More on Optimal Denominations for Coins and Currency

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February 1997

Research Department

Working Paper

97-02

Federal Reserve Bank of Dallas

More on optimal denominations for coins and currency*

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October, 1996
Revised: February 1997

Abstract: Telser (1995) has shown that the problem of Bâchet helps answer the question of the optimal denominational structure of currency in the U.S. and U.K. This note provides further evidence to support this claim using cross-country data.

Keywords: Currency denominations; problem of Bâchet.

JEL classification: E42

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1. Introduction

In a recent communication Telser (1995) argued that the problem of Bâchet can shed light on the problem of choosing denominations for coins and currency. The relevant version of the problem of Bâchet is the one that seeks the smallest number of weights capable of weighing any unknown quantity up to some prespecified amount to a given degree of accuracy, using a two pan balance and allowing the weights to be placed in either pan. The solution to the problem is weights that are powers of three, and a system of k such weights allows one to weigh any quantity up to $(3^{k+1}-1)/2$. The analogy with the problem of choosing denominations for coins and currency is obvious. The unknown quantity to be weighed can be viewed as the nominal value of a cash transaction; allowing the weights to be placed in either pan corresponds to the ability to make change. Telser argues that a "proclivity for the decimal system" means that the optimal denominations may deviate from those observed in reality, but then goes on to show that for the denominations of U.S. coins and currency that circulate (i.e. excluding the 50 cent coin and the $2 bill) the face value of each denomination is on average three times the face value of the denomination below it.

2. Currency Denominations Around the World.

This striking conformity between the predictions of the simple theory and what we observe in the U.S. currency system raises the question of whether we see a similar conformity when we look across a larger group of countries. A useful source of data for addressing this question is the *Statesman's Yearbook* (Hunter (1994)), which includes among other information about countries details on the units and denominations of each country's

currency. An important caveat accompanying this data is that we cannot identify denominations that are issued but do not circulate.

A cursory analysis of the data (which is too space consuming to be presented here but is available on request from the author) reveals that the so called *binary-decimal system* (consisting of the triplets {0.01, 0.02, 0.05}, {0.10, 0.20, 0.50}, {1, 2, 5}, {10, 20, 50}, {100, 200, 500} etc.) is by far the most prevalent system of currency denominations that we observe. For 20 of the 156 countries listed, the binary-decimal system completely characterizes the currency system.[1] For another 42, the binary-decimal triplet appears at least twice in the currency system. The binary-decimal triplet appears a lot more frequently than the *fractional-decimal* triplet {1, 2.5, 5}, and none of the countries in the sample has a denominational structure based solely on the fractional-decimal triplet. The countries that come closest are Lebanon (which issues coins of 1, 2.5, 5, 10, 25, and 50 piastres, and notes of 100, 250, 500, 10,000, 25,000 and 50,000 Lebanese pounds, as well as notes of 0.1, 0.5, 1,000, 5,000 and 100,000 Lebanese pounds), Madagascar (which issues coins of 10, 25, 50, 100, and 250 Malagasy francs, and notes of 500, 1,000, 2,500, 5,000, 10,000, and 25,000 Malagasy francs, as well as coins of 1, 2, 5, and 20 Malagasy francs), and the Netherlands (which issues coins of 1, 2.5, and 5 guilders, and notes of 10, 25, 50, 100, and 250 guilders, as well as low denomination coins of 5, 10, and 25 cents and a high denomination note of 1,000 guilders). For another 10 of the countries the currency system is based exclusively on

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[1]These countries are Argentina, Australia, Bulgaria, Colombia, Fiji, France, Ghana, Gibraltar, Honduras, Italy, Mexico, Mongolia, New Zealand, Papua New Guinea, Solomon Islands, South Africa, Swaziland, Tonga, Uruguay, and Western Samoa.

the *decimal pair* {1, 5} and multiples thereof (i.e. {0.01, 0.05}, {0.10, 0.05}, {1, 5}, {10, 50}, {100, 500}, {1000, 5000}).[2]

In light of Telser's argument it is striking that only 5 countries have denominations that are either powers or integer multiples of three: Albania issues 3 lek note, the Bahamas issue a 3 Bahamian dollar note, Cuba issues 3 peso note, Romania issues a 3 bani (fractional unit) coin, and Russia issues a 3 rouble note. Burma issues notes at the 15 kyat, 45 kyat and 90 kyat denominations. Before proceeding, we might note that the comparative rarity of notes or coins at denominations that are powers or integer multiples of three does not seem to characterize currency systems of the past. For example, the fractional currency issued in the U.S. during and after the Civil War included notes at the 3¢ and 6¢ denominations. Likewise, almost every issue of Continental currency in the U.S. during the Revolutionary War included notes at the $3 and $6 denominations, most issues included a note at the $30 denomination, the issue of February 17, 1776 included notes at the $1/6, $1/3, and $2/3 denominations, while the last issue (of January 14, 1779) included notes at the $45 and $60 denominations. There were also numerous issues of colonial currency at denominations that were integer multiples of three.[3]

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[2]These countries are Chile, Comoros, Iceland, Japan, Korea, North Korea, Norway, Paraguay, Taiwan, and Yugoslavia.

[3]See Friedberg (1995) for an introduction to denominations of U.S. paper money. These observations raise the interesting question of why the currency system in the United States evolved away from these denominations to its current structure. A referee points out that a 3-mark coin was also issued in Germany in 1924.

So how well does Telser's argument work when we look across countries? Using the data on currency denominations, for each country I calculated the ratio of the face value of each denomination to the one immediately below it and then calculated the average multiple for each country. Thus for a country with a denominational structure based exclusively on the binary-decimal triplet with, say, four complete triplets appearing, the sequence of denominations would be 1¢, 2¢, 5¢, 10¢, 20¢, 50¢, $1, $2, $5, $10, $20, and $50. Each denomination has a face value equal to on average 2.2 times the face value of the denomination below it (i.e. (2+2.5+2+2+2.5+2+2+2.5+2+2+2.5)/11). Note that the average multiple for a system based on the fractional-decimal triplet with four complete triplets appearing would also be 2.2, and either 2.1 or 2.3 if the system included incomplete triplets.[4] A currency system based on the decimal pair {1, 5} would have an average multiple of 3.5 or 4 depending on whether the system included complete or incomplete pairs.

Figure 1 is a plot of the histograms of the average multiple for all countries and for the subset of OECD countries. What is remarkable is that the arithmetic mean of the average multiples across countries is exactly equal to three as predicted by Telser! However the histogram also reveals that the distribution is not concentrated around the arithmetic mean, and if anything seems to be bi-modal with peaks at 2.2 and 2.7. The former value would be the mean of the distribution if all countries had denominational structures consisting of four binary-decimal triplets, while the latter would be the mean if all countries had denominational structures consisting of four binary-decimal triplets, plus two more denominations at 100 units

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[4]Telser (1995) points out that denominations that are powers of two would be optimal if all transactions had to be conducted with exact change.

and 1000 units.

While it is comparatively rare for two denominations to be separated by a factor of 10, it is not uncommon: thus in Canada the two highest denominations are the C$100 and C$1,000 notes, while in Israel the two lowest denomination coins are the 5 and 50 agorot. In no fewer than 17 countries do we find two denominations separated by a factor of 10 or more, and Vanuatu has the distinction of a currency system where the highest denomination coin is the 1 vatu, while the lowest denomination note is the 100 vatu! Panel B of Figure 1 shows what happens when we exclude countries with large "gaps" in their denomination structure from consideration (defined as those countries with at least two denominations separated by a factor of ten or more), and panels C and D present the same information for the subset of OECD countries. Excluding the outliers only marginally reduces the various measures of central tendency.

3. Conclusions

The evidence presented here lends support to Telser's (1995) argument that the problem of Bâchet provides insights into the issue of optimal denominations for currency, but also suggests that the observed denominational structures reflect other considerations. For example, the problem of Bâchet ignores the fact that mental calculations seem to be easier with binary-decimal or fractional-decimal triplets than with the ternary system that emerges as the solution to the problem. The assumptions that all denominations are equally costly to produce and that the distribution of cash payments is uniform are also at variance with reality. Even under fiat monetary standards, coins are generally more expensive to produce than notes, and

the coin-note boundary is determined by trading off these higher costs of production against the savings in terms of lower replacement costs for coins. This probably has little bearing on the choice of denominations, but the second assumption, that cash transactions are uniformly distributed probably does. Evidence on this question is hard to come by, but Boeschoten and Fase (1989) present evidence that suggests that in the Netherlands at least the distribution follows a lognormal distribution. Finally, the observed denominations probably also reflect the desire of the cash using public to be able to conduct transactions efficiently, where efficiency is defined (following Cramer (1983)) in terms of minimizing the number of coins and notes that change hands in the course of a transaction. A simple numerical comparison of the binary system $1,2,4,8,16,\ldots,2^k$ with the ternary system $1,3,9,27,\ldots 3^k$ for transactions between \$0.01 and \$100.00 shows that in terms of minimizing the number of coins or notes that must change hands if transactions are conducted efficiently, the binary system is indeed superior. The problem of Bâchet provides a partial but incomplete explanation for the denominations of coins and currency that we observe.

Acknowledgments

I thank Carrie Kelleher for her assistance in preparing this note and a referee for comments. The views in this paper are those of the author and do not necessarily reflect the views of the Federal Reserve Bank of Dallas or the Federal Reserve System.

References

Boeschoten, W.C., and M.M.G. Fase, 1989, "The way we pay with money," *Journal of Business and Economic Statistics*, volume 7, number 3, July, 319-326.

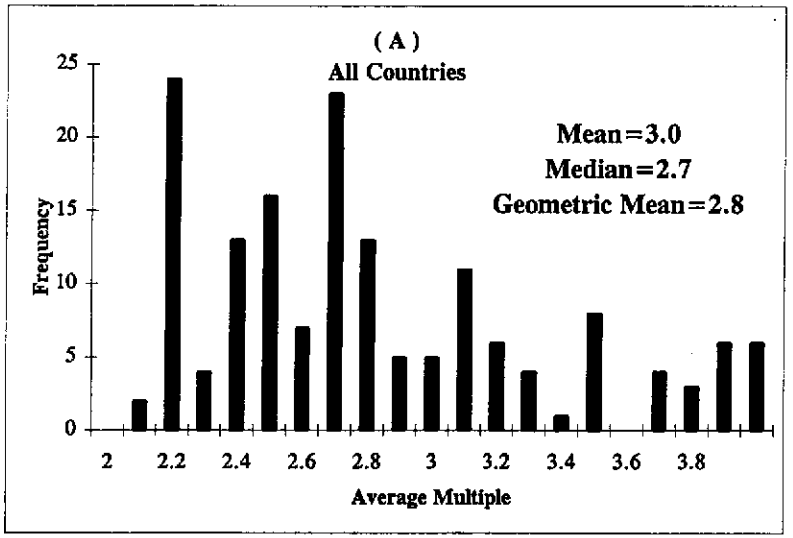
Cramer, J.S., 1983, "Currency by denomination," *Economics Letters*, volume 12, 299-303.

Friedberg, Robert, 1995, *Paper Money of the United States, Fourteenth Edition*, Clifton, NJ: The Coin and Currency Institute, Inc.

Hunter, Brian, ed., 1994, *The Statesman's Yearbook, 131st Edition*, New York: St. Martin's Press.

Telser, Lester B., 1995, "Optimal denominations for coins and currency," *Economics Letters*, volume 49, 425-427.

Figure 1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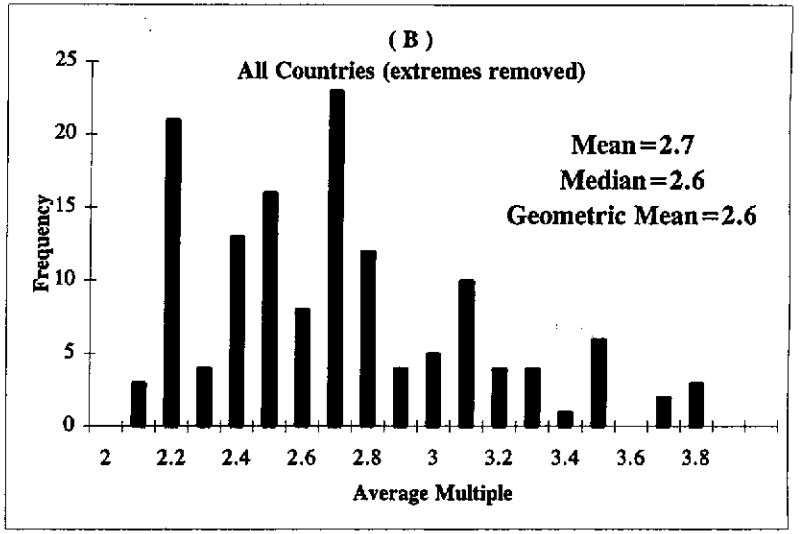
Median=2.7
Geometric Mean=2.8
Frequency
Average Multiple


(B)
All Countries (extremes removed)
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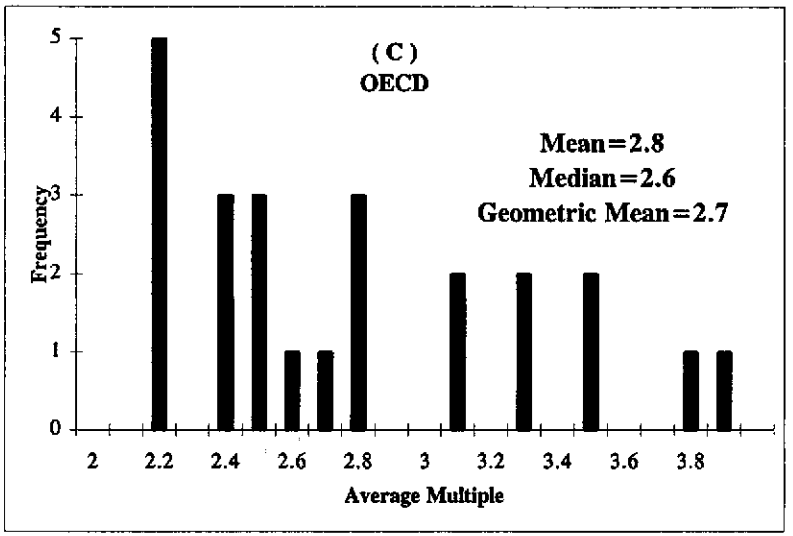
Median=2.6
Geometric Mean=2.6
Frequency
Average Multiple


(C)
OECD
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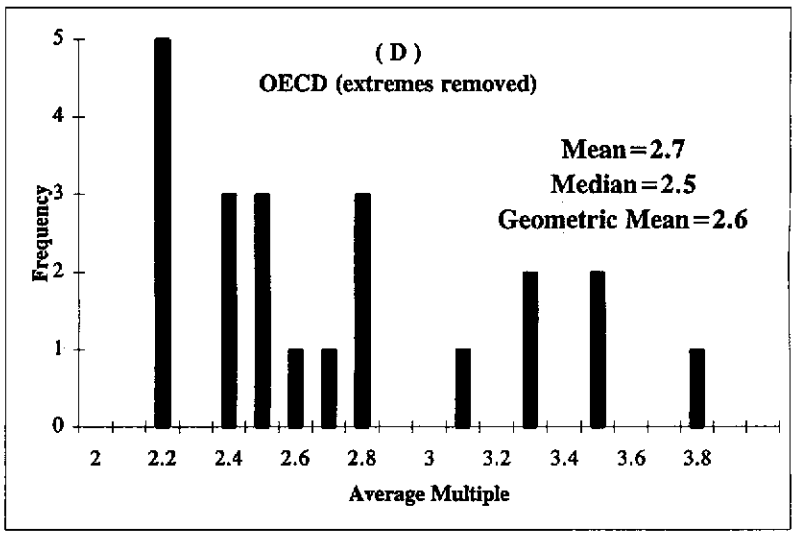
Median=2.6
Geometric Mean=2.7
Frequency
Average Multiple


(D)
OECD (extremes removed)
Mean=2.7
Median=2.5
Geometric Mean=2.6
Frequency
Average Multiple

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