ESTIMATION OF CONSUMER CREDIT AT COMMERCIAL BANKS

Stephen Taubman, Darrel Parke and Jules Shapiro, Federal Reserve Board

I. Definition

Consumer instalment credit consists of short and intermediate term credit extended through regular business channels to finance the purchase of goods and services for personal consumption or to refinance debts incurred for such purposes and scheduled to be repaid in two or more instalments. Single payment loans are excluded and mortgage credit is generally excluded. The seven major credit items and their amounts outstanding at commercial banks in June 1977, in billions of dollars were:

auto	44.6 billion
credit card	11.6
check credit	3.3
mobile home	8.8
other consumer goods	7.8
home improvement	6.6
personal loans	18.5
Total Consumer Instalment Credit (CIC)	101.2

Commercial bank credit accounts for approximately 49% of all consumer credit. The remaining major holders include finance companies (21%), credit unions (17%), and retailers (9%).

Previous estimation procedures are described by the Board of Governors of the Federal Reserve System [1]. This above reference work also presents a detailed discussion of consumer credit. Currently, end of month estimates of CIC are calculated and published monthly. These estimates are based on a sample of 567 banks from a bank population of approximately 14,500. All 14,500 banks report their end of quarter figures so that a check on the accuracy of the estimates can be made four times a year. (Actually non-insured banks only report twice a year but there are only 38 of these banks accounting for .0003% of the total CIC). In October 1977, the Board decided to revise the sample in order to reduce costs and burden for the commercial banks. A new sampling procedure was to be developed with the following restrictions:

1) The sample size should be reduced but the standard deviation of the estimate of CIC should not exceed 0.6 billion;

2) All banks in the new sample should be selected from the current sample of 567 banks;

3) The new reduced sample should only include banks which are members of the Federal Reserve System. In the 567 bank sample 420 banks are members. NOTE: In June 1977, there were 5,720 member banks out of a total bank population of 14,467. The CIC of members account for 69% of the total CIC.

The purpose of this paper is to describe the methods used to choose both the new sample and the form of the estimator.

II. Sampling Procedure

The first problem was to choose a stratification variable. While accuracy of the estimates of the credit aggregates is the objective, a secondary consideration is that users occasionally are interested in consumer credit outstanding by size class of bank where "size" is measured by total assets. Chart 1 plots the standard deviation of estimates of CIC vs sample size where the estimate is the sum of the ratio estimates of the seven components of CIC. (These deviations are calculated as if stratified random samples were to be selected from the population. However, as noted earlier, the sample is to be selected from the original 567 bank sample). Optimal allocation was used with total assets being the stratification variable. The data are from the latest available time periods. A chart was also prepared using CIC as the stratification variable which produced only slightly lower standard deviations than those in Chart 1. Thus only a small loss would be incurred by using total assets and it was the variable selected. Stratum limits were chosen utilizing the $\text{cum}\sqrt{f(y)}$ rule (see Cochran [2], p. 130). Nine strata were selected with the ninth stratum containing only the 14 largest banks of the 567 bank sample which were also 14 of the largest 15 banks in the population.

In Chart 1, the variance calculated is the sum of the variances and co-variances of the seven individual credit item estimates. Based upon this chart, a sample size of 300 was judged acceptable. A random sample was drawn from the 567 sample banks and 298 banks were chosen. One stratum was unable to be filled due to an insufficient number in the 567 sample.

Finally, for the chosen 298 bank sample two estimates were compared using historical data. The first, the ratio estimate is given by:

$$e_1 = (\bar{y}/\bar{x}) X$$

where $\bar{y}$ is the sample mean in the current time period, $\bar{x}$ is the sample mean in the previous time period, and X is the population total in the previous time period.

The second estimate is:

$$e_2 = \bar{r}X$$

where $\bar{r}$ is the mean of the sample ratios for the two time periods. Assuming the relationship between x_i and y_i is a straight line through the origin, Cochran [1] suggests e_1 if the variance of the y_i about this line is proportional to x_i and e_2 if this variance is proportional to x_i^2.

For each of the first eight strata the regression of y_i on x_i through the origin was calculated. Each stratum was then divided into three segments. For each segment the variance of y_i about its stratum regression line was computed. Finally the array of 24 such variances were regressed both on the segment midpoint and on the square of this midpoint. The

r^2 = Reg SS/TSS for each regression and credit item is now given for two different sets of recent time periods.

Credit Item	r^2 For Time 1		r^2 For Time 2	
	M	M^2	M	M^2
1	.59	.45	.88	.69
2	.96	.94	.84	.63
3	.88	.99	.84	.86
4	.79	.82	.88	.69
5	.88	.80	.88	.67
6	.77	.66	.75	.96
7	.73	.54	.83	.73

In the above table M denotes the midpoint.
The above results suggest that the variance is more proportional to size than (size)^2.
Further test results for six time periods comparing estimates to actual data are now given:

(1)	(2)	(3)	(4)	(5)
Time Period	Error in CIC for e_1	Error in CIC for e_2	Sum of e_1 Component	Sum of e_2 Component
7712	224 million	1027	1329	1107
7709	111	155	461	432
7706	355	10	1126	884
7703	331	229	528	634
7612	192	34	637	1060
7606	304	290	1419	1485
Avg.	253	291	917	934

All numbers in the table are absolute values. Columns (2) and (3) represent the errors in the CIC estimate. Columns (4) and (5) are the sums of the absolute errors in each of the seven credit components making up CIC. Columns (2) and (3) show that the errors are about what we could expect in view of the results in Chart 1. These results favors e_1 and thus are consistent with the regression results. For these reasons e_1 the ratio estimate was recommended to estimate CIC.

Estimates will continually be compared to actual values four times each year and large discrepancies will be investigated.

References
[1] Board of Governors of the Federal Reserve System (1976), Banking and Monetary Statistics, 1941-1970, Washington, D.C.: Board of Governors of the Federal Reserve System.

[2] Cochran, W.G. (1963). Sampling Techniques. John Wiley & Sons.

CHART 1

STD. DEV. OF CIC EST. ($\times 10^4$) vs SAMPLE SIZE ($\times 10^1$)