RESPONSE RATES AND OTHER EFFECTS OF THE NEW SINGLE PANEL DESIGN FOR MONTHLY BUSINESS SURVEYS

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Key Words: Fixed panels, revisions, composite estimation, rotating panels

1. Overview

The Census Bureau began publishing monthly wholesale sales and inventory estimates based on a new single (or fixed) panel sample design for the first time for the February 1997 data month. A little later, we began publishing monthly retail sales and inventory estimates using this new design for the April data month. Prior to these times, estimates were based on a rotating panel design. For the current fixed panel design, we request data each month from all units selected in the sample, both large and small, and produce simple weighted estimates for the reference month. Here the sample weight is the inverse of the probability of selection, and we refer to these simple weighted estimates as "unbiased estimates" throughout this paper. In contrast, in the previous rotating panel design, we requested a single reference month's data each month from the larger units, but from the smaller units we requested two months' data, the reference month and the month prior to it. Furthermore, these smaller units were split into three rotating panels, and only one of the panels was included in the tabulations each month, depending on the month. In effect, each of the three panels of smaller units received a survey questionnaire only four times a year. Each month we used a composite estimator for estimates of total and month-to-month change for the rotating panel design.

We had several concerns in going to a fixed panel design. Chief among these was the possible reduction in response rates because the smaller units would be canvassed more frequently than before. This was potentially worrisome because reporting in the monthly surveys is voluntary for business firms, and these more frequent requests for data might be deemed burdensome. We also faced the prospect of having either a much larger sample size, and therefore increased costs, or relaxing our desired level of precision for small subcategories (essentially, Standard Industrial Classification (SIC) groupings), since these smaller levels benefit most from the gain in precision effected by composite estimation.

One major benefit we hoped to achieve in going to a fixed panel design was an overall reduction in the revisions of monthly level and change estimates. These revisions result directly from the rotating panel and composite estimation design. Another major benefit is that the fixed panel sample is easier to process, maintain, and analyze, and results in a more simplified system overall. For a broader discussion of the reasons for changing to a fixed panel design, see Cantwell et al. (1996).

In what follows, we contrast the old and new designs in terms of sample size, extent of revisions, response rates and precision of the estimates. By this we attempt to measure whether we are indeed achieving the desired benefits of the new procedures without incurring any unanticipated adverse effects.

2. Contrasts Between the Old and New Designs

2.1 Estimation Methodology Comparisons

The estimation methodology for the rotating panel design can be illustrated by the following. Each month we obtained unbiased estimates for two particular reference months, termed the "current" month and the "previous" month (the month just prior to the current month). For example, where January was considered the current month and December the previous month, we produced unbiased estimates for January and December. When collecting data with January considered as the current month, we used both a fixed and rotating panel component. The fixed panel consisted of sample units that were canvassed each month for their monthly data. These were the largest, most significant businesses. The January rotating panel component made up of smaller businesses was termed panel 1, and from it we collected current (January) month data and previous (December) month data. In turn, February's (as a current month) rotating panel component was labeled panel 2, March's panel 3, and April was panel 1 again, and so went the rotation. Thus, using the first unbiased estimate for January coming from the fixed panel and rotating panel 1, we constructed a preliminary composite estimate for January as a weighted average of: (1) the current month unbiased estimate (weight = 0.25 for retail sales and inventory, and 0.35 for wholesale sales and inventory), and (2) a ratio estimate (weight = 0.75 for retail sales and inventory, and 0.65 for wholesale sales and inventory) obtained by multiplying the current-to-previous month ratios developed from the two months of data (January and December) on the January questionnaires (and thus from the fixed panel and rotating panel 1) by the preliminary composite estimate calculated a month earlier for the previous month (December). In this way, January's preliminary composite estimate was linked directly to

December's preliminary composite estimate, and by this chained procedure, to earlier months' preliminary composite estimates.

About a month after producing the preliminary composite estimate for January, when February was considered the current month and January the previous month, we obtained from the fixed panel and rotating panel 2 a second unbiased estimate for January and a first such estimate for February. With these added data we then produced the final composite estimate for January, also as a weighted average of two estimates: (1) the preliminary composite estimate for January (weight = 0.8 for retail sales and inventory, and 0.7 for wholesale sales and inventory) and the unbiased estimate for January (weight = 0.2 for retail sales and inventory, and 0.3 for wholesale rates and inventory) obtained from the February (as current month, and therefore from the fixed panel and rotating panel 2) tabulations. The ratio of the preliminary (for January) to final for December estimates gave the January month's preliminary trend estimate. After the February tabulations, we obtained a final trend estimate for December to January as the ratio of the January final to the December final.

The difference between these trend estimates--January preliminary/December final and January Final/December final was called the revision in trend. Similarly, the change in level estimates from the preliminary composite estimate for a given month to the final composite level estimate for that same month constituted the revision in levels. These changes occurred chiefly due to the fact that we were using different rotating panels, or equivalently, different samples each month. Thus we termed these revisions as being the result of panel "imbalance." These are the revisions we sought to minimize with the new design. For more details on composite estimation and rotating panels in the monthly business surveys, see Cantwell et al. (1995).

Note that the weights used in the composite estimation were determined so as to control the variances of both the level and month-to-month change estimates for these surveys. For further details see Wolter (1979).

The estimation methodology for the new fixed panel design uses simply the unbiased estimate for the month. For the new sample, we have essentially the same fixed panel sample month after month so that revisions in the "preliminary" to "final" estimate are mostly the result of businesses revising their earlier data. We could also see revisions, however, because we later receive data for a business to replace an imputed value we used in the earlier tabulations. This sameness of the sample is not strictly true, since in reality, there are small changes in the make-up of the fixed panel sample because of the start-up of new businesses, changes in business affiliation or structure, and firms going out of business. Although we select samples to represent new businesses and drop out sample units going out of business on a quarterly processing schedule, we introduce adjustments to the sample for these reasons on a monthly basis. Preliminary measures of the effects of this "birth and death" process show the impact on the revisions to be small. We will continue to measure these effects.

2.2 Sample Sizes

We next look at the differences in sample sizes between the old and new samples. We determine sample sizes so that they meet estimate precision criteria -- design coefficients of variation (cvs) -- and cost constraints (determined by sample size). Our task here was to meet cv constraints with the new fixed panel design and yet not increase the sample sizes too much over those of the old design.

The sampling units for both the old and new samples were of two types: 1) the company unit consisting of all establishments in the relevant trade area for the larger businesses; and, 2) the Employer Identification Number (EIN) unit for the smaller businesses. In essence then, while a large business is sampled as a whole entity, the smaller ones are sampled on an EIN basis, so that if they have more than one EIN, each EIN is treated as a separate sampling unit. In practice, the vast majority of the smaller businesses have only one EIN. Table 1 below gives sample size comparisons between the old and new samples and for both company and EIN units.

TABLE 1

Monthly Sample Sizes
(Number of Reporting Units)

Wholesale Sales and Inventory

	Old Sample			New Sample
Units	Fixed	Rotating	Total	Fixed
Company	1410	0	1410	1421
EIN	803	1512	2315	2476
Total	2213	1512	3725	3897

Retail Sales

	Old Sample			New Sample
Units	Fixed	Rotating	Total	Fixed
Company	2018	0	2018	2517
EIN	4223	7123	11346	11117
Total	6241	7123	13364	13634

The counts in Table 1 are given in terms of reporting units. By reporting unit here we mean the units from which data

are collected. Reporting unit counts are generally slightly higher than sampling unit counts, because we allow selected sampling unit firms the option of reporting for different parts of their company, such as for geographic regions, or company divisions, from different company locations. For the old sample, Table 1 shows only panel 1's count under the "rotating" heading. The other rotating panel counts are typically only slightly different from panel 1. The panel counts vary because of different rates of units going out of business within the three panels. However, in the old design, we tried to keep the panels balanced by assigning new business births first to panels that were low. This helped somewhat to reduce the panel imbalances.

Note that in terms of reporting units, the new sample is only 4.6% higher than the old for wholesale. For retail, the new sample is 2.0% larger than the old. Also, for the old wholesale sample, the rotating panel cases made up about 41% of the total sample size; for retail this percentage was about 53%.

2.3 Revisions in Estimates of Trend (Month-to-Month Change)

We next look to see if the new sample is reducing the preliminary to final shifts in level and trend estimates relative to the old sample. For the new sample, the final estimate, coming one month after the preliminary, changes the preliminary only due to corrections for the data earlier reported or imputed. Table 2a gives these comparisons for total retail sales for September 1996 through May 1997.

TABLE 2a

Revisions in Estimates of Month-to-Month Change -- Old Vrs New Sample

Retail Sales

	Old Sample			New Sample		
Month, Yr	Prel	Final	Rev	Prel	Final	Rev
Sept 96	- 7.8	- 7.8	0.0	--	--	--
Oct 96	5.7	6.0	0.3	--	--	--
Nov 96	1.0	1.3	0.3	--	--	--
Dec 96	16.2	16.3	0.1	--	--	--
Jan 97	-23.9	-23.9	0.0	--	--	--
Feb 97	- 2.2	- 2.1	0.1	- 1.5	- 1.6	-0.1
Mar 97	14.5	14.4	-0.1	13.8	13.9	0.1
Apr 97	--	--	--	- 2.2	- 2.4	-0.2
May 97	--	--	--	6.9	6.9	0.0

Data Unadjusted

In this time period, the old sample shows a range of 0.0 to 0.3 for the revisions. The new sample, for which we have data only for the sample overlap months of February, March, and April, and also for May 1997, shows a range of 0.0 to 0.2 (in absolute value). Although the new sample appears to be not much better than the old thus far, several points need to be made. First, the old sample has had several months where the revision was 0.4 percent. We expect to avoid changes of this magnitude in the new sample. Second, the measured revisions for the sample in the overlap months are probably larger than what we will observe once the sample has been in use for a few more months. May's data reflects what we should normally see. This is because of the start-up problems of obtaining response and doing the necessary analysis of the month-to-month reporting patterns for new sample cases. We are also seeing comparable improvements (smaller revisions) at the kinds of business levels from the new sample.

Table 2b gives similar comparisons for wholesale sales. For wholesale sales enough months have passed since the sample overlap to begin to see a distinct pattern of reduced revisions in month-to-month change.

TABLE 2b

Revisions in Estimates of Month-to-Month Change -- Old Vrs New Sample

Wholesale Sales

	Old Sample			New Sample		
Month, Yr	*Prel	Final	Rev	Prel	Final	Rev
Sept 96	-2.3	-2.7	-0.4	--	--	--
Oct 96	9.3	9.7	0.4	--	--	--
Nov 96	-9.2	-9.7	0.5	--	--	--
Dec 96	1.8	1.2	-0.6	1.5	1.2	-0.3
Jan 97	-1.3	-1.9	-0.6	-2.0	-2.6	-0.6
Feb 97	--	--	--	-2.0	-2.1	-0.1
Mar 97	--	--	--	9.9	10.2	0.3
Apr 97	--	--	--	-1.0	-1.0	0.0
May 97	--	--	--	1.1	0.9	-0.2

* Regressed Prel

Data Unadjusted

The "Regressed Prel" footnote to Table 2b refers to a regression adjusted preliminary where the regressions take into account systematic and regular patterns in the month-to-month changes due to panel imbalance. Without these regression adjustments, the revisions would have been much higher. No regressions for the new sample should be needed.

2.4 Measures of Response: Imputation Rates

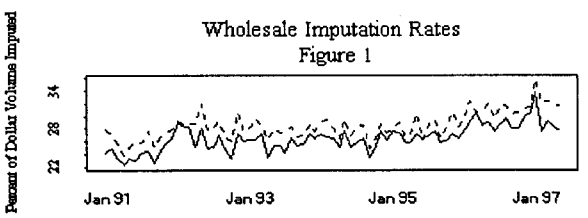
Because the wholesale sample overlap (concurrent running of both samples) ended with the February 1997

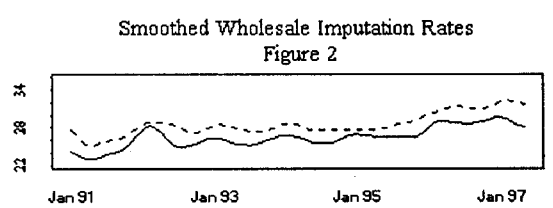
data month, and the retail overlap only started with the February 1997 data month, it is still a little early to determine the long term effects on response rates of the fixed panel design. Preliminary investigations (undertaken before we decided to implement a fixed panel design) into some small businesses that started out as rotating panel cases but were switched to fixed panel reporting (for various reasons, usually because they grew to be larger than when first selected for the sample) showed that their response rate was not significantly different from other rotating panel cases. What we are waiting to see is whether, as time goes on, the smaller businesses will drop out of participation because of our monthly requests for data. We plan to watch this closely.

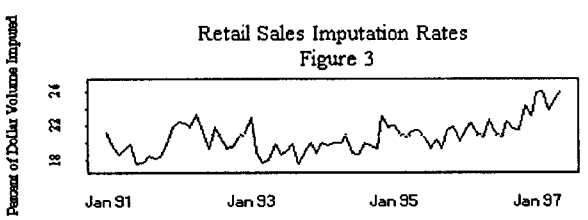
Over the past several years, however, we have observed a gradual increase in the nonresponse or imputation rate (in terms of percent of dollar volume of total) for the rotating panel sample. This has become more pronounced in the final full year (1996) of this sample. Figures 1 and 2 illustrate this situation and provide "unsmoothed" and "smoothed" imputation rates, respectively, for wholesale sales (solid line) and inventory (dotted line). For smoothing we used an iterative median smoothing method from S-PLUS as described by Tukey (1977). Although it is usual for imputation rates for a new sample to be higher during its first few months while we are still running the old sample in a sample overlap (the previous overlap occurred over the four months December 1991 through March 1992), the rates normally return to their pre-overlap levels. As one can see from Figures 1 and 2, this did happen throughout 1992 and for most of 1993. However, the imputation rates started to climb in 1994 and increased substantially in late 1996. A similar pattern held for retail imputation rates, as can be seen from Figures 3 and 4 for retail sales and Figures 5 and 6 for retail inventory.

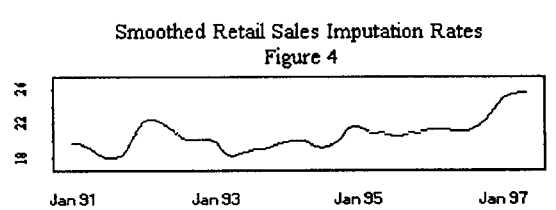
There are several reasons why response rates might go up (as we observed above) over the five year life-span of a sample. First, it must be pointed out that these important monthly retail and wholesale surveys are voluntary and, as such, they provide an easy way for a selected unit to decline participation. Second, selected units may tire of reporting since they perceive it as a burden to report periodically over a long period of time. Third, funds and other resources for data collection may be (and, in this case, have been) cut. This may reduce the resources spent on collection tasks, such as telephoning, mailing and faxing to nonresponding units, and also effect the frequency and effectiveness of training. It has an impact too on the skills level and effectiveness of supervisory controls in the data collection units. While there is little we can do about the voluntary nature of these surveys, we see it as our task to continually attempt to reduce imputation rates as much as possible. To do this we need to upgrade and improve our data collection operations wherever we can.

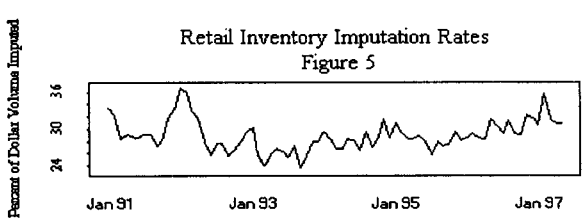
We next look at imputation rates for the old and new samples for a common period. Table 3 gives imputation rate comparisons for total wholesale and total retail sales during a span of ten months that included the old and new sample overlap. Generally, for wholesale sales, we would

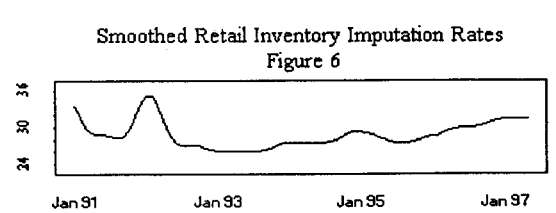












have expected the imputation rates to be lower for the old sample through the overlap, since the wholesale estimates from the old sample were published through February. (We later revised this February estimate by publishing the February new sample estimate.) What we observed is that while in the first month of the wholesale overlap, December 1996, we had a lower imputation rate for the old sample, we had lower imputation rates for the new sample in January and February, 1997. What may have happened, and this is only conjecture, is that the data collection staff may have put more emphasis on the new cases coming into the survey (smaller businesses that in the old design would have been rotating cases) rather than the rotating cases from the old survey that were dropping out. Thus they may not have pursued the cases dropping out of the survey as much as those coming in. If this were done, it was done to make what was thought to be the best use of limited resources for data collection. Note that the larger businesses would have been in both samples. Their data were collected for the old survey and used also for the new sample tabulation, so these should not effect the differences in imputation rates. In contrast, in the retail overlap months, February, March and April 1996, we did observe what we expected, that the old sample imputation rates were lower for the first two months and the same for the final month. The imputation rates are generally higher whenever a new sample is introduced. Therefore, through additional attempts and more time to concentrate on a single sample, these rates should diminish somewhat from their initial levels.

TABLE 3

Imputation Rate Comparisons
(Percent of Dollar Volume of Total Sales)

	Wholesale		Retail	
Month, Yr	Old Sample	New Sample	Old Sample	New Sample
Sept 96	28	--	22	--
Oct 96	28	--	21	--
Nov 96	30	--	24	--
Dec 96	31	33	23	--
Jan 97	34	30	26	--
Feb 97	32	28	26	32
Mar 97	--	29	24	27
Apr 97	--	28	25	25
May 97	--	28	--	26
June 97	--	28	--	27

2.5 Coefficient of Variation Comparisons

Table 4 below compares the coefficient of variation (cv) estimates for the old and new samples for retail sales and wholesales sales for the final month of their respective sample overlap periods. These were April 1997 for retail and February 1997 for wholesale. These comparisons are done at the broad levels of total sales, durables sales and nondurables sales.

TABLE 4

CV Comparisons

Retail Sales
(April 97)

	Old Sample		New Sample
	Unb	Comp	Unb
Durables	1.5	1.2	.4
Nondurables	1.6	1.3	1.1
Total	1.4	1.0	.5

Wholesale Sales
(Feb 97)

	Old Sample		New Sample
	Unb	Comp	Unb
Durables	2.6	2.2	2.2
Nondurables	2.9	2.7	1.9
Total	1.5	1.5	1.2

For sales, the new sample unbiased estimates (Unb) have equal or smaller estimated cvs than the old sample preliminary composite (Comp) estimates at these levels, and they are significantly less than the old sample's unbiased estimate cv levels. This was somewhat surprising to us, even though we put great effort into improving our sampling operations. For example, we did considerable computer editing and correcting of the sampling frame. Also, for the first time we used annual administrative tax return data to determine a sampling measure of size for about two-thirds of our single establishment EIN businesses. We also used resistant regression computations for determining the proper sales to payroll ratio used in measures of size calculations. In addition, we used Chromy's algorithm for sample allocation for the first time. All of these efforts, we feel contributed to our obtaining an increase in sampling precision. Another possible factor is

the analysts' ability to identify and correct outliers in the data because all sample cases are in the tabulations each month. This makes it much easier for survey analysts to detect errors in reporting for the smaller units. We plan to continue to study this process in order to determine whether the cv estimates will remain low over the life of the sample.

We also looked at cv comparisons for retail sales and for wholesale sales and inventory at the four-digit SIC levels along with a few five and six-digit Census Bureau defined refinements of the SIC codes. These comparisons were for the final overlap months, that is, April 1997 for retail and February 1997 for wholesale. At these levels, for retail sales we observe the following: (1) the new sample cvs of the four digit (last digits = 00) SICs are less than the old sample unbiased cvs for nearly 80 percent of the SICs; and, (2) the new sample unbiased estimate cvs are less than the old sample composite cvs for a similar percentage of SICs. The results confirm the fact that the new sample design is giving us good precision relative to the old rotating panel, composite estimate design pretty much across the board. We expect some increase in cvs as the sample ages. However, for our modest increase in sample size, we are happy with the performance of the fixed panel sample thus far. The results for wholesale sales and wholesale inventory estimates for February 1997, show the same improvement of the new sample versus the old, but not quite to the same degree as retail.

3. Conclusions and Future Plans

Although we are still in the early stages of implementing our new fixed panel design, we see encouraging evidence that we selected the correct path. With a slight increase in monthly sample size, we have: (1) reduced the complexity of processing and analyzing our monthly surveys; (2) reduced the revision in estimates of total between the preliminary and the final estimate, and thereby reduced the shift in month-to-month change between the preliminary and final estimates; (3) significantly reduced our estimated cv measures; and, (4) suffered no increase in imputation rates.

Thus, at least in the early stages, we appear to have achieved all we set out to do and more. However, we plan to monitor each of these areas closely so that we can take immediate actions to address any unanticipated problems. Another important component, which we did not put into play because of the resource constraints during the sample overlaps, is the new birth and death processing procedure. We identify new births and deaths each quarter and reflect these changes in the sample gradually over a three month period. This small change in the sample is one source of potential shifts in preliminary to final estimates that we need to verify as not being a problem. We began this new birth and death process effective with the May 1997 data month for both the retail and wholesale surveys.

We also produce an early monthly estimate of retail sales called the Advance Monthly Retail Sales estimate or, simply, Advance estimate. This survey is described in detail in Konschnik, et al., (1996). In the near future we are planning to draw a new Advance sample from this new fixed panel sample. We will introduce this new Advance sample in late 1997. At that point the Advance sample will be a proper subsample of the monthly retail sales sample. This close agreement between these important monthly samples will allow us to test and select the most appropriate model for improving the Advance estimates as predictors for the monthly retail sales estimates. Thus we will have an excellent opportunity to improve the quality and reliability of the important Advance estimates of retail sales.

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* This paper reports the general results of research undertaken by Census Bureau staff. The views expressed are attributable to the authors and do not necessarily reflect those of the Census Bureau.

We thank Carol King, Michael Shimberg, Bill Davie, and Tim Braam for providing data for our study and Kathy Trickey for typing this paper.