

Rotation Group Bias in Smoking Prevalence Estimates Using TUS-CPS

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Motivation

- It is important to precisely measure current smoking prevalence in the U.S. adult population
 - 443,000 deaths each year due to smoking
 - Decrease the prevalence of smoking to less than 12 percent among adults: One of the national health objectives for 2020
- Tobacco Use Supplement to the Current Population Survey (TUS-CPS)
 - Sponsored by the National Cancer Institute
 - A survey of tobacco use that has been administered as part of the Current Population Survey (CPS) in select months since 1992
 - Large sample size: individuals living in about 56,000 households (3)
 - => Extensively used in tobacco research, in particular for small geographic regions and small groups

Contributions of this paper

By examining if the sampling rotation scheme used in the CPS results in an underestimation of smoking prevalence in the TUS-CPS,

This paper finds that

- ⇒ For the years 2003, 2006-07, and 2010-11, rotation group bias causes an underestimation of smoking prevalence in the TUS-CPS
- ⇒ Rotation group bias is due to panel attrition and panel conditioning, which seemed to be caused by the increased number of additional questions for smokers in the years 2003, 2006-07, and 2010-11

Outline of talk

1. 4-8-4 Rotation Scheme of the Current Population Survey
2. Literature Review
3. Descriptive Analysis of Rotation Group Bias
4. Regression Analysis of Rotation Group Bias
5. Changes in the TUS-CPS
6. Panel Attrition in the TUS-CPS
7. Panel Conditioning in the TUS-CPS
8. Conclusions

4-8-4 Rotation Scheme of the Current Population Survey

- Each household whose address is selected for the sample is interviewed for 4 consecutive months, not surveyed for 8 consecutive months, and then re-interviewed for 4 consecutive months before being dropped from the survey
=> Reduces response burden
- A compromise between a permanent sample (from which a high response rate would be difficult to maintain) and a completely new sample each month (which results in more variable estimates of change)
- Each month a new group of households enters the sample for the first time and another group of households retires from the sample permanently
 - In any particular month, there are eight groups of households
 - The number of times each household's address is in the sample varies from 1 (Rotation Group 1) to 8 (Rotation Group 8)
 - Most of the interviews for the first and the fifth rotation groups: personal interview; for other rotation groups: telephone interview
 - Majority of the data is collected by self-response but proxy responses allowed

Rotation Group Bias (Time-in-sample Bias)

- Estimates from eight rotation groups in a month supposedly should not differ systematically
- **Rotation Group Bias:** Some estimates, such as unemployment rates, tend to be significantly higher in the first rotation group than among other rotation groups (Bailar 1975; Brooks and Bailar 1978; Hansen et al. 1955; McCarthy 1978; Shack-Marquez 1986; Solon 1986; U.S. Census Bureau 2006; Williams and Mallows 1970)
- Possible causes (McCarthy 1978)
 - 1) Conditioning of respondents by repeated interviews
 - 2) Differences in the lengths and contents of the questionnaire among rotation groups (the first interview is longer than others)
 - 3) Differences in the mode of interview
 - 4) Differences in the respondents for the household
 - 5) Differences in the characteristics of nonrespondents among rotation groups

Focus of this Paper

Given that the TUS-CPS is based on the CPS, it is natural to suspect that smoking prevalence estimates using the TUS-CPS will exhibit rotation group bias

Among the various factors suggested, this paper focuses on

- 1) Differences in the characteristics (smoking status) of nonrespondents among rotation groups: **Panel attrition**
- 2) **Panel conditioning**

But also controls for other factors in the regression analysis

Panel Attrition

- Tobacco users are more likely to attrite in longitudinal surveys (Cunradi et al. 2005; Gray et al. 1996; Young et al. 2006) because
 - 1) Smokers are more likely to develop health problems that would decrease their ability to respond to follow-up surveys
 - 2) Some characteristics associated with smoking make smokers less willing to participate in survey follow-up than nonsmokers
 - Smokers are less likely to use a seat belt, brush or floss their teeth than nonsmokers (Hersch 1996)
 - Smokers have substantially less education (Levine et al. 1997), lower wages (Grafova and Stafford 2009; Munasinghe and Sicherman 2006), and are less likely to vote at election time (Denny and Doyle 2007; Keller et al. 2002) than nonsmokers
 - Smokers are more impulsive than nonsmokers in that they choose small but immediate rewards over large but delayed rewards (Bickel et al. 1999; Khwaja et al. 2006; Lahiri and Song 2000; Odum et al. 2002; Reynolds et al. 2004)
 - Smokers spend more time on activities that provide immediate gratification, such as watching television, but less time on activities that provide long-term returns, such as exercising and education, than nonsmokers (Song 2011)

Panel Conditioning

Evidence of panel conditioning in the CPS (Halpern-Manners and Warren 2012)

- Used only individuals in the first and second rotation groups in the same CPS month, who were household heads, self-respondents, and matched across their first and second months in sample
- Unemployment rates are consistently lower for the group interviewed for the second time in the CPS than those interviewed for the first time
- Because, in an effort to minimize their survey burden after participating in the CPS for the first time, some respondents change their labor force status from “unemployed” to “out of labor force”

Descriptive Analysis of Rotation Group Bias

Estimates of smoking prevalence for the population 18 years and older by rotation group for the following eight years of TUS-CPS

- 1992-93 (Sep 92, Jan 93, and May 93)
- 1995-96 (Sep 95, Jan 96, and May 96)
- 1998-99 (Sep 98, Jan 99, and May 99)
- 2000 (Jan 00 and May 00)
- 2001-02 (Jun 01, Nov 01, and Feb 02)
- 2003 (Feb 03, Jun 03, and Nov 03)
- 2006-07 (May 06, Aug 06, and Jan 07)
- 2010-11 (May 10, Aug 10, and Jan 11)

All estimates are weighted using the TUS-CPS nonresponse weight (PWNRWGT) and estimated using the svy command in Stata

Rotation group index: the ratio of the estimate based on a particular group to the average estimate over all eight rotation groups, multiplied by 100 (Bailar 1975; U.S. Census Bureau 2006)

Figure 1 Rotation Group Indices for Current Smokers, 1992-2011 TUS-CPS

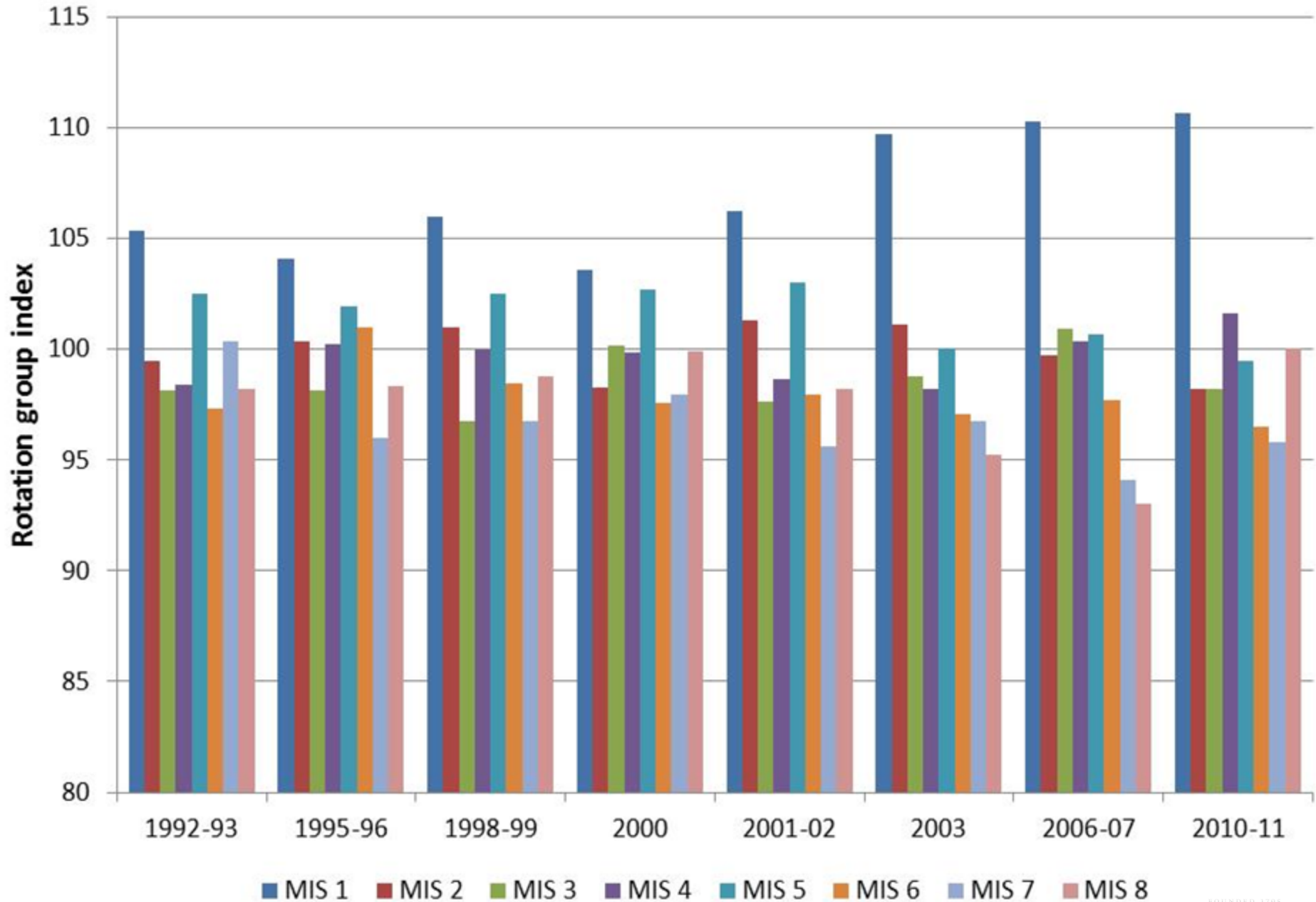


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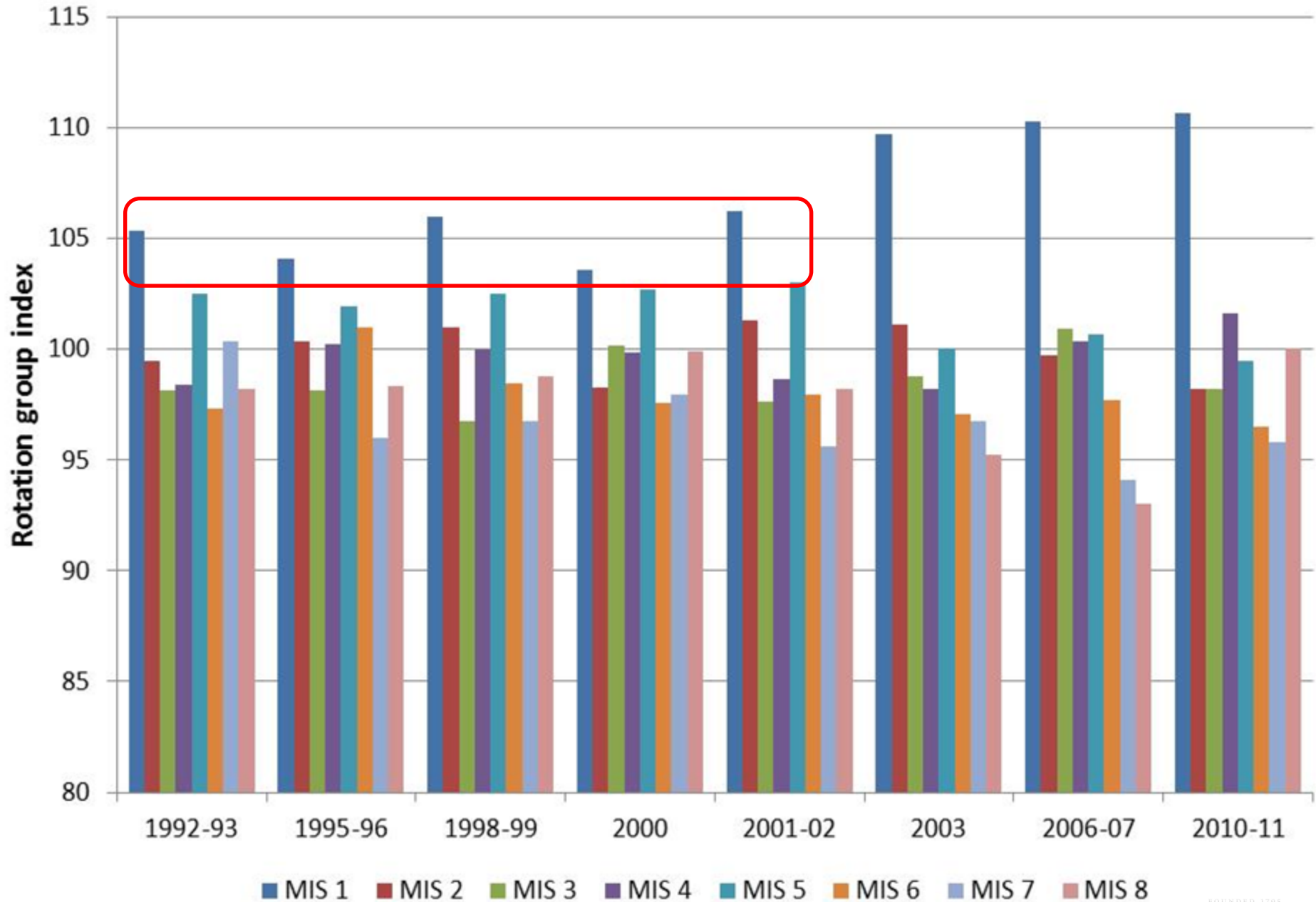
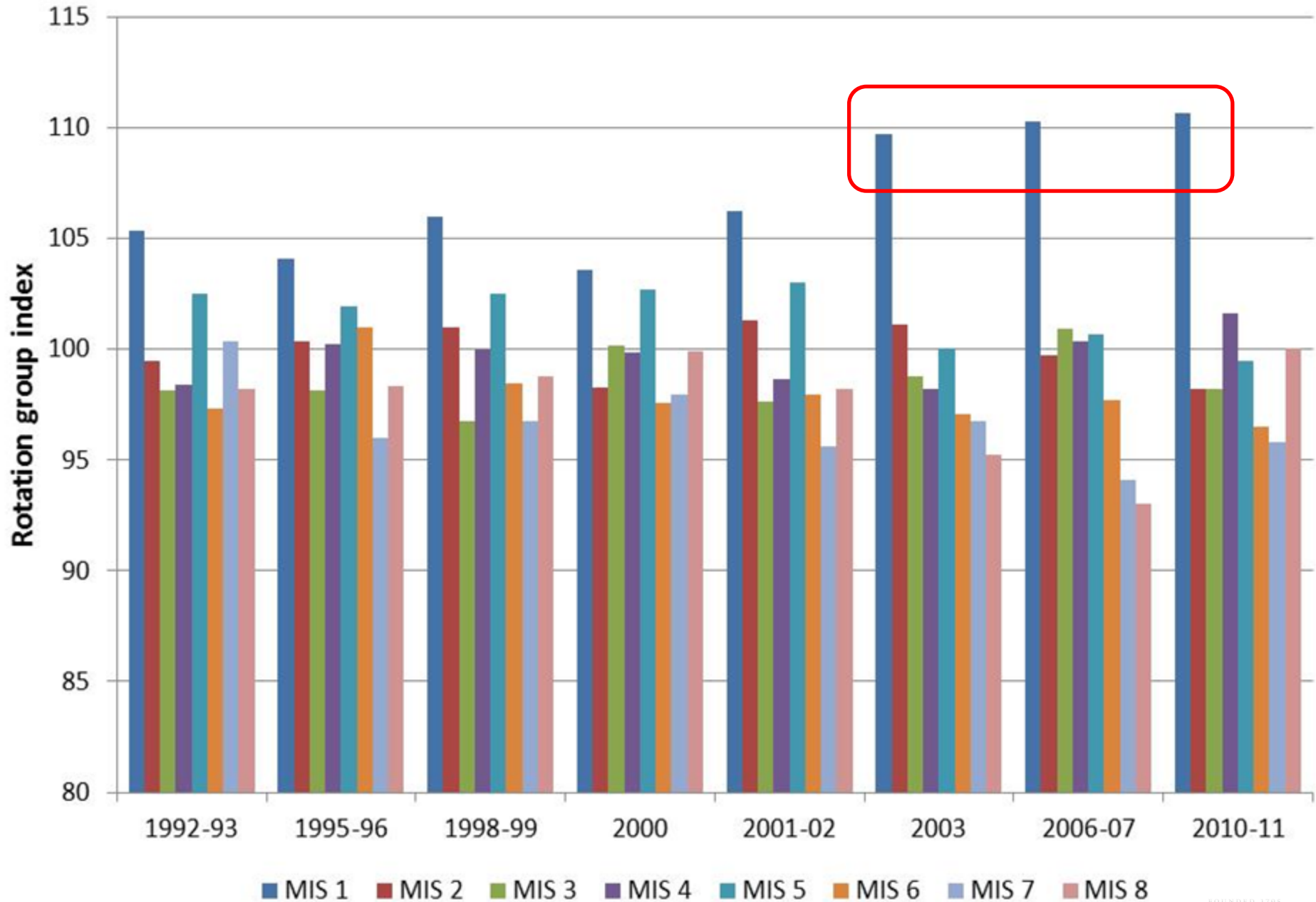


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Regression Analysis of Rotation Group Bias

Multivariate Probit analysis

Dependent variable: Smoker dummy

Independent variables

- A dummy for Rotation Group 1
- Three age-category dummies
- A female dummy
- Five dummies for race/ethnicity
- Three dummies for education
- Two dummies for employment status
- Three dummies for marital status
- Dummies for family income levels
- A dummy for home owner
- Two dummies for metropolitan areas
- Three region dummies
- Dummies for TUS-CPS month in each period
- A dummy for self-response
- Two dummies for survey mode

Table 2 Marginal Effects of Rotation Group 1 in Probit Regression on Current Smokers, U.S. Household Population, 18 Years and Over, 1992-2011 TUS-CPS

Dependent variable: Current Smoker

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1992-93	1995-96	1998-99	2000	2001-02	2003	2006-07	2010-11
Rotation group 1	-0.001	-0.001	-0.000	-0.002	0.004	0.016***	0.011***	0.009***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Observations	277,703	233,737	224,902	156,764	234,227	234,274	227,428	227,722
Mean of the dependent variable	0.237	0.231	0.214	0.213	0.205	0.184	0.177	0.154
Mean of the dependent variable for rotation group 1	0.250	0.240	0.227	0.221	0.217	0.202	0.195	0.170
Difference	-0.013	-0.009	-0.013	-0.008	-0.012	-0.018	-0.018	-0.016

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Changes in the TUS-CPS

According to the National Cancer Institute (2013), all the TUS-CPS generally contain the same information, covering

- Current cigarette smoking status and amount smoked
- Smoking history
- Quit attempts and intention to quit
- Medical/dental advice to quit
- Cigar, pipe, and smokeless tobacco use
- Workplace and home smoking restrictions
- Attitudes toward smoke-free policies in public places

But since 2003, the following information is additionally collected from smokers

- Use of menthol cigarettes
- Level of nicotine dependence
- Cost of cigarettes and purchase location
- Harm reduction and other emerging products

Table 3 Number of Variables and Changes in the TUS-CPS Over Time

Year	Number of variables	Changes	Person nonresponse rate
1992-93	86		N/A
1995-96	69		14.8; 15.6; 13.1
1998-99	73		13.0; 15.4; 18.0
2000	27	An abbreviated version of the TUS-CPS and consisted of several questions measuring basic tobacco use prevalence (cigarettes, cigars, pipes, chewing tobacco, and snuff)	12.0; 12.9
2001-02	75		18.4; 17.7; 16.3
2003	240	<p>The 2003 Tobacco Use Special Cessation Supplement (TUSCS) had several unique topics covering:</p> <ul style="list-style-type: none"> • type of cigarette usually smoked (menthol, lights); • switching to lighter cigarettes; • level of nicotine dependence; • products, treatments and methods used to quit cigarette and/or other tobacco product use; • cessation behavior for "other" non-cigarette tobacco products (cigars, pipes, chewing tobacco and snuff); • use of new harm reduction products; • specific guidance from health professionals; and • cost of last pack/carton of cigarettes purchased and in which state purchased. 	16.4; 18.3; 16.8
2006-07	168	<p>A core TUS was fielded that combined some of the new features of the 2003 TUSCS-CPS with the general 2001-02 TUS. Topics that had not previously been fielded included:</p> <ul style="list-style-type: none"> • cost and purchase of "single" cigarettes; • smoking consumption about 12 months ago; • awareness and use of "quitlines" and advising family and friends to quit smoking; • use of "Marlboro Ultrasmooth", a new test-marketed tobacco product; • asking about other non-cigarette tobacco products separately rather than combined; and • asking about attitudes toward clean indoor air policies for children's outdoor sports fields and playgrounds, and indoor concert venues. 	19.3; 18.3; 14.8
2010-11	323	<p>The TUS-CPS included more detailed questions than previous survey cycles on:</p> <ul style="list-style-type: none"> • menthol cigarette use; • recent quit attempts; • recent quitting; • treatment and other methods used to quit; • emerging products (dissolvables and E-cigarettes); and • attitudes toward clean indoor air policies for casinos and cars. 	17.8; 17.9; 18.4

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Panel Attrition in the TUS-CPS

1. Match Rotation Group 1 from all the TUS-CPS to the subsequent CPS
 - eg) Rotation Group 1 in the Jan 2007 TUS-CPS can be matched to Rotation Group 2 in the Feb 2007 CPS and to Rotation Group 3 in the Mar 2007 CPS and so on
2. Test if smokers are less likely to be interviewed in the subsequent rotation groups in the CPS by using multivariate probit regression

Table 4 Marginal Effects of Smoking in Probit Regression of Matching between the First Rotation Group in the TUS-CPS and the Subsequent Basic CPS

Dependent variable: Successful matching

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Years	MIS 2	MIS 3	MIS 4	MIS 5	MIS 6	MIS 7	MIS 8	Sample size
1992-93	-0.000	-0.009**	-0.014***	-0.027***	-0.021***	-0.028***	-0.025***	34,325
	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	
1995-96	-0.002	-0.007*	-0.008*	-0.036***	-0.037***	-0.036***	-0.037***	29,754
	(0.003)	(0.004)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	
1998-99	-0.004	-0.014***	-0.010**	-0.038***	-0.033***	-0.033***	-0.034***	28,823
	(0.004)	(0.004)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	
2000	0.002	-0.007	-0.002	-0.010	-0.011	-0.023***	-0.021***	19,423
	(0.004)	(0.005)	(0.006)	(0.008)	(0.008)	(0.008)	(0.008)	
2001-02	-0.004	-0.012***	-0.018***	-0.032***	-0.035***	-0.035***	-0.036***	33,308
	(0.003)	(0.004)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	
2003	0.002	-0.000	-0.009*	-0.031***	-0.029***	-0.030***	-0.030***	32,733
	(0.004)	(0.004)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	
2006-07	-0.010***	-0.010**	-0.011**	-0.026***	-0.022***	-0.023***	-0.026***	32,293
	(0.004)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	
2010-11	-0.008**	-0.013***	-0.019***	-0.037***	-0.040***	-0.038***	-0.044***	31,874
	(0.004)	(0.005)	(0.005)	(0.007)	(0.007)	(0.008)	(0.008)	

Table 4 Marginal Effects of Smoking in Probit Regression of Matching between the First Rotation Group in the TUS-CPS and the Subsequent Basic CPS

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	(0.004)	(0.005)	(0.006)	(0.008)	(0.008)	(0.008)	(0.008)	
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	(0.003)	(0.004)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	
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	(0.004)	(0.004)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	
2006-07	-0.010***	-0.010**	-0.011**	-0.026***	-0.022***	-0.023***	-0.026***	32,293
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	(0.004)	(0.005)	(0.005)	(0.007)	(0.007)	(0.008)	(0.008)	

Problems with Table 4

1. Smokers are significantly more likely to attrite in the subsequent rotation groups in the basic CPS in almost all years, not just for the years 2003, 2006-07, and 2010-11
2. The magnitudes of the marginal effects are too small to generate the large marginal effects of Rotation Group 1 observed in Table 2 for the years 2003, 2006-07, and 2010-11

eg) With the smoking prevalence of 0.2 in Rotation Group 1, the difference in attrition rates of 0.03% between smokers and nonsmokers would generate a difference less than 0.005% in smoking prevalence between Rotation Group 1 and other rotation groups

$$0.2 - (0.2 \cdot 0.97) / (0.2 \cdot 0.97 + 0.8) = 0.2 - 0.1952 = 0.0048$$

3. It only shows that smokers are more likely to attrite in the subsequent rotation groups in the *CPS*, not in the *TUS-CPS*.

Panel Attrition in the TUS-CPS

1. Match two TUS-CPS data a year apart

- 1992-93 (Sep 92, Jan 93, and May 93)
- 1995-96 (Sep 95, Jan 96, and May 96)
- 1998-99 (Sep 98, Jan 99, and May 99)
- 2000 (Jan 00 and May 00)
- 2001-02 (Jun 01, Nov 01, and Feb 02)
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- 1998-99 (Sep 98, Jan 99, and May 99)
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- 2003 (Feb 03, Jun 03, and Nov 03)
- 2006-07 (May 06, Aug 06, and Jan 07)
- 2010-11 (May 10, Aug 10, and Jan 11)

eg) Rotation Group 1 in the Jan and May 1999 TUS-CPS to Rotation Group 5 in the Jan and May 2000 TUS-CPS; Rotation Group 1 in the Feb 2002 TUS-CPS to Rotation Group 5 in the Feb 2003 TUS-CPS

2. Test if smokers are less likely to be interviewed in the subsequent rotation groups in the TUS-CPS by using multivariate probit regression

Table 5 Marginal Effects of Smoking in Probit Regression of Matching between the First Rotation Groups in the January and May 1999 and February 2002 TUS-CPS and Fifth Rotation Groups in the January and May 2000 and February 2003 Basic CPS and TUS-CPS

Dependent variable: Successful matching

	(1) Basic CPS	(2) TUS-CPS	Sample size
January and May 1999	-0.0309*** (0.0078)	-0.0312*** (0.0087)	19,058
February 2002	-0.0547*** (0.0114)	-0.0684*** (0.0130)	11,027

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Panel Conditioning in the TUS-CPS

1. Select people who differ only with respect to whether they are interviewed for the first time or second time in the TUS-CPS or CPS (Halpern-Manners and Warren 2012)

eg) From Rotation Group 1 in the May 2006 TUS-CPS, only those matched to Rotation Group 2 in the Jun 2006 CPS are selected; from Rotation Group 2 in the May 2006 TUS-CPS, only those matched to Rotation Group 1 in the Apr 2006 CPS are selected

2. If attrition rates for smokers do not change regardless of whether a TUS-CPS data is matched to the TUS-CPS or to the CPS

=> A higher proportion of smokers among Rotation Group 1 than among Rotation Group 2 is an indicator of panel conditioning

3. If attrition rates for smokers become higher in matching to the TUS-CPS than to the CPS

=> A higher proportion of smokers among Rotation Group 1 than among Rotation Group 2 is an indicator of panel conditioning and/or panel attrition

Table 6 Panel Conditioning: Marginal Effects of Rotation Group 1 in Probit Regression on Smoking, TUS-CPS Respondents Matched Across Their First and Second Months in Sample

Dependent variable: Current Smoker

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1992-93	1995-96	1998-99	2000	2001-02	2003	2006-07	2010-11
Rotation group 1	0.003	0.004	-0.001	0.006	-0.002	0.014***	0.006	0.010**
	(0.005)	(0.007)	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)	(0.004)
Observations	69,760	35,927	54,065	35,969	59,384	60,294	58,766	58,055

Conclusions

- For the six waves of TUS-CPS before 2003, there is no evidence that smoking prevalence estimates were significantly affected by the rotation scheme of the CPS
- For the three waves of TUS-CPS since 2003, however, the results showed that smoking prevalence has been underestimated due to panel attrition and panel conditioning
- It appears that rotation group bias in these waves was caused by the substantially increased number of additional questions smokers have to answer
 - => One way to reduce the effect of rotation group bias in the future waves of TUS-CPS would be to alleviate the burden on respondents by reducing the number of additional questions for smokers