GRESHAM'S LAW REGAINED

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ABSTRACT

It has been argued that Gresham's Law, bad money (money with
a low value in non-monetary uses) drives out good, often fails
because one money can circulate at its market value. Various
cases involving the U.S. dollar in the nineteenth century have
been cited as possible violations of the law resulting from non-
par circulation of the dollar. This paper analyzes these cases,
and finds to the contrary that a "93 percent version" of
Gresham's law held in all them. Evidently, there were high
transactions costs associated with using good money at a premium
or bad money at a discount.

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1. Introduction

Gresham's law, "bad money drives out good," has been accepted by economists for generations, and has become widely used as an epigram for describing non-economic events. While previous students of the law such as Jevons (1878), Fetter (1931), and Friedman and Schwartz (1963, p. 27, n. 16) note various qualifications, each argues for its validity. However, a recent paper, by Arthur Rolnick and Warren Weber (1986), raises serious doubts about the generality of the law. They stress and refine a qualification based on the potential for good money to circulate at a premium along side bad money, a dual currency. They further suggest a number of cases (drawn primarily from nineteenth-century America) in which the law might have been frustrated by the rise of a dual currency. They conclude that Gresham's Fallacy might be closer to the truth than Gresham's law.

We begin by reviewing the qualifications added to the law over the years, and add our own, that bad money be accepted by the community. We then follow up the research agenda proposed by Rolnick and Weber, (U.S. cases only), but none of their exceptions pan out.[1] In each case, bad money drove out most of the good money. A 93 percent version of Gresham's law, to borrow the title of George Stigler's famous paper, covers all of these cases. Although a number of its assumptions could be further refined, we think Gresham's law still belongs in the monetary economist's tool kit.

2. A Restatement of Gresham's Law

Gresham's law does not apply to all cases of bad and good money. The metal

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[1]They also suggest a British case, which we have not examined.

contained in four quarters is worth more than the paper a one-dollar federal reserve note is printed on. But paper dollars have not driven quarters out of circulation. The law assumes a number of conditions about the supplies and demands for the two moneys. We first discuss a simple explanation, typical of those found in Jevons, Fetter, Fisher, and others, and then explore the implicit assumptions in detail.

Suppose that the money supply consists of coins. The coins are labelled one dollar and contain $.50 worth of gold. Then the government issues paper money, also labelled one dollar. The increased money supply raises the price level, and with it the bullion value of the gold coins. For a time, the increased value of the bullion is limited, say to $.60 or $.70, and gold dollars remain in circulation. But when the bullion value exceeds $1.00, gold coins are melted down. Eventually the supply of paper money increases enough to drive all gold coins from circulation.

A. Some Traditional Qualifications of Gresham's Law

Although this scenario seems natural, it rests on a number of implicit assumptions. Some are straightfoward. The law assumes, first of all, a non-monetary demand for good money -- indeed this defines it as "good" money. The terms bad and good refer to the value of money in non-monetary uses, and it is, therefore, more accurate to express the law as "cheap money drives out dear." Non-monetary demands for gold and silver moneys come from arts, industry, and medicine. The use of a metal as money in other countries is another form of non-monetary demand. For example, silver driven out of the United States by paper in the 1860s, was used as money in Latin America (see 3.C below).

Another assumption implicit in the canonical story is that the good money is the basic

medium of account. Certain coins or denominations of currency may be strongly complementary with the rest of the money stock. Therefore, a rapid increase would not produce an increase in the total stock of money or drive out other kinds of money. A rapid increase in the stock of pennies, for example, would produce a reflux upon the banks and the Federal Reserve. If for some reason the Federal Reserve refused to convert them into federal reserve notes, pennies might well go to a discount. The community might, in fact, refuse to accept them altogether as money. We discuss how a community makes such a decision in section 2.C. The failure of bad pennies to drive out other kinds of money is not a failure of the law because the law assumes that bad money is regarded as a close substitute for the basic medium of account.

The canonical story also claims that when the bullion value of coins rises above $1.00, they are withdrawn from circulation. Of course, $1.00 is only an approximation. Normally the price will have to rise a bit more, to say $1.02. The premium compensates the bullion dealer for the cost of culling coins from circulation and repackaging them as bullion. The existence of a premium in the bullion market is, thus, a natural part of the operation of the law. The canonical story, moreover, is not very specific about how or when the coins are removed. In many discussions of the law it is assumed that the undervalued money is gradually removed by a small number of sharp traders and bullion dealers, and would, therefore result in considerable transfers of wealth from the general public to the minority of informed dealers. But this addition to the story is not central to the law. The undervalued currency might be hoarded quickly, and the losses incurred by uninformed money holders might turn out to be quite limited.

Finally, the law clearly refers to a situation in which the supply of bad money is increasing rapidly. The law does not specify a level at which bad money will begin to drive out good money, but, as our story indicates, limited increases are consistent with continued circulation of good money: Gresham's law, in other words, implicitly assumes that bad money increases "a lot."   Under a fiat standard the increase in the supply of bad money is often linked to attempts to raise revenue from seignorage. During the Civil War (3.C below) the Union's urgent need for revenue led to an increase in the supply of greenbacks (bad money). The same motive can explain the increase in bad money under a metallic standard, such as the debasements of the coinage in the Middle Ages. But a rapid increase in bad money can occur for another reason. In certain periods the mint provided unlimited coinage of gold or silver bullion. Anyone who brought bullion to the mint received coins in return. When the cost of mining fell, as it did when gold was discovered in California and eastern Australia in the 1850s, large amounts of bullion were turned into coin--fulfilling one of the conditions for the law.

Most of these points are not controversial. There are, however, two assumptions underlying the law which are less straightforward.

B. A High Elasticity of Substitution in Demand between Bad and Good Money

The canonical story assumes that substituting between bad money and good money is highly elastic at the nominal price of $1.00. If the price of good money rises a bit above $1.00, bad money is easily substituted for good.

Friedman and Schwartz stress this assumption, as do Rolnick and Weber. Rolnick

and Weber point out that if the costs are low enough, people will use good money at a premium. Using our example, suppose the bullion value of a gold coin rose to $1.10. What prevents good money from being used in ordinary transactions at this price? While this raises a valid theoretical point and marks an important refinement in the theory of Gresham's law, armchair reflections and the evidence we examine in Section 3 lead us to believe that, in practice, the costs of using good money at a premium (or bad money at a discount) are quite high, thus fulfilling this condition for the law.

Using non-par money requires its holder to monitor the price of bullion. The costs of monitoring can be avoided by converting all money balances into par money. Specialization pays; the butcher, the baker, and the candlestick maker could spend time negotiating the price of bullion, but they would do better to leave the matter to others. The point is hardly a new one. As Irving Fisher (1971 [1922], p. 114) noted in his discussion of the law, "The better money might conceivably be used at a premium, i.e. at its bullion value; but the difficulties of arranging payments in it, which would be satisfactory to both parties, are such that in practice it is never so used in large quantities."

Rolnick and Weber (1986, p. 195-96), on the other hand, assume this cost is negligible. In their view circulation of good money at a premium can only be prevented by a degree of government intervention they find implausible. Legal-tender laws, they rightly point out, merely require accepting a money at its face value. So the letter of the law can be fulfilled by quoting prices in terms of bad money and accepting good money at a premium. Legal tender laws would not be violated (no one would be refusing either money at par), and there would be no incentive to cull good money from circulation. But this argument does not

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explain why people would rather use good money at a premium, instead of converting it into par money. A "liberal coinage policy" under which the mint would exchange different moneys at their respective face values could provide another means of enforcement. According to Rolnick and Weber, however, no mint would operate in this way because it would risk running out of the undervalued metal and amassing large stocks of the overvalued metal. But this risk explains why mints were committed to nothing more than free coinage (i.e., buying but not necessarily selling) (Friedman, 1990 (b), p. 1162). It does not address the public's attitude toward a non-par currency.

Rolnick and Weber suggest one case where they believe that the transactions costs of using good money at a premium might be high-small denomination coins. A 25 percent premium on a nickel, for example, is 1.25 cents. If 1.25 cents were rounded to a penny, customers using nickels would lose on small transactions. People would therefore bundle nickels for large transactions and thus take advantage of the full premium. Alternatively they could melt the nickels for bullion. The real issue then is whether high transaction costs are limited to small denomination coins.

While the law assumes a high elasticity of substitution for most purposes, in sheltered markets good money may enjoy special advantages that compensate for the difficulties inherent in using it at a premium. Anyone who travels knows Canadian dollars are used internally, but some merchants keep small amounts of U.S. dollars on hand. Similarly, during the Civil War, customs duties had to be paid in gold, a small sheltered market for good money arose, and limited amounts of gold circulated at a premium.

In Appendix B we develop a simple quantity theory model of an economy using two

moneys. In the model we allow for an elasticity of substitution of less than infinity between two components of the money supply. Considerable driving out can occur in this model, even though the elasticity of substitution between the two moneys is less than infinite, and the good money rises to a premium. It is more in keeping with the way we treat similar ideas in economics to regard Gresham's law as incorporating the assumption that the elasticity of substitution between two moneys is "very high" over a "significant" range. What "very high," and "significant" mean would then become matters of research and judgment. A finding, for example, that an increase of $1.00 in bad money drove out $.05 in good money would count as evidence against the law, but a finding that an increase of $1.00 in bad money drove out $.95 in good money would count as evidence for the law.

C. Acceptability - a Schelling Tipping Model

The assumption that the monitoring costs of using a money at a premium or discount are normally high leads us to expect a corner solution. A currency, or a component of it, in other words, will generally be accepted at par or refused. Gresham's law assumes, of course, that the expanding component of the money supply achieves and maintains acceptability. In our canonical story, if the community refused the new paper money, then the law would not operate. So this assumption must also be listed among the qualifications to Gresham's law.

Cases in which a component of the money supply fails to achieve or loses general acceptability are more common than supposed and deserve further attention. A recent example is the Susan B. Anthony Dollar which the public rejected because it was easily confused with a quarter. The Anthony dollars could have been discounted to reflect the risk

of mistaking one for a quarter, but it was simpler to refuse to deal with the coin altogether. An older example is the U.S. Trade dollar which circulated for a time at par, but was eventually rejected. (See section 3.E) Acceptability has not been completely neglected in the literature. Jevons (1878, pp. 78-80) discusses the acceptance or rejection of coins under the heading "the force of habit in the circulation of money" before discussing Gresham's law. Fetter (1931/1932) notes that people do sometimes reject bad money and cites conflicts between local Chinese currencies and the Japanese yen in interwar China. And Peter Bernholz (1989) has recently examined the staying power of bad money as it applies to economies experiencing very high rates of inflation.

To understand the U.S. experience, consider how a person decides whether to accept or reject a particular medium of exchange. A variety of considerations influence costs and benefits including the bullion value of a coin, its legal-tender status, its denomination, and the policies advised by banks and trade associations. Further, the positions being taken by political parties representing debtors, creditors, and even the producers of monetary metals may influence dicisions by individuals.

The greatest influence upon an individual's decision, however is simply what everyone else does. If most people use a coin, then most individuals have a good reason to use it; If most people refuse to us it, then no one will have much reason to use it. Only two outcomes, general acceptance or general refusal, therefore, are "Schelling points (1978)," and the monetary system will normally tip toward one corner solution or the other. Usually the economy tips toward acceptance of bad money because of the support the government gives it. Occasionally countervailing political or economic costs tip the economy toward

rejection of bad money. We will consider one case, California's adherence to the gold standard during the Greenback Era (3.D)

Some might consider acceptance of bad money the inferior outcome. Universal use of fiat money, for example, might be considered inferior to the use of gold in terms of long-run price stability. But once fiat money was generally accepted, no individual would have an incentive to change. Only external pressures that rewarded people for switching to the desired currency could push the economy past the tipping point and produce the preferred equilibrium.

The analogy between a dominant language and a dominant medium of exchange may be instructive. Because learning and using two languages entail significant costs, many societies tip toward the predominant use of one, normally the one preferred by the central government. The use of second and third languages is usually limited to merchants involved in foreign trade, scholars, and so on. Similarly, when the government gives bad money legal-tender status, we expect it to become the medium of exchange. In some circumstances, however, political pressures may cause a country or region to tip toward the predominant use of a language that lacks the central government's sanction. Indeed, David Laitin (1988, pp. 295-296) uses the Schelling tipping model to examine regional language conflicts. Similarly, political pressures may offset governmental efforts to force acceptance of bad money and lead to its rejection.

3. The American Experience in the Nineteenth Century

Having fixed these ideas we now trace the experience of the U.S. dollar in the

nineteenth century. The central question is whether the dollar (or its competitor) disappeared from circulation when it ran into competition, according to Gresham's law, or whether it circulated at a premium or discount.

A. Foreign Coins before the Civil War

The circulation of foreign silver coins between the American Revolution and the Civil War supposedly contradicts the law.[2] The Spanish milled dollar, for example, supposedly contained 373.5 grains of pure silver, whereas the U.S. dollar, established by legislation in 1792, contained 371.25 grains of pure silver. Rolnick and Weber (1986, p. 187) point to two pieces of evidence suggesting that the law failed: (1) the Spanish dollar's reportedly commanding a 0.25 to 1 percent premium between 1792 to 1811 and as late as 1819, and (2) the circulation of the Spanish dollar throughout the antebellum period accounting for 22 percent of all U.S. coinage in 1830, according to an estimate reported by Laughlin. Rolnick and Weber conclude, then, that bad money, the U.S. dollar, failed to drive good money, the Spanish dollar, out of circulation.

Actually, most of the Spanish coins in circulation contained less than 373.5 grains, the result of changing mint practices, defacement of the coins through gauging and clipping, and losses from ordinary wear and tear.[3] The shortfall was well understood even before the United States established its mint. In setting the weight of the silver dollar, Congress followed the recommendations made by Alexander Hamilton. In his Treasury Report of

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[2]Schilke and Solomon (1964) give an excellent history of this phenomenon, stressing the numismatic aspects.

[3]Many of them were fractions of a Spanish dollar. Some were coins, but it was a common practice to cut up Spanish dollars to make small change. One eighth of a Spanish dollar was known colloquially as a bit.

January 1791, Hamilton (1791, pp. 164-165, 186) explained that the Spanish mint had been reducing the silver content of the Spanish dollar and that only the most recently-minted Spanish dollars remained in circulation. The heavier Spanish dollars circulated before the Revolution but had long since disappeared. He cited conflicting evidence from assays on the weight of the newest Spanish silver dollar. The most reliable assay, in his opinion, put the weight of the most common Spanish dollar at about 371 grains. And this became the main basis for his choice for the weight of the new U.S. dollar.[4]

Thus, from the onset of the minting in the United States, Spanish dollars in circulation did not weigh more than the U.S. dollar, and probably weighed more. By choosing a weight for the U.S. dollar approximately equal to the Spanish dollar's weight, Hamilton, without having to spend more silver per coin than necessary, minimized the danger that the system would tip against the U.S. dollar.

In the period up to 1805, the U.S. minted considerable quantities of silver dollars, but these were exported to the West Indies. There they were used to purchase Spanish dollars for import to and reminting in the United States. The mint was closed in 1805 because it seemed to operate merely for the profit of arbitragers. This episode would be difficult to understand if the full-weight Spanish dollar in the United States commanded a premium and circulated alongside the U.S. coin, while being driven from the West Indies. More likely, a substantial supply of older, full-weight coins remained in the West Indies, but most of the full-weight Spanish dollars in the United States had already disappeared from circulation.

The mint did not begin coining silver dollars again until 1836, although it continued

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[4]The weight finally chosen, 371.25 grains, was also based on consideration of the desirable ratio between silver and gold.

to coin full-weight half-dollars, quarters, and dimes. Laughlin (1885, p. 54) reports that as late as 1830, the U.S. coinage was estimated at $23 million: $14 million in U.S. coins, $5 million in Spanish dollars and parts of dollars, and $4 million in other dollars and parts mostly from Latin America (Laughlin, 1885, p. 54). But the Spanish silver, according to Laughlin (p. 55), "much worn and reduced in weight, and, being in practice current with other coins, without regard to weight, naturally acted to drive out our own coins." In the same vein Carothers (1930, p. 81) reports: "It was feasible to clip Spanish coins to the legal weight of 415 grains [373.7 fine grains]...."; "Silver coins of Mexico and Spain entered into circulation in a degenerate condition"; "The entire coin currency was depreciated from 6 to 20 percent, the smaller coins showing the greater losses.... "; and "Shopkeepers habitually accepted coins in any state of depreciation.... "

The 1830 Senate report that estimated that 22 percent of the coinage consisted of Spanish silver also estimated the depreciation of the Spanish silver. The report claimed that Spanish dollars were typically depreciated about 1 percent, half-dollars about 3 percent, eighths of a dollar 11 percent, and so on (New American State Papers, Public Finance, vol. 27, pp. 219-220). Overall, a weighted average of the Spanish coins in circulation showed them to be about 6 percent lower in weight than their face values.[5] The report, moreover, noted, "All these coins are equally current, without regard to actual weight" (p. 221). Indeed, the report concluded that underweight Spanish coins were driving American coins out

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[5]According to McCullough (1984, p. 105), actual average weights and mint weights in Lower Canada also differed.

	1830	1840
Spanish Dollar	-.6%	-1.1%
U.S. Dollar	NA	-.5
Spanish Quarter	-4.7	-6.4
U.S. Quarter	NA	-.9

of circulation through Gresham's law.   Now, this Senate select committee was taking aim at the laws that made foreign coins legal tender. Thus, the committee may have exaggerated the amount of Spanish silver in circulation or the extent of its depreciation.[6] But it is highly unlikely that the committee would have tried to misrepresent the facts of interest to us: whether the Spanish silver was full weight or depreciated and whether it circulated by weight or by tale.

A book published in 1852 by the assay office of the U.S. mint explained the U.S. dollar derived from the Spanish dollar and reported, "Its [the Spanish dollar's] divisions, though greatly depreciated by wear, continue to circulate largely in this country.... " (Eckfeldt and Du Bois, p. 117). It was a common practice, apparently, to mark the price of small items to 12.5 or 6.25 cents, corresponding to the bit or half-bit. In the southern and western states, a U.S. dime was often taken interchangeably with a bit. This could be interpreted as a violation of the law, since the lighter coin, the dime, was not driving the (nominally) heavier coin, the bit, out of circulation. Moreover, the failure of the dime to drive out the bit violates even the case in which Rolnick and Weber give the law a chance, the case of small-denomination coins. A social convention had been established, though not codified by the legal system, to accept the two coins as equivalent, perhaps temporarily until more dimes were available. Under these conditions, three possible outcomes existed: use only bits for small change, use only dimes for small change, or use bits and dimes interchangeably. The southern and western states tipped toward the third outcome.

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[6]A study done by the mint in 1826 and criticized by the committee reported much less depreciation, and mostly on the smaller coins (American State Papers, Finance, vol. 5, pp. 585-92.

If the Spanish coins were below full weight and circulated at par, what about the references in the literature to a premium on Spanish coins in the early republic? The Spanish dollar commanded a premium but not in general circulation. Because the Chinese heavily discounted the newer U.S. coins, the premium was paid by merchants in the China Trade. Assays made in China showed the true worth of the U.S. coins, but for a time the U.S. coins lacked the credibility of the more familiar Spanish dollar. The premium compensated Chinese merchants for culling acceptable coins from the U.S. circulation. In other words, the premium was a sign that the law was working, not a sign of its being contradicted. In this case, coins were culled not because they were worth more as bullion to be reminted, as in the West Indies, but because they were worth more in a foreign market where the U.S. dollar lacked credibility. When the premium on the Spanish dollar rose to about 4 percent, merchants would use U.S. dollars in the China trade, because 4 percent was the extent of their undervaluation by the Chinese.

The confusion concerning the nature of the premium paid on Spanish coins traces to a footnote in Laughlin (1885, p. 53) that quotes Secretary of the Treasury Crawford in 1819. "Spanish milled dollars compose the great mass of foreign silver coins which circulate in the United States," Crawford said, "and generally command a premium when compared with the dollar of the United States." The full sentence includes the phrase "especially for exportation to China" (American State Papers, Finance, vol. 3, p. 395). Subsequently, Crawford further reports that the Spanish dollar circulated in the United States at anywhere from par to a 10 percent premium. Taken together, Crawfords's two statements do not rule out a premium not connected with the China or other foreign trades. But other observers were unambiguous. A

House committee, for example, appointed to examine the currency laws, reported at about the same time: "Within the United States it [the Spanish dollar] has an equal value with the U.S. dollar, and in many foreign countries a much higher value." In slightly different words, the House committee noted, "The dollar of Spain and that of the United States are of exactly the same value within the United States" (American State Papers, Finance, vol. 3, p. 398). We conclude therefore, that the Spanish dollar circulated at par within the United States but bullion dealers paid a premium for the large amounts they collected for export.

B. Antebellum Changes in the Bimetallic Ratio

Another possible violation of the law concerns the circulation of gold before 1834 and the circulation of silver afterward. In 1792, the ratio of silver to gold in the U.S. coinage was set at 15:1, the dollar containing 371.25 grains of pure silver or 24.75 grains of pure gold. The ratio almost exactly equalled the ratio established by world market prices. But almost immediately, the market ratio began to climb. According to Soetbeer's figures, the ratio was 15.17:1 in 1792, rose to peak of 16.25 in 1813, then after a brief fall, climbed to 15.95 in 1821.[7] Gold flowed out, as Gresham's law says it should have.

Rolnick and Weber (1986, p. 188) point to the continued minting of gold (though in a smaller volume than silver) as evidence against the law.[8] A small difference between the European ratio and the U.S. ratio, however, need not have produced a complete exodus of

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[7]Given in Laughlin (1885, pp. 223-24). See also Officer (1983, pp. 580-587, 592).

[8]Since the mint coined gold without taking a seignorage, minting was an inexpensive way of assaying bullion and converting it into a form that could be readily marketed.

U.S. gold. Around the legal ratio, there was some range of variation, similar to the range that gold points set off under the gold standard. As Friedman (1990 (a), p. 90) has stressed recently, as long as the market ratio stayed within that range, both metals could have stayed in circulation.

As a matter of fact, however, considerable amounts of gold were withdrawn from circulation during the period 1792-1834. According to the House committee report of 1819, "Gold is estimated below its fair relative value, in comparison with silver, and ... can scarcely be considered as having formed a material part of our money circulation for the last twenty-six years" (American State Papers, Finance, vol. 3, p. 399). In 1821, another House committee reported that "on inquiry, they find that gold coins, both foreign and of the United States, have in great measure disappeared" (American State Papers, Finance, vol. 3, p. 646). And an 1830 congressional committee noted, "Our gold coins ... have never had any general circulation in the country; they have ceased to be used as money; they are merely merchandise, purchased by a considerable premium over silver; and they are used in manufactures, or exported to Europe" (cited in Watson, 1899, p. 82). In the same year, 1830, a select committee of the Senate stated flatly: "The coins held by the banks and in circulation among the people, are silver. All the coins in common circulation, and most of those held by the banks, are half dollars and the minor silver pieces. We have no gold coins in circulation" (New American State Papers, Public Finance, vol. 27, p. 292). In 1832, the director of the mint, Samuel Moore, noted, "Gold at present constitutes no part of our currency; and not having, within any recent period, performed in the United States the office of coin, it has not been the standard of value assumed in existing contracts" (New American

State Papers, Public Finance, vol. 27, p. 325).

In short, when Laughlin (1885, p. 30), concluded, "Gold coins were seldom seen during the largest part of this period from 1792 to 1834," he seems to have assessed the situation accurately. Although the congressional committees may have been wrong about causes and cures, it is unlikely that they would have been wrong about the actual state of the circulation, a state that anyone reading the report at the time could easily verify.

Even though gold did not circulate, it was still being coined. But to what purpose? Rolnick and Weber note that between 1793 and 1833, gold coin accounted for about 25 percent of the mint's output (1986, p. 188). Much of the gold coinage was exported (1986, p. 196), although some part of it may have found its way into non-monetary uses. In either case, why would someone mint bullion into coins, only to resell them for use as bullion? Apparently, there was some advantage in first converting bullion or coins of lesser known countries into U.S. coins. The senate committee of 1830, quoted above, reported:

> We prohibit and punish all private coinage of gold; we coin this
> metal at the mint, upon a principle which does not permit it to
> circulate as money; and we pay the expenses of this useless
> coinage. In practice, this coinage affords a facility to the
> possessor of gold bullion; since it enables him to employ the
> mint to weigh and assay his bullion, and to divide it into
> convenient portions, without expense to himself. When the coins
> are received from the mint, they are sold for their value as
> bullion; some of them are used in manufactures, and the greater
> part are exported. (New American State Papers, Public Finance,
> vol. 27, p. 292)

Apparently, bullion dealers used the mint for one of its most ancient purposes, namely, to certify the weight and fineness of gold.

The situation reversed in 1834. Congress reduced the weight of the gold dollar from

24.75 grains to 23.2 grains, changing the legal ratio from 15:1 to 16.002:1.[9] Silver flowed

out and gold flowed in, just as Gresham's law predicts. The process, however, was neither

instantaneous nor complete. Since the difference between the legal ratio and the market ratio

was small, it did not pay to cull out smaller coins as many were worn below full weight and

were effectively subsidiary coins.

Meanwhile, Mexico was in the throws of a revolution, which deranged her coinage

and led the country to export considerable amounts of bullion to the United States. If

arbitrage were based solely on mint and market ratios, Mexican silver would be sent to

Europe, where it would be traded for gold, from there European gold would head to the

United States and be traded for silver. Evidently, transportation expenses and other

inconveniences encouraged sending Mexican silver directly to the United States.   In

1835, a branch mint opened in New Orleans, the usual entrepot for Mexican silver,

facilitating coinage of Mexican bullion. The cross current in bullion flows obscures but does

not contradict the workings of the law. Abnormal conditions forced silver out of Mexico.

There is no evidence, however, that silver coins minted after 1835 remained in circulation

alongside gold by circulating below par.

C. Gold in the East During The Greenback Era

The Greenback Era (1862-1879) for Friedman and Schwartz was the occasion for

qualifying the law, and for Rolnick and Weber (1986), a major example of the law's failure.

On December 31, 1861, banks suspended paying specie (gold or silver) for notes and

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[9]In 1837, for technical reasons, the weight of the gold dollar was increased
to 23.22 grains, making the ratio 15.988 to 1.

deposits. The suspension can be traced first to a requirement the government placed upon its

creditors (mostly banks), that they remit in specie, not notes, and second to a temporary

scare of war with Britain. Suspension would probably have come eventually, however,

because the government used financed wartime spending with monetary expansion,

(Friedman and Schwartz 1963, p. 59, fn. 64).

Gold immediately went to a premium in terms of notes and deposits, as it had in

innumerable other such cases. So why did gold rise to a premium and why didn't notes and

deposits fall to a discount? Legal tender laws, after all, worked against using notes and

deposits as the numeraire. Since the bulk of the money supply consisted of notes and

deposits, however, merchants must have assumed that others would continue setting prices in

terms of these assets, making special arrangements for payments made in gold. A significant

incentive thus arose to use notes and deposits as the basic form of money, and the system

tipped quickly to the use of notes and deposits as the numeraire.

The Legal Tender Acts of 1862 and 1863 created the United States Notes, or

greenbacks. These notes swiftly filled channels of trade, serving both as bank reserves (since

they could be used to fulfill banks' obligations to redeem their notes and deposits) and as a

hand-to-hand currency. The National Banking Act, as well as the related legislation taxing

state bank notes, solidified the position of the greenback. Gold, however, did not disappear

from the financial scene. Gold was used in international trade, to pay customs house duties,

and to pay interest on the national debt. In July 1864, the price of gold climbed to its high,

$2.85 for what, in 1861, had carried a $1 price tag (Mitchell 1908, pp. 31-42).   After

the Civil War came a severe dose of monetary contraction. Debate then centered on

whether, and if so when, the United States should resume specie payments. Not until January 1, 1879, did growth-produced deflation coupled with milder contraction produce conditions permitting smooth specie resumption at the prewar parity.

How should we characterize the role gold played during the Greenback Era? Did a dual-money system exist with gold and greenbacks circulated side by side? A few writers claim a genuine dual-money system existed. But most analysts who immersed themselves in the literature of the period consider the Greenback Era a prime example of Gresham's law in action. According to J. Lawrence Laughlin (1885 p. 87), for example, "The result of the depreciation of the paper money which became manifest by a premium on gold in June [1862] to the extent of 5 percent, and in July of 20 percent, naturally brought Gresham's law into operation, by which the cheaper paper was substituted for the more valuable gold. Gold disappeared before the depreciating paper, and it was not until January 1, 1879 that it again appeared." Wesley C. Mitchell, the leading authority on the period, believed that after the issue of the greenbacks, gold no longer circulated in the eastern part of the United States. A table (1903, p. 179) in which he gives estimates of "the circulating medium" shows no gold circulating in the loyal states, except on the Pacific coast.

Mitchell's judgment gains support from other students of the period. Don Barrett (1931, p.73) says, "Gold practically disappeared from circulation for a period of eighteen years." Francis A. Walker, a superb economist with actual experience of the period, says that gold saw no use (except by special contract) other than to pay customs duties and interest on the national debt (1883, p. 508).

A second piece of evidence that argues against the dual-money view the comes from

the fate of the national gold banks. Legislation enacted in 1870 permitted the organization of national banks that could issue currency redeemable in gold. Had a large quantity of gold remained in circulation, gold banks would have succeeded throughout the country. However, gold banks only succeeded in California. One gold bank, the Kidder National Gold Bank, which was established in Boston, was soon liquidated, because there was no demand for its notes (Greenfield and Rockoff, 1990).

Mitchell and the others used medium of exchange to define money. Gold, held as an asset to provide portfolio diversification but not used in transactions did not qualify as part of the circulating medium. However, even if we define money broadly, it is clear that gold (and silver) played a minor monetary role by the end of the Civil War. Table 1 presents a simple before-and-after comparison. A number of conjectural elements go into the table. But if the figures are accepted they show the role of specie shrank considerably. In nominal terms, the amount of specie held by the public fell to a bit more than one-third of their pre-war level; In real terms, to a bit less than one-third. Comparisons with the stock of money make this point even more dramatically. Before the Civil War, more than a quarter of the money stock consisted of specie. By 1867, the figure fallen to about 6 percent. These measures, moreover, do not allow for sheltered markets where gold had a special advantage. Adjusting the figures to get at money circulating outside the Pacific Coast, we see in Table 1 that only a little more than 3 percent of the post-war money stock consisted of specie. Were we to subtract the specie that was tied to the payment of customs duties, the residual would then be cut even more.

Table 1			
The Stock of Specie in 1859 and 1867			
	1859	**1867**	
Stock of specie (face value, $ mill.)	237	169	
Specie held by the public (face value, $ mill.)	149	55	
Specie held by the public (greenback value, $ mill.)	149	77	
Specie held by the public (1859, $ mill.)	149	45	
Specie-money ratio	26.4%	5.9%	
Specie-money ratio (adjustments for Pacific Coast)	23.2%	3.2%	
Source: Appendix A.			

Figure 1 provides a long-term perspective, showing how the ratio of specie to the money stock behaved from 1850 to 1890. Although the ratio is conceptually simple, calculating a consistent data series presents problems. The details, therefore, have been relegated to Appendix A. The lower lines in Figure 1 adjust the gross ratio for estimates of specie circulating on the Pacific Coast and gold held to pay customs duties. The adjustments are relatively crude. Specie used on the Pacific Coast comes from Mitchell's estimate, based on Treasury opinions. Gold used in customs duties is based on the aggregate money-income ratio and the share of customs duties in total income. More refined estimates, however, are not likely to change the tenor of the results.

The ratio exhibits a falling trend. However, during the Civil War, the ratio fell below

Figure 1

The Specie-Money Ratio, 1850-1890
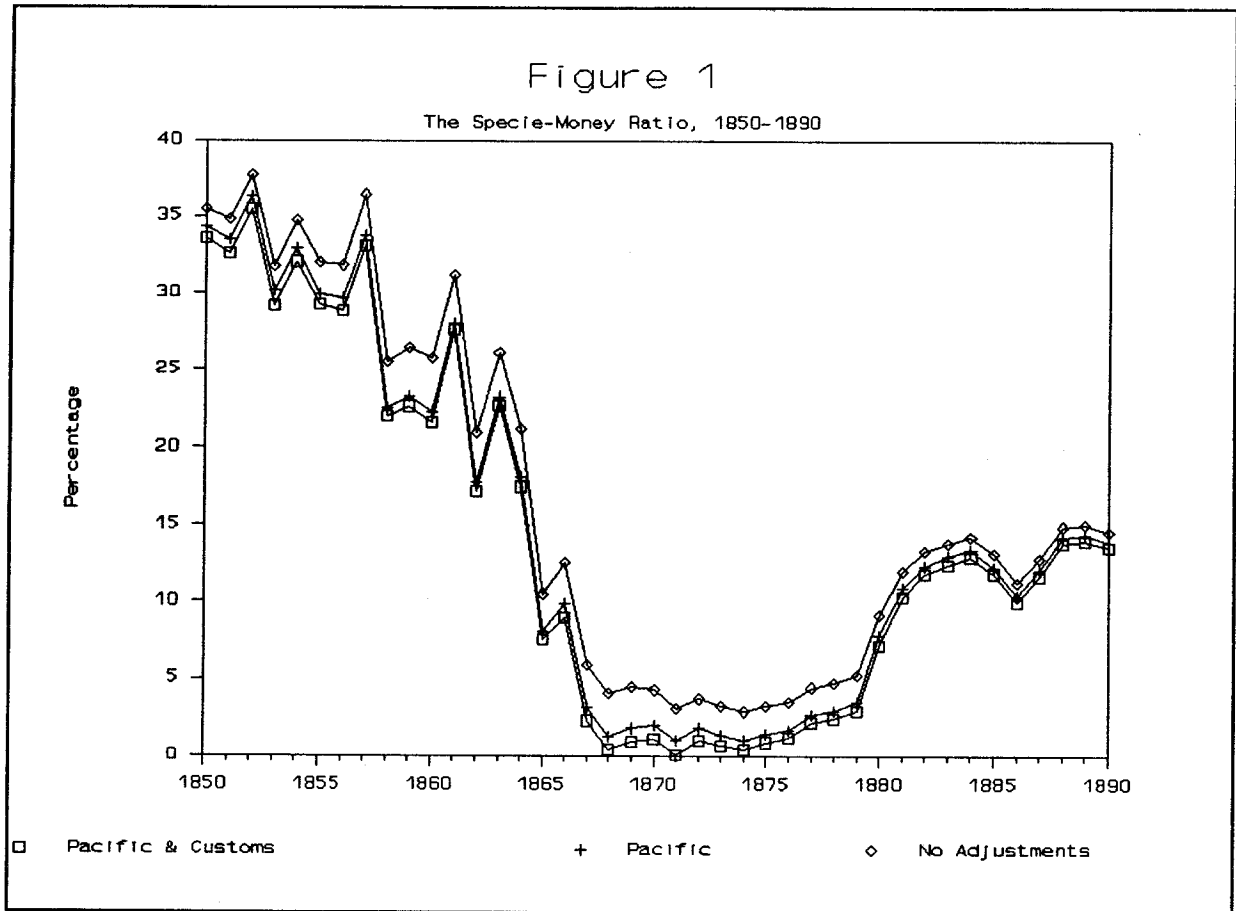
its long-run trend; and by 1875, when the Resumption Act became law, probably less than 1 percent of the money stock consisted of specie, after we adjust for specie used on the Pacific Coast and for gold held to pay customs duties. Figure 1, therefore, confirms Gresham's law: bad money drove out good money.

What happened to the specie? Silver, apparently, did not wind up in the melting pot. Instead, most of the silver that went out of circulation went to Latin America and, in lesser amounts, to Canada, where it served as currency (Carothers, 1930, p. 219). Toward the end

of the Greenback Era, as the greenback price of silver fell, a substantial reflux of this coinage occurred (Carothers 1930, p. 259). During the Civil War, the U.S. mint continued to produce silver coins, but they did not enter domestic circulation. Instead, "The mints were, so far as silver was concerned, merely establishments conducted for the benefit of New York and San Francisco bullion dealers" (Carothers, 1930, p. 219).

We cannot be quite as precise about the fate of gold. There were considerable net exports of gold during the Civil War. Net gold exports averaged $54.75 million in the period 1862-1865, while in the four proceeding years they averaged $34.25 million. The peak year was 1864, when net gold exports totalled $90 million. At no time during the nineteenth century did net gold exports exceed this figure, although they came close in 1892 (U.S. Bureau of the Census, 1975, p. 885).

Real events, as well as monetary factors, affected the balance of payments during the war. The cutoff of cotton, for example, deprived the North of an important commodity for reexport and of a raw material for finished goods. But if temporary real shocks caused the exports of specie, there should have been a reflux after the war. However, as Figure 1 shows, the use of specie remained depressed until resumption.

In using the law, we must be precise about the role specie is being driven out of. To judge by what Mitchell, Walker, and the others say, specie was driven out of use as a medium of exchange almost immediately after the banks suspended specie payments and the government issued the greenbacks. But specie did not actually leave the country until some years later.

A thin residue of gold remained. Gold and paper money were imperfect substitutes

for some purposes: servicing and paying the government's bonded debt, paying railroad gold bonds and the interest on them, paying customs duties, diversifying asset portfolios, and buying things abroad -- gold and paper money were imperfect substitutes. The gold residue probably did not reflect any denominational differences between paper money and gold because they were generally available in the same denominations. National banks could issue greenback-convertible notes in large denominations, and checks could be written for any amount. But the main point is that the vast bulk of gold and silver was driven from ordinary circulation, just as the law predicts. Earlier writers, Laughlin for example, who described this period as one confirming the law, recognized that a premium on gold had developed and that a residue of gold had remained. They held a "93 percent version of Gresham's law."

D. Gold in California During the Greenback Era

During this entire period, however, as Mitchell and the others noted, California clung to the standard weight of gold as its unit of account, and the greenback fell to a discount. In July 1864, for example, a U.S. note denominated "$1" sold for as little as $.35 gold (Wright, 1916/1980, p. 87). In California, the greenback never became anything more than an ordinary item of commerce and, until resumption, had a flexible nominal price, though one constrained by the eastern price of gold.[10] "While the value of the national paper currency was bobbing up and down like a cork on waves," one historian of California banking says, "California handled such currency as it handled other forms of merchandise, and it was bought and sold daily by brokers" (Wright, 1916/1980, p. 87).

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[10]The situation in Oregon was similar. See Gilbert (1907).

Greenbacks fared poorly in California despite their status as legal tender. Newspapers sometimes served public notice that a certain person had, at its face value, forced the depreciated government currency upon his creditors, a policy known as "greenbacking."[11] The California legislature passed the Specific Contract Act of 1863, upheld by the California Supreme Court and, later, by the United States Supreme Court, to permit contracts written explicitly in terms of the gold dollar (Moses, 1893).

Why did gold remain at par in California and the greenback fall to a discount? Some writers have pointed to the Specific Contract Act as an important legal force. Gold, however, never relinquished its role as California's unit of account. Rather than establish new precedent, the Specific Contract Act legitimized the prevailing state of affairs. Futhermore, the act did not address spot transactions. Nothing in the law precluded posting prices in greenback dollars and offering a premium to someone willing to pay in specie.

Our explanation for California is actually the reverse of our explanation of what happened in the East. Initially in the West, gold faced little competition, because before the war, California had no state-chartered banks of issue. In fact, California's constitution, written in 1849, prohibited paper money. Considerable private deposit banking developed, but deposits could not always substitute for hand-to-hand money. A few private banks defied the law by issuing notes, but these notes could not swim against the tide of public opinion. Because, Californians used gold more extensively than Easterners at least before the Civil War, a gold-dollar unit of account was more plausible in California than in the East.

When the greenback appeared, in other words, California was close to the tipping

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[11]Cross (1927, p. 342) gives some examples of the notices.

point. Absent local pressures from gold producers, however, California might have tipped toward the greenback, since greenbacks were legal tender and had the support of the central government. Evidently, local political pressures were sufficient to push California toward gold. California passed the tipping point, and the use of gold became universal. The extreme monetary politics (such as denouncing "greenbacking") that pushed the economy toward gold were then no longer necessary. Banks of issue did not emerge in California until the U.S. Congress passed legislation authorizing National Gold Banks. No California banks issuing greenback-denominated liabilities were chartered until general specie payments resumed in 1879. The ploys and prejudices that merchants in California used to get past the tipping point are similar to pressures an ethnic group can exert to have its language preferred, such as French in Quebec and Catalan in Catalonia.

California's adherence to the gold standard split the country into two distinct monetary areas. A flexible rate of exchange linked the greenback and the gold dollar and hence the country's two sections. The process by which California tipped toward gold, though fascinating, lies outside the scope of the law because the law assumes the community has an established unit of account.[12] The greenback's failure to achieve unit-of-account status in California, therefore, is no more a signal of the failure of Gresham's law than the "cheaper" Canadian dollar's failure to gain adoption in New England.

E. The Trade Dollar

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[12]This assumption was recognized by Fetter (1931), who pointed to a similar problem in interwar China. Merchants had to choose between local Chinese currencies and the Japanese currency.

The last alleged contradiction of the law in the United States offers a peculiar twist. In 1873, hoping to encourage the China trade, Congress authorized minting a Trade dollar containing 378 grains of silver.[13] Then, in 1878, came the Bland dollar, as it was called, which contained the usual 371.25 grains. The Bland dollar circulated at its face value, and the Trade dollar, according to Rolnick and Weber (1986, p. 190), often passed at its bullion value of about 93 cents. Again, we have something that looks like a violation of the law, though oddly, good money appears to have carried a discount.

The story of the Bland dollar is not a problem. The Bland dollar had unlimited legal-tender status and could be exchanged for $10.00 silver certificates, which were accepted at par, along with gold dollars, to discharge customs duties. Because the market price of silver was below the mint price, the Bland dollar was actually a subsidiary coin.

The story of the Trade dollar is more complicated. Congress inadvertently gave the Trade dollar legal-tender status for sums under 5 dollars (Gilbert, 1917, p. 96). In July 1876, however, Congress revoked that provision. Even after 1876, the Trade dollar circulated at its face value in certain areas. The Trade dollar was issued by the U.S. mint, looked very much like a standard silver dollar, and actually contained more silver. (Although both were subsidiary coins.) Individually, therefore, merchants hesitated to refuse or discount the coin. But numbers offered safety, and trade associations successfully worked to ban the Trade dollar from general circulation.

In California, the Trade dollar disappeared as early as 1878 (Willem, 1959, p. 126). In New York, however, the matter did not come to a head until 1883. The New York Times

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[13]The best overall history of the Trade Dollar is Willem (1959).

in June 1883, noted that at a meeting of produce dealers, strong disagreement arose over whether to ban par acceptance of Trade dollars (Willem, 1959, p. 133). But, the movement was gathering steam. Bankers Magazine (cited by Taxay, 1966, p. 284) reported that in certain lines of business, the pressure to refuse Trade dollars had succeeded completely, and that in others it had succeeded partially. Where pressure had only partially succeeded, merchants would give credit but not change for Trade dollars.

Late in June 1883, posters suddenly appeared in New York warning people not to accept the Trade dollar at face value. According to Willem (1959, pp. 133-134), the warnings had an immediate effect. Trade dollar ceased circulating at par and began gravitating toward bullion dealers. Trade dollars continued to be used in the China trade, but not in the United States.

Other forces helped push the Trade dollar out of domestic circulation. The government worked against the Trade dollar. For example, the U.S. Post Office would not accept it. Banks, too, generally refused to accept Trade dollars, except for large deposits by favored customers. Deposits that banks did accept were accepted at their bullion value. Although we have not found a specific regulation, perhaps the Trade dollar, lacking legal-tender status, could not fulfill reserve requirements.

The pressure on Congress to redeem the Trade dollar strengthened with its demonetization since some Trade dollars remained in the hands of ordinary citizens who had accepted them at face value. Formulating a redemption bill that would satisfy both silver and gold interests within the Congress proved difficult. Not until 1887 did legislation finally pass

authorizing redemption of Trade dollars.[14] For six months, unstamped, full-weight Trade

dollars were redeemed at face value in standard silver dollars.[15]

In short, although the Trade dollar did circulate at its face value while it had legal-

tender status and to a limited extent afterwards, we find no evidence that it ever circulated at

a discount as hand-to-hand money. Only when ordinary merchants dealt with bullion dealers

did the discount apply. The experience in New York, particularly, shows that once the

proportion of users falls below the tipping point, the transition from one equilibrium to

another can occur very rapidly.

4. Conclusions

Gresham's law describes a process in which one component of the money supply (bad

money) expands at the expense of another (good money). Operation of the law depends on

several empirical considerations: (a) existence of an important nonmonetary demand, perhaps

foreign-trade related, for good money, (b) a "sufficient" increase in bad money to raise the

bullion value of good money above its face value, and (c) close substitutability of the two

moneys for monetary purposes. Condition (c) rules out cases in which bad money is a minor

component of the money supply having strong elements of complementarity with other

components. All these conditions depend on an antecedent condition, (d), that bad money has

been accepted by the community as a means of exchange.   Fulfillment of these

conditions means that an increase in the supply of bad money will be primarily reflected in a

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[14]Speculation that the Trade dollars would eventually be redeemed at par served, of course, to keep them circulating at par.

[15]Chinese merchants would stamp coins (the stamps were known as "chop" marks) to indicate that they were genuine.

reduced supply of good money in circulation. During the process, a premium may well develop on the contracting component of the money supply in sheltered markets and on money sold in bulk to bullion dealers. The premium, far from contradicting the law, is a natural part of its operation, serving to reward arbitragers as they remove good money from domestic circulation.

An interpretation of Gresham's law resting on the assumption that bad money is a perfect substitute for good money and that all adjustment takes the form of quantity changes is overdemanding and inconsistent with earlier usage.

The assumption that bad money is generally accepted as a medium of exchange deserves more attention. An attempt to introduce a new money can result in either general acceptance, like what happened with the greenback in the East during the Civil War and with the Bland dollar during the postbellum period, or in general refusal, as with the Greenback in the West and the Trade dollar. The direction in which the system moves can be described by a Schelling tipping model and depends on the initial conditions, legal-tender laws, bank regulations, the role played by trade associations, and so on. Typically, the incentives provided by legal-tender laws and other forms of government support will cause the system to tip toward acceptance of bad money. In unusual cases, however, as when countervailing political forces develop, the system may tip toward good money as bad money fails to gain currency. Once the system has tipped, Gresham's law has wide scope to operate.

Our main conclusion is that a "93 percent" version of Gresham's law held in all of the nineteenth-century cases advanced as possible failures of Gresham's law: In no case did the domestic circulation include both good and bad money with good money circulating at a

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premium. (1) Lighter U.S. and Spanish silver dollars drove heavier Spanish dollars out of circulation before and after establishment of the U.S. mint; heavier Spanish dollars did not circulate domestically at a premium. (2) In the period between 1810 and 1834, silver, overvalued, drove gold out of circulation. Although the mint did produce some gold coins, they were exported or melted for non-monetary use, not placed into circulation. (3) During the period 1834 to 1862, when the mint overvalued gold, gold drove silver out of circulation. The few silver dollars minted were mostly exported. (4) During the Greenback Era, paper drove gold and silver out of eastern circulation. The small amounts of gold money remaining were used in sheltered markets. (5) Gold-convertible media of exchange circulated in California, but in California the greenback never gained acceptance. Locally, gold and greenbacks did not circulate alongside one another on either coast. (6) The Bland dollar and the slightly heavier Trade dollar circulated at par before 1878 when they both had legal tender status. They were both subsidiary coins. The Trade dollar maintained a limited circulation at par even after losing legal-tender status in 1878, but was eventually driven from circulation by the combined efforts of the government and the trade associations. The Trade dollar, redeemed in 1887, never circulated domestically at a discount.

Gresham's law worked because people prefer a single, definite unit of account. The United States of the nineteenth century had a strong government, an effective legal system, and a highly developed and through most of the period a heavily regulated banking system. Legal tender laws were important. Modern computational techniques and the rapid flow of information have reduced the costs of using a dual or multiple-money system. The process of dollarization found in Peru, Israel, and other countries today shows this effect. Such cost-

reducing advantages, however, did not exist in nineteenth-century America.

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Appendix A

Money and Specie, 1850-1890

Appendix Table 1 shows the data that underlie Figure 1. A considerable margin of error surrounds these figures, but they appear to be adequate for a test of Gresham's law. In describing the derivation of these numbers, we consider the three periods 1850-1859, 1860-1866, and 1867-1890 separately.

1850-1859. The data for this period are the end-of-year estimates that Friedman and Schwartz (1970, pp. 222-225, Table 13) give for the whole country, money being defined as the sum of (1) specie (gold and silver) held by the public, (2) bank notes held by the public, and (3) deposits held by the public. The money total comes from summing Friedman and Schwartz's columns 5, 12, and 17. For most years, the total is the same as given by George Macesich (Friedman and Schwartz, 1970, p. 232). The exception is 1850, when Macesich's estimate is about 5 percent higher. The data come quite close, too, in most years, to the estimates that Temin derives, though on a slightly different definition.

1860-1866. The data for this period are June estimates. To get the 1862-1865 estimates, which are for the loyal states only, we used the components given by Friedman and Schwartz (1970, Table 13, pp. 224-225) and defined money as the sum of (1) specie held by the public, (2) bank notes held by the public, (3) bank deposits held by the public, and (4) government currency issues. (Because the South may have had an unusually high ratio before the war, excluding the South may exaggerate the fall in the specie-to-money ratio somewhat. But the South's banking system was well-developed, and it seems unlikely that excluding the South would introduce much bias.)

For specie held by the public, we used the total stock of specie, reduced for 1862-1865 by the $38 million estimate of the South's specie stock (Carothers, 1930, pp. 151-153), less the sum of (1) specie held by the Treasury (in excess of the amount backing Treasury Certificates), (2) specie held by the national banks, and (3) specie held by state banks. The raw data come from Friedman and Schwartz (1970, Table 13, cols. 1, 2, 3, and 3a.): (a) They give annual estimates of the Treasury's specie holdings. (B) Specie held by National banks in 1865 and 1866 comes from Friedman and Schwartz. We estimated the amount of specie that national banks held in 1864, their first year, by applying the 1865 specie-to-note to notes and the specie-to-deposit ratios to deposits reported for 1864. (c) Specie held by state banks is estimated at June dates for 1860, 1861, and 1862 by interpolating (logarithmically) between end of year figures given by Friedman and Schwartz. They provide the June 1863 estimate. The June 1864 estimate is interpolated from the June 1863 estimate and a June 1865 estimate, both based on the specie reserve ratio of the national banks. The June 1866 estimate also is based on the specie reserve ratio of the national banks.

Government currency issues includes postage currency, fractional currency, old demand notes, U.S. notes (greenbacks), one-year 5 percent Treasury notes of 1863, two-year Treasury notes of 1863, and compound-interest notes. The last three were interest-bearing notes intended to circulate as currency. Evidently, the Treasury document on which Friedman and Schwartz (1970, p. 228) relied does not note inclusion of these items as part of currency. But a comparison with the break-down given by Mitchell in A History of the Greenbacks (1903, p. 179) reveals that the Treasury included these items in the totals that it

reported. Since the qualitative evidence suggests these items did circulate, at least to some extent, we included them, along with ordinary currency, in the money stock for the Civil War years.

Holdings of government currency issues and bank notes held by state and national banks are not reported in full for the war years. Estimates of notes held by state banks in 1860 and 1861 are interpolated to June dates from end-of-year estimates. For 1862, an estimate of notes held by state banks comes from the figure on government currency issues held and the estimate of state bank notes that state banks held at the end of 1861. The estimate for 1863 is based on the aggregate reserve ratio for 1862 and also the estimate of specie held by state banks reported by Friedman and Schwartz. To get the estimate for 1864, we interpolated between the estimate for 1863 and an estimate for 1865 based on the note-reserve ratio of national banks. The estimate for state banks in 1866 also is based on the note-reserve ratio of national banks.

Friedman and Schwartz did not attempt to combine their bits of data into money stock estimates, probably because a wide margin of error would attach to these estimates, a far wider margin than attaches to their estimates that begin in 1867. Since interest in this period continues strong, however, we give our estimates in Appendix Table 2.

1867-1890. We used the estimates that Kindahl (1971, p. 475) gives of the money supply for 1867-1882, adjusting upward for the premium on gold. For the period 1883-1890, we used the June figures reported in Friedman and Schwartz (1970, p. 7, col. 9). All estimates are for M2.

Specie is the sum of gold and silver held by the public and valued at the greenback

price. To get the face value of the public's specie holdings, we estimated the total amount of gold and silver outside the Treasury and then deducted an estimate of gold and silver held by banks. Gold outside the Treasury for the period 1867 to 1882 is the estimate that Kindahl (1971, p. 475) gives. For 1883 to 1890, gold outside the Treasury is the stock of monetary gold that Cagan (1965, p. 340) estimates, less gold held by the Treasury as Friedman and Schwartz (1963 p. 130) give it. Silver outside the Treasury is the sum of silver dollars, silver certificates, and subsidiary silver from U.S. Bureau of the Census (1975, series X426, X427, and X429).

To estimate the face value of banks' specie holdings, we began with the specie held by National Banks, as given by the U.S. Comptroller of the Currency (1918, pp. 200-201, 248-256). Since specie holdings varied significantly over the year, we used the average for all call dates within the year. For the period 1880-1890, we deducted Clearing House Certificates from "total specie," since, apparently, during these years, "total specie" included them. Then, to get our estimate of specie held by all banks, we multiplied specie held by national banks by the ratio of all bank vault cash to national bank vault cash. Our estimates of bank vault cash come from Friedman and Schwartz (1970, pp. 340-341). We used an average of their quarterly figures to get annual estimates.

To get the public's specie holdings adjusted for the premium on gold, we multiplied our face-value estimate of the public's specie holdings by the ratio of gold outside the Treasury to specie outside the Treasury, both at face value, and then multiplied by the premium on gold. We then added the result to our face-value estimate of specie held by the public, obtaining our estimate of the public's specie holdings at greenback prices. In effect,

our procedure assumes that banks held gold and silver in the same ratio as the public held them.

Adjustments for Pacific Coast and Customs Duties. No exact data on specie used on the Pacific coast during the Greenback Era or for gold used in paying customs duties are available. We can, however, construct some plausible estimates.

Mitchell (1903, p. 179) reports estimates of gold and silver circulating on the Pacific coast, 1862-1866. For the prewar period, we projected the 1862 estimate backward on the basis of population. For the postwar period, we took specie holdings as unchanged, assuming that the notes and deposits of national gold banks and then, after resumption, ordinary national banks, met the demand for increased money holdings.

To estimate the amount of gold used to pay customs duties, we multiplied the customs duties by the ratio of the public's currency holdings to GNP. This crude expedient assumes that, relative to customs duties, money was held in the same amount as relative to GNP (i.e., that the money held against these payment streams is divided in the same proportion between currency and deposits, but that all currency held against customs duties took the form of gold). Customs duties are from U.S. Bureau of the Census (1975), series Y353, and currency held by the public for 1850-1867 are our estimates, based on Friedman and Schwartz and described in our discussions of the money stock figures above.) For the period 1867-1890, we used the nearest mid-year observation given by Friedman and Schwartz (1963, pp. 704-705). GNP comes from Berry (1988, pp. 26-27).

Appendix Table 1

Specie-to-Money Ratio, 1850-1890

	(a)	(b)	(c)	(d)	(e)
	percent			00's at greenback prices	
	Specie Money Ratio Outside Pacific Coast & Customs	Specie Money Ratio Outside Pacific Coast	Specie Money Ratio	Specie (thousands at greenback prices)	Money

Year

Year	(a)	(b)	(c)	(d)	(e)
1850	33.57	34.34	35.43	127700	360400
1851	32.57	33.50	34.79	142100	408500
1852	35.48	36.32	37.70	170200	451400
1853	29.18	30.12	31.75	160300	504900
1854	32.02	32.92	34.72	176600	508700
1855	29.24	29.91	31.96	170800	534500
1856	28.83	29.63	31.77	182500	574500
1857	33.03	33.73	36.42	173800	477200
1858	21.98	22.51	25.53	139600	546800
1859	22.63	23.23	26.38	149100	565200
1860	21.61	22.24	25.77	142700	553700
1861	27.58	28.00	31.16	187800	602700
1862	17.20	17.73	20.97	147767	704600
1863	22.68	23.21	26.12	252010	964900
1864	17.47	18.06	21.19	286327	1351400
1865	7.53	8.02	10.48	145180	1384700
1866	8.97	9.89	12.56	167923	1336600
1867	2.27	3.15	5.91	77459	1311000
1868	0.43	1.21	4.02	53114	1320000
1869	0.91	1.76	4.49	58601	1304000
1870	1.07	1.96	4.26	58473	1373000
1871	0.08	0.99	3.06	46026	1504000
1872	1.00	1.78	3.68	60088	1632000
1873	0.62	1.30	3.23	52782	1632000
1874	0.41	0.97	2.85	47093	1650000
1875	0.86	1.38	3.24	55229	1703000

1876	1.13	1.64	3.50	58179	1663000
1877	2.19	2.65	4.42	72565	1640000
1878	2.36	2.89	4.71	73264	1557000
1879	2.90	3.46	5.19	83974	1619000
1880	7.18	7.77	9.12	180212	1976000
1881	10.29	10.86	11.94	286047	2396000
1882	11.75	12.28	13.26	343518	2590000
1883	12.40	12.92	13.80	390677	2830000
1884	12.83	13.32	14.22	393947	2770000

1885	11.81	12.23	13.12	375250	2860000
1886	9.92	10.33	11.16	346054	3100000
1887	11.62	12.03	12.80	422413	3300000
1888	13.79	14.17	14.90	503769	3380000
1889	13.97	14.33	15.02	533341	3550000
1890	13.51	13.86	14.49	568159	3920000

Notes: 1850-1859, end of year; 1860-1866, June; and 1862-1865, loyal states only.

Appendix Table 2

The Stock of Money in the Civil War
($ millions)

Year	Specie Held by Public (official prices)	Government Currency & Banknotes Held by the Public	Deposits Held by Public	Total Money (official prices)	Total Money (Greenback prices)

1860	142.7	180.9	230.1	553.7	553.7
1861	187.8	169.1	245.8	602.7	602.7
1862	138.1	251.9	305.7	695.6	704.6
1863	173.8	365.3	348.5	887.6	964.9
1864	135.7	635.9	429.8	1201.3	1351.4
1865	103.7	610.6	628.8	1343.1	1384.7
1866	112.7	536.8	632.2	1281.7	1336.6

Notes: June estimates. For 1862-1865, the estimates are for the loyal states only. Gold coin

and certificates held by the public have been valued at greenback prices. No adjustments

have been made for gold deposits. Totals may differ from subtotals as a result of rounding.

Appendix B

A Quantity Theory Approach to a Dual Currency

We assume two monies are circulating that are not perfect substitutes. One of them,

for example, might be useful in foreign trade or have greater long-run value because of its

bullion content. Both moneys combine to produce monetary services through a constant-

elasticity-of-substitution production function, and people demand these services in a fixed

proportion to their income. People post prices in terms of bad money, but some transactions

are made with good money, at a premium. The quantity equation in our model would appear as:

(1) $[Mg^{-\alpha} + Mb^{-\alpha}]^{-(1/\alpha)} = kPy,$

where, Mg is good money,

Mb is bad money,

k is the ratio of income to monetary services

P is the price level, and

y is real income.

Equation (1) contains the conventional quantity theory (Mg+Mb = kPy) as the special case in which the elasticity of substitution ($\sigma = 1/[1+\alpha]$) is infinite.

As usual, the value of the marginal product, here good money's marginal product in producing monetary services, equals its price. Taking bad money as numeraire, we obtain our marginal conditions, which when combined, yield the following equation for Pg, the price of good money.

(2) $Pg = (Mb/Mg)^{(1/\sigma)}$

Equation (2) says that good money's price depends on the relative amounts of good and bad money and also on their elasticity of substitution. As the elasticity of substitution approaches infinity, the price of good money approaches one. The premium, that is, disappears. Focussing solely on the existence of a premium on good money, therefore, can be misleading. A premium would signify a less-than-infinite elasticity of substitution. But (2)

shows also that if the elasticity of substitution is "high," a "moderate" premium on good

money can develop even while bad money replaces good money almost completely.

To close the model, assume that the government arbitrarily determines the amount of

bad money, Mb, and that a constant-elasticity supply function (3) determines the amount of

good money, Mg.

(3) $Mg = S(Pg/P)^\mu$

The supply function reflects the nonmonetary (or foreign monetary) demand for dear money.

(Here, we have in mind a fiat money as the bad money. If each money was a commodity

money, say silver and gold, we would have included a supply function for the bad money,

too.) Taking time rates of change of (1), (4), and (5), holding S constant, using s to denote

the initial ratio of good money to bad money, and then combining terms yields the following

expression for E, the percentage change in good money produced by a given percentage

change in bad money.

(4) $E = \{\mu[1-\sigma(1-s)]\}/\{\sigma+\mu(1+s\sigma)\}$

Evidently, the degree to which bad money physically drives out good money is a complicated

function of the two moneys' elasticity of substitution, good money's elasticity of supply, and

the initial relative importance of good money. In general, the greater the elasticity of

substitution and the greater good money's supply elasticity, the greater the degree of driving

out. If each of the two elasticities were infinite and if good money accounted for half the

money supply, then (4) would give the archetypal case: each added dollar of bad money would physically displace a dollar of good money and no premium on the dear money would appear.

But why exclude cases that nearly but do not quite fit this one? To test Gresham's law, we should look at how the stocks of good money and bad money actually change. The existence of a premium rejects an extreme version of the law, but a more moderate version may still hold.