Avoiding a meltdown: Managing the value of small change

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Introduction and summary

In 2007, the American bald eagle, a symbol of our nation, was removed from the threatened species list. But another American icon (or two) might well take its place on the list. On December 14, 2006, the United States Mint announced new regulations "to limit the exportation, melting, or treatment" of the American penny and nickel coins. The purpose of these regulations is "to safeguard against a potential shortage of these coins in circulation." The regulations make it illegal to export, melt, or treat one-cent and five-cent coins of the United States, except in some cases or with the Secretary of the Treasury's explicit permission.[1]

Our pennies and nickels, it turns out, are threatened with extinction by melting. Why that is the case, and what can be done about it, is the subject of this article. As inflation erodes the value of money, a coin of a given denomination (say, one cent or five cents) loses value. But coins are made of a physical material whose intrinsic value is usually low relative to the value of the coin, yet not negligible. Every now and then, we reach a point where the market value of the coin (its purchasing power) drops close to or below the intrinsic value of the materials used to make it. Our pennies and nickels have now reached that point.

This has two consequences. One is that the Mint is producing these coins at a loss. It now costs 1.67 cents to make a penny and 5.97 cents to make a nickel. The other is that it can be profitable to melt down the coins and recycle their metal content. The Mint's regulations were announced because we are close to the melt-down point for pennies and nickels.

The problem we are now facing is infrequent but, in many ways, a very old one. Seven hundred years ago (in the statute of 1299), the Parliament of England enacted that "no good money of silver, of the king's coin or other, nor any silver in plate or otherwise, should go forth or be carried out of the Realm or out of the King's power into foreign parts without especial leave from the king" (Ruding, 1817–19, Vol. 1, p. 385). This was the first of many such prohibitions—sometimes under penalty of death.

These prohibitions were passed at a time when money was different from ours, that is, when it was made of precious metals like gold and silver. Our money does not derive its value from its intrinsic content, which should be immaterial. In this article, I will first explain how a medieval problem can reappear in modern times. I will provide a quick overview of the history of American coinage, highlighting earlier instances of such problems, in particular the coin shortages of 1964 and 1965, and what solutions were adopted then. I will then discuss possible remedies to our current situation.

Historical background

The economy needs money to operate. Money is commonly described as having two functions: a unit of account in which prices and obligations are denominated and a medium of exchange in actual transactions. The two functions are logically distinct, but typically the unit of account has been tied to an actual medium of exchange. Coined money—that is, standardized quantities of metal shaped into a convenient form for everyday use—was introduced in Europe in the sixth century BC, and has served as a medium of exchange for almost all of subsequent history; and the unit of account has consequently been tied to the metal or metals coined.

In medieval Europe, where our modern system has its roots,[2] the metal was silver; the coin was the penny, made of silver alloyed with a little copper for

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convenience. Governments set the standards by deciding how much metal went into a penny. The quantity of money was determined by the private sector, in the following way. If more money was needed, metal was brought to the mint and transformed into new coins, usually for a fee called seigniorage. If less money was needed, money was melted down and the metal turned to other uses. The signal for minting or melting was given by the price level (the inverse of the value of money): If silver in the form of coins was too cheap, it was profitable to turn it into bullion; if it was too expensive, it was profitable to sell bullion to the mint and acquire new coins. These two actions (and the equivalent actions of importing and exporting coins) served to regulate the price level.

The system worked well with one coin. But the growing needs of trade led to the introduction of larger silver coins and later even more valuable gold coins; and with multiple coins, the system does not work as well. The reason is that smaller coins are more expensive to make, in proportion to value, than larger ones. Mints were not subsidized and had to recover their production costs. This created a wider gap between minting and melting points for small coins than for large coins: The value of small coins had to go up higher before minting new ones became profitable (net of production costs). This led to a dilemma. If the mint bought silver for the same nominal price whether it paid in large or small coins, small coins had to contain less silver relative to their value and large coins might disappear and be melted down for their content. If the mint made all coins full-bodied, but charged more for small coins, large coins would be produced but not small coins, even when they were needed.

The Middle Ages were plagued with difficulties in maintaining an adequate supply of all denominations (Sargent and Velde, 2002). One common response to a shortage of one denomination was to prohibit the melting or exporting of the coins in short supply. The English statute of 1299 was an early example. It was followed within a few years by many other such statutes—a clear indication that such measures were difficult to enforce and had limited effect.

Another short-term solution was to debase the coin in short supply. Debasing a coin meant reducing its intrinsic content—for example, putting less silver in each penny. For a given market value of silver, debasement of one denomination can make it profitable to mint it again. In the case of medieval England, the cycle of melting prohibitions begun in 1299 led to a debasement of silver money in 1343. A debasement would restore the supply of the scarce denomination for a while, but inevitably shortages reappeared and further debasements followed. This repeated process led over time to pennies containing less silver and more copper, so much so that by the late eighteenth century, British (and American) pennies were made of pure copper.

A long-term solution was to return to the single-coin system, preserving the traditional minting and melting mechanism for one large gold coin and making the other coins token—that is, worth substantially more as money than as metal. The large coin pegged the value of the unit of account to a particular commodity, as in any commodity money system. Smaller denominations, however, were fiduciary; that is, their value in circulation was significantly higher than that of their intrinsic content. Their value came not from their content, but from a policy of convertibility: The authorities stood ready to exchange subsidiary coinage for gold coins, and vice versa. The provision of token coins was then left to the government, which bought and sold token coins on demand and made a profit from the substantial difference between face value and content. This is called the gold standard, and it became the norm, after much experimentation, in most countries by the end of the nineteenth century.

The U.S. monetary system, which Congress has sole power to regulate, began in 1792 as a bimetallic system.[3] This is a system in which silver and gold coins are provided by the minting and melting mechanism, and both coins play the same role as anchor of the monetary system. The founding fathers did not innovate at all in monetary matters. The bimetallic system was commonplace in Europe (though not in the mother country of Great Britain). The very mixed record of paper money during the colonial era, as well as the decidedly disastrous experience of the Continental money issued to finance the American Revolution, had predisposed the U.S. government to adhere to a commodity money system throughout the denomination structure. Even the smallest coins, the cent and half cent, were made of copper but were not token, which led to various problems. Copper was not that valuable and a cent's worth of copper was inconveniently large. Also, the world price of copper was volatile (because of its military uses), and it was difficult to maintain the cent at a fixed parity of 100:1 with the silver dollar. A similar problem arose from fluctuations in the relative price of gold to silver, which led to periods when no gold coin or no silver coin was minted and which prompted one debasement in 1834.

Prompted by the same forces as other countries, the U.S. gradually moved to a gold standard by making the smaller coins token. The first step was in 1853, when the silver content of quarters and dimes

was reduced relative to the silver content of the dollar coin. This proved difficult to enact, as there was reluctance on the part of many legislators to issue token money. Then, in 1873, silver dollars ceased to be minted on demand. The market value of silver fell substantially so that silver dollars became tokens too. The U.S. formally adopted the gold standard in 1900. Smaller coins were made of silver (the quarter and dime), nickel and copper (the nickel), or a copper alloy (the penny). The value of the silver in a quarter was around 10 cents. A quarter was worth 25 cents because the U.S. Department of the Treasury was always willing to exchange 40 of those coins for a gold $10 coin.

When the Federal Reserve System was created in 1914, the U.S. remained on a gold standard because Federal Reserve notes were redeemable on demand into gold at a fixed parity of $20.67 per ounce. The Great Depression, as well as the perceived need to increase the money supply without constraints to stimulate the economy, led to drastic changes. The gold content of the dollar was reduced by 40 percent, private holdings of gold by U.S. citizens were prohibited, and the Federal Reserve notes ceased to be redeemable on demand. The U.S. was on its way to a fiat money system (one in which money has value by fiat, that is, because the monetary authority or the government decrees it). After World War II, the Bretton Woods system restored a semblance of the gold standard, with foreign currencies convertible into dollars and dollars convertible into gold for foreigners. This lasted until 1971, when President Nixon closed the gold window and permanently severed the tie between the dollar and any commodity.

What about smaller denominations? In 1934, the Silver Purchase Act was passed, requiring the Treasury to purchase silver with the goal of reaching either a market price equal to its "monetary price" of $1.29 or a certain proportion of the monetary stock. The reasons for this action were complex: The issue of silver certificates in exchange for the silver purchased was to provide an additional avenue for increasing the money supply. Also, strong pressures from western states where silver was mined played a role in the legislation.

The market price of silver in late 1933 was 44 cents an ounce, and during the following years, the U.S. Department of the Treasury bought silver at above-market prices, between 50 cents and 77.5 cents an ounce, and after 1946 at 90.5 cents an ounce, accumulating a stockpile of 3,200 million ounces. By 1955, however, the world price of silver had risen to the Treasury's purchase price, and the Treasury began selling its silver, as it was authorized to do under existing legislation. Prices remained pegged at the Treasury's price of 90.5 cents an ounce, and the stockpile of silver that was not held to back silver certificates dwindled until November 1961, when President Kennedy stopped the sales. The price of silver started rising, and it reached the monetary price in September 1963.

At that price, the metallic content of dimes, quarters, half dollars, and dollars was exactly equal to their face value. Anyone needing silver for industrial uses could readily buy it on the commodities market as bullion or buy it from the banking system in the form of coins and melt them down.[4] As world supply and demand factors kept exerting upward pressure on prices, the U.S. monetary stockpile was drawn down, in various ways, either by redemption of silver certificates or else by the United States Mint working overtime to meet the "demand" for quarters and dimes. In early 1963, Treasury officials estimated that their silver supply would last 20 years. But the demand for subsidiary coinage proved unexpectedly strong, and the Mint's annual production quadrupled from 1963 to 1964. This was attributed initially to the growing use of vending machines, but it became clear that much of this demand was speculative: The public was buying the Treasury's stockpile at $1.29 an ounce in expectation of exhausting it and seeing the market price rise above the value they had paid. The Senate held hearings on the question in April and August of 1964 but came to no conclusion. The Treasury conducted its own studies and recommended in February 1965 that the silver content of subsidiary coinage be reduced or eliminated. In the end, following the recommendation of the Treasury studies, President Johnson proposed to Congress new legislation in June: It was swiftly voted into law and signed as the Coinage Act of 1965.[5]

The new law provided for the minting of the quarters and dimes made of copper and nickel (or cupronickel) that we know. The half dollar was replaced with a 40 percent silver core clad in copper and nickel.[6] The new quarters were issued in November 1965, by which time the reports of coin shortages had disappeared; dimes and half dollars followed in March 1966.

At the signing ceremony on July 23, 1965, President Johnson made curious remarks: "Some have asked whether our silver coins will disappear. The answer is very definitely no. … If anybody has any idea of hoarding our silver coins, let me say this. Treasury has a lot of silver on hand, and it can be, and it will be used to keep the price of silver in line with its value in our present silver coin. There will be no profit in holding them out of circulation for the value of their silver content."[7]

Indeed, the government's intention was not to replace silver dimes and quarters with cupronickel dimes and quarters, but only to reduce global demand for silver by removing the United States Mint from the ranks of the buyers. But keeping the existing stock of silver dimes and quarters in circulation was possible only if the price of silver did not rise above $1.29 an ounce. To achieve this, the Treasury had two means. One was its large stockpile of silver. The other was the authority given by the Coinage Act of 1965 to prohibit the melting and exportation of coins when necessary. The Treasury used both means in succession. First, for two years it sold silver at $1.29 an ounce, the price at which a quarter's content was worth 25 cents. The silver stockpile went from 1,200 million ounces in 1964 to 350 million in 1967. Then, using its new powers under the Coinage Act of 1965, it banned the melting, treatment, and export of silver dimes and quarters on May 20, 1967. Soon after, the Treasury stopped supplying silver at a fixed price on July 14, 1967, the day on which silver became "just another metal."

The prohibition met with some negative reactions in Congress, where two representatives introduced bills to repeal it, without success.[8] Although the ban was enforced and resulted in several indictments,[9] it did not prevent the disappearance of silver quarters and dimes from circulation. Silver half dollars had virtually disappeared from circulation by early 1966, and there were already reports of "culling" by consumers, that is, people picking out silver coins from their change and paying out only clad quarters.[10] By June 1968, the Treasury was itself melting silver quarters in its vaults, using new electronic sorting machines.[11] In August 1968, it was reported that dealers were paying 12 percent above face value for silver quarters and dimes. The combined forces of the Treasury and private speculators rapidly removed the silver coinage from circulation, making the ban moot. It was lifted in June 1969.

The provisions of the Coinage Act of 1965 were used a second time—this time to protect the penny. The peg to gold had ended in August 1971. Inflation was rampant, and commodity prices were exploding. On April 1, 1974, the price of copper reached a record of $1.40 per pound. At the time, 154 pennies contained one pound of copper. Although copper prices fell back somewhat, the demand for pennies rose to suspiciously high levels. The Treasury concluded that hoarding was under way in expectation that it would become profitable to melt pennies, and it announced the ban on April 18, 1974.

A few months later, Public Law 93-441 (31 USC 5112(c)) granted to the Secretary of the Treasury the power to change the proportion of zinc and copper in pennies to ensure adequate supplies. This gave the Treasury the option to replace copper with zinc in the composition of the penny, at its discretion. Copper prices stayed below the penny's melting point in subsequent years, so the ban was lifted in June 1978 without any further action. Soon, however, copper prices rose again and hit another record of $1.44 per pound on February 12, 1980. The Treasury briefly considered another ban, but instead used its statutory authority to change the composition of the penny, almost reversing the proportions. The Mint announced in June 1981 that, instead of 95 percent copper and 5 percent tin and zinc, pennies would be primarily zinc with a coating of copper; production started early the following year. As in 1965, no effort was made to retire the older coins: They were allowed to remain in circulation side by side with the new pennies.

Most people do not know that all pennies are not the same. Lincoln's profile has been unchanged since 1909. But take a penny dated 1983 or later and scratch its surface; you will see the shiny white zinc underneath the copper coating. As for the nickel, its size and composition have not changed since 1866. The effort to maintain the outward appearance of the coinage suggests the importance of habits in our attitudes toward coinage and currency.

The current situation

Between 1982 and 2004, the price of copper surged to the level of $1.50 per pound a few times, briefly. But in late 2004 it reached that level once more and has not come down since. Other commodities have surged in value as well, notably zinc and nickel. Table 1 shows the current value of the metal contained in U.S. coins.

The values shown in table 1 do not properly measure the profit to be made by melting down the coins. It would be necessary to subtract melting and refining costs (scrap copper is worth about 20 percent less than high-grade copper whose price is used in table 1). Collecting and shipping the coins for melting would impose additional costs, and those costs would be relatively larger for the smaller denominations, since digging a penny or a nickel out of a sofa requires the same effort.

Nevertheless, in 2006 some businesses became interested in the activity and inquired with the Mint about the legality of melting down coins. One firm in a midwestern state even began buying pennies from banks and sorting them to extract pre-1982 copper pennies. When the regulations were issued in December 2006, the Treasury had good reason to think that melting pennies and nickels was close to being profitable.

TABLE 1

Intrinsic value and composition of U.S. coins, 2007

Coin	Composition (percent of metal)	Intrinsic value (percent of face value)
Penny	95 zinc, 5 copper	69.7
Penny (pre-1982)	95 copper, 5 zinc and tin	209.5
Nickel	75 copper, 25 nickel	136.2
Dime, quarter, and Susan B. Anthony dollar	75 copper, 25 nickel	20.9
Golden dollar	88.5 copper, 2 nickel, and 3.5 manganese	5.7

Note: These are data as of November 14, 2007.
Sources: Author's calculations based on data from the United States Mint and Haver Analytics.

The nature of the problem

This brief historical overview frames the problem, which is something of a paradox.

A fiat money system is one in which money has value by fiat, that is, because someone said "let it be so." Economists like to describe money in their models as "intrinsically useless pieces of colored paper" because the challenge for monetary economics is to explain the value of such objects. For objects that are not intrinsically useless, we have standard price theory. For claims on objects that are not intrinsically useless, we have finance theory.

Since at least 1971, the U.S. has operated under a pure fiat money system, in which the intrinsic value of the objects used as a medium of exchange should not matter. This is in stark contrast with the commodity money regime of 1900. In that regime, the intrinsic content of coins provided a floor below which the value of coins could not fall, and minting on demand provided a ceiling above which it could not rise. The gap between floor and ceiling was usually fairly small. Under a fiat money regime, the ceiling is removed, as there is no minting on demand. The floor is normally of no consideration because no one pays much attention to the content of coins (copper pennies and zinc pennies circulate at par, although the content of the former is twice as valuable as the content of the latter). The stock of money, and its value, is determined not by minting and melting, but by the monetary authority's policy. In this respect there is no difference between notes and coins. The value of a dollar bill has nothing to do with its alternative uses as wallpaper or insulating material. Pennies and nickels are like notes, except they are made of something more durable than paper.

Now that all our currency is fiduciary (that is, with a market value higher than the intrinsic value), the market value of the tokens we use in physical transactions should be of no consequence to their value. The problem of small change was a difficult one to solve under a commodity money regime, but in a fiat money regime shortages of small change should not occur. The value of pennies and nickels has reached the floor set by their intrinsic content. We are printing our money on needlessly expensive material.

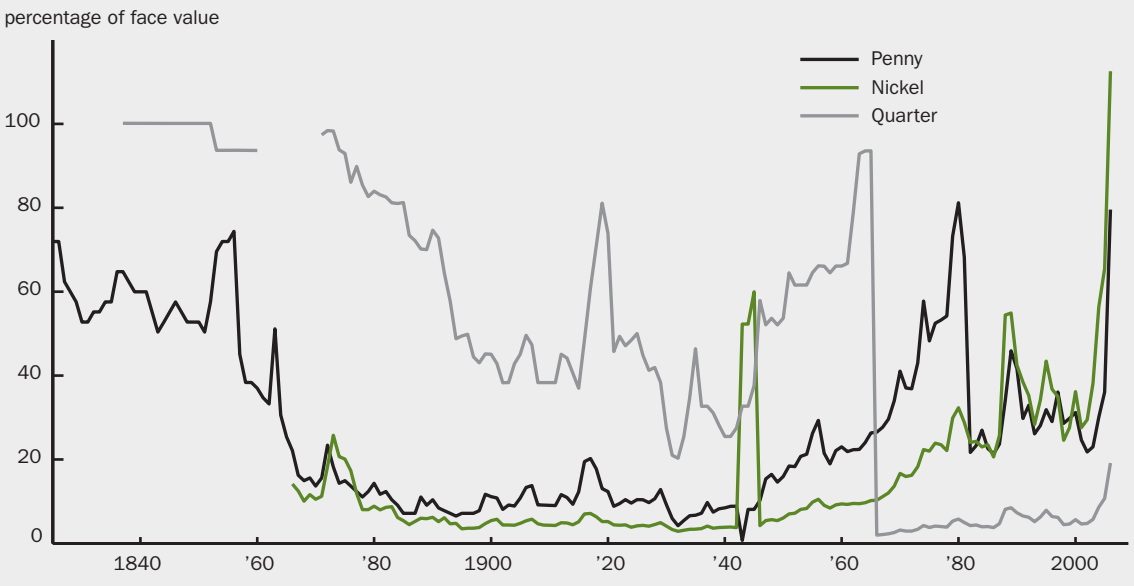
The historical overview also shows that this problem is not new. Figure 1 shows the value, as a percentage of face value, of the intrinsic content of coins minted every year since 1825 for three denominations. For all three types of coins (the penny, nickel, and quarter), there is over time a general upward trend; every time the value comes close to 100 percent, it becomes necessary to change the composition, which has the effect of abruptly lowering the value of the intrinsic content. The quarter began at 100 percent because it was a full-bodied coin, but in 1853 it became a subsidiary coin, overvalued relative to its silver content.[12] Figure 1 clearly shows what happened in 1965, when its composition was changed from silver to cupronickel. The line for the nickel displays a sharp uptick during World War II. At that time, nickel being needed for the war effort, nickels were made of silver. These coins swiftly disappeared in the early 1960s when the price of silver began to rise. Finally, the penny's line falls sharply in 1982 with the switch from copper to zinc.

The authority that the Secretary of the Treasury is using today to prohibit the melting and exportation of pennies and nickels was granted during the shortage of quarters and dimes in 1964–65. This authority was used to protect pennies in 1974. In each instance when the intrinsic value of the coin exceeded its face value, the long-term solution was to change the composition of the threatened coin.

Logic suggests, and history shows, that prohibitions on melting will not solve the problem. If it is really profitable to melt pennies or nickels, people will do it. The ban imposed in 1967 was lifted in 1969 because the coins it was designed to protect had disappeared. Such stopgap measures at best increase the costs of melting by a small amount—the probability of being caught times the penalties imposed. Devoting enough law enforcement resources to increase the probability of catching penny smelters hardly seems worthwhile. Alternatively, speculators can simply hoard the coins and incur time and storage costs as they wait for the regulations to be repealed. Those costs are real, but

FIGURE 1

Intrinsic value of U.S. coins, 1825–2006



Note: No quarters were produced from 1861 through 1870.
Sources: Author's calculations based on data from the United States Mint; and the U.S. Department of the Interior, U.S. Geological Survey.

they are modest compared with potential movements in commodity prices.

What drives this long-term trend in the intrinsic content of coins? Inflation is the answer. Although it was not much of a force in the nineteenth century (the price level was about the same in 1913 as in 1825), in the twentieth century it has been the main culprit. Money steadily loses its value relative to other goods, including the goods with which it is made. In other words, the floor on the value of coins is always creeping up, however slowly. In countries with high levels of inflation, the process can be rapid, and coins become obsolete in a matter of a few years. Our relatively low inflation in the U.S. means that these problems occur relatively infrequently, but they do occur.

The upward trend can be accelerated if metals rise in price faster than other goods. Figure 2 plots the real price of several metals that have been used in coins, deflated by the Consumer Price Index. The evidence is rather mixed. For some metals, such as aluminum, the secular trend is clearly downward. For other metals, there are long cycles—for example, the rise in the 1970s and the fall in the 1980s and 1990s. Since 2000, however, all metals have shown a sharp increase. The recent surge in commodity prices may arguably be speculative, and prices could well come down again, lowering the floor for a while. But as long as inflation is positive, the real value of a penny (which is always $0.01 in nominal terms) will fall relative to goods and services. When zinc replaced copper in the manufacture of pennies in 1982, the respite gained was relatively brief, since zinc was only half as costly as copper. Since zinc pennies were introduced, the real value of the penny (as measured by inflation) has fallen by half. Even if commodity prices stabilize, a 2 percent annual inflation rate will reduce the real value of the penny by another one-third over the next 20 years, and the problem will inevitably return unless another metal is found to replace those used in pennies and nickels.

Replacing the metal is not easy. As the law currently stands, the United States Mint has no authority to change the composition of the nickel and can only use copper and zinc for pennies. The Mint is nevertheless investigating alternatives. Finding a cheap metal is not enough: It must be easy to mint and must not present health risks, be allergenic, or wear out too quickly in circulation. Other countries, such as Canada, the United Kingdom, and those of the eurozone, have found steel a convenient substitute for other metals in the one-cent coin. Steel was used for the U.S. penny during World War II and was considered as an alternative in the 1970s. It has the advantage of being cheaper than other metals that have been used historically, such as aluminum (which was also considered in the 1970s), tin, and lead. New Zealand's

FIGURE 2

Real price of metals used in U.S. coins, 1825–2006

Notes: The data plotted are three-year moving averages. The values are deflated by the Consumer Price Index. There are no data available for silver from 1860 through 1871.
Sources: Author's calculations based on data from the U.S. Department of the Interior, U.S. Geological Survey; and Carter et al. (2006).

coinage now consists solely of steel cores, plated for aesthetic reasons with other metals and produced by the Royal Canadian Mint.

Even if a suitable metal is found, however, it will be difficult to produce pennies without taking a loss because production costs other than the metal were already 66 percent of face value in 2004 (see table 2). The Royal Canadian Mint is able to produce its penny for 0.8 cents.[13]

Should we eliminate the penny?

A simpler alternative is to let the penny melt out of existence. After all, do we need the penny?

The penny's role in our economy is not as a medium of exchange. There is nothing that a penny buys: Dime stores have long ago been replaced by dollar stores. Almost no coin-operated machinery accepts it.[14] We don't even use it truly to make change. It is merely a symbolic counter to simulate remainders of a division by five in retail transactions. When I buy a cup of coffee and the price comes out to $1.98, I give two dollar bills, the cashier takes two pennies from the saucer next to the register and hands them to me, and I return them to the saucer. The transaction is the same as if the cashier rounded to $2.00, except for a little side game between me and the cashier involving copper-colored tokens.

That I and the cashier are willing to give away the pennies in the saucer suggests that the penny isn't worth much. One way to see this is to measure the

TABLE 2

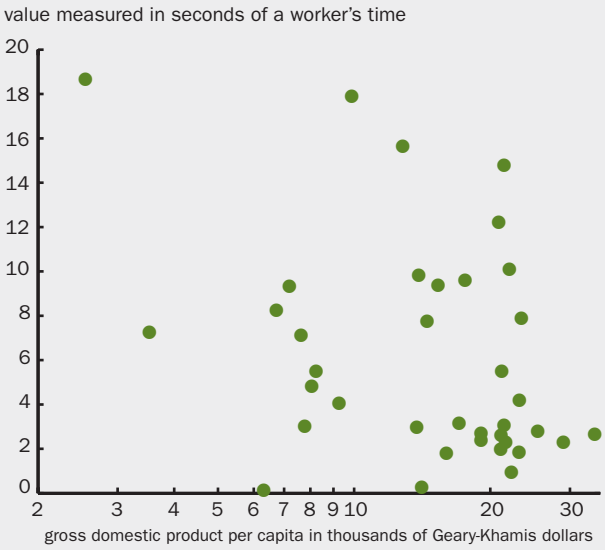
U.S. coin production costs and profits, 2004

Coin	Costs			Profits
	Metal	Other	Total	
	(- - - - percent of face value - - - -)			*($millions)*
Penny	27	66	93	2
Nickel	56	35	91	6
Dime	9	22	31	170
Quarter	9	20	29	424
Half dollar	9	25	34	2
Golden dollar	2	19	21	4

Notes: Metal cost is based on average metal prices for 2004. The profits are calculated from coin production numbers for 2004.
Sources: Author's calculations based on data from the United States Mint, *United States Mint Annual Report 2004*; and the U.S. Department of the Interior, U.S. Geological Survey.

FIGURE 3

Value of the smallest circulating coin compared across countries, 2003



Notes: The sample includes the OECD (Organization for Economic Cooperation and Development) countries plus other European countries. For details on Geary-Khamis dollars, see Maddison (1995).
Sources: Author's calculations based on data from the Organization for Economic Cooperation and Development, International Labor Organization, national mint websites, and Maddison (1995).

penny with the value of time. Median weekly earnings for wage earners and salaried workers are $675. Assuming a 40-hour workweek, it takes most U.S. workers no more than two seconds to earn a penny. Rounding transaction prices to the nearest five cents would save more than the time we spend fishing for pennies in our pockets or wallets.

A comparison with other countries is instructive. Figure 3 compares the values of the smallest circulating coins in about 30 countries—mostly the OECD (Organization for Economic Cooperation and Development) countries plus other European countries. The values of each coin are again measured in the time it takes to earn it at the average wage in manufacturing. The values are plotted as a function of gross domestic product (GDP) per capita, measured in Geary-Khamis dollars (Maddison, 1995). There seems to be a small negative relationship. However, this relation is not very robust and is largely due to the recent adoption of the euro as the common currency by the relatively rich European countries (the same figure in 1999, right before the introduction of the euro, shows no significant relationship between the value of small coins and GDP per capita).

What figure 3 does show is that there is a wide range across countries in terms of the value of their smallest denomination. That is in part because, in recent years, a number of countries have abandoned their smallest denominations. In Australia and New Zealand, whose dollars are comparable in value to the U.S. dollar, one-cent coins were also made essentially of copper. In 1987, the rise of copper prices made the one-cent coin unprofitable to mint. Instead of changing the content, New Zealand stopped producing its one-cent and two-cent coins (worth about 0.5 cents and one cent in U.S. currency, respectively) in March 1989, and they ceased to be legal tender in April 1990. The coins were bought back by the Reserve Bank of New Zealand and melted down for scrap metal.[15] Australia followed suit, stopping production of the coins in August 1990 and issuance in February 1992.[16] New Zealand went further in 2006: Existing five-cent, ten-cent, 20-cent, and 50-cent coins ceased to be legal tender, and all but the five-cent denomination were replaced with smaller and cheaper coins of plated steel.

In the eurozone, the smallest euro denominations are the one-cent (currently worth about 1.5 cents in U.S. currency) and two-cent coins. Each country can mint its own coins (with a common European obverse and nationally designed reverse), and all coins are legal tender throughout the eurozone. Two countries, the Netherlands and Finland, opted not to issue one-cent and two-cent coins at all, and they officially encourage rounding to the nearest five cents within their borders. Outside of the eurozone, the Czech Republic and Slovakia have recently eliminated their two smallest coins, and Hungary plans to do so next year.

The penny is disappearing of its own accord in economic terms. Various interest groups (for example, zinc producers, charities, and the state of Illinois) can point to continued support for the penny shown in polls.[17] But the United States Mint's annual output of pennies, nickels, dimes, and quarters as a ratio of GDP tells a different story (see figure 4). While the relative importance of 25-cent coin output has been stable over the past 30 years, that of the other coins has been declining steadily. Relative to GDP, the output of pennies is 12 percent of what it was in 1982. The trend is not much better for the nickel.

So a penny isn't worth much and the quantities produced are declining relative to GDP, but we still

FIGURE 4

Ratio of U.S. coin production to gross domestic product, 1946–2006

Note: The data plotted are three-year moving averages.
Sources: Author's calculations based on data from the United States Mint and U.S. Bureau of Economic Analysis.

produce a lot of them. Since 1982, the Mint has produced 910 pennies for every man, woman, and child in America. It estimates that 100 billion pennies currently circulate. In 2006, the Mint used 20,000 tons of zinc, worth $60 million, to produce pennies. Even if the Mint (and the taxpayer) were not losing money on this activity, it would be fair to ask whether all that zinc might be put to better use than manufacturing throwaway tokens.

The declining value of the penny is not a temporary phenomenon. It is a trend driven by several factors. One, noted previously, is inflation. The penny has been part of our denomination structure since the beginning, in 1792, but the price level has gone up by a factor of 20 in the past century: A penny today is worth one-twentieth of a penny before World War I. If people got by without coins as small as 0.05 cents back then, we can probably do so today. A second factor is that, even in the absence of inflation, a penny means less over time because we are becoming richer. As productivity grows, a penny will be worth ever less of our time because our time is more productive. A third factor is the replacement of cash (coins and notes) by other means of payment, notably electronic ones. Just as there was a boom in the demand for coins in the 1950s and 1960s because of the spread of coin-operated machinery, we can expect technological change to affect the demand for coins in the future.

These factors together tell us that the penny will disappear sooner or later, as did the farthing (one-quarter of a penny) and the ha'penny (one-half of a penny) of medieval England, and our own half cent, last minted in 1857.

Moreover, the experience of other countries suggests that there are few problems involved in doing so. The Reserve Bank of New Zealand has not found any evidence of inflation or upward rounding since it withdrew its one-cent and two-cent coins. The Royal Canadian Mint recently published survey results indicating that small retailers were vastly in favor of removing the penny, and consumers were split on the issue.

Current legislative proposals

As I noted earlier, the solution to our problem of small change is constitutionally vested in the hands of Congress, and some legislation is on the agenda.

Two bills were introduced in Congress in early August 2007.[18] Both bills confer on the Secretary of the Treasury the power to "prescribe the weight and the composition" of existing denominations, considering "such factors that the Secretary considers, in the Secretary's sole discretion, to be appropriate." A third

bill introduced in October 2007 includes a similar provision.[19]

Delegating such power to the Secretary of the Treasury would represent a significant change. Ever since the Coinage Act of 1792,[20] Congress has retained for itself the exercise of its constitutional powers to "coin money, regulate the value thereof." There were good reasons for the founding fathers to assign such powers to Congress. Under a commodity money system (the only system they could conceive for our country), setting the weight and composition of coins is the essence of monetary policy and is therefore an extremely important power. Recent European history, with which they were familiar, gave them reason to be wary of handing over monetary policy to the executive branch.

But things have changed. The composition of coins is not central to monetary policy anymore. Under a fiat system, it is a purely technical issue, whose only potential consequence for the legislature is the profit or loss made on coining.

Profit on coinage, of course, is not negligible. Table 2 (p. 23) shows that, on some coins, the profits can be substantial. The high figure for the quarter reflects the success of the "state quarters" program, which has generated $3.2 billion in "above-average" profits on this denomination over eight years.

But profits can rapidly turn into losses. The United States Mint made a small profit ($5 million) on pennies and nickels in fiscal year 2005, but this turned into a loss of $33 million in fiscal year 2006 and a loss of almost $100 million in fiscal year 2007.

Congress therefore retains an interest in the issue of coin composition, but it could nevertheless delegate the details to the executive branch (namely, the U.S. Department of the Treasury) because the issue is purely technical and because action in the executive branch will be timelier than passing new legislation each time.[21]

A medieval solution to a medieval problem

In a recent *Chicago Fed Letter*, I made a different proposal.[22] Starting from the observation that there are many pennies in circulation but they are not really needed as one-cent coins and inspired by medieval debasements, I proposed that the prohibition on melting should be repealed and that pennies should henceforth be worth five cents.

In this proposal, the existing nickels would disappear and be melted down, which seems likely to be their fate under any conceivable proposal. Pennies would then be recycled as five-cent coins, avoiding the need to design and produce a new coin (a lengthy process). Since the Mint has produced about seven times as many pennies as nickels in the last 20 years, there should be enough pennies to serve as five-cent coins for a while.

The new value would be easily established by the monetary authority standing ready to exchange 20 pennies for a dollar bill, instead of 100 pennies presently. It is true that vending machines and other coin-operated equipment currently accepting nickels would have to be modified to accept pennies as five cents. But such modifications may be unavoidable if the nickel in its current form is doomed.

I call this a medieval solution because medieval debasements were sometimes carried out in this manner. When a coin was threatened by melting, as is now the case with our penny, there were two ways to debase it: One was to mint it with less metal than before, and the other was to increase its face value. Thus, in 1269 Venice increased the face value of its grosso coin from 26 to 28, and again in 1282 to 32, each time leaving its composition unchanged. As I recently found out, the idea also has precedent in U.S. history. During the 1965 silver coinage crisis, Congressman Craig Hosmer (a Republican from California) proposed to "arbitrarily double the value of existing silver coins" in order to save them from being melted down.[23]

The proposal would require everyone to ignore the inscription on the penny that says "one cent." But there is also precedent for U.S. coins being worth more than what is written on them. In 1834, when the gold–silver ratio was adjusted, half eagles minted before that date and bearing the inscription "5 D" (five dollars) were declared to be "receivable in all payments at the rate of 94 and 8/10ths of a cent per pennyweight," which works out to $5.33 for a full-weight coin.[24] This was nothing else than a debasement, albeit a relatively modest one.

Would such a measure be inflationary? The estimated stock of pennies is 100 billion, so increasing their value to five cents would add $4 billion to the money supply, which represents 0.5 percent of the monetary base or 0.3 percent of M1 (a monetary aggregate composed of currency and demand deposits). This is a modest addition. The average monthly increase in the monetary base over the past three years has been about $2 billion; the monthly standard deviation of M1 is about $6 billion over the same period. Thus, an addition of $4 billion would fall well within the range of typical monthly variations in the money supply. The one-time increase would also be offset by reduced issues of other coins and thus unlikely to have a noticeable impact.

Conclusion

To prevent a shortage of small change, the U.S. Department of the Treasury recently enacted regulations to prohibit melting and exportation of pennies and other coins. The threat of shortage arises because pennies and nickels are made of inappropriately expensive material, and there is or soon will be a profit to be made from transferring their content to alternative uses.

There is $1 billion worth of resources sitting in cash registers, jars, and sofas across the United States. It makes little sense to keep replenishing them, and the regulations hold little promise of forestalling the inevitable very long. The traditional solution since medieval times is to "debase" the threatened coin, that is, make it of a cheaper material or assign it a higher face value, either of which requires congressional action. But the current situation may well prompt a more general debate on whether such small denominations are worth saving—a debate that is ongoing in many other industrialized countries.

NOTES

[1]The regulations became permanent on April 16, 2007, and now constitute 31 CFR Part 82 (*Federal Register*, April 16, 2007). By law (31 USC 5111 (d1)), the Secretary of the Treasury "may prohibit or limit the exportation, melting, or treatment of United States coins when the Secretary decides the prohibition or limitation is necessary to protect the coinage of the United States." One of the exceptions to the regulations allows Federal Reserve Banks and depository institutions to continue exporting coins for circulation in "dollarized" countries, such as Ecuador and Panama.

[2]The word "penny" itself goes back at least to the ninth century.

[3]See Carothers (1930).

[4]This neglects refining costs: Coins consisted of silver at 90 percent purity mixed with copper.

[5]The Coinage Act of 1965 is also known as Public Law 89-81 (79 Stat. 254).

[6]The silver core was abandoned in 1971; at the same time the Eisenhower dollar, also made of copper and nickel, was introduced to replace the silver dollar discontinued in 1964.

[7]Times Mirror Company (1965).

[8]Cabeen (1967).

[9]Three Manhattan jewelry technicians were arrested in December 1967. Three men were arrested near Tucson, AZ, with two tons of dimes and quarters and a small smelter in April 1968; two men were arrested in Brooklyn and arraigned in December 1968 (Laurence 1968; Dow Jones and Company, 1968a, b).

[10]Janssen (1966).

[11]Times Mirror Company (1968).

[12]The break in the quarter series in figure 1 is related to another shortage of small change—this one prompted by the introduction of fiat money in the form of "greenbacks," notes that were not redeemable into gold or silver. During the subsequent period of inflation, from 1861 through 1870, the dollar price of silver made it unprofitable to mint silver quarters, while existing quarters were hoarded or melted.

[13]Branswell (2007).

[14]One notable exception is the acceptance of pennies in automatic toll lanes on Illinois roads. Until a few years ago parking meters in downtown Hilo, HI, accepted pennies, but parking is now free.

[15]APN News and Media (1990).

[16]Glover (1992).

[17]Hagenbaugh (2006).

[18]HR 3330 and S 1986.

[19]HR 3956.

[20]1 Statutes at Large 246.

[21]The Reserve Bank of New Zealand is vested with the power to "determine the denominations, form, design, content, weight, and composition of its bank notes and coins," according to the Reserve Bank of New Zealand Act 1989, s. 25(2). Thus, the recent decision to abolish the five-cent denomination was taken by the Reserve Bank of New Zealand, without any legislation.

[22]Velde (2007).

[23]Foley (1965).

[24]4 Statutes at Large 699, section 3.

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