

EVALUATION OF THE 1980 CENSUS
PRECANVASS COVERAGE IMPROVEMENT OPERATIONS

Milton C. Fan, Martha L. Sutt, and John H. Thompson, U.S. Bureau of the Census

I. Background and Introduction

The 1980 Census Precanvass Operation was one of the methodologies employed by the Census Bureau in compiling the address list. The 1980 census was conducted primarily as a mail-out/mail-back census, in which respondents were mailed a questionnaire to complete and mail back. Thus, a complete and accurate address list was an essential component of the census. In the more urban areas of the United States, where a commercial mailing list was available and the Census Bureau was able to assign census geographic codes by computer, the address list was compiled by first purchasing a commercial mailing list and updating it with postal checks and the precavass operation. The areas covered by this address list are referred to as Tape Address Register (TAR) areas. In the remaining areas where a mail census was to be conducted, the Census Bureau compiled the address list by first having the area canvassed by census enumerators, and then updating the list by postal checks. These areas are referred to as Pelist areas.

In the TAR areas, the commercially purchased mailing list was sent for an Advance Post Office Check (APOC) in August of 1979. As a result of this check the post office added residential addresses which were not on the list, deleted undeliverable or non-residential addresses, and corrected existing addresses, if required. The APOC updated commercial mailing list was then run through the Census Bureau's geocoding programs. As a result of this operation, it was possible to assign geographic codes, such as tract and block number to approximately 40 million addresses. This geocoding operation also produced an additional 6 million addresses which could not be computer geocoded, but which appeared to be potentially good addresses. These uncoded addresses were printed on cards (yellow cards) for field geocoding.

The 40 million coded addresses were structured into Enumeration Districts (EDs), small geographic areas consisting of about 300 addresses and respecting all geographic boundaries recognized by the Census Bureau. A Master Address Register (MAR) was prepared for each ED. The MAR contained a computer-printed listing of each address geocoded to the ED. A Precanvass Address Register (PAR) was also printed for each ED. Unlike the MAR, the PAR contained a listing of each basic address and the associated number of housing units in the basic address that had been assigned to the ED.

The precavass field operation took place in February and March of 1980. This was a dependent canvass procedure in which census enumerators were given a PAR and an ED map and told to canvass the entire ED, to add missed residential units, to delete erroneous units, and to verify, for each basic address, that the number of units listed in the PAR was correct. When an enumerator discovered more units in a basic address than were listed in the PAR, the enumerator listed the apartment designation of each unit in the basic address.

As a quality check on the precavass enumerator's work, a sample of housing units was delib-

erately suppressed from the PARs. Later, the precavass enumerator's work was redone if too many suppressed units had not been reinstated.

At the conclusion of the precavass field operation, an office operation took place in which the updated Precanvass Address Registers were compared to the Master Address Registers. Several procedures were employed to update the Master Address Registers based on the results of the precavass field operation. If the precavass enumerator indicated that one or more units in a basic address had been missed, it was necessary to compare the apartment designations listed in the PAR with those in the MAR in order to determine which units were missed. This operation was complicated when the apartment designations from the two sources did not agree. For those basic addresses that the precavass enumerator found to have been missed, a search operation was instituted to determine if the basic address appeared in a different ED and/or block. Those basic addresses found in a different ED or block were examined to see if the precavass enumerator for this new location had deleted the basic address. If so, these basic addresses were added to the correct geography and referred to as precavass transfers. In the situation where the same basic address was found to be not deleted in two different geographic locations, a field reconciliation operation was instituted. Thus, the results of the precavass were used to both add missed units and transfer existing units to correct geography. It should be noted that in those basic addresses for which the number of units listed in the Precanvass Address Register was equal to or less than what the enumerator found, no attempt was made to verify the apartment designations. A detailed description of precavass field and office operations is given in [1] and [2].

The precavass office operation was further complicated by the field reconciliation of the yellow cards which represented addresses that required field geocoding. The materials were delivered late to the field which resulted in the precavass and the yellow card operations being conducted either simultaneously or in reverse order. This complicated the precavass office operations, since in some instances yellow card corrections had been made to the Master Address Registers and in some instances they had not.

After the conclusion of the precavass operations, two additional postal reviews were instituted to further update the address list. These were the Casing and the Time-of-Delivery checks. As a result of these operations, the post office again added missing addresses, deleted undeliverable or nonresidential addresses, and corrected existing addresses if required. The added units were delivered to the Census Bureau on blue cards and are thus referred to as blue card adds. Unfortunately, the precavass adds were often not included in the Casing and the Time-of-Delivery checks so that duplicate adds were sometimes received.

In this paper, an evaluation of the precavass operation will be discussed. The discussion will cover such aspects as the number and proportion of precavass adds, the overlap be-

tween the precavass and the other update procedures (yellow and blue card adds), the potential problems that resulted from not updating apartment designations in each structure, duplicate enumerations and demographic characteristics of those persons enumerated in units added by the precavass operation.

II. Sample Design

The sample was essentially a two-stage cluster sample. The first-stage unit was the District Office (DO). The second-stage unit was ED within DO. The sample of DOs was selected from the 409 DOs set up for the 1980 census. Prior to sampling, the DOs were separated into the following 6 strata:

Stratum	No. of DOs	Description
I	39	Centralized district offices in a city with 1,000,000 or more population.
II	48	Balance of centralized district offices.
III	194	Decentralized district offices without Prelist.
IV	67	Decentralized district offices with Prelist-Urban.
V	25	Decentralized district offices with Prelist-Rural.
VI	36	Conventional plus two-procedure district offices.

Samples of DOs were selected randomly from each of the 6 strata, and supplemented several times. The sample of DOs is listed in [3]. The EDs were selected systematically within DO with equal probability. About 50 EDs were selected for each sample DO. A total of 43 sample DOs and 2,085 EDs were processed for the evaluation of the precavass operation.

III. Estimation

The estimate of the characteristic of interest for a specific sample DO in a specific stratum is

$$\hat{Y}_{hi} = \frac{1}{p_{hi}^{(2)}} \sum_{j=1}^{M_{hi}} Y_{hij}$$

where

Y_{hij} is total of characteristic in the j th sample ED in the i th sample DO in the h th stratum,
 $p_{hi}^{(2)}$ is the 2nd stage selection probability

of sample EDs in the i th sample DO in the h th stratum, and

M_{hi} is the number of sample EDs in the i th sample DO in the h th stratum.

The estimate of characteristic of interest for a specific stratum is

$$\hat{Y}_h = \frac{X_h}{\sum_{i=1}^{n_h} p_{hi}^{(1)}} \sum_{i=1}^{n_h} \frac{\hat{Y}_{hi}}{p_{hi}^{(1)}}$$

where $p_{hi}^{(1)}$ is the 1st stage selection probability of the i th sample DO in the h th stratum, X_h is the total number of housing units in the h th stratum, X_{hi} is the total number of housing units in the i th sample DO in the h th stratum, and n_h is the number of sample DOs in the h th stratum. Furthermore

$$\hat{Y}_h = \sum_{i=1}^{n_h} \sum_{j=1}^{M_{hi}} \left[\frac{X_h}{\left(\sum_{i=1}^{n_h} \frac{X_{hi}}{p_{hi}^{(1)}} \right) p_{hi}^{(1)} p_{hi}^{(2)}} \right] Y_{hij}$$

$$= \sum_{i=1}^{n_h} \sum_{j=1}^{M_{hi}} W_{hij} Y_{hij}, \text{ where } W_{hij} \text{ equals the expression in the brackets.}$$

$$= \sum_{i=1}^{n_h} W_{hi} Y_{hi}, \text{ where } Y_{hi} = \sum_{j=1}^{M_{hi}} Y_{hij},$$

unweighted total of characteristic in the i th sample DO in the h th stratum.

Thus, the estimate Y_h for stratum h is a weighted estimate with weight W_{hij} assigned to sample DO i in stratum h for all $i=1, \dots, M_{hi}$ and $h = 1, 2, \dots, 6$.

The variance estimation is given in [4]. The coefficient of variation (CV) of the estimate is between 0.10 and 0.20.

IV. Evaluation Methodology

The procedures used for the evaluation of the precavass operation involved matching the listings in the PARs against those in the MARs. The results of matches were entered as codes into the PAR and the MAR. Briefly, the procedures for the evaluation were as follows:

- 1) Match yellow and blue cards against the listings in the sample ED MAR.
- 2) Identify the suppressed unit listing.
- 3) Identify potential adds to the PAR as one of the following three types:
 - (i) Single unit basic address add.
 - (ii) Multi-unit add within a multi-unit structure.
 - (iii) Multi-unit basic address add.
- 4) Match adds in the sample ED PAR against listings in the sample ED MAR.
- 5) Match single unit or multi-unit basic address adds in the sample ED PAR against listings in neighboring ED MARs.
- 6) Match single unit or multi-unit basic address adds in the sample ED PAR against the Block Header Record, Form D-327.
- 7) Summarize the codes in the MAR and the PAR.

The procedures for the evaluation are detailed in [5].

During the matching of the listing in the sample ED PAR against the sample ED MAR, the potential adds in the PAR were identified as one of three types of adds:

- 1) Single unit basic address add.

2) Multi-unit add within a multi-unit structure.

3) Multi-unit basic address add.

Within a sample ED, the adds (handwritten) which appeared in the MAR were classified as to the results of matching the listing in the sample ED PAR against the listings in sample ED MAR, and yellow and blue cards against the listings in the sample ED MAR into the following categories:

- 1) Precanvass alone.
- 2) Both precavvass and yellow and/or blue card.
- 3) Yellow and/or blue card.
- 4) Unknown - other than categories 1 through 3.

The adds in the MAR from categories 1 and 2 were matched by questionnaire serial number to census record to obtain the number and the demographic characteristics of those persons enumerated in units added by the precavvass operation.

Finally, it should be noted that it became apparent during our evaluation, that the precavvass field operation became extremely complicated in multi-unit structure for which apartment designation discrepancies occurred. Matching the added listings in the sample ED PAR against the listings in sample ED MAR was very difficult in our controlled evaluation environment and resulted in the assignment of several hundred match codes to be analyzed.^{2/} The precavvass operation as conducted in the census district offices was more complicated and uncontrolled.

V. Results

A brief summary of the results from the precavvass evaluation is discussed below.

A. Additions to Master Address Register

Table 1 gives the estimated total of adds to the MAR and add rates by sources.

An estimated 7.6 million addresses was added to the MAR. Of this total, 2.36 million were added by precavvass operations alone with a 5.0 percent add rate, about 1.95 million were added by precavvass and yellow and/or blue cards operations with a 4.1 percent add rate, 1.51 million were added by yellow and/or blue cards operations with a 3.2 percent add rate and 1.62 million were added by coverage improvement operations other than precavvass and yellow and/or blue card operations with a 3.4-percent add rate. The precavvass operations alone accounted for 30.9 percent of the estimate of total of addresses added to the MAR, while precavvass and yellow and/or blue cards operations accounted for 25.6 percent, yellow and/or blue card operation alone 19.7 percent and coverage improvement operations other than precavvass and yellow and/or blue card operations accounted for 21.3 percent.

B. Additions to the Census

The estimate of net gain of pure precavvass adds was obtained by subtracting the sum of estimates of the total of duplicates (matched to good handwritten or computer printed listings) and the total of definite transfers (matched to deleted computer printed listings) from the estimate of total pure precavvass adds. A duplicate is defined as a unit duplicate, not a person duplicate. Transfers are those adds

which were matched to deleted computer printed listings in the MAR. Table 2 gives the estimate of net gain of pure precavvass adds by type of structure. As may be seen in Table 2, it was estimated that pure precavvass operation added 2,356,846 adds to the census 1,575,798 single unit basic adds, 555,009 multi-unit basic adds and 226,039 multi-unit within structure adds.

For single unit basic adds, 1.9 percent were within ED duplicates, 15.8 percent within ED transfers, 2.2 percent between ED duplicates and 4.3 percent between ED transfers. The multi-unit basic adds had almost the same percentage estimate for between ED transfers as did single unit basic adds but had smaller percentages for within ED duplicates and between ED duplicates. The percents for multi-unit basic adds were 0.9 for within ED duplicates and 1.2 for between ED duplicates. The multi-unit within structure adds had a percent of 2.0 and 1.9 for duplicate and transfers respectively.

Because the apartment designations were often lacking in the PAR, it was very difficult and confusing to match the adds in the sample ED PAR against the listings in the MAR to determine the precavvass adds, duplicates and transfers for multi-unit basic and multi-unit within structure adds. In particular, for multi-unit within structure adds it was very hard to determine transfers without a doing unit-by-unit matching.^{4/} For this reason, the figures in Table 2 tend to slightly understate transfers for multi-unit within structure adds.

C. Demographic Characteristics

Table 3 gives estimates by race and Spanish origin and DO type of the total number and the percentage of persons enumerated in housing units added by the precavvass operation and of the weighted population and its corresponding percentage.^{5/} Among persons added by precavvass operations^{6/}, 85.0 percent were white, 9.3 percent were black, and 5.7 percent were other; 5.4 percent were Hispanic and 94.6 percent were non-Hispanic. Comparing the percentage of estimate of persons added with the percentage of the weighted population by race and Spanish origin and DO type, it is seen that a higher percentage of whites (63.0 percent vs. 57.7 percent), a lower percent of blacks (25.5 percent vs. 31.3 percent), a slightly lower percentage of Hispanics (16.9 percent vs. 18.9 percent), and a slightly higher percentage of non-Hispanic (83.1 percent vs. 81.1 percent) were added by precavvass operation in centralized DOs than were represented in the weighted population. One reason why whites were added disproportionately may be that most units added were single units and persons living in single housing units were more likely to be whites.

Table 4 gives the estimate by race and Spanish origin, add type and DO type of total and percentage of persons enumerated in housing units added by precavvass operation. As may be seen in Table 4, in the centralized DOs, whites living in single housing units and blacks living in multi-unit housing units were more likely to be added. Others and Hispanics were more likely be added by multi-unit within structure adds. In decentralized DOs, Hispanics were likely to be added by multi-unit within structure adds.

VI. Conclusion

In summary, the precanvass operation added an estimated 2.36 million addresses to the census. It costs approximately \$11,800,000. Thus, the precanvass was cost effective, costing about \$5.00 per address added. While the precanvass operation alone added a substantial number of units to the census, it also overlapped considerably with the post office and yellow card operations. There was also considerable evidence found that the office operations were unnecessarily complicated by apartment designation discrepancies, and confusion due to jointly conducting the precanvass, yellow card, and post office update operations. In looking toward 1990, automation would appear to offer great promise in controlling the office operations associated with the precanvass, as would strong QC procedures. Apartment designation discrepancies can be addressed by moving towards a unit-by-unit precanvass as opposed to the structure-by-structure operation used in 1980, and expanded post office update methods will also address this problem. Finally, in view of the number of single unit structures added, at the noted overlap between the precanvass and post office, it would seem desirable to explore expanding the precanvass into rural areas. The Address List Compilation Test will provide some insights into this area. ^{1/}

Footnotes

1/ Different match codes were assigned for multi-unit adds to determine the net gain and potential loss. Detailed descriptions of the match codes used in the MAR and the PAR are detailed in [6] and [7].

2/ Final TAR address count.

3/ May be added by coverage improvement operations other than precanvass and yellow and/or blue cards operations.

4/ To simplify the coding procedures; the coding scheme used for multi-unit basic adds was also used for multi-unit within structure adds. Unfortunately, in some situations the transfer could not be measured accurately.

5/ Weighted population is obtained by using same weighting scheme used for the evaluation of precanvass operation.

6/ There were 13.6 million persons were enumerated in units added by the precanvass operation. Some of these units were transfers and duplicates. Some units may have been added by coverage improvement operations other than precanvass alone, or precanvass and yellow and/or blue cards.

7/ The urban part of the Address List Compilation Test (ALCT) is currently being conducted in Hartford and Bridgeport, Connecticut. The detailed description of ALCT is presented in [8].

APPENDIX. Glossary of Terms

This glossary contains definitions of terms used but not referred in this paper.

Block

An area bounded on all sides by physical features such as streets, roads, railroad tracks,

or rivers or sometimes by invisible boundary.

Block Header Record

Block Header Record is an alpha-numeric street listing of address ranges within a given geographic area. The listing contains the name, direction (including prefix, "S. Main," or suffix "Main S."), and type (street, avenue, road, etc.) for a street, and the range of house numbers along each side of that street. The listing also contains the Zip code and district office code, as well as the block and ED numbers in which each address range for the street is located.

Block Number

A three-digit number that identifies a census block on the listing pages and census map.

Canvass

Systematically travel all streets, roads, paths, and so forth, for each block in the assignment area to identify every place where people live or could live.

Casing Check

A postal operation, occurring approximately three weeks prior to Census Day. During the casing check, postal clerks placed all census questionnaires into individual route slots. The clerks completed an address card for each residential slot for which the clerks had no census questionnaire.

Centralized District Office

Used in central cities of large metropolitan areas. Clerks in the DO receive, check in and edit questionnaires and do telephone followup.

Decentralized District Office

Mail returns are given to enumerators who work in their homes, check in the questionnaires for EDs, edit them, and accomplish followup for incompletes or nonresponse cases. Enumerators work from their own homes rather than from the district office.

District Office

The census office in a local area.

Housing Unit

A house, apartment, group of rooms, or single room occupied as a separate living quarters, or if vacant, intended for occupancy as a separate living quarters.

Multi-unit Structure

A structure containing more than one housing unit. The individual housing unit may be identified by specific designations (Apt. 101, A, 213, and so forth), may have separate basic addresses, or may not be specifically described, as in a former single-family house that has been converted into more than one housing unit.

Serial Number

A four-digit identification number assigned to all known living quarters in an ED. Serial numbers are not repeated within an ED.

Time-of-Delivery Check

A postal operation, occurring during the delivery of census questionnaires approximately four days prior to Census Day. The postal carrier were to complete cards for every address for which no questionnaires were available for delivery.

Tract

One of several geographic areas into which a county is divided for the reporting of census

statistical information.

Reference

- [1] Precanvass Enumerator's Instructions in the Precanvass Address Register
- [2] Precanvass Corrections Manual Form D-513A.
- [3] Sausman, K. "Sample of DOs for Coverage Improvement Evaluation Program," Census Internal Memorandum, June 15, 1982.
- [4] Fan, M.C. and Thompson, J.H. "Evaluation of the 1980 Census Precanvass Coverage Improvement Operations," Census Internal Memorandum, to be released in October 1984.
- [5] Fan, M.C. "Final of the Study Plan for the Evaluation of Precanvass Operation," Census Internal Memorandum, October 20, 1982.
- [6] Fan, M.C. "Draft of Computer Specifications for Conversion of Keyed Data to SPSS System Files for MAR Summary Data for Precanvass Evaluation," Census Internal Memorandum, August 1, 1983.

[7] Fan, M.C. "Draft of Computer Specifications for Conversion of Keyed Data to SPSS System Files for PAR Summary Data for Precanvass Evaluation," Census Internal Memorandum, November 4, 1983.

[8] Franklin, D. K. "Analysis Plan for the Address List Compilation Test," Census Internal Memorandum, June 22, 1984.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of a number of colleagues for their help in preparing this paper. In particular, we wish to thank Robert Edson, John Linebarger and William Mockovac for their comments, Daniel Glowa for his dedicated computer program support, and Susan Heskamp for her excellent supervision of the clerical work. The authors also owe a great deal of thanks to Ms. Frances Gunther for typing the manuscript.

Table 1
Estimate of Total Adds to the Master Address Register

Sources	(1) Total	(2) Percent of Adds (%)	(1)/47,258,351 ^{2/} Percent of TAR Listing (%)
Precanvass alone			
net gain	2,356,846	30.9	5.0
duplicates	102,449	1.3	0.2
Precanvass and yellow and/or blue cards			
net gain	1,951,809	25.6	4.1
duplicates	88,340	1.2	0.2
Yellow and/or blue cards only	1,506,590	19.7	3.2
Unknown ^{3/}	1,624,879	21.3	3.4
Total	7,630,913	100.00	16.1

Table 2
Estimate of Net Gain of Pure Precanvass Adds by Structure

	Single Unit		Multi-Unit Basic		Multi-Unit Within		Total	
	Estimate	Percent of Gross Add (%)	Estimate	Percent of Gross Add (%)	Estimate	Percent of Gross Add (%)	Total	Percent of Gross Add (%)
Gross add	2,079,844	100.0	595,225	100.0	235,246	100.0	3,910,315	100.0
Within Duplicate ED	40,389	1.9	5,033	0.9	4,672	2.0	50,094	1.7
Transfer	328,096	15.8			4,535	1.9	332,631	11.4
Between Duplicate ED	45,008	2.2	7,347	1.2			52,355	1.8
Transfer	90,553	4.3	27,836	4.7			118,389	4.1
Net gain	1,575,798	75.8	555,009	93.2	226,039	96.1	2,356,846	81.0

Table 3

Estimate of Persons Added by Precanvass Operation by DO Type and Race
and Spanish Origin

DO Type	Race/ Spanish Origin	Estimate of Persons Added	Percent (%)	Weighted Population	Percent (%)
Centralized	White	1,067,941	63.0	16,852,025	57.7
	Black	431,936	25.5	9,135,893	31.3
	Other	195,463	11.5	3,224,491	11.0
	Hispanic	286,898	16.9	5,529,049	18.9
Decentralized	White	10,413,715	88.1	143,550,977	87.5
	Black	833,728	7.0	14,709,455	9.0
	Other	578,241	4.9	5,806,415	3.5
	Hispanic	443,870	3.8	6,365,481	3.9
Two Procedures	White	79,813	94.1	1,657,176	95.5
	Black	1,391	1.6	20,022	1.1
	Other	3,611	4.3	58,937	3.4
	Hispanic	1,653	2.0	30,650	1.8
Total	White	11,561,469	85.0	162,060,178	83.1
	Black	1,267,055	9.3	23,865,370	12.2
	Other	777,315	5.7	9,089,843	4.7
	Hispanic	732,421	5.4	11,925,180	6.2

Table 4

Estimate of Persons Added by Precanvass Operations by DO Type, Type of Add, and Race
and Spanish Origin

DO Type	Type of Add	White	Percent	Black	Percent	Other	Percent	Hispanic	Percent
Centralized	Single Unit	518,921	69.0	161,750	21.5	71,566	9.5	104,481	13.9
	Multi-Unit Basic	315,530	63.2	134,319	26.9	49,368	9.9	66,600	13.3
	Multi-Unit Within	233,490	52.6	135,867	30.6	74,529	16.8	115,817	26.1
	Total	1,067,941	63.0	431,936	25.5	195,463	11.5	286,898	16.9
Decentralized	Single Unit	7,754,535	89.2	506,834	5.8	435,892	5.0	312,561	3.6
	Multi-Unit Basic	2,178,549	85.1	270,535	10.6	110,649	4.3	90,844	3.6
	Multi-Unit Within	480,631	84.5	56,359	9.9	31,700	5.6	49,465	7.1
	Total	10,413,715	88.1	833,728	7.0	578,241	4.9	443,870	3.8
Two Procedures	Single Unit	36,472	96.6	336	0.9	936	2.5	328	0.9
	Multi-Unit Basic	23,986	92.4	684	2.6	1,279	4.9	734	2.8
	Multi-Unit Within	19,355	91.6	371	1.8	1,396	6.6	591	2.8
	Total	79,813	94.1	1,391	1.6	3,611	4.3	1,653	2.0
Total	Single Unit	8,309,928	87.6	668,920	7.1	508,394	5.4	417,370	4.4
	Multi-Unit Basic	2,518,065	81.6	405,538	13.2	161,296	5.2	158,178	5.1
	Multi-Unit Within	733,476	71.0	192,597	18.6	107,625	10.4	156,873	15.2
	Total	11,561,469	85.0	1,267,055	9.3	777,315	5.7	732,421	5.4