

The Adverse Effects of Changing Materials of Construction for U.S. Coins

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A report measuring the impacts of a proposal to change the materials of construction of nickels, dimes & quarters on the U.S. economy

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10-27x

the benefits to the U.S. Mint



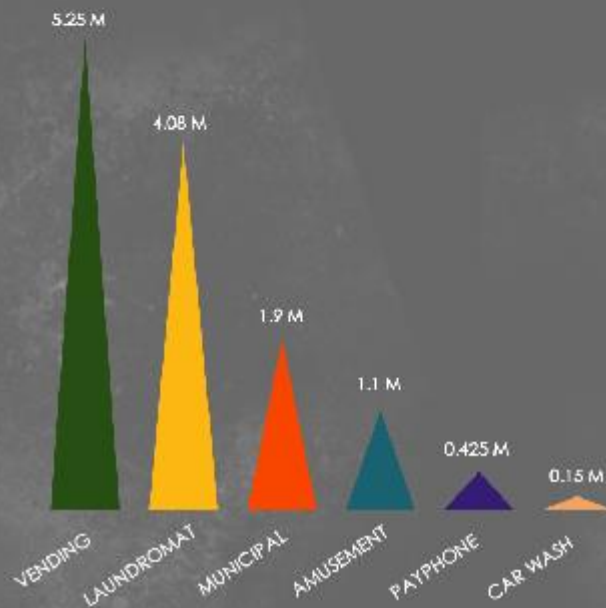
While generating up to \$85 million at best, the U.S. Mint will create total retrofitting costs for industries and municipalities totalling between

\$0.9 and \$2.3 billion

13 million units

Number of Affected Machines by Industry

72.8% of the existing 17.9 million coin-operated machines need to be upgraded



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Nam D. Pham, Ph.D.¹

Proposals to change the materials of construction of nickels, dimes, and quarters will create operational disruptions for over 13 million (72.8% of the existing 17.9 million) coin-operated machines across the country. The U.S. Mint potentially generates up to \$85 million in addition to the existing \$208 million in seigniorage in FY2013 at the expense of small business owners, municipal officials, and American consumers. The upfront retrofitting costs to the municipalities and owners and operators of coin-operated machines are estimated to be between \$941.6 million and \$2.3 billion to upgrade the hardware and software of over 13 million affected coin-operated machines. These costs could increase significantly if the diameter and thickness of U.S. coinage are also changed.

While revenues of coin-operated machine businesses are declining and profits are shrinking, retrofitting costs will put an additional financial burden on small business owners that could drive them out of business. Similarly, municipalities will have to pay between \$41 million and \$199 million to retrofit nearly 2 million coin-operated parking meters and buses. Evidence shows that these costs will be passed-through consumers via price increases. With currently modest inflation and stagnant real wages, a price increase of 10% on vending machines, 12.5% on laundromats, 20% on metered parking and payphones, and 50% on amusement machines, will take a toll on the average American household. The costs to retrofit far outweigh the benefits. Indeed, the direct costs to the U.S. economy will be between 10 and 27 times the benefits to the U.S. Mint.

Key Findings of the Report

This report uses official data to quantify the costs and benefits of changing the materials of construction to produce U.S. nickels, dimes, and quarters. The costs to retrofit over 13 million coin-operated vending machines, laundromats, amusement machines, jukeboxes, gaming machines, payphones, carwash units, parking meters, bus coin acceptors, and tolls outweigh the benefits to the U.S. Mint by between 10 and 27 times.

Highlights of the report are:

1. The U.S. Mint generated \$208.1 million in seigniorage (the difference between value of shipments and production costs) of nickels, dimes, and quarters in FY2013, an increase of 110.8% from FY2012 and 320.4% from FY2011. Compared to FY2011, the unit costs of production of nickels, dimes, and quarters have declined by 15.8%, 19.4%, and 5.8%, respectively.
2. Proposals for alternative materials to produce nickels, dimes, and quarters are not necessarily generating cost savings for the U.S. Mint. Indeed, several proposed alternatives have higher production costs than the costs to produce these coins in FY2013. Among proposed alternatives,

¹ I would like to thank Don't Change Our Change Coalition for their financial support to conduct this study. Anil Sarda and Michael Socarras provided their excellent assistance to complete the report. The opinions and views expressed here are solely those of the author.

the highest cost savings for the U.S. Mint is an additional \$85 million in seigniorage. However, the alternatives will not remove or mitigate the fluctuations of commodity prices for the U.S. Mint. Over the past 35 years, prices of zinc and steel (the alternative materials) have been highly correlated with the prices of copper and nickel (current materials).

3. Alternative new materials of construction of coins will create adverse effects for the coin-operated machine owners and operators as well as municipalities. Total retrofitting costs for over 13 million affected coin-operated machines will be between \$941.6 million and \$2.3 billion. The range of costs among major industries include:
 - \$553.5 million and \$1.2 billion to retrofit 5.25 million vending machines.
 - \$204 million and \$612 million to retrofit 4.08 million washer and dryer units.
 - \$70 million and \$170 million to retrofit 1.1 million amusement machines.
 - \$1 million and \$5 million to retrofit 50,000 gaming machines.
 - \$59.5 million and \$78.5 million to retrofit 425,000 payphone units.
 - \$12.6 million and \$27 million to retrofit 150,000 carwash units.
 - \$38 million and \$190 million to retrofit 1.9 million parking meters.
 - \$3 million and \$9 million to retrofit 70,000 public buses and tolls.
4. Findings of empirical studies suggest that increases in production costs are typically passed-through consumers within twelve months. In the case of retrofitting costs for coin-operated machines, prices will increase by 5 cents or 25 cents, depending on the lowest denomination of the type of machine. For vending machines, payphones, parking meters, and toll booths that accept nickels, consumers will experience price hikes as high as 20%. For other machines such as amusement machines that only accept quarters, price hikes will be as high as 50%.

Overall, the proposed alternative materials for nickels, dimes, and quarters are not optimal for the U.S. economy. For example, a nickel price increase in vending machines, public pay phones, parking meters, and bus rides will lead to a higher demand for nickels from the U.S. Mint. Since the cost of production for nickels is higher than its face value, the U.S. Mint's seigniorage will fall. While cost savings for the U.S. Mint are limited, the adverse effects to small businesses, municipalities, and consumers are extensive. The retrofitting costs will create a financial burden and business disruptions for small owners that will lead some out of business.

Background

In its 2015 budget proposal, the Obama Administration revisited the cost of production and composition of the U.S. coinage. Under the Coin Modernization, Oversight, and Continuity Act of 2010, the Secretary of the Treasury was authorized to conduct research on alternative metallic materials to produce U.S. coins at a lower cost. Since then, the Treasury has undertaken a series of research endeavors to identify alternative production materials for the U.S. coinage, as well as to examine the financial impacts to stakeholders.

The U.S. Mint, an independent agency, is the only manufacturer who is responsible for producing and distributing all coinage for the United States. About 3% of the U.S. circulating coin supply is replenished each year with newly minted coins, with the life of U.S. coins being about 30 years. In FY2013, the U.S. Mint produced over 10.696 billion circulating coins of four denominations (penny, nickel, dime, and quarter) totaling \$578 million in value of shipments. The number of pennies accounted for two-thirds of total

circulating coinage but only 11.4% of the total value of shipments. Since the penny is rarely accepted by coin-operated machines, this report excludes the penny in its analysis and focuses solely on nickels, dimes, and quarters.

In FY2013, the U.S. Mint produced 4.086 billion coins of 5-cent, 10-cent, and 25-cent denomination. The total value of shipments of these three denominations was \$511.9 million. While accounting for only 9.9% (1.062 billion coins) of total circulating coinage (10.696 billion coins), the value of shipments of 25-cent coins was nearly 46% (\$265.6 million) of the total value of shipments (\$578 million). About 17.8% (1.9 billion coins) and 10.5% (1.1 billion coins) of circulating coinage was 10-cent and 5-cent denominations, respectively. The value of shipments of the 10-cent and 5-cent denominations was 32.9% (\$190.1 million) and 10.5% (\$56.2 million), respectively (Table 1).

Total costs to produce 4.086 billion nickels, dimes, and quarters in FY2013 were \$303.8 million. The value of shipments of these nearly 4.1 billion coins was \$511.9 million. The seigniorage, the difference between the face value and cost of producing circulating coinage, was \$208.1 million. Among three denominations, quarter coins generated the highest in seigniorage, \$154.1 million and \$0.58 per \$1 issued. The dimes generated \$103.5 million and \$0.54 in seigniorage per \$1 issued. But total costs to produce the nickels were higher than the face value in FY2013. The seigniorage of nickels was -\$49.5 million and -\$0.88 per \$1 issued in FY2013 (Table 1).

Table 1. Current Production Costs of Circulating Coins, FY2013 (in millions)²

	5-cent	10-cent	25-cent	Total
Coin shipments	1,123	1,901	1,062	4,086
Value of shipments	\$56.2	\$190.1	\$265.6	\$511.9
Total costs	\$105.7	\$86.6	\$111.5	\$303.8
Unit cost	\$0.0941	\$0.0456	\$0.1050	--
Seigniorage	-\$49.5	\$103.5	\$154.1	\$208.1
Seigniorage per \$1 issued	-\$0.88	\$0.54	\$0.58	--

The seigniorage of three denominations (nickel, dime, and quarter) quadrupled from \$49.5 million in FY2011 and \$98.7 million in FY2012 to \$208.1 million in FY2013. The negative seigniorage of 5-cent coinage decreased slightly while seigniorage of 25-cent coinage tripled from \$45 million in FY2011 to \$154.1 in FY2013 (Table 2).

Table 2. Seigniorage of Circulating Coins, FY2011-13 (in millions)³

	5-cent	10-cent	25-cent	Total
FY 2011	-\$56.5	\$61.0	\$45.0	\$49.5
FY 2012	-\$51.2	\$83.1	\$66.8	\$98.7
FY 2013	-\$49.5	\$103.5	\$154.1	\$208.1

² U.S. Mint. 2013. *2013 Annual Report*, Department of Treasury; U.S. Mint. 2012. "2012 Biennial Report to the Congress on the Current Status of Coin Production Costs and Analysis of Alternative Content," Department of the Treasury.

³ Ibid.

The increase in seigniorage in the last three years is the combination of the decline in commodity prices and the increase in shipments of quarter coinage. Indeed, shipments of quarters increased 228.8% compared to 35.5% of the dimes and 22.9% of the nickels during the period between FY2011 and FY2013.

Construction Materials of Circulating and New Coins by Denomination

The compositions of the current U.S. coins were originally specified in the Coinage Act of 1965 and amended in 1974. The current materials of construction for nickels, dimes, and quarters are copper and nickel. A nickel is made of 75% copper and 25% nickel. Both the dime and the quarter are made of 91.67% copper and 8.33% of nickel. Each of the coins has a different weight, diameter, thickness, and number of reeds around the edge (Table 3).

Table 3. Current Materials and Specifications of Circulation Coins⁴

	5-cent	10-cent	25-cent
Bulk Composition	Monolithic Cupronickel	Cupronickel-Clad Copper	Cupronickel-Clad Copper
Content/Weight Percent (%)	75% CU; 25% Ni	91.67% CU; 8.33% Ni	91.67% CU; 8.33% Ni
Core	-	C110 Cu	C110 Cu
Surface	-	0.175 mm; 75Cu-25Ni	0.226 mm; 75Cu-25Ni
Weight	5.000 g	2.268 g	5.670 g
Diameter	0.835 in; 21.21 mm	0.705 in; 17.91 mm	0.955 in; 24.26 mm
Thickness	1.95 mm	1.35 mm	1.75 mm
Edge	Plain	Reeded	Reeded
No. of Reed	0	118	119

The U.S. Mint commissioned a study to evaluate potential materials and processing methods to produce new U.S. circulating coins. Two new proposed commodities for circulating nickels, dimes, and quarters are zinc and steel. To reduce the production costs, proposals for new coin materials also reduce the weights of nickels, dimes, and quarters (Table 4).

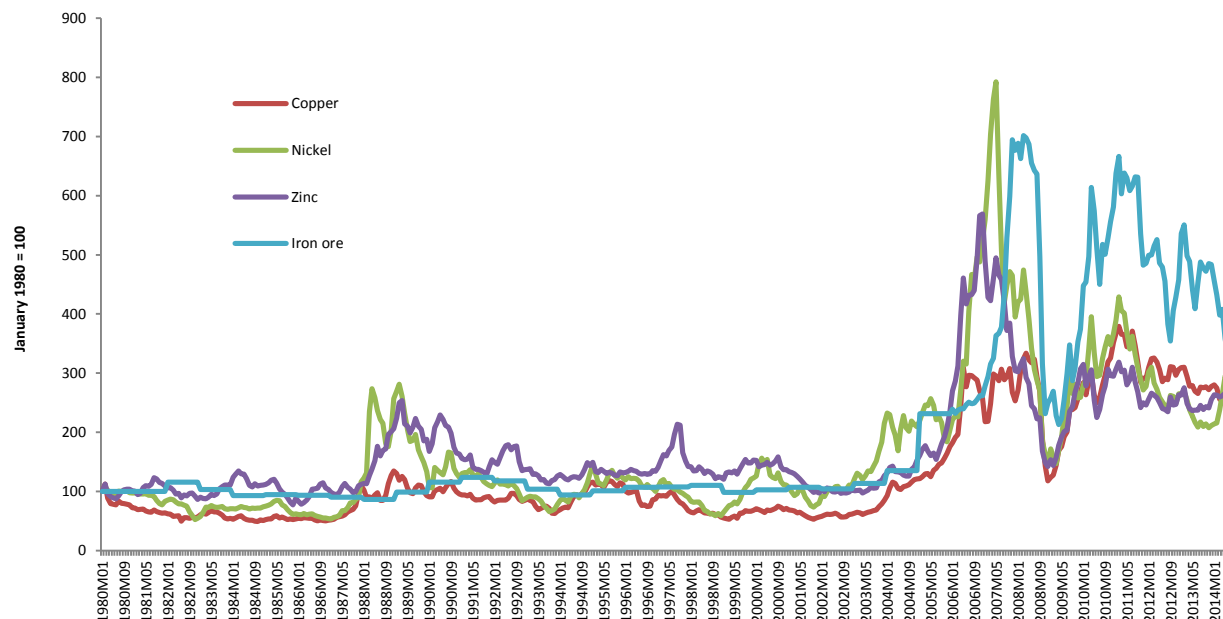
⁴ U.S. Mint. 2012. "2012 Biennial Report to the Congress on the Current Status of Coin Production Costs and Analysis of Alternative Content," Department of the Treasury.

Table 4. Proposed Materials and Specifications of New Coins⁵

Range of Alternatives	5-cent	10-cent	25-cent
Material Candidates	Copper Alloys, Dura-White™-Plated Zinc, Multi-Ply-Plated Steel, Nickel-Plated Steel, Stainless Steel	Alternative Clad Copper	Alternative Clad Copper, Dura-White-Plated Zinc, Multi-Ply-Plated Steel, Stainless Steel-Clad Copper
Weight	4.060 g ~ 4.790 g	2.200 g ~ 2.230 g	4.540 g ~ 5.590 g

The costs of copper and nickel are a large component of the production costs of U.S. nickels, dimes, and quarters. The fluctuations of commodity prices in the past ten years inevitably affected the production costs of U.S. coinage. However, prices of two main alternative materials (zinc and steel) also correlate to prices of copper and nickel. Monthly data during the period between January 1980 and June 2014 shows commodity prices are highly correlated during price fluctuations, whether they are increasing or decreasing. For example, the correlation coefficient of copper and nickel prices was 0.833, while the correlation coefficient values of copper and iron prices were 0.932 and copper and zinc was 0.837. Similarly, the correlation coefficient of nickel and zinc was 0.903 and nickel and iron was 0.736. Thus, proposals of using additional zinc and steel to produce U.S. nickels, dimes, and quarters would not reduce the dependency of commodity prices and their price fluctuations (Figure 1).

Figure 1. Monthly Commodity Prices, January 1980 – June 2014⁶



⁵ Concurrent Technologies Corporation. 2012. “Alternative Metals Study: Final Report,” Submitted to U.S. Mint.

⁶ World Bank Commodity Price Data (The Pink Sheet).

Costs and Seigniorage of Circulating and New Coins by Denomination

The Alternative Metals Study, commissioned by the U.S. Mint, provides a range of estimated costs and savings using alternative materials for new nickel, dime, and quarter coins. Assuming the diameter and thickness of the coins remained unchanged, alternative materials will only affect the weights of these coins. Alternative unit costs range between \$0.0485 and \$0.0995 for a nickel, between \$0.0485 and \$0.0500 for a dime, and between \$0.0679 and \$0.1060 for a quarter. Compared to the unit costs in FY2013, alternative materials do not produce savings for U.S. dimes. In fact, proposed unit costs for the dime are between \$0.0044 and \$0.0029 higher than the unit cost for the dime in FY2013. The cost savings for the nickel and the quarter are mixed.

In FY2013, total costs to produce 4.086 billion nickel, dime, and quarter coins were \$303.8 million. Using the proposed alternative materials, it would cost between \$218.8 million and \$319.4 million to produce 4.086 billion nickel, dime, and quarter coins. The U.S. Mint may have a negative savings of \$15.6 million (i.e., alternative materials are more costly) and could potentially save up to \$85.0 million.⁷ The breakdown of alternative unit cost and savings by denomination is included in Table 5 below.

Table 5. Estimated Costs and Savings of Alternative Materials for New Coins⁸

Total	5-cent	10-cent	25-cent
Alternative unit cost	\$0.0485~\$0.0995	\$0.0485~\$0.0500	\$0.0679~\$0.1060
Total unit cost in 2013	\$0.0941	\$0.0456	\$0.1050
Savings per unit	-\$0.0054~\$0.0456	-\$0.0044~\$0.0029	-\$0.0010~\$0.0371
Savings per \$1 issued	-\$0.1075~\$0.9125	-\$0.0445~\$0.0295	-\$0.0040~\$0.1484
Coin shipments in 2013	1.123 billion	1.901 billion	1.062 billion
Savings vs 2013 cost	-\$6.0M~\$51.2M	-\$8.5M~\$5.6M	-\$1.1M~\$39.4M

Adverse Effects on Business Owners and Operators, Municipalities, and Consumers

Changes in the materials to produce coins will have negative impacts on owners and operators of coin-operated machines, municipalities, and consumers across the country. Estimates indicate that about 17.9 million coin-operated machines are currently accepting nickels, dimes, and quarters around the country. There are two types of sensing technology to validate coins in the markets: (1) passive devices (hardware-based) mechanically validate a coin based upon physical properties including dimensions (diameter and thickness), weight, and/or edge profile (smooth vs. reeds) and (2) active devices (hardware and software-based) rely upon input from electronic sensors whose output is interpreted through software, measuring coin characteristics and/or properties including thickness, diameter, edge profile and electromagnetic signature (EMS).

⁷ Our estimation of cost savings is similar to the U.S. Mint report. We multiplied alternative unit costs to the number of coin shipments in FY2013 to estimate the alternative production costs to produce the same number of coins in FY2013.

⁸ U.S. Mint. 2013. *2013 Annual Report*, Department of Treasury; Concurrent Technologies Corporation. 2012. "Alternative Metals Study: Final Report," Submitted to U.S. Mint; author's estimates.

Based on the U.S. Mint surveys and industry data, more than 13 million coin-accepted machines (72.8%) will need to be retrofitted to accept new coins with different weights and materials of construction. The affected rate will be higher than 72.8% if the diameter and thickness of the new coins are different than the current circulating coins. Table 6 below identifies major affected groups and estimates the number of coin-operated machines in the markets. The number of affected machines is calculated based on the affected rates estimated by the U.S. Mint surveys and industry data.

Table 6. Affected Groups: Size, Affected Rate, and Number of Affected Machines⁹

Affected Groups	Size of Affected Groups	Affected Rates	# of Affected Machines
TOTAL	17.895 million units	72.8%	13.025 million units
Owners & Operators			
Vending machines	<u>7.3 million machines</u> (2.55 million vending machines older than 10 years and 0.2 million non-multi-drop bus (non-MDB)) ¹⁰	100% for older vending machines, 75% for non-MDB	<u>5.25 million machines</u> (2.55 million full replacement for older units and 0.15 million for non-MDB units)
Laundromats	<u>5.1 million units</u>	80%	<u>4.08 million units</u>
Amusement machines	<u>1.7 million coin acceptors</u> (1.2 million passive and 0.5 million active units)	50% for passive and 100% for active units	<u>1.1 million machines</u> (0.6 million passive and 0.5 million active units)
Gaming machines	<u>1.0 million units (active)</u>	5%	<u>50,000 units</u>
Payphones	<u>425,000 units</u> (360,000 passive and 65,000 active units)	100%	<u>425,000 units</u> (360,000 passive and 65,000 active units)
Car Wash	<u>300,000 coin acceptors</u> (240,000 passive and 60,000 active units)	50%	<u>150,000 units</u> (120,000 passive and 30,000 active units)
Municipalities			
Metered Parking	<u>2.0 million units</u> (100,000 passive and 1.9 million active units)	100% for active units	<u>1.9 million units</u>
Public Transit (buses and tolls)	<u>70,000 units</u> (60,000 public bus coin acceptors (20,000 passive and 40,000 active units) and 10,000 toll collection units)	100%	<u>70,000 units</u> (60,000 public bus coin acceptors and 10,000 toll collection units)

⁹ Concurrent Technologies Corporation. 2012. "Alternative Metals Study: Final Report," Submitted to U.S. Mint; author's estimates.

¹⁰ Multi-drop bus (MDB), the most commonly used communications protocol within vending machines, allows the vending machine controller to communicate with other vending machine components, including the currency sensor.

Changes of the materials of construction for nickel, dime, and quarter coins will cost the industry between \$941.6 million and \$2.3 billion to retrofit 13.025 million coin-operated machines. The retrofitting cost ranges between \$72.29 and \$177.08 per unit. The retrofitting costs for municipalities alone will be between \$41 million and \$199 million to retrofit 1.9 million parking meter units and 70,000 public bus coin acceptors and toll collection units (Table 7).

Our estimates are based on the extensive U.S. Mint surveys of age and type of affected machines that need to be retrofitted. In general, we assume the retrofitting cost per unit, depending on the age (more or less than 10 years old) and the type (passive or active) of the machine. The retrofitting cost ranges between \$100 and \$200 to upgrade hardware for older machines and between \$20 and \$200 to upgrade software for newer machines. These estimates and assumptions are comparable with the U.S. Mint and tend to be lower than the industry estimates (Table 7).

Table 7. Estimated Conversion Costs by Affected Group¹¹

Affected Groups	Number of Affected Machines	Retrofitting Cost per unit	Total Retrofitting Cost
TOTAL	13.025 million units	\$72.29 ~ \$177.08	\$941.6M ~ \$2.306B
Owners & Operators			
Vending machines	<u>5.25 million machines</u> (2.55 million full replacement for older units and 0.15 million for non-MDB units)	\$150~\$200 for hardware replacement of an old unit; \$20~\$100 for software upgrade of an active unit; \$800~\$3,000 to purchase a new non-MDB unit.	<u>\$553.5M~\$1,215M</u>
Laundromats	<u>4.08 million units</u>	\$50~\$150 per unit	<u>\$204M~\$612M</u>
Amusement machines	<u>1.1 million machines</u> (0.6 million passive and 0.5 million active units)	\$100~\$200 for hardware upgrade of a passive unit and \$20~\$100 for software upgrade of an active unit.	<u>\$70M~\$170M</u>
Gaming machines	<u>50,000 units</u>	\$20~\$100 for software upgrade of an active unit.	<u>\$1M~\$5M</u>
Payphone	<u>425,000 units</u> (360,000 passive and 65,000 active units)	\$150~\$200 for hardware upgrade of a passive unit and \$85~\$100 for software	<u>\$59.5M~\$78.5M</u>

¹¹ Concurrent Technologies Corporation. 2012. "Alternative Metals Study: Final Report," Submitted to U.S. Mint; author's estimates.

		upgrade of an active unit.	
Car Wash	<u>150,000 units</u> (120,000 passive and 30,000 active units)	\$100~\$200 for hardware upgrade of a passive unit and \$20~\$100 for software upgrade of an active unit.	<u>\$12.6M~\$27M</u>
Municipalities			
Metered parking	<u>1.9 million units</u>	\$20~\$100 for software upgrade of an active unit.	<u>\$38M~\$190M</u>
Public transit (buses and tolls)	<u>70,000 units</u> (60,000 public bus coin acceptors and 10,000 toll collection units)	\$100~\$200 for hardware upgrade of a passive unit and \$20~\$100 for software upgrade of an active unit.	<u>\$3M~\$9M</u>

Similar to other capital investments, business owners will make decisions to retrofit based on the expected investment returns and available resources. Empirical studies found that small businesses are slower than large businesses to adopt changes in technologies and innovations due to limited resources.¹² Assuming that the materials of construction change, for those businesses that choose to retrofit, the conversion costs will be paid first by owners and operators of the affected coin-operated machines and eventually will be passed through directly or indirectly to consumers via price changes. The break-even point measures the time (expressed in months) for business owners and operators and municipalities to recoup their retrofitting costs (i.e., retrofitting costs / annual profits x 12). Average annual revenues per unit and average annual gross profit per unit are estimated from the latest industry data. Average retrofitting costs per unit is total retrofitting costs divided by the number of affected machines (Table 7 above). Our estimates show that the break-even point varies across industries. Owners and operators of amusement machines and car wash units will need between 1 and 3 months while owners and operators of laundromats will need up to 47 months to recoup their retrofitting costs. Since municipalities are not for-profit entities, the break-even point is expressed by revenue per hour for metered parking and the number of bus rides for public transit (Table 8).

¹² Swamidass, Paul M. 2003. "Modeling the adoption rates of manufacturing technology innovations by small US manufacturers: a longitudinal investigation." Research Policy.

Table 8. Average Revenue, Profit, and Retrofitting Cost per Unit¹³

Affected Groups	Average Annual Revenues per Unit	Average Annual Gross Profits per Unit	Average Retrofitting Costs per Unit	Break-even Point (months)
Owners & Operators				
Vending machines	\$9,042.34	\$470.20	\$105.42~\$231.43	3~6 months
Laundromats	\$745.10	\$38.00	\$50~\$150	16~47 months
Amusement machines	\$4,560.78	\$688.68	\$63.64~\$154.55	1~3 months
Payphones	\$2,000.00	\$100.00	\$140.06~\$184.71	17~22 months
Car Wash	\$17,868.00	\$750.46	\$84.00~\$180.00	1~3 months
Municipalities				
Metered parking	\$2.00 per hour	--	\$20.00~\$100.00	10~50 hours
Public transit (buses)	\$1.00 A fare ride	--	\$42.86~\$128.57	43~129 rides

Studies have found that businesses will pass through production and material cost increases to their consumers. For example, Hong and Li estimated that U.S. retailers passed through approximately 70% of cost increases to their customers within the first 12 months¹⁴. Kim and Cotterill found that the range of pass-through rates for U.S. processed cheese was between 73% and 103% during the period 1988 and 1992.¹⁵

The price increases will depend on the smallest coin denomination of the machine. While vending machines, payphones, and parking meters accept nickels, dimes, and quarters, almost all laundromats, amusement machines, and car wash machines accept only quarters. When coin-operated machine owners and operators raise prices by 5 cents or 25 cents to cover the retrofitting costs, consumers will experience an additional price increase to the inflation. For example, vending machines sell food and drinks for between 50 cents and \$2.00, with an average cost of \$1.04. A 5-cent increase to cover the retrofitting cost of a 50-cent drink or a snack at a vending machine translates to a 10% price increase for consumers. Similarly, a 25-cent increase on a 50-cent children's ride, pinball game, soccer table (foosball), pool table, or video game translates to a 50% price hike for consumers (amusement machines range between 50

¹³ Annual Revenues per unit derived from U.S. Census Bureau's American FactFinder and Concurrent Technologies Corporation. 2012. "Alternative Metals Study: Final Report," Submitted to U.S. Mint; annual gross profits per unit derived from IBISWorld Industry Data, various reports; and author's estimates.

¹⁴ Hong, Gee Hee and Nicholas Li. 2013. "Market Structure and Cost Pass-Through in Retail." Bank of Canada and University of Toronto.

¹⁵ Kim, Donghun and Ronald W. Cotterill. 2008. "Cost Pass-Through in Differentiated Product Markets: The Case of U.S. Processed Cheese." The Journal of Industrial Economics.

cents and \$7.50 per transaction). Table 9 estimates retrofitting costs as a percentage of sales transactions to consumers.¹⁶

Table 9. Retrofitting Costs to the Consumers

Affected Groups	Coin Accepted	Sales per transaction	Minimum Coin Increment as % of Sale
Owners & Operators			
Vending machines	Quarter, Dime, Nickel	\$0.50~\$2.00	2.5%~10.0%
Laundromats	Quarter	\$2.00~\$5.00	5.0%~12.5%
Amusement machines	Quarter	\$0.50~\$7.50	3.3%~50.0%
Gaming machines	Quarter	n/a	n/a
Payphone	Quarter, Dime, Nickel	\$0.25~\$0.50	10.0%~20.0%
Car Wash	Quarter	\$4.00~ 6.00	4.2%~6.3%
Municipalities			
Metered parking	Quarter, Dime, Nickel	\$0.25~\$6.00 per hour	0.83%~20.0%
Public transit (buses)	Quarter, Dime, Nickel	\$0.50~\$2.00 for a bus ride	2.5%~10.0%

Conclusion

The proposal to change the materials of construction for U.S. coins is not optimal for the U.S. economy. The U.S. Mint is already generating approximately \$208 million in FY2013 in seigniorage from producing coins. Changing the material contents does not necessarily produce additional cost savings for the U.S. Mint. Compared to FY2013 circulating coins and the production cost, alternative materials at best will provide the U.S. Mint an additional \$85 million in seigniorage (several options are more expensive than the FY2013 production cost). However, the costs to small business owners and operators, municipalities, and consumers are between 10 and 27 times (\$941.6 million~\$2.3 billion) the additional benefits to the U.S. Mint. The retrofitting will create a financial burden for small business owners that will inevitably drive some out of business. The retrofitting costs will eventually pass through consumers via price increases. Furthermore, the pass through price increase to consumers will lead to a higher demand for nickels to deposit in coin-operated machines. Consequently, the U.S. Mint will have to supply more nickels, which will reduce total seigniorage because the cost to produce nickels is higher than its face value.

¹⁶ Vending Times. 2013. "Census of the Industry 2013 Edition." Vending Times; BMI Gaming website.

References

BMI Gaming. August 2014. <http://www.bmigaming.com/>

Concurrent Technologies Corporation. 2012. "Alternative Metals Study: Final Report," Submitted to U.S. Mint.

Hong, Gee Hee and Nicholas Li. 2013. "Market Structure and Cost Pass-Through in Retail." Bank of Canada and University of Toronto.

Kim, Donghun and Ronald W. Cotterill. 2008. "Cost Pass-Through in Differentiated Product Markets: The Case of U.S. Processed Cheese." *The Journal of Industrial Economics*.

Swamidass, Paul M. 2003. "Modeling the adoption rates of manufacturing technology innovations by small US manufacturers: a longitudinal investigation." *Research Policy*.

The World Bank. August 2014. World Bank – Prospects. Commodity Price Data (The Pink Sheet).

U.S. Census Bureau. August 2014. American FactFinder.

U.S. Mint. 2013. *2013 Annual Report*, Department of the Treasury.

U.S. Mint. 2012. "2012 Biennial Report to the Congress on the Current Status of Coin Production Costs and Analysis of Alternative Content," Department of the Treasury.

Various U.S. Industry Reports. August 2014. IBIS World Industry Report. www.ibisworld.com

Vending Times. 2013. "Census of the Industry 2013 Edition." Vending Times.

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