attman 1986, p. 70), which in turn is consistent with the evidence showing a 32% decline in England's per-year re-export of New World specie to the Old World between the 1760s and the first half of 1770s (derived from Attman 1986, p. 66). With relatively better terms of trade with England in the early 1770s, the specie the colonies imported from their trade surplus with Spanish America could linger longer in the colonial economy before being exported to cover the colonies' trade deficit with England. In conclusion, changes in the relative composition of specie, gold versus silver, and in the absolute amount of specie in circulation relative to paper currency in Pennsylvania over time are consistent with changes in the global markets for gold and silver and changes in the colony's terms of trade with England.



## WAS SPECIE SCARCE IN COLONIAL AMERICA?

As indicated in Figure 1, the relative scarcity of specie depends on the period of analysis. Therefore, some of the debate over whether specie was scarce in colonial America may simply reflect the use of evidence from different periods. For example, the primary first-hand literary sources used to claim that specie was scarce come from the period before the Seven Year's War (Brock 1975, pp. 86, 267, 386; Lester 1938), whereas the primary first-hand literary sources used to claim that specie was not scarce come from the very end of the colonial period (Michener 1987, p. 275; 1988, p. 687). Even by 1775, however, Figure 1 indicates that specie was still just under 50% of total currency in circulation, thus it is difficult to conclude that specie was not relatively scarce even on the eve of the Revolution. As such, some assessment of the evidence and arguments offered in the literature to support the claim that specie was not scarce, namely, that it was well over 50% of the money supply by the early 1770s, is required.<sup>11</sup>

The evidence against specie being scarce is both sparse and dubious. Michener (1988, p. 687), quoting a statement by Philip Mazzei (Marchione 1983, vol. 1, p. 325), argued that "Much of the prewar money supply consisted of specie. 'In 1773,' wrote one observer, 'all transactions were made almost entirely in specie.'" Michener quoted Mazzei out of context and mispunctuated the quotation. When put into context and correctly punctuated this evidence yields a conclusion that is the opposite of what Michener suggests and not inconsistent with the data presented in Figure 1 above. Mazzei was also not writing as an observer in 1773. The quotation above was taken from Mazzei's treatise on American finance written in Florence, Italy on January 1782, and enclosed in a letter to Thomas Jefferson.<sup>12</sup> Reading the passage in fuller context and correctly punctuated is instructive (Marchione 1983, vol. 1, pp. 325-26):

The extremely unfavorable trade the American States had with England...was responsible for their never having an abundance of specie (...).

Since for the above reason specie was often lacking, it had to be made up by bills of credit, that is, paper money. ...during the previous war [Seven Year's War] the American states ...had gone into debt for almost ten million pounds. As a consequence the paper money of the state of Massachusetts lost so much value that it lost up to 10/11 of its face value (...). But as the Americans had almost paid off the said debt before the Revolution, very little paper money had remained in circulation and had regained its full value. In 1773, the year disorders began,

that is, ten years after the end of the previous war, all transactions were made almost entirely in specie, which, however, did not abound.

...before communication between the two countries [England and America] was cut off [1776], America was left almost entirely without hard money [specie].

Similarly, the quantitative evidence offered by Michener (1987, p. 275) for the non-scarcity of specie is tenuous. Comparing the total amount of cash per capita in the middle colonies derived from probate inventory data reported by Jones (1980, p. 129) with the amount of paper currency per capita in New York and Pennsylvania derived from the sources reported here in Appendix Table A for the year 1774, Michener (1987, p. 275) concluded, "...over two thirds of the money supply must have been specie in New York and Pennsylvania in 1774."<sup>13</sup> Yet, Jones' (1980, p. 132) own assessment of the relative amount of specie in 1774 based on her data was that "...inventoried cash was largely in the form of current local money, in paper, of the particular province." This inconsistency, as well as the discrepancy between Michener's statement and the data presented here in Figure 1, can be reconciled by correcting the conversion factor used to transform Jones' data on average cash per probated wealthholder into the estimated average cash per capita. Michener (1987, p. 275) simply multiplied the average cash per wealthholder reported by Jones (1980, p. 129) by the percentage of wealthholders in the population (Jones 1980, p. 41) to get the average amount of cash per capita. However, the original data is not derived from all wealthholders, but only from probated wealthholders. The percentage of "probate-type" wealthholders in the population was smaller than the percentage of all wealthholders, 14.1% versus 22.4%, respectively (Jones 1980, p. 41). While a 25 year-old cottager with a cow was a wealthholder, he was unlikely to be a cashholder. If "probate-type" wealthholders were the primary cashholders, then to derive the average cash per capita, the average cash held per wealthholder should be multiplied by the percentage of "probate-type" wealthholders in the population rather than the percentage of all wealthholders in the population. This adjustment to Michener's calculation produces a division of total cash in 1774 into 49% specie and 51% paper money, which is almost identical to that reported in Figure 1 above for 1774.<sup>14</sup>

The theoretical argument offered to support the claim that specie was not scarce in colonial America is based on specie-market equilibrium, where "in the long-run, the world's supply of specie will automatically distribute itself among nations so that each will be in monetary equilibrium" (Redish 1984, pp. 713-14). If specie becomes scarce in one location, then the relative price of specie in that location will rise above the cost of transporting specie

to that location, and market arbitragers will move specie from where it is relatively plentiful to where it is relatively scarce until the scarcity is eliminated. This outcome, however, only holds in the long-run, and how long the long-run is in terms of time is unclear. In theory, the long-run is defined conceptually rather than in specific time units. It is the amount of time it takes the market to overcome information costs, transactions costs, asymmetric possession of information, unforecastable time-varying uncertainty and risk costs, and unforecastable relative price shocks which occurred continuously by unforecastably varying amounts. The question becomes not whether specie can be scarce, but how long will it take markets to overcome the costs and conditions maintaining that scarcity. In addition, the freight-space opportunity cost of shipping specie into the colonial economy has to be considered. That cost was the expected shipping profits gained from arbitrage in alternative goods markets, which could be substantial. The cost of specie market adjustments in the colonial world and the size and frequency of shocks to that market might have easily produced short-run specie scarcity that could have lasted for a considerable number of years. To assume instantaneous costless market adjustment and thus conclude that specie could never be scarce is naive economics. Until we know more about these market adjustment costs, theoretical arguments cannot prove, by themselves, that specie was not scarce in colonial America.<sup>15</sup>

Finally, why colonists complained of specie scarcity needs to be considered. In the absence of specie, trade and commerce still went on. Barter and merchant book credit were ubiquitous. Even for international trade, when specie was not available British merchants readily accepted goods in payment (Cheston-Galloway Papers). With regard to trade, a lack of specie created inconvenience, even stifled growth, but caused no general panic or crisis. When colonists complained that specie was scarce, it was more likely to be in reference to their inability to easily acquire enough specie to pay their colonial taxes (Bouton 1996). Colonial governments, such as Pennsylvania, would not accept trade goods, merchant book credit, etc. in payment of taxes. Only payment in specie or in that colonial government's bills of credit (paper money) were acceptable, the exception being colonies such as Maryland who accepted tobacco in payment of taxes before the mid-18th century. In addition, most quit rents in Pennsylvania, paid to the Lord Proprietors (the Penn Family) in England, had to be paid, by contracted grant, in sterling (specie). This created another market-adjustment cost specific to the colonial economy which, in addition to the general costs

mentioned above, may have helped maintain somewhat lengthy periods of "short-run" specie scarcity.

### **NOMINAL CURRENCY BALANCES PER CAPITA**

Figure 2 presents the total amount of currency per capita in Pennsylvania from 1729 through 1775, as well as its two subcomponents--specie per capita and paper currency per capita. Overall, total cash balances per capita did not remain constant in the short-run.<sup>16</sup> They declined more or less continuously from 1729 through 1754. This largely reflected the effect of population growth on a relatively constant stock of paper currency in the face of little addition to the money stock by specie (Appendix Table A). The Seven Year's War was a colossal monetary event mid-century. By mid-War, total cash balances were around 85% higher than in 1729 and 300% higher than in 1754. Increases in specie per capita and paper currency per capita both contributed to this rise, though the latter contributed the most. From mid-War to 1772, total cash balances per capita plummeted. All of this decline was the result of the effect of rising population on the declining stock of paper currency (Appendix Table A). By 1772, the amount of paper currency per capita was almost identical to what it had been in 1754. Specie per capita between mid-War and 1772 rose, though not enough to offset the fall in paper currency per capita. In 1772, total cash balances per capita had returned to where they had been in the early 1730s. Following the British credit crisis of 1772 (Sheridan 1960), total cash balances increased sharply through 1775, both as a result of increased paper currency per capita and increased specie per capita. The constant complaint by colonists of the shortage of money may have been, in part, the result of the rather lengthy periods of decline in total cash balances per capita, i.e., 1729-1754 and 1760-1772.

[Place Figure 2 Here]

The large changes in nominal cash balances per capita displayed in Figure 2 indicate that, given the relatively modest change in prices (Bezanson 1935), assuming constant money demand for the short-run in colonial America may not be tenable.<sup>17</sup> The evidence is also consistent with the likelihood that large, short-run, partially offsetting changes in the velocity of money ( $V$ ) occurred across the Seven Year's War. Paper currency was issued in concert with the passage of credible future taxes designed to redeem that money and remove it from circulation.

Large issues of these "tax anticipation" notes would result in a lowered  $V$  as subjects held increased cash balances in anticipation of having to pay the increased future taxes (Wicker 1985). If the Seven Year's War is removed from the data, the overall long-run trend in currency per capita is more constant. The likelihood of large short-run changes in  $V$ , which cannot be directly measured, implies that applications of the quantity theory of money to the colonial economy must be sensitive to periodization and cannot meaningfully be used to chart short-term cyclical amplitude in real output.

The data in Figure 2 can be used to assess whether Gresham's Law applies to colonial America, i.e., did paper money drive out specie? In other words, were paper and specie (perfect) substitutes (McCallum 1992; Michener 1987, 1988) or were they (perfect) complements (Hanson 1979; Lester 1938; Smith 1985a, 1985b)? The evidence in Figure 2 and Appendix Table A indicates that they were sometimes substitutes and sometimes complements. It depends on the period of analysis. One conclusion, however, is clear in the evidence. Paper and specie were never perfect substitutes or perfect complements. For example, Figure 2 shows that paper and specie co-vary positively (are complements) during the Seven Year's War and also after the 1772 British Credit Crisis, but co-vary negatively (are substitutes) between the Seven Year's War and the 1772 British Credit Crisis. Using the data in Appendix Table A, the correlation coefficient between paper and specie is +0.47 for the entire sample, 1729-1775 (complements), but it is -0.71 for the subperiod 1762-1772 (substitutes) and +0.51 for the combined subperiods of 1729-1761 and 1773-1775 (complements).<sup>18</sup> These findings indicate that the formulations of Gresham's Law and of currency-substitution theory in the literature on colonial American money are too simplistic. More sophisticated formulations are required to make sense of the empirical evidence.<sup>19</sup>

## **MONETARY ESTIMATES OF THE LONG-RUN GROWTH IN REAL OUTPUT PER CAPITA**

Measuring the growth of colonial economies has been difficult because little direct evidence on real aggregate output ( $Y$ ) exists. Thus, scholars who use the traditional approach to measuring economic growth, i.e., directly measuring changes in  $Y$  or  $GDP$  (gross domestic product or the value of all the goods and services sold in

the economy), have had to rely on a high ratio of assumptions about  $Y$  to actual data on  $Y$ , so much so that the resulting estimates of growth appear to many readers to have been assumed rather than estimated (Davis and Engerman 1999; Gallman 1999; McCusker 1999, 2000). A recent example of this approach is by Mancall and Weiss (1999). Prior examples include that by McCusker and Menard (1985, pp. 53-58), Robert Gallman (Davis, 1972, pp. 17-32), and George Rogers Taylor (1964). The average yearly rate of growth in  $Y$  per capita between 1710 and 1775 reported in these studies using this "brute force" approach range from an "almost imperceptible" 0.04% by Mancall and Weiss (1999, pp. 18, 36) to 0.48% by Gallman (Atack and Passell, 1994, p. 4) to between 0.3% and 0.6% by McCusker and Menard (1985, p. 55) to 1.18% by Taylor (Atack and Passell, 1994, p. 4). In almost all cases, these numbers are referred to as conjectures rather than estimates.

Several decades ago, historians devised an alternative measure based on the growth in probated inventory wealth. This method is still a direct approach in that it attempts to measure one of the components of  $Y$  in the national income accounting identity  $Y = C + I + G$  ( $C$  = consumption,  $I$  = investment,  $G$  = government spending), namely, the accumulated amount of net personal household savings which is assumed to approximately equal the net  $I$  in the economy. Given an assumed  $I/Y$  ratio, the growth in  $I$  can be used to track the growth in  $Y$  (Gallman 1999, McCusker 2000). Using this approach, Jones (1980, p. 78) found that average "end-of-life" wealth grew between 0.3% and 0.5% per year between 1700 and 1775. More recent studies applying this method to St. Mary's County, Maryland (Carr and Menard 1999, p. 120) and to New England (Main and Main 1999, p. 131) have found growth rates in wealth per living probate-type wealthholder to be approximately somewhere between 0.4 and 1.0% per year between 1700 and 1775.

This approach, however, still relies on a plethora of assumptions whose validity and impact have not been satisfactorily assessed. Besides the obvious issue of whether relatively small samples of surviving probated inventories are consistently representative over time of wealthholding in the whole economy, the problem of mapping end-of-life wealth per capita into contemporaneous measures of  $Y$  per capita, especially considering that most of the probated wealth consists of land claims of unclear productive value, has never been satisfactorily addressed. In other words, the approach assumes that the growth in a particular subset of  $I$  matches that of aggregate

$Y$  regardless of what might be going on with  $C$ ,  $G$ , or the non-measured subset of  $I$ .

An alternative approach will be offered here (Friedman 1961). The best continuous aggregate data we have for the colonial economy, besides population ( $Pop$ ), are not real values, but nominal values, i.e., the money stock ( $M$ ) and the price level ( $P$ ). Thus, while little direct evidence on  $Y$  exists, we can nevertheless estimate per capita growth in  $Y$  indirectly by using the quantity theory of money (equation [1]). Dividing equation [1] by  $Pop$  yields per capita values (equation [2]). Rearranging terms and expressing values in growth rates yields equation [3], which will be used to estimate the growth in per capita  $Y$ .

$$MV = PY \quad [1]$$

$$MV/Pop = PY/Pop \quad [2]$$

$$\text{Per Capita } \ln(Y) = \ln(M) - \ln(P) - \ln(Pop) + \ln(V) \quad [3]$$

Of the four components needed to indirectly estimate per capita growth in  $Y$ , we have high quality data on three,  $M$ ,  $P$ , and  $Pop$ , for Pennsylvania between 1729 and 1775. Estimating colonial economic growth through the quantity theory of money, therefore, relies on a much higher ratio of data to assumptions than the direct "brute force" method described above.<sup>20</sup> In addition, the quantity theory of money approach obviates the problem of how to deal with the introduction of new products and changes in the quality of old products over time, as well as the problem of measuring an adequate sample of the overwhelming plethora of goods in the economy, problems typically left unresolved in the direct "brute force" method. The key drawback of using the quantity theory of money is that  $V$  cannot be measured directly. This is a universal problem with the theory. In modern studies,  $V$  is taken as the residual after measuring  $M$ ,  $P$ , and  $Y$ . Because both  $Y$  and  $V$  are unknown here, the key to applying this method will involve assuming a plausible range of values for  $\ln(V)$ . In short, the quantity theory of money provides a way to estimate colonial economic growth that relies on different data, different assumptions, and a much higher ratio of data to assumptions than what has been done previously.

The quantity theory of money, as defined in equation [1], is an identity. Theoretically, it cannot not hold. It may fail to hold in application because of measurement or definitional error, but not because it is not true. In the literature on the colonial economy, when scholars have occasionally insinuated that the quantity theory fails to hold

and so is not true, they were making assumptions such as the growth in both  $Y$  and  $V$  were constants and then testing if  $b = 1$  in the equation  $[\ln(M) = a + b \cdot \ln(P)]$  over a short period of time. If  $b$  was not close to 1, for example, then they would claim that the quantity theory failed to be true (Smith 1985a, 1985b; West 1978). Because  $V$  cannot be directly measured and so must be assumed, applications of the quantity theory of money are really just tests of a particular assumption about  $V$ . For example, the debate between the "backing" theorists and the "quantity of money" theorists regarding colonial monetary performance (Calomiris 1988a, 1988b; McCallum 1992; Michener 1987, 1988; Smith 1985a, 1985b; Wicker 1985) is not a debate over the validity of equation [1] above, as some readers have assumed, but is really just a debate over assumptions about the short-run dynamics and determinants of  $V$  and/or the definition of money.<sup>21</sup> In fact, many debates in monetary economics can be boiled down to disagreements over assumptions about  $V$  both in terms of its short-run movement over the business-cycle and its long-run trend, e.g., compare the Fisher/Friedman formulation of the quantity theory with that of the Cambridge formulation. In short, the validity of the quantity theory of money is not questionable, but assumptions about  $V$  are.

As with measuring growth using the traditional method of directly measuring changes in  $Y$  or  $GDP$ , the quantity theory of money measures growth only in terms of changes in "marketed"  $Y$ . Thus, a pure substitution move from in-home production of candles and butter for one's own use to buying candles and butter at the local market will show up as growth in  $Y$ , whereas net physical productive activity may not have changed (though utility income will have been increased by this move).<sup>22</sup> Even today, our measure of  $GDP$  counts the increase in restaurant meals consumed as a net increase in  $GDP$  without considering that it may be a pure substitution of meals prepared at home for meals bought in the marketplace with no net change in physical productive activity. This must be kept in mind, because while the range for such pure substitutions may be relatively small today, it was not as small in the colonial economy. All growth rates estimated here, therefore, must be considered as growth in real "marketed" output only.

For colonial America, because the construction of a continuous measure of total  $M$  (specie plus paper currency) has only been done, so far, for Pennsylvania for the years 1729 through 1775, and because the data on  $P$  and  $Pop$  are relatively better for Pennsylvania than for many other colonies, the application of the quantity theory of money here to estimating the growth in per capita  $Y$  will be confined to that colony and time period. Yearly  $M$ ,  $P$ ,



and *Pop* are derived from the data constructed above, the price indices constructed by Bezanson (1935), and from *Historical Statistics* (1975, part 2, p. 1,168), respectively. Data construction details are described in Appendix Tables A and B. For a number of historical periods,  $V$  has been estimated to fall between 1 and 4 (Bordo and Jonung 1987, Friedman and Schwartz 1963, Riley and McCusker 1983).  $V$  will therefore be assumed to fall within this range here.

The key assumption in this application involves the behavior of  $V$ . The short-run movement in  $V$  may be too large, too varied, and too sensitive to expectations about how money is backed and to the unit of time measured to make meaningful assumptions for the purposes of equation [3] calculations for short-run or cyclical movements in  $Y$ . For example,  $V$  per hour is markedly different between 1am-2am and noon-1pm. Likewise,  $V$  per day and  $V$  per month will be markedly different between Saturday and Sunday and between February and September, respectively, in a religious society that is predominantly agricultural, such as the colonial economy. Even from year to year,  $V$  may have experienced substantial short-run variation in the colonial economy due to wars and the tax structure of paper currency issuance and redemption (Calomiris 1988a, Grubb 2001, Wicker 1985). Because these potential short-run movements in  $V$  are difficult to ascertain, the focus here will be on estimating the long-run trend in  $Y$  rather than on measuring the short-run cyclical amplitude in  $Y$ . As such, the cyclical amplitude in  $Y$  displayed in Figure 3 below should be ignored (see also McCallum 1992, p. 157).

Estimates of the trend growth in per capita  $Y$  using four assumptions about the long-run trend in  $V$  are presented in Table 2, Figure 3, and Appendix Table B. The first estimate assumes that  $V$  is a long-run constant, e.g., equal to 1 throughout. The last three estimates assume that  $V$  grew at a constant rate of 0.88%, 1.72%, and 2.56% per year, e.g., growing from 1 to 1.5, 2.2, and 3.25 between 1729 and 1775, respectively. These three rates were chosen because they equaled one-quarter, one-half, and three-quarters of the average yearly growth rate of Philadelphia's population in this period (Appendix Table A). The assumption that  $V$  grew over time comes from the evidence of substantial declines in the proportion of bound labor in the population and substantial growth in commercialization and population density, especially in eastern Pennsylvania, during this period (Clemens 1980, Jensen 1986, Lemon 1972, Main and Main 1999, Salinger 1987, Schweitzer 1987, Shammass 1990, Smith 1990, Steffen 1993, Tomlins

2001, Walsh 1999). By the end of the period Philadelphia was the second largest English-speaking city on the planet, and the consumer/commercial revolution increasingly shifted self-use in-home production and local barter or book credit transactions towards arm's-length market transactions. The colonial economy, unlike the post-colonial economy, also had no banks, no convenient interest-rate sensitive financial instruments, or near-currency substitutes to increase the demand for cash holding, soak up cash stores, and so cause long-run  $V$  to decline (Bordo and Jonung 1987, Friedman and Schwartz 1963). Finally, only assumptions about the long-run rate of change in  $V$ , rather than about the absolute level of  $V$ , are required to estimate the long-run rate of growth in  $Y$ . Thus, for convenience of calculation,  $V$  will be assumed to start at a value of 1 in 1729 for all estimations.<sup>23</sup>

[Place Table 2 and Figure 3 Here]

Table 2 estimates the long-run per capita growth in  $Y$  using three different methods; each method reports the results for the four different assumptions about the long-run growth in  $V$ .<sup>24</sup> The first method calculates the average-yearly-growth rate needed to connect the end points of the sample. The second method calculates the average-yearly-growth rate as the *OLS* regression trend line. The third method divided the sample into two portions, calculates the average values for the two subperiods, and then calculates the yearly growth rate needed to connect these two averages. In addition, each method is calculated for slightly different periods to test how sensitive the results are to the choice of sample end points and to how the Seven Year's War is treated. Figure 3 plots the yearly values of per capita  $\ln(Y)$  for the four different assumptions about the long-run growth in  $V$ . While Figure 3 illustrates the cyclical pattern in per capita  $\ln(Y)$ , little stock should be put in the exact amplitude of these cycles because short-run movements in  $V$  most likely dampened, though not reversed, cycle amplitude. Both Table 2 and Figure 3 show that long-run per capita growth in  $Y$  depends on two key issues: the period of analysis and the long-run growth in  $V$ . They also show that the Seven Year's War is a colossal mid-century disruption to nominal values whose treatment can affect estimates of long-run per capita growth.

Estimates of the long-run per capita growth rate in  $Y$  are sensitive to the selection of sample periods. Figure 3 shows that with judicious selection of particular subperiods, one can show that the long-run per capita growth rate in  $Y$  was negative, e.g., 1729 to 1754 or 1759 to 1772, or that it was positive, e.g., 1729 to 1775, 1740s to the 1760s,

or 1770 to 1775. Table 3 shows that altering periodization by only one year, i.e., from 1730-1775 to 1729-1774, can change the estimated long-run growth rate in per capita  $Y$  by between 0.2 and 1.0 percentage points. Likewise, the period in which the Seven Year's War is placed, or removing the Seven Year's War from the sample altogether, can change the estimated long-run growth rate in per capita  $Y$  by over 1 percentage point. Periodization is everything. Debates over whether growth was likely in colonial America that do not take into account periodization are largely meaningless.

Table 2 and Figure 3 also show that long-run growth in per capita  $Y$  depends on the extent to which rising commercialization and population density increased  $V$ . Even a moderate rise in  $V$  over the sample period would increase the estimated long-run growth rate per year in per capita  $Y$  by 0.9 to 2.5 percentage points, yielding growth rates in the 1 to 2.5% range. Compared with the growth rates estimated for the 19th-century U.S. (Atack and Passell 1994, p. 11), such high growth rates in the colonial period may seem preposterous, until it is remembered that in all cases what is being estimated is not the growth in total  $Y$ , but the growth only in "marketed"  $Y$ . Once this is noted, then such high growth rates in the colonial period becomes more plausible because these high growth rates may represent a substitution of marketed exchange for non-marketed in-home production and/or bartered transactions.

So what might be the best guess for the long-run per capita growth rate in  $Y$ ? My conservative choice would rely on using the end points of the sample (1729 and 1775) because they are both the farthest apart and closest to typical years, and would rely on the assumption that the long-run growth in  $V$  is either zero or very modest (columns 1 and 2 in Table 2).<sup>25</sup> It would also rely on using estimation methods *I* and/or *III* in Table 2, rather than method *II*, because regression trend estimates are overly sensitive to outlying values and, as discussed above, the cyclical amplitude in estimated  $\ln(Y)$  is most likely biased high. The average values of this conservative growth rate in per capita  $Y$  falls very close to the rates offered by Gallman (Atack and Passell, 1994, p. 4), McCusker and Menard (1985, p. 55), McCusker (2000, p. 156), Jones (1980, p. 78), and, in its upper range of values, to those offered by Main and Main (1999, p. 131) and Carr and Menard (1999, p. 100). It is far above the rate of 0.04% offered by Mancall and Weiss (1999, pp. 18, 36). Given that totally different data, methods, and assumptions were employed here, compared with that used by these other authors, the concurrence of my conservative estimate with those of

Gallman, McCusker and Menard, McCusker, Jones, Carr and Menard, and Main and Main is noteworthy.

Pointing out that we are measuring the growth in "marketed"  $Y$  only, I would not, however, consider the growth rates in the 1.5 to 2.5% range (columns 2 and 3 in Table 2) unlikely. This choice is also relatively closer to the estimate of 1.18% offered by Taylor (Atack and Passell, 1994, p. 4) and to the higher estimates in Carr and Menard (1999, p. 100). In any case, the low growth rate of 0.04% recently offered by Mancall and Weiss (1999) can only be made consistent with the findings presented here under very particular periodizations, or under the assumption that  $V$  is declining, or under the assumption that  $V$  is constant and the proper method for estimating growth is a regression trend line.<sup>26</sup> At least for colonial Pennsylvania, growth seems more likely than not.

## CONCLUSIONS

Incorporating quantitative micro-market data into macroeconomic analysis holds the promise of substantially improving our knowledge of aggregate economic behavior in colonial America. It has the potential of refreshing old debates, and maybe even answering questions long thought unanswerable. Briefly, the micro-market data used here for Pennsylvania between 1729 and 1775 indicate that, as a circulating medium of exchange among the general populous, specie was relatively scarce, though it was becoming rapidly less so from 1772 through 1775, that the composition of the specie in use shifted from being almost exclusively gold pistoles prior to 1761 to being almost exclusively silver dollars after 1762, and that the movements in the magnitudes of specie and paper money were in some years complements and in other years substitutes. The data also indicate that paper money did not freely circulate as a medium of exchange outside of the colony of issuance. Finally, when used in the quantity theory of money equation, the data indicate that growth in real output per capita was likely, but its magnitude depends on periodization and the extent to which rising commercialization increased the velocity of circulation, and that, under the assumption that long-run  $\ln(V)$  was zero, the long-run growth in real money balances equaled the population growth rate. The surface has only been scratched with regard to the potential of this approach for re-assessing colonial economic history. Scholars are encouraged to explore micro-market data sets in other colonies with an eye

towards fulfilling this potential. For example, along the lines explored here, the use of micro-market data may be especially useful for estimating the long-run growth in real output via the quantity theory of money for colonies which already have good data on prices and the amount of paper money in circulation, such as South Carolina (Brock 1975, pp. 460-01; Cole 1938, pp. 155-6).

[Place Appendix Tables A and B Here]

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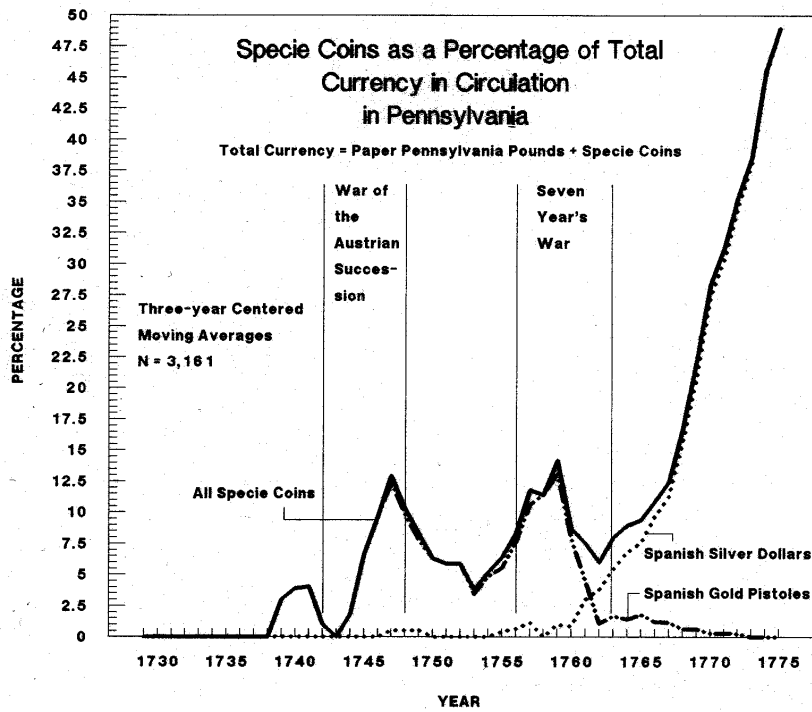
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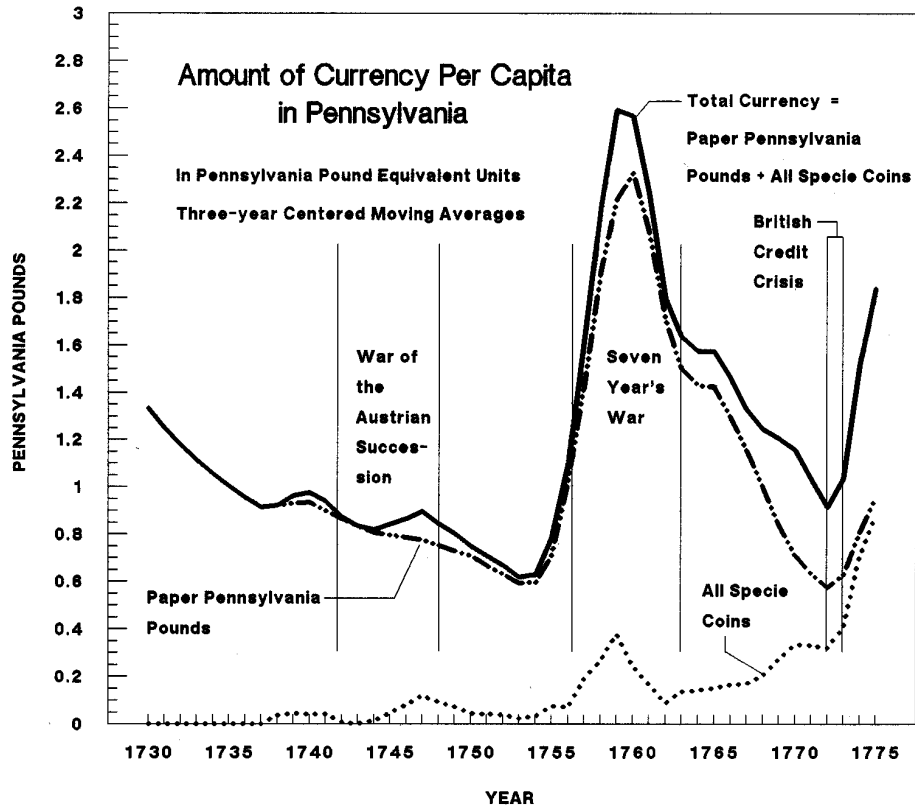
**FIGURE 1. Specie Coins as a Percentage of Total Currency in Circulation: Pennsylvania, 1729-1775**

Sources: Derived from the data in Appendix Table 1.



**FIGURE 2. Nominal Currency Balances Per Capita, Pennsylvania, 1729-1775**

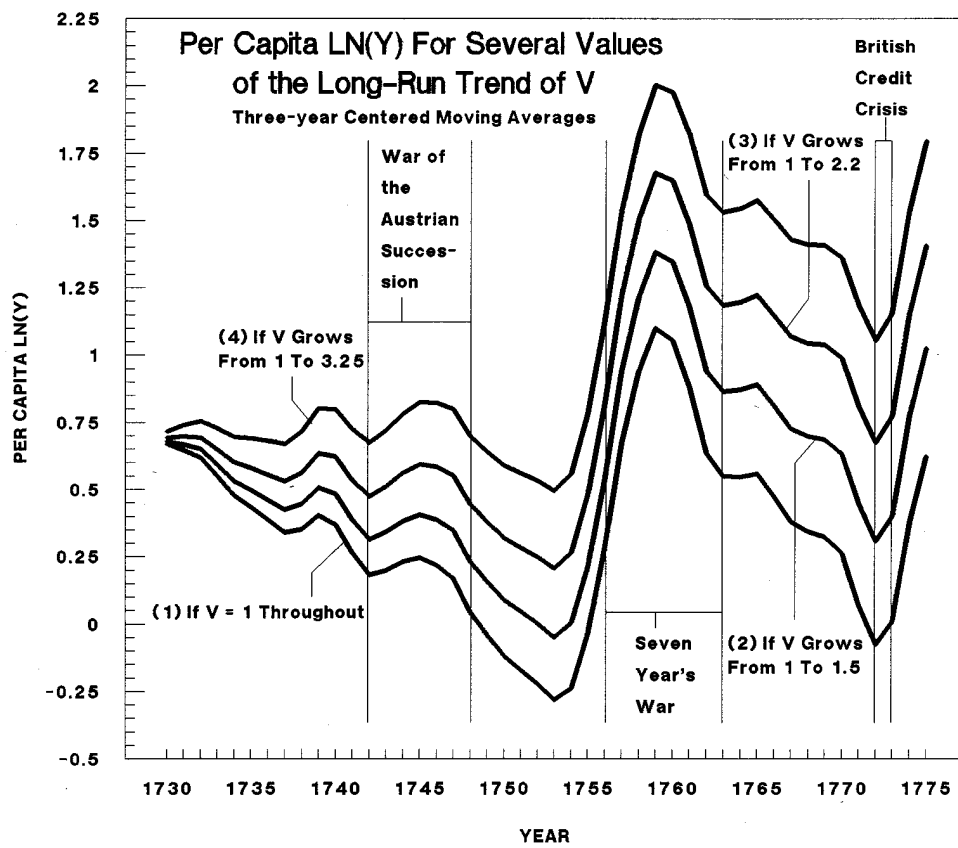
Sources: Derived from the data in Appendix Table A.



**FIGURE 3. LN(Y) Per Capita, Pennsylvania, 1729-1775**

Notes: Lines (1) through (4) correspond to estimates of Ln(Y) in Appendix Table B, where Y equals real marketed output per year, and V equals the velocity of currency circulation per year.

Sources: Derived from the data in Appendix Table B.



**TABLE 1. Percentage of Different Currencies Offered as Rewards for the Capture of Runaway Servants in the *Pennsylvania Gazette*, 1729-1775**

Type of Currency	By Philadelphia Residents Only <i>N</i> = 814	By All Pennsylvania Residents Only <i>N</i> = 3,024	By All North American Residents <i>N</i> = 5,371
<b>Paper Currencies:</b>			
Pounds [unspecified] <sup>a</sup>	83.1%	83.3%	80.5%
Pounds "of the currency where taken"	0.0	0.1	0.5
"Pennsylvania" Pounds	0.1	0.4	0.7
"Maryland" Pounds	0.0	0.0	0.6
"Virginia" Pounds	0.0	0.0	0.1
"New Jersey" Pounds	0.0	0.0	0.0 <sup>b</sup>
<b>Specie Currencies:</b>			
Silver Dollars (Spanish Pesos)	13.0	13.0	12.0
Gold Pistoles (Spanish Doblons)	3.4	3.0	5.3
Pounds "Sterling" (or silver shillings)	0.1	0.0 <sup>c</sup>	0.1
Gold Guineas (English)	0.1	0.1	0.1
Silver Crowns (English)	0.0	0.0 <sup>c</sup>	0.0 <sup>c</sup>
Groots (Dutch)	0.0	0.0 <sup>c</sup>	0.0 <sup>c</sup>
Coppers	0.1	0.0 <sup>c</sup>	0.0 <sup>c</sup>

<sup>a</sup> By practice, convention, and colonial law, unless the modifier "sterling" was explicitly used, the term "pounds" was taken to refer to pounds of local paper currency.

<sup>b</sup> Only two observations were recorded in this category cell.

<sup>c</sup> Only one observation was recorded in these category cells.

*Notes:* Only advertisements where a monetary reward was offered are included. Only 40 advertisements were so dropped from the full sample, either because they had no monetary reward or offered a non-monetary reward.  
*Source:* *Pennsylvania Gazette*.

**TABLE 2. Average Yearly Growth Rate in Marketed Output Per Capita: Pennsylvania, 1729-1775**

Given Several Values of the Long-Run Trend in $V$ :	(1)	(2)	(3)	(4)
<b>I. Sample Beginning Point to Sample End Point:</b>				
1729-1775	+0.30%	+1.18%	+2.02%	+2.86%
1730-1775	+0.46%	+1.34%	+2.15%	+2.97%
1729-1774	-0.65%	+0.24%	+1.08%	+1.94%
<b>II. Regression Trend Line Estimation:</b>				
1729-1775	-0.10%	+0.78% <sup>*</sup>	+1.58% <sup>*</sup>	+2.36% <sup>*</sup>
1730-1775	-0.01%	+0.87% <sup>*</sup>	+1.66% <sup>*</sup>	+2.41% <sup>*</sup>
1729-1774	-0.25%	+0.64% <sup>+</sup>	+1.45% <sup>*</sup>	+2.23% <sup>*</sup>
1729-1755 & 1764-1775 (Seven Year's War Data Dropped)	-0.47%	+0.39%	+1.18% <sup>*</sup>	+1.95% <sup>*</sup>
<b>III. Sample Division Estimation (the Sample Divided at the Seven Year's War):</b>				
1729-1755 versus 1756-1775	+1.20%	+2.07%	+2.84%	+3.56%
1729-1763 versus 1764-1775	-0.08%	+0.77%	+1.50%	+2.16%
1729-1755 versus 1764-1775 (Seven Year's War Data Dropped)	+0.39%	+1.24%	+1.99%	+2.67%

\* Statistically different from zero above the 0.10 level (in reference to method **II.** only).

<sup>+</sup> Statistically different from zero above the 0.12 level (in reference to method **II.** only).

*Notes:* The four columns [(1) through (4)] represent different estimates of  $\ln(Y)$  contingent on the assumed long-run trend in  $V$  (velocity), see Appendix Table B. Estimate **I.** calculates the constant growth rate needed to get from the beginning observation to the ending observation in the sample. Estimate **II.** reports the coefficient on the variable 'time' in the equation  $[\ln(Y) = \text{constant} + \text{time}]$  in percentage growth rate terms. 'Time' is coded in integer increments from zero for the first sample year through  $n$  for the last sample year. Estimate **III.** divides the sample into two, calculates the average  $\ln(Y)$  in each respective portion, subtracts the first average from the second average, and then divides by the number of years separating the average year in each sample half.

*Source:* Appendix Table B.

## APPENDIX

**TABLE A. The Amount of Currency in Circulation in Pennsylvania, 1729-1775**

Year	Outstanding Pennsylvania Paper Pounds	Ratio of Specie to Paper	Implied Total Specie	Total Currency in Circulation (Paper + Specie)	Pennsylvania Population	Philadelphia's Population
1729	68,890	0/11	0	68,890	49,632	6,855
1730	68,890	0/36	0	68,890	51,707	7,075
1731	68,890	0/20	0	68,890	55,100	7,294
1732	68,890	0/19	0	68,890	58,493	7,514
1733	68,890	0/14	0	68,890	61,886	7,867
1734	68,890	0/15	0	68,890	65,279	8,220
1735	68,890	0/6	0	68,890	68,672	8,573
1736	68,890	0/11	0	68,890	72,065	8,926
1737	68,890	0/25	0	68,890	75,458	9,279
1738	68,890	0/34	0	68,890	78,851	9,631
1739	80,000	0/35	0	80,000	82,244	9,874
1740	80,000	3/28	8,571	88,571	85,637	10,117
1741	80,000	1/35	2,286	82,286	89,040	10,360
1742	80,000	0/32	0	80,000	92,443	10,755
1743	80,000	0/35	0	80,000	95,846	11,150
1744	80,000	0/29	0	80,000	99,249	11,545
1745	80,000	2/42	3,810	83,810	102,652	11,940
1746	85,000	7/56	10,625	95,625	106,055	12,336
1747	85,000	8/61	11,148	96,148	109,458	12,731
1748	85,000	9/45	17,000	102,000	112,861	13,126
1749	85,000	2/59	2,881	87,881	116,264	13,521
1750	84,500	5/73	5,788	90,288	119,666	12,736
1751	84,000	8/92	7,304	91,304	126,070	13,237
1752	83,500	3/92	2,723	86,223	132,474	13,884
1753	82,500	6/89	5,562	88,062	138,878	14,563
1754	81,500	2/99	1,646	83,146	145,282	15,084
1755	96,000	7/87	7,724	103,724	151,686	15,623
1756	147,510	6/35	25,287	172,797	158,090	16,182
1757	247,013	0/22	0	247,013	164,494	16,790
1758	312,859	4/18	69,524	382,383	170,897	17,422
1759	422,911	5/30	70,485	493,396	177,300	18,076
1760	446,158	5/37	60,292	506,450	183,703	18,756
1761	408,972	0/38	0	408,972	189,338	19,701
1762	320,676	5/48	33,404	354,080	194,973	20,694
1763	264,460	6/86	18,451	282,911	200,608	21,737
1764	316,082	8/86	29,403	345,485	206,243	22,832
1765	305,095	11/82	40,927	346,022	211,878	23,982
1766	281,431	12/131	25,780	307,211	217,513	25,191
1767	258,420	13/82	40,969	299,389	223,149	26,460
1768	233,934	17/83	47,914	281,848	228,785	27,240
1769	220,911	23/100	50,810	271,721	234,421	28,042
1770	201,173	31/66	94,490	295,663	240,057	28,802

1771	171,871	40/71	96,829	268,700	248,782	29,582
1772	149,115	32/89	53,614	202,729	257,507	30,384
1773	135,006	64/89	97,083	232,089	266,232	32,073
1774	217,633	68/83	178,302	395,935	274,957	33,856
1775	318,613	77/78	314,528	633,141	283,682	33,290

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*Notes:* The value of all currency totals are expressed in Pennsylvania pound equivalents. For population estimates, linear interpolation between the decadal data points are used for Pennsylvania, and between 1732 and 1738 data points for Philadelphia. The *Implied Total Specie* = [(Ratio of Specie to Paper) \* (Outstanding Pennsylvania Paper Pounds)].

*Sources:* The data on outstanding Pennsylvania pounds are taken from Brock (1975, pp. 82-83, 386-87; 1992, p. 113); on the ratio of paper to specie from the currency denomination frequency of all rewards offered in the *Pennsylvania Gazette* by Pennsylvania residents for the capture of their runaway servants, apprentices, and convicts; on the Pennsylvania population from *Historical Statistics* (1975, part 2, p. 1,168); and on Philadelphia's population for 1729 through 1749 from Smith (1977, p. 871), and for 1750 through 1775 from Smith (1990, p. 206).



**TABLE B. Growth in Marketed Output Implied by the Quantity Theory of Money for PA, 1729-1775**

Year	$\ln(M)$	$-\ln(P)$	$-\ln(Pop)$	$+\ln(V)$	Per Capita $\ln(Y)$ [For Several Values of the Long-Run Trend of $V$ ]				
						(1)	(2)	(3)	(4)
1729	11.1403	-0.3707	10.8124	?	=	0.6986	0.6986	0.6986	0.6986
1730	11.1403	-0.3439	10.8533			0.6309	0.6417	0.6567	0.6786
1731	11.1403	-0.4526	10.9169			0.6760	0.6976	0.7269	0.7693
1732	11.1403	-0.4692	10.9767			0.6328	0.6650	0.7082	0.7697
1733	11.1403	-0.4396	11.0330			0.5469	0.5896	0.6462	0.7255
1734	11.1403	-0.4140	11.0864			0.4679	0.5210	0.5906	0.6866
1735	11.1403	-0.4140	11.1371			0.4172	0.4806	0.5627	0.6745
1736	11.1403	-0.4625	11.1853			0.4175	0.4910	0.5853	0.7119
1737	11.1403	-0.4172	11.2313			0.3262	0.4098	0.5158	0.6564
1738	11.1403	-0.4119	11.2753			0.2769	0.3705	0.4879	0.6416
1739	11.2898	-0.4804	11.3174			0.4528	0.5563	0.6847	0.8509
1740	11.3916	-0.4459	11.3579			0.4796	0.5928	0.7320	0.9100
1741	11.3180	-0.2538	11.3968			0.1750	0.2979	0.4475	0.6367
1742	11.2898	-0.2811	11.4343			0.1366	0.2691	0.4287	0.6287
1743	11.2898	-0.4161	11.4705			0.2354	0.3774	0.5468	0.7569
1744	11.2898	-0.4439	11.5054			0.2283	0.3797	0.5587	0.7784
1745	11.3363	-0.4353	11.5391			0.2325	0.3933	0.5815	0.8105
1746	11.4682	-0.3809	11.5717			0.2774	0.4474	0.6446	0.8824
1747	11.4736	-0.2719	11.6033			0.1422	0.3213	0.5273	0.7736
1748	11.5327	-0.1829	11.6339			0.0817	0.2699	0.4844	0.7388
1749	11.3837	-0.1779	11.6636			-0.1020	0.0952	0.3180	0.5801
1750	11.4108	-0.1804	11.6925			-0.1013	0.1048	0.3357	0.6052
1751	11.4219	-0.1737	11.7446			-0.1490	0.0660	0.3047	0.5813
1752	11.3647	-0.1721	11.7941			-0.2573	-0.0336	0.2129	0.4963
1753	11.3858	-0.1980	11.8414			-0.2576	-0.0252	0.2288	0.5188
1754	11.3284	-0.2282	11.8864			-0.3298	-0.0888	0.1725	0.4688
1755	11.5495	-0.2520	11.9296			-0.1281	0.1214	0.3899	0.6923
1756	12.0599	-0.2520	11.9709			0.3410	0.5990	0.8744	1.1827
1757	12.4172	-0.2449	12.0106			0.6515	0.9179	1.2001	1.5141
1758	12.8542	-0.2195	12.0488			1.0249	1.2996	1.5885	1.9079
1759	13.1091	-0.1205	12.0856			1.1440	1.4269	1.7223	2.0470
1760	13.1352	-0.1143	12.1211			1.1284	1.4195	1.7212	2.0510
1761	12.9214	-0.1213	12.1513			0.8914	1.1906	1.4986	1.8333
1762	12.7773	-0.0255	12.1806			0.6222	0.9295	1.2435	1.5830
1763	12.5529	-0.0442	12.2091			0.3880	0.7032	1.0232	1.3673
1764	12.7527	-0.1245	12.2368			0.6404	0.9636	1.2893	1.6379
1765	12.7543	-0.1245	12.2638			0.6150	0.9460	1.2775	1.6304
1766	12.6353	-0.0768	12.2900			0.4221	0.7609	1.0979	1.4550
1767	12.6095	-0.0813	12.3156			0.3752	0.7218	1.0642	1.4254
1768	12.5491	-0.1316	12.3405			0.3402	0.6944	1.0423	1.4074
1769	12.5125	-0.1630	12.3649			0.3106	0.6731	1.0255	1.3944
1770	12.5970	-0.1127	12.3886			0.3211	0.6905	1.0487	1.4213
1771	12.5014	-0.0760	12.4243			0.1531	0.5300	0.8932	1.2695
1772	12.2196	0.0239	12.4588			-0.2631	0.1213	0.4894	0.8692
1773	12.3549	-0.0156	12.4921			-0.1216	0.2702	0.6431	1.0263

1774	12.8890	-0.0428	12.5244	0.4074	0.8065	1.1842	1.5707
1775	13.3584	-0.0344	12.5556	0.8372	1.2436	1.6259	2.0157

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- (1) Given that the long-run trend of  $V$  is a constant, i.e.,  $V = 1$  throughout.
- (2) Given that long-run trend of  $V$  increases at a constant 0.88 percent per year, i.e.,  $V$  increases from 1 in 1729 to 1.5 by 1775 at a constant 0.0109 increase per year. This rate of growth was selected because it equals one-quarter of the average yearly growth rate of Philadelphia's population from 1729 to 1775, see Appendix Table A.
- (3) Given that long-run trend of  $V$  increases at a constant 1.72 percent per year, i.e.,  $V$  increases from 1 in 1729 to 2.2 by 1775 at a constant 0.0261 increase per year. This rate of growth was selected because it equals one-half of the average yearly growth rate of Philadelphia's population from 1729 to 1775, see Appendix Table A.
- (4) Given that long-run trend of  $V$  increases at a constant 2.56 percent per year, i.e.,  $V$  increases from 1 in 1729 to 3.25 by 1775 at a constant 0.0489 increase per year. This rate of growth was selected because it equals three-quarters of the average yearly growth rate of Philadelphia's population from 1729 to 1775, see Appendix Table A.

*Notes and Sources:*  $M$  is the outstanding quantity of money in circulation in Pennsylvania pounds estimated in Appendix Table A (paper plus specie).  $P$  is the average current price of output in Pennsylvania pounds based on the 20 commodity unweighted arithmetic price index for Philadelphia [base year equal to 1741-45] reported in Benzanson, et al. (1935, pp. 429, 433). This price index is converted to the average current output price by multiplying the index number by the summation of the 20 commodity prices for the base year, dividing this number by 100, dividing this number by 20 (the number of commodities), and then dividing this number by 20 (to convert shillings to pounds).  $Y$  is marketed output and  $V$  is velocity of currency circulation.  $Pop$  is the Pennsylvania population and is taken from Appendix Table A.

## Footnotes

1. This disagreement, as well as that over whether specie was scarce and whether specie and paper money were substitutes, is part of the general debate between the "backing" (Calomiris 1988a, 1988b; Smith 1985a, 1985b; Wicker 1985) and the "quantity" (McCallum 1992; Michener 1987, 1988) monetary theorists working in colonial history. The backing theorists argue that the value of paper money and the relationship between changes in the quantity of paper money and changes in prices depend on how the paper money is backed and redeemed by future taxes. If credibly backed, then large changes in the quantity of paper money may have little effect on changes in prices. Conversely, the quantity theorists assert that a fixed exchange rate with costless transactions exists between paper money and specie, making paper money and specie perfect substitutes. How this rate is maintained is not well explained. Perhaps custom or a conspiracy of myopic merchant-arbitraders maintained it. In any case, being perfect substitutes, changes in the quantity of paper money in a colony would be perfectly offset by opposite flows of specie in and out of that colony, resulting in a constant money supply. Thus, large changes in the quantity of paper money would have little effect on changing prices, because offsetting changes in specie kept the total money supply constant. Only when the amount of paper money had finally driven all the specie out of the colony would further changes in the quantity of paper money have a direct positive effect on changes in prices. The quantity theorists assert that their interpretation saves the classical quantity theory of money from being proved untrue by the backing theorists. What is not mentioned is that if the quantity theorists position is true and if specie has yet to be completely driven out of circulation by issuances of paper money, then the quantity theory of money is useless for colony-specific or even regionally-specific analysis.

Surprisingly, the modern protagonists in this debate have added little new or original to the arguments that were prevalent and well articulated among the colonists themselves (for just a few of the many examples, see *Archives of State of New Jersey*, 1st series, vol. 5, pp. 120-22, 156-57; Davis 1964, vol. 4, 377-405; Marchione 1983, pp. 325-30; various editorials on money in the *Maryland Gazette* between 1780 and 1782 and in the *Pennsylvania Gazette* between 1739 and 1760; Webster 1969, pp. 139-61). Contrary to what many readers think, the main contributions of the modern protagonists in this debate are not theoretical but applied, namely, efforts to test their respective theoretic positions with low-tech analysis of the quantitative data gathered many years ago by other scholars.

2. Currency, or the total money supply, is defined here the way that the colonists themselves defined it, namely, currency was whatever their colonial government would accept in payment of the colony's taxes. For the period under consideration, Pennsylvania accepted specie coins and the colony's own paper money (Pennsylvania pounds). You could not pay Pennsylvania taxes with book or store credit, with barter goods, or with the paper money of some other colony (Bouton 1996). Because there were no banks, there were no demand and time deposits, nor was there bank vault cash. Thus, money becomes currency only, i.e., specie and the colony's paper bills of credit. See Friedman (1961, pp. 271-73). When Pennsylvanians used the word "current" when referring to prices they always meant prices in Pennsylvania pounds (Bezanson 1935, pp. 7-8).

3. Unfortunately, the data in Grubb (1992) contain a small number of transcription errors on the reward variable which the author failed to catch before publication. Scholars who wish to use this data should contact the author directly for a corrected computerized version. The first complete surviving year of publication of the *Pennsylvania Gazette* was 1729. Between 1729 and 1775, the paper was issued weekly, with very few issues missing. The paper also circulated widely throughout the middle colonies and was the main outlet for advertising runaway servants. Only original advertisements are used. Repeat advertisements for the same act of escape were excluded (see Grubb 1999).

4. Among Pennsylvania residents advertising between 1739 and 1761, the average and standard deviation extra-cash reward in advertisements specifying a reward in Pennsylvania pounds was 2.31 and 1.15, respectively. For the same period, the average and standard deviation extra-cash reward in advertisements specifying a reward in pistoles was 2.73 and 1.48, respectively. Among Pennsylvania residents advertising between 1762 and 1775, the average and

standard deviation extra-cash reward in advertisements specifying a reward in Pennsylvania pounds was 2.56 and 1.50, respectively. For the same period, the average and standard deviation extra-cash reward in advertisements specifying a reward in dollars was 6.08 and 4.05, respectively. See Figure 1 below for justification of the choice of sample periodization. Using the exchange rates between pound sterling and pistoles, dollars, and Pennsylvania pounds, respectively, reported in McCusker (1978, pp. 10-11, 185-86), the implied value of one Pennsylvania pound was 0.72 pistoles and 2.74 dollars in the two periods, respectively. After using these exchange rates to convert Pennsylvania pounds to pistoles and dollars, the averages between rewards offered in pistoles versus Pennsylvania pounds in 1739-1761 and in dollars versus Pennsylvania pounds in 1762-1775 are statistically different above the 0.01 significance level. Statistical significance, however, is merely a function of the large sample sizes here. Given that over two-thirds of the sample distributions overlap in both comparisons, and given the crude approximation nature of the exchange rate data, the difference in rewards offered in specie versus in Pennsylvania pounds would appear to be economically insignificant. At best, rewards offered in specie may have been slightly larger in exchange-rate-equivalent value than rewards offered in Pennsylvania pounds. This difference is consistent with the observation that rewards in specie were more likely to be offered on runaways thought to have fled the province. The increased cost of recovering a runaway captured in a distant province, along with the fact that the person who captured the runaway would be reluctant to take out-of-province paper currency, would simultaneously increase the likelihood that the reward offered on such a runaway would be both slightly larger in value and denominated in specie.

5. See footnote 7.

6. For example, Thomas White, a dry-goods merchant in Philadelphia, when advertising his goods for sale in the *Pennsylvania Gazette*, May 24, 1750, also noted that "He exchanges Pennsylvania money for Maryland money."

7. Context is everything. Before Pennsylvania issued bills of credit (paper money) in 1723, "pounds" meant pounds in colonial pounds sterling equivalents (Bezanson 1935, pp. 7-8) which was a specie accounting unit and not an actual coin. After 1723, "pounds" without some qualifier like "sterling" always referred to what was "current" which were Pennsylvania paper pounds. Just like today in Delaware, if I say "dollars" everyone here knows I mean U.S. dollars and not Canadian dollars. The qualifier "U.S." is never used because it is understood. In Delaware, I would have to explicitly use the qualifier "Canadian" if I were referring to those non-U.S. dollars. The exact opposite holds if I were in Edmonton, Alberta.

By contrast, the alternative interpretation would be to assert that colonists, who used language very precisely in other commercial matters (Grubb 1998), were exceptionally vague with regard to statements about money and prices. Namely, it would be to assert that when colonists said "10 pounds" they meant either 10 pounds sterling, or 10 pounds Pennsylvania paper currency, or 10 pounds Maryland paper currency, or 10 pounds Virginia paper currency, or 10 pounds New York paper currency, or 10 pounds Pennsylvania colonial units of account, or some random combination of said, and so forth, with no one knowing exactly which currency was meant by the statement. These "pound" currencies differed in value. For example, in 1769 10 pounds sterling equalled 15.8, 16.1, 12.2, 17.2, and 16.7 pounds in the other currencies listed above, respectively (McCusker 1978, pp. 165, 177, 186, 199, 211). This alternative interpretation of what "pounds" mean would also make the data on colonial prices and price indices (e.g., Bezanson 1935, Cole 1938) useless.

8. McCusker (1978, pp. 195-96) also reports examples where the exchange between residents of Virginia, Maryland, and Pennsylvania entailed exchange-rate equivalent conversion of non-specie monies across colonies rather than the free circulation of out-of-colony paper money.

9. By contrast, citing McCusker (1978, p. 193), Michener (1987, p. 236) claimed that "...for many years in the mid-18th century, the primary medium of exchange in Maryland was Pennsylvania currency." See also Michener (1987,

p. 244). Yet the evidence in McCusker (1978, p. 193), which Michener cites as his principle original source in support of his claim, consists of a single quotation--a statement by an Eastern shore tobacco merchant, who wrote in 1762 to a business correspondent, "I said currency, which does not imply Maryland money, of which there is hardly any current--I think was yet more particular, for I spoke of money and exchange as current in Pennsylvania which is our current money at present." Besides a single quotation being a thin reed on which to hang such an extensive claim, the statement is being made by an Eastern shore Maryland merchant, and not by a Western shore Maryland merchant. Being on the Eastern shore, this merchant was more likely to have been in commercial contact with Pennsylvania. While the context of the quote is not clear, the merchant may have been referring to cross-colony trade/debt transaction clearing rather than to local exchange. The quotation also confirms that when referring to paper money from outside the colony it was stated so explicitly, as the merchant said "...I think was yet more particular, for I spoke of money and exchange as current in Pennsylvania..." In addition, by 1762 the stocks of Maryland paper currency outstanding had reach perhaps their greatest low relative to that of Pennsylvania paper currency (Behrens 1923, pp. 46-47; Brock 1975, pp. 386-87, 418-22). Thus, this period, circa 1762, was atypical in being one of relative scarcity of Maryland paper currency. Not surprisingly, some Maryland merchants near the Pennsylvania border might have been forced to resort to using the neighboring colony's paper money for arm's-length, one-off exchanges. In addition, the above quotation is inconsistent with Michener's (1987, 1988) other claim, namely, that specie was not scarce. If specie were not scarce, then Eastern shore merchants would have shifted to specie when Maryland paper currency became scarce, rather than resort to out-of-colony paper money.

The other two sources cited by Michener (1987, p. 236, footnote 3) to support his claim of the free circulation of out-of-colony paper currencies among the middle colonies (New York to Virginia) refer only to the circulation of New Jersey paper money in the late 1720s. In December of 1726, 35 merchants in New York City and Perth Amboy, New Jersey "certified" in letters to New Jersey Governor Burnet that New Jersey paper money circulated in "...Pennsylvania without any scruple or discount..." and "...that the people of New York will soon be convinced that our [New Jersey] currency is upon as good a foundation as the currency of New York..." (*Archives of the State of New Jersey*, 1st series, vol. 5, pp. 153-55; Brock 1975, pp. 87-89). These merchant testimonials, however, appear to have been directly solicited by Governor Burnet for the sole purpose of placating the Lords Commissioners for Trade and Plantations' concern over, and reluctance to recommend approval to the Crown of, New Jersey's paper money emissions (*Archives of the State of New Jersey*, 1st series, vol. 5, pp. 120-22, 156-57). The Lord Commissions, themselves, placed little credence in the merchant testimonials sent by Governor Burnet. Similarly, in 1730, New Jersey Governor Montgomerie in a letter to the Lords Commissioners for Trade and Plantations claimed that New Jersey did not have enough of its own paper money because much of it had either been redeemed or had left the colony (*Archives of the State of New Jersey*, 1st series, vol. 5, p. 289). He was making this claim for the sole purpose of winning the approval of the, otherwise reluctant, Lords Commissioners for a new emission of New Jersey paper money. Given the intended purpose of these letters, this evidence is of questionable merit and so cannot support a strong claim to the free circulation of out-of-colony paper money among the general populous of the middle colonies.

10. In 1781, Alexander Hamilton (Ferguson 1973, p. 35) came to the opinion that specie comprised 27% of total currency in circulation (paper plus specie) before the Revolution. He said, "From a comparison of several estimates I have [seen of the quantity] of [current cash] in this Country previous to the War (specie and paper) I have settled my opinion of the amount at thirty millions of Dollars, of which about eight might have been in Specie." Hamilton did not state the exact year to which he was referring. If he was referring to sometime between 1770 and 1772, his ratio of specie to paper currency would be consistent with that found here in Figure 1. Michener (1987, pp. 278-79) argues that Hamilton over estimated the amount of paper money which, if true, may also account for the difference between the Hamilton and the Webster estimate if Hamilton was per chance referring to 1774 or 1775.

11. Michener (1987, pp. 282, 295) also claims that specie was not scarce in Pennsylvania in the late 1740s and early 1750s. However, the three original sources Michener cites to support his claim are presented without critical

evaluation as to their quality and veracity. Upon inspection, these sources appear to be either polemical, unrepresentative, or biased. Michener (1987, p. 295) wrote, "Another, writing in 1749, echoed these sentiments: 'At *New York* and *Philadelphia* Silver is their Medium, and mill'd Dollars pass current at a known determinate Rate, and other foreign Coins in proportion: Paper Bills are sometimes the Instrument in Payment, but the Proportion is small compar'd with the Silver, (...)'." The quotation is taken from the pamphlet *A Brief Account of the Rise, Progress, and Present State of the Paper Currency of New-England* written by an unnamed author and printed in Boston in 1749 (Davis 1964, vol. 4, pp. 377-405). The pamphlet is a polemic against paper money and its purpose is to convince Massachusetts that it should swear off paper money and return to a pure specie monetary standard. The three sentences in the pamphlet that immediately precede the passage quoted by Michener are instructive. They are: "I think therefore we may rest satisfy'd, no stable Currency can be projected, other than that of Silver and Gold. And here I expect to be ask'd: Why may not *New-England* have a Currency of Bills of Credit, as well as *New-York* and *Pennsilvania*? I answer." (Davis 1964, vol. 4, p. 387). There is no evidence in the pamphlet that the author knew anything about what was actually going on in New York and Pennsylvania. The author mentions nothing else in reference to these two colonies in the rest of the pamphlet. As such, and given the polemical purpose, the author's claim that specie was the primary medium of exchange in Pennsylvania in the late 1740s lacks credibility. Polemical oratory should not be confused with historical reality.

Michener (1987, p. 282) also wrote, "The Pennsylvania receiver of quit rents reported in 1753 that 'full four fifths' of the money received by him was specie." (See also Brock 1975, p. 386.) However, most quit rents, payments to the Lord Proprietor of Pennsylvania (the Penn family), had to be paid in sterling (specie). Such payments, after all, were to be remitted to the Penn family in England (see *Pennsylvania Gazette*, Jan. 25, 1739). Only with the Pennsylvania Legislature's Currency Bill of 1739, did the Proprietor agree, after much debate and assured compensation, to take Pennsylvania paper money instead of sterling in payment of quit rents, but then only "...upon grants made before the year one thousand seven hundred and thirty-two and upon all grants afterwards, according to the tenor of the said grants..." (*Statues at Large*, vol. 4, p. 324; vol. 5, p. 14; *Pennsylvania Gazette*, Sept. 13, 1739). Based on evidence in property sale advertisements, the Proprietor had required most quit rents by contract of the grant to be paid in pounds sterling by 1750, as the following advertisement from the *Pennsylvania Gazette* (Feb. 26, 1754) illustrates: "To be sold by John Snowden, sadler, living in Market street, Philadelphia, a good brick house...subject to a ground rent of Four Pounds, Ten Shillings, a year, and a quit rent to the proprietaries, of Two Shillings, and Six pence, Sterling, per annum...." For other examples, see the *Pennsylvania Gazette* (9/15/1737, 11/29/1744, 5/28/1747, 8/13/1747, 5/3/1750, 7/5/1750, 9/28/1752, 10/12/1752, 9/27/1753, 11/21/1754, 12/5/1754, 2/4/1755, 6/12/1755, 12/13/1759, 1/28/1762, 3/18/1762, 7/8/1762, 6/7/1764, 10/25/1764, 5/23/1765, 6/20/1765, 8/8/1765). Between 1750 and 1765, 80% of the land sales advertised in the *Pennsylvania Gazette* that were listed as subject to quit rent payments, and that enumerated that payment, explicitly indicated that said payments were required to be made in sterling. This is exactly the same percentage as the "four fifths" quoted above. By contractual design, therefore, the proportion of quit rents collected in specie is patently unrepresentative of the ratio of specie to paper money circulating as a medium of exchange in the colony.

12. Mazzei arrived in Virginia sometime in 1773 and returned to Europe in June of 1779 (Marchione 1983). He discusses in his treatise the finances of colonies to which he had never been and in time periods for which he was not in America. Clearly, his treatise was written not from direct observation, but from second-hand information. The paragraph from which Michener took the quoted passage refers specifically only to Massachusetts. Unlike other colonies, Massachusetts had returned to a specie monetary standard long before 1773 (Brock 1975, pp. 244-334). Therefore, the absence of paper money in Massachusetts in 1773 cannot be taken as a general American condition. In addition, Mazzei mis-identifies the period of inflation of the Massachusetts paper pound, which inflated not during the "previous war" as Mazzei claimed in 1782, but during the war previous to that, namely, King George's War which ended in 1748 (Brock 1975, pp. 33-34). It was after King George's War that Massachusetts moved towards a specie only monetary standard.

13. Michener's calculation is less than transparent. Michener (1987, p. 275) says that "Jones estimated that in 1774 the per capita cash-holding in the Middle Colonies was 1.8 pounds sterling (Jones, 1980, Table 5.2)." In fact, Jones provides no such estimate in Table 5.2. What Jones (1980, p. 129) reports is the sterling exchange rate equivalent of 8.1 pounds per wealthholder. Michener took it upon himself to multiply Jones' 8.1 pounds sterling exchange rate equivalent per wealthholder by .224--the share of wealthholders in the population (Jones 1980, p. 41)--to get the above 1.8 pounds sterling exchange rate equivalent per capita. While Jones converted other components of wealth per wealthholder into wealth per capita by multiplying by .224, she did not do so for cash wealth. She did report aggregate net worth held in cash in the middle colonies by multiplying the 8.1 pounds sterling exchange rate equivalent per wealthholder by the total number of wealthholders, but she did not take the extra step, as she did with other wealth components, of dividing it by population and reporting it in per capita terms (Jones 1980, p. 128). While she did not directly explain why she did not so convert cash per wealthholder into cash per capita as she did with other wealth components, from the tenor of her discussion, it is likely that she did not do so because probated inventories were the most unrepresentative relative to non-probated inventories with regard to cash holdings (Jones 1980, pp. 343-80). While Jones (1980, pp. 128, 132) states that most of this cash was paper money, and converted it to pound sterling equivalents based on that judgement, Michener chose to ignore Jones on this issue and instead assumed that the 8.1 pounds sterling exchange rate equivalence of cash per wealthholder is the total cash amount whose components (paper and specie) cannot be discerned. Second, for New York and Pennsylvania, Michener (1987, p. 275) took the amount of paper money outstanding in 1774 (Brock 1975) and divided it by the population (*Historical Statistics* 1975, part 2, p. 1,168) to get the amount of paper money per capita. This number is then multiplied by the exchange rate between the respective paper monies and pounds sterling (McCusker 1978) to get sterling exchange rate equivalent paper pounds per capita. For the middle colonial, Michener estimates this number to be 0.58. Finally, to get the percentage of specie in total cash (specie plus paper), Michener takes the Jones-derived number of 1.8 pounds sterling exchange rate equivalent total cash per capita and subtracts from it the Brock-derived number of 0.58 pounds sterling exchange rate equivalent paper money per capita to get what he assumes to be the implied 1.22 pounds sterling exchange rate equivalent specie money per capita. Dividing 1.22 by 1.8 equals 67.8%, or two-thirds of the money supply was specie.

14. The calculation uses the exact same evidence and methods used by Michener (1987, p. 275), explained in detail in footnote 13, with the exception that the conversion rate to go from per-wealthholder to per-capita was changed from 0.224 to 0.141.

15. Redish (1984), accepting the specie-market-equilibrium argument for why specie in general cannot be scarce, concludes that colonists' complaints about specie scarcity were really only complaints about the scarcity of high-quality specie. Because specie, in general, could not theoretically be scarce, low-quality specie must have abounded. The problem with this approach is that it runs afoul of the same theoretical argument that makes the scarcity of specie in general an impossibility, at least in the long-run. Given time to overcome information costs, asymmetric information across parties, and measurement costs, the market (and even governments) can determine the difference between high- and low-quality specie and thus price these differences accordingly. An ounce of gold is an ounce of gold regardless of whether it is in a full-bodied coin or several clipped coins. The scarcity of high quality specie is a meaningless concept given the specie-market-equilibrium argument. Redish's interpretation can work only if there are information costs, asymmetric information across parties, and measurement costs that market participants cannot easily overcome for considerable periods of time, or if governments maintain, through legal tender laws, incorrectly priced high versus low quality specie coins. But once these factors are introduced, you are back in a world where specie in general can be scarce over some length of time.

16. With regard to the long-run trend in real cash balances, see footnote 26.

17. With regard to the long-run trend in real cash balances, see footnote 26.

18. All correlation coefficients are statistically different from zero above the 0.02 significant level.
19. See also footnote 1.
20. Gallman (1999, p. 30) listed the monetary approach as a possible method for estimating colonial growth, but then dismissed its usefulness because of the lack of knowledge (at that time) of the total money supply in a given colony.
21. See footnote 1.
22. The mere act of going from non-marketed to marketed  $Y$  for rational maximizers, even when total marketed and non-marketed  $Y$  per capita is constant, entails an increase in average welfare (utility) per capita. It is this fact that makes measuring the growth in marketed  $Y$  per capita so important, besides the fact that measuring non-marketed  $Y$  is close to impossible. For example, suppose we could do the impossible and measure non-marketed  $Y$  as well as marketed  $Y$ , and suppose our economy consists of Silas and Nathaniel who initially both make their own butter and candles in their own individual homes for their own individual use. One day, suppose Silas decides to specialize in butter and Nathaniel in candles and they trade (market) butter for candles with each other. Furthermore, since you can only eat so much butter and burn so many candles, suppose each consumes the same amounts of butter and candles as before they specialized, and they both take their gains from specialization as increased leisure (increased card-playing at the local tavern). Our measure of  $Y$  per capita will show no growth, yet welfare per capita increased significantly. Suppose we could even measure  $Y$  per capita per unit time, and that despite their specialization Silas' production of butter per unit time and Nathaniel's production of candles per unit time is the same as it was before they specialized, and what they gained by specialization is not more leisure time but more daydreaming-on-the-job. When producing both butter and candles for one's own use, the shift point between making the two goods requires focus and attention, and thus a decrease of daydreaming consumption. Our measure of physical  $Y$  per capita per unit time (per capita physical productivity) will show no growth, yet welfare per capita increased significantly with the increase in marketed  $Y$ . Therefore, even in the face of pure substitution effects, measuring the growth in marketed  $Y$  per capita by itself is an important and meaningful objective for charting changes in welfare.
23. For this approach to yield accurate estimates of the levels of  $Y$  over time, the correct absolute values of  $V$  would have to be used. If we had some truly reliable independent estimates of  $Y$  for Pennsylvania in this period, assumed absolute values of  $V$  could be calibrated to be consistent with those estimates. However, because precisely what is in dispute are reliable estimates of  $Y$ , it is better to eschew levels and just concentrate on rates of change.
24. All estimates in Table 2 are biased low relative to what the estimates would be if the data could be extended back to 1720. The early 1720s were recessionary years (Lester 1938).
25. See footnote 24.
26. If  $\ln(V)$  is zero (with  $V$  set equal to 1 throughout) then the regression method in Table 2 column (1) shows that long-run per capita  $\ln(Y)$  is not significantly different, statistically, from zero. With both  $\ln(V)$  and per capita  $\ln(Y)$  being zero, then on average between 1729 and 1775  $\ln(M) - \ln(P) = \ln(Pop)$ , i.e., the long-run growth in real money balances equals the population growth rate. This estimated condition or outcome in the data might provide some comfort to the "quantity" theorists among colonial historians. See also McCallum (1992).