

Approaches to Estimating Subnational Victimization Estimates

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Abstract

The Bureau of Justice Statistics (BJS) has been using the National Crime Victimization Survey (NCVS) to produce national-level estimates of crime since the early 1970s. Local stakeholders, however, would find the survey data more useful if statistics could be produced at a local level as a means to reflect local crime conditions and as a tool to assess police and criminal justice services. To address this demand for small area or subnational victimization estimates, the Bureau of Justice Statistics (BJS) has embarked on a multi-pronged approach for developing a portfolio of both direct and indirect estimation procedures. The overall goal is to create an approach that produces reliable, valid, and timely estimates that affords the Bureau the flexibility to expand or contract the focus in a data demanding, but fiscally uncertain environment. This paper describes the portfolio and highlights the generic area approach to producing subnational violent victimization estimates. Statistical and substantive limitations are discussed to understand the implications of using criminal victimization estimates as a measure of local crime and police services.

1. Introduction

Since 1972, the National Crime Victimization Survey (NCVS) has provided national estimates of the incidence of crime by asking household respondents about crimes committed against them in the previous 6 months, whether or not they had reported them to the police. The primary focus of the survey has been on national estimates of crimes categorized by type of crime, on characteristics of the specific instances of crime, and on characteristics of the victims.

However, national estimates of victimization are perceived to be of little value to local stakeholders in assessing their own needs. Local social and economic conditions, often thought to be related to crime levels and types, may not reflect national conditions suggesting that the national crime trend is of little relevance. Most local areas typically rely on data from official statistics generated from police activities, such as calls for service, recorded crimes, and arrests. However, much is known about the various social and policy filters associated with police records, most importantly, that a large portion of crime is not reported to the police.

The production of small area estimates (SAE) of crime and victimization can serve two general purposes: 1) a vehicle to compare standard measures of crime across geographic areas and to the nation as a whole, and 2) a vehicle to assess local patterns and trends independent from police records. A third purpose that reaches beyond measuring the amount and type of crime that occurs, is the ability to capture citizen perceptions and attitudes about the status of crime and policing in their community. Subsequently SAE can be used to craft an appropriate response to problems and serve to allocate resources within and between communities. To address the need for reliable estimates at the local level, BJS has developed a research program to identify the best methods for producing subnational victimization estimates.

2. Approaches to subnational victimization estimates

To address the interest in small area estimates and to increase the value and utility of the general NCVS collection, the Bureau of Justice Statistics (BJS) has embarked on developing a small area estimation program using a multi-prong approach that is exploring both direct and indirect estimation procedures. The specific details of many of these strategies are outlined in Cantor, D., Krentzke, T., Stukel, D., and Rizzo, L. (2010). Direct estimations use current data or current data with increased sample cases (“sample boosts”) to generate estimates directly from the NCVS responses. The benefit to direct estimation is that particular subnational areas are identifiable and rely on direct observation. For areas with small or nonexistent sample sizes, direct estimates are problematic and provide

unreliable estimates. Given the rare nature of crime even relatively large boosts to the sample may not produce measures with reliable precision. Another approach is to use indirect methods that involve modeling techniques to create estimates with ancillary information related to victimization at the local level. This approach uses information from direct sample cases when available, but primarily relies on the performance of secondary indicators to produce the local victimization rate.

The characteristics and concerns about the development and use of subnational estimates mirror those of general survey data collection operations. The decision to implement a particular option will rest on trade-offs between:

- reliability and precision (annual, multi-year averages);
- generalizability;
- number of and types of local areas reported out: states, MSAs, cities, counties;
- sub domain disaggregations (type of crime, reporting to police, victim and incident characteristics);
- timeliness; and
- costs.

National survey collections are able to produce reliable estimates representative of the national level. The problems associated with producing direct estimates at finer levels, such as state, county, or city, are the costs and time required to collect adequate sample sizes for reliable estimates as well as designing the sample to be representative of the area of interest. A common solution to increase the precision of small area estimates is to aggregate data over multiple years in an effort to increase sample sizes. However, even with an increase in statistical power, it is not always the case that the national sample was designed to be representative of these smaller areas.

Further, these characteristics often provide complex trade-offs that are not easy to understand up-front. For example, using current sample will have lower precision, lower generalizability, fewer areas reported out, but is the least expensive option. Boosting and reallocating sample of the current NCVS design would increase precision, increase generalizability, produce estimates for most areas, but is the most expensive and lengthy option. Other trade-offs need to consider schedule and timelines for deliverables; ideal unit for reporting (MSA, state, county, etc.); victimization measures of importance (total violence, property crime, serious violence, IPV, sexual violence, etc); value to stakeholders; and metrics to evaluate the performance for each option.

The four methods currently being examined are generic areas, direct boost and reallocation, model based estimates, and supplementing the core collection with a companion collection. Each approach is described briefly and a detail example of the generic area approach is described in section 3 below.

2.1 Generic areas

A generic area typology is created using available geographic identifiers to create “like places” (RTI, 1984).¹ As the term implies, these categories are not specific to any one state, city or place, rather, these generic areas represent places that share the same general geographic characteristics. For example, a “city with a population of 250,000-500,000 in the northeast” represents places such as Buffalo, NY, and Pittsburgh, PA. Issues related to the lack of statistical power can be addressed by aggregating multiple years. Generic areas are limited to the availability of geographic variables (e.g., state variables are only available on restrict-use files), the ability to obtain sufficient sample sizes, the homogeneity shared within categories (are places really alike?), and whether sample cases properly represent the targeted place. This is the least expensive option, requiring no change in the survey design.

2.2 Direct boost and reallocation

This approach would boost the sample sizes and reallocate the sample so that it is more suitable for subnational rather than national estimates. It would increase the precision and generalizability of small places through direct observation. Given the increase in sample to accommodate the small places, national estimates wouldn’t necessarily lose precision, but the design wouldn’t be optimal for the national estimate. This is the most expensive option as it

¹ Other sources of information at the subnational level include the NCVS MSA file (Lauritsen and Schaum, 2005) and the availability of micro-level geo-coded restricted-use data (<http://www.census.gov/ces/rdcresearch/>).

involves increases in sample cases. Details of this approach can be found in Cantor, Krenzke, Stukel and Rizzo (2010), Fay and Li (2012), and Fay and Li (2011).

2.3 Indirect or model based estimates

Indirect techniques use statistical modeling to capture information from the current sample and leverage auxiliary information related to victimization to produce subnational estimates. This approach is used to develop estimates for areas without sufficient sample for direct estimates. The relationship between ancillary data on areas and NCVS estimates in the areas with data are used to predict victimization rates. A critical concern is identifying proper covariates that perform well in the modeling efforts. In addition, since these estimates are partially or completely based on modeling rather than direct observation, the response from stakeholders is a concern. Details of this approach can be found in Li, J., Diallo, M.S., and Fay, R.E. (2012).

2.4 Supplementing sample sizes with a companion study

A fourth option is to administer a supplemental or companion survey in local areas. Estimates are generated by blending the companion survey with the existing core-NCVS sample. An important challenge is to develop a blending methodology that accounts for the measurement differences between the two sources of information. Ideally this companion study would be a low cost option. Details on this approach can be found in Brick, J.M., Edwards, W.S., and Lohr, S. (2012). While this particular approach to sub-national estimation is expensive and on its face not practical for a large number of jurisdictions, it may be useful for assessing the effects of targeted interventions in specific jurisdictions.

3. Generic areas

This section of the paper highlights the direct generic area approach to estimating violent victimization estimates at the subnational geography levels for regions, jurisdictions of a specific population size, and metropolitan areas (MSA). A generic area typology or taxonomy is created by these geographic identifiers to create “like places”, which are areas that share one or more characteristics. Based on this typology comparisons are made between place typologies and national victimization rates to identify similar patterns and points of divergence. Information about other geographic units such as state or city is currently limited because of concerns over respondent confidentiality and disclosure risks as well as the sample design since the NCVS sample is designed to optimize generating national crime estimates.² The primary advantage of the generic area approach is the use of existing data, which are readily available from the NCVS public-use files. A drawback to this approach is that annual estimates can be prone to relatively lower statistical precision due to small sample sizes and possibly lower levels of external validity. In addition, estimates are not specific to a unique area, so specific places such as states, cities or counties are not identifiable. The next sections describe the typology and examine the variability of these estimates as measured by the standard error and relative standard error.

3.1 Methodology

The report uses NCVS data from 1996-2010. The violent victimization rate includes attempted and completed rape, sexual assault, robbery, and both aggravated and simple assault. Victimization are classified based upon detailed characteristics of the event provided by the respondent. During data processing an algorithm classifies each incident into a type of crime, based upon the entries on a number of items on the survey questionnaire. This process ensures that similar events will be classified using a standard procedure rather than relying on the victim or interviewer to make these determinations. If an event can be classified as more than one type of crime, a hierarchy is used which classifies the crime according to the most serious event that occurred. The hierarchy is: rape, sexual assault, robbery, assault, burglary, motor vehicle theft, theft. Therefore, the NCVS creates a standard definition across all places in an attempt to increase comparability. The three geographic variables used in the analysis are place size, region, and urbanicity or metropolitan area.

Place size. The relationship between place size and crime has been examined by a number of researchers (Ackerman, 1998; Chamlin and Cochran, 2004; McDowall and Loftin, 2009; Rotolo and Tittle, 2006). Generally,

² Is it possible that direct boosts and reallocations of sample could change these constraints e constraints.

research has found larger places have higher crime rates, but there is some evidence that the strength of this relationship has become weaker over time. Place size uses population size to define areas. Eight categories are used:

- Not in a place
- Under 10,000
- 10,000-49,999
- 50,000-99,999
- 100,000-249,999
- 250,000-499,999
- 500,000-999,999
- 1,000,000 or more

Region. Regional differences have been examined in relation to crime rates in terms of structural, social, and economic variation (Loftin and Hill, 1974; Messner, 1983; McCall, P., Land, K., and Cohen, L., 1992). For this analysis regional areas divide the states into four groups or census regions:

- *Northeast* - Includes the 9 states of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.
- *Midwest* - Includes the 12 States of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.
- *South* - Includes the District of Columbia and the 16 States of Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.
- *West* - Includes the 13 states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

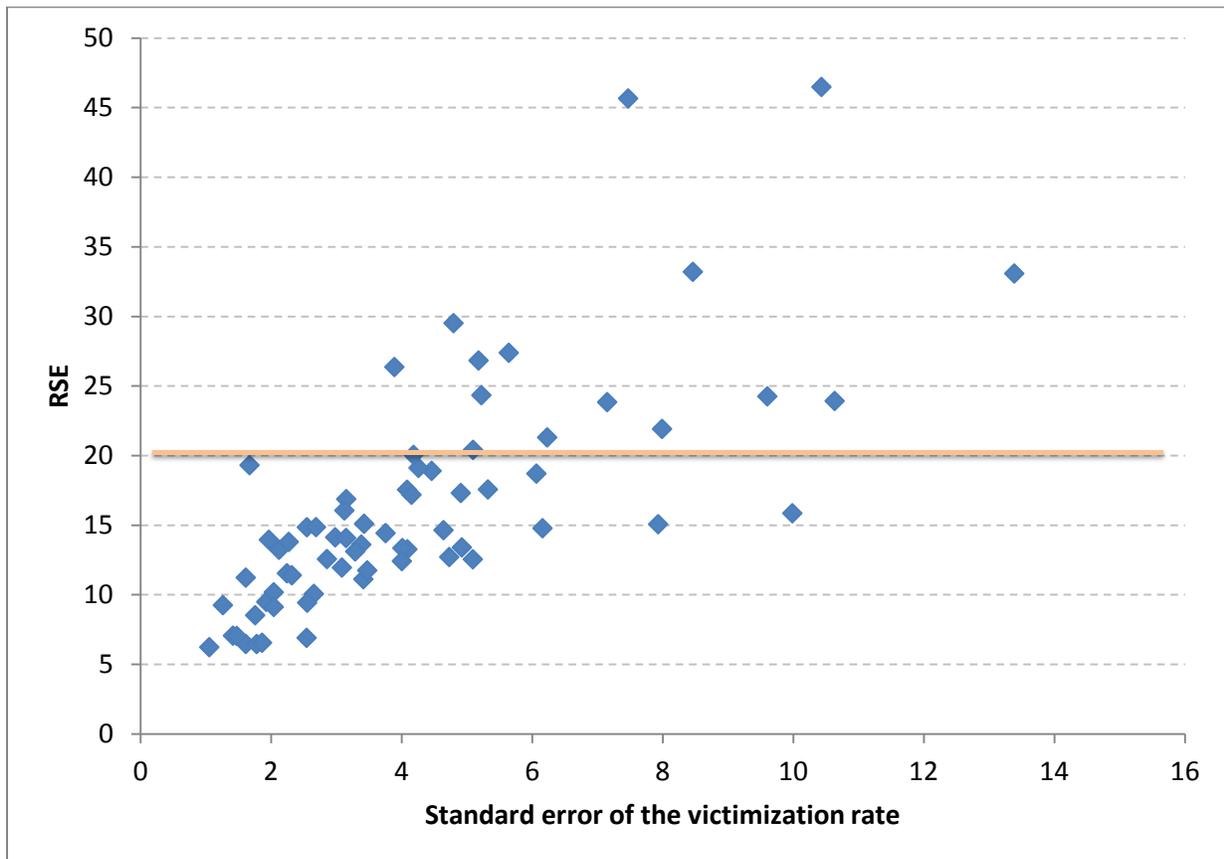
Urbanicity and Metropolitan Statistical Area (MSA). Urban areas or cities have been an intense focus of criminological research and theory (Bachman, 1992; Feld, 1991; Gibbs, 1979; Lauritsen and Schaum, 2005; Laub, 1983; McDowall and Loftin, 2009; Skogan, 1977b, 1977a; Shaw and McKay 1942). We create three measures of urbanicity based on MSA status:

- *Rural area* - A place not located inside the Metropolitan Statistical Area. This category includes a variety of localities, ranging from sparsely populated rural areas to cities with populations less than 50,000
- *Suburban areas* - A county or counties containing a central city, plus any contiguous counties that are linked socially and economically to the central city. On data tables, suburban areas are categorized as those portions of metropolitan areas situated "outside central cities."
- *Urban areas* - The largest city (or grouping of cities) in a Metropolitan Statistical Area (see definition of Metropolitan Statistical Area).

These three variables are used to create a typology subnational "generic areas." As the term implies, these categories are not specific to any one state, city or place, rather, these generic areas represent places that all share the same general geographic characteristics. For example, one category is a "city with a population of 250,000-500,000 in the northeast" representing places like Buffalo, NY, and Pittsburgh, PA. Along with violent victimization rates, standard errors and the relative standard error (RSE) are shown as measures of reliability. Large standard errors or RSEs are associated with less precision and go toward the eventual decision to accept a particular estimate as fit for use.

Region, place size and MSA. Table 1 shows 3-year rolling average violent victimization rates per 1,000 persons and 90% confidence intervals by combination of region, MSA and population size. Table 2 presents the standard errors and relative standard errors (RSE) for the estimates. Figure 1 shows that most estimates have a RSE between 5 and 20 percent, a range considered to be a reasonable level of reliability.

Figure 1. NCVS violent victimization rate standard errors by relative standard errors (RSE), 2008-2010



4. Discussion

BJS is currently considering options for generating small area victimization estimates. The need for subnational victimization estimates has been recognized for almost as long as the NCS and NCVS have been collecting data. BJS is currently exploring ways to generate these important statistics. One method is through generic area estimation. This paper presents findings about generic area violent victimization rates for region, MSA, and population size. Point estimates and measures of reliability indicate that most places showed very similar patterns over time, however, there is some evidence that mid-size cities between 100,000-499,999 experienced larger declines than other places. While these generic area statistics can provide greater insights to victimization at a subnational level, they are some important limitations to consider about use.

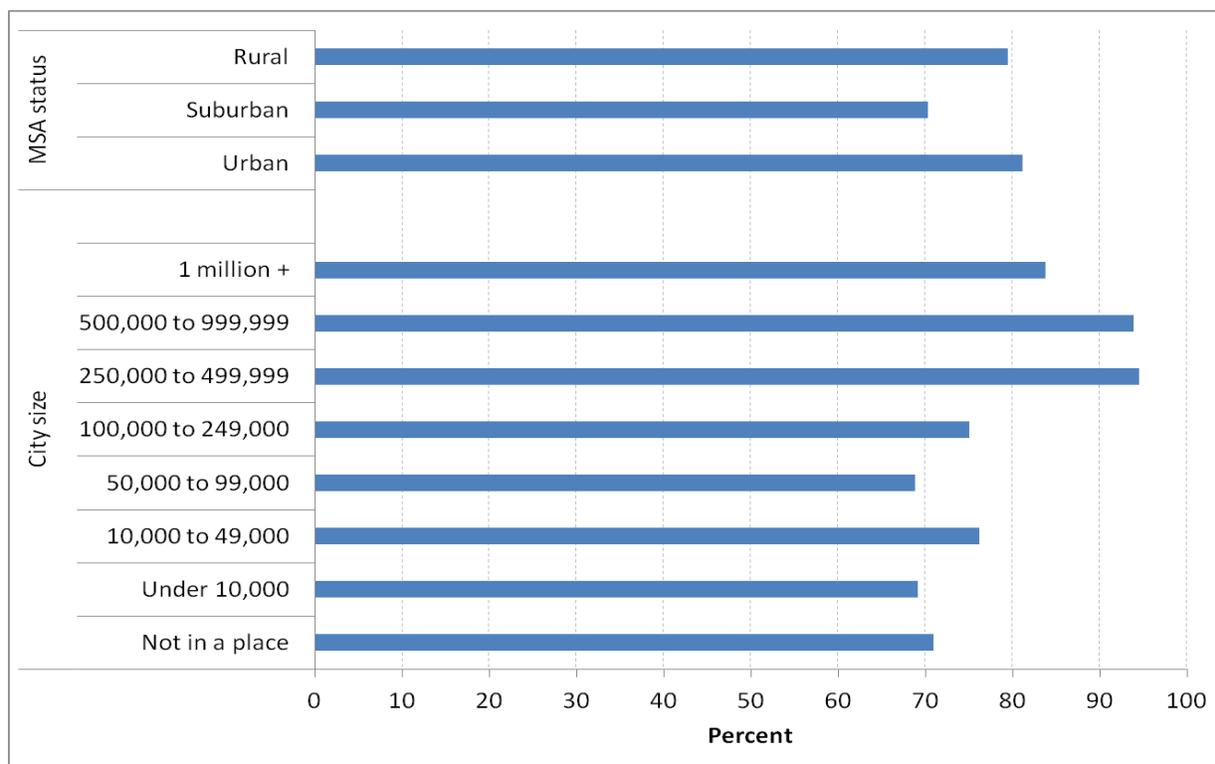
The value of police and victimization statistics for local stakeholders is determined in part by estimate reliability and timeliness, but also validity as it relates to purpose or use. Like any measure, local victimization estimates have limitations. Police statistics represent the amount of crime that occurs in a specific place or jurisdiction. It includes crime that occurs against all persons in that area, including crimes against the homeless, tourists, folks visiting business or entertainment districts. Police statistics also include commercial crime, as well as victimless crimes such as drug use, traffic citations, and disorder. The most severe limitations on police statistics is that many crimes that occur within a jurisdiction go unreported or are reported but not recorded by the police (Skogan, 1977; Hart and Rennison, 2003). While a large percentage of crime goes unreported to the police, police statistics do capture primarily those events that occur within a jurisdiction.

Unlike police statistics NCVS victimization statistics reflect the amount of crime the local residential household population has experienced in a particular time frame. The actual incident may have occurred in a very different area

and not necessarily in their current neighborhood. For example, residents may be victimized at work, school, or while on vacation or travel. The NCVS survey provides information on where the incident occurred, however, it does not capture specific information on the region, population size, or MSA status. Therefore, while we know if the incident occurred in a different place than their current residential area, we have limited information on where to classify the event.

Figure 2 shows the percentage of crimes that occur in a different place from the victim’s local residential community as measured by the NCVS. In 2010, about 81% of urban victims were victimized in their local community compared to 70% of suburbanites. This is due in part to commuting patterns of suburbanites to work and entertainment districts outside of their communities. This type of variation is important to consider in terms of the use of victimization surveys. Even if the residential household crime location was all in their current neighborhood, victimization surveys still could miss a significant portion of crime that happens to non-residents.

Figure 2. Percentage of violent victimizations reported to have occurred within the victim’s residential area, 2010



This study is an important first step in better understanding local patterns of victimization. More work is needed in developing reliable, cost-effective approaches to generating subnational victimization estimates. Future research would include the following steps and considerations.

- How valid are the generic areas in relation to population totals compared to other sources such as the American Community Survey? The sample is not explicitly stratified or controlled to these refined subareas so it is possible to misrepresent the actual coverage, size and distribution of such smaller populations.
- Use of more specific area identifiers including the geo-coded microfiles available at the restricted-use Census Research Data Centers. These more detailed area codes could be used to refine the classification typology in an effort to create more homogeneous or policy relevant groups.
- Exploration of other classification systems that include socio-economic and demographic measures similar to the U.S. Nielsen PRIZM (<http://www.tetrad.com/demographics/usa/claritas/prizmne.html>) project and

the British Crime Survey ACORN project.³ For example, ACORN is a geodemographic classification system that sorts small areas or neighborhoods into 17 groups and 56 types. This taxonomy describes the local area in terms of population change, wealth, education, labor market status, urban status, family structure, and housing types. The five-group categories are:

- Wealthy Achievers – wealthy executives, affluent older people and well-off families.
- Urban Prosperity – prosperous professionals, young urban professionals and students living in town and city areas.
- Comfortably Off – young couples, secure families, older couples living in the suburbs and pensioners.
- Moderate Means – Asian communities, post-industrial families and skilled manual workers.
- Hard Pressed – low-income families, residents in council areas, people living in highrise and inner-city estates.

Disclaimer

The views expressed here are the author's and do not reflect those of the Bureau of Justice Statistics.

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³ For the BCS and the use of ACORN classification see: <http://webarchive.nationalarchives.gov.uk/20110220105210/http://rds.homeoffice.gov.uk/rds/pdfs10/crimestats-userguide.pdf> and for general information about ACORN: <http://www.caci.co.uk/acorn-classification.aspx>

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Table 1. Point estimates and 90% confidence intervals, 1996-98 and 2008-2010, 3-year averages

Rate per 1,000														
			1996-98	90% CI	2008-10	90% CI				1996-98	90% CI	2008-10	90% CI	
Northeast	Urban	10,000 to 49,000	109	21.1	36	13.1		South	Urban	10,000 to 49,000	44	8.4	21	8.6
		50,000 to 99,000	68	12.3	25	8.4				50,000 to 99,000	98	12.4	25	5.6
		100,000 to 249,000	61	11.8	30	11.8				100,000 to 249,000	75	8.5	23	4.7
		250,000 to 499,999	71	19.1	25	13.9				250,000 to 499,999	64	7.7	37	7.8
		500,000 to 999,999	45	19.7	40	22.0				500,000 to 999,999	70	10.3	25	5.4
		1 million +	54	6.3	14	3.2				1 million +	56	10.7	37	8.1
		Total	62	5.2	20	3.2				Total	69	4.6	28	2.9
	Suburban	Not in a place	39	4.6	20	3.4		Suburban	Not in a place	55	4.3	14	2.1	
		Under 10,000	57	7.2	26	5.1			Under 10,000	57	6.7	16	3.7	
		10,000 to 49,000	46	5.5	16	3.5			10,000 to 49,000	74	6.2	22	3.4	
		50,000 to 99,000	47	10.9	19	8.5			50,000 to 99,000	67	13.7	15	6.4	
		100,000 to 249,000	13	13.9	16	12.3			100,000 to 249,000	45	12.5	21	9.3	
		Total	46	3.4	20	2.3			Total	61	3.5	17	1.7	
		Rural	Not in a place	62	10.2	24			7.3	Rural	Not in a place	39	4.3	19
Under 10,000	61		14.5	44	17.5	Under 10,000	32	5.4	21		4.9			
10,000 to 49,000	91		27.1	40	15.8	10,000 to 49,000	40	8.4	23		6.7			
Total	65		8.4	31	6.7	Total	37	3.4	21		2.9			
Midwest	Urban	10,000 to 49,000	62	14.0	63	16.4		West	Urban	10,000 to 49,000	133	18.5	29	10.2
		50,000 to 99,000	69	11.8	30	6.6				50,000 to 99,000	73	12.2	32	7.6
		100,000 to 249,000	80	10.3	41	8.4				100,000 to 249,000	89	12.1	31	5.6
		250,000 to 499,999	125	16.8	42	10.1				250,000 to 499,999	81	9.4	32	6.6
		500,000 to 999,999	102	14.3	28	8.1				500,000 to 999,999	83	12.2	24	6.8
		1 million +	76	11.0	32	10.0				1 million +	57	8.7	22	5.2
		Total	85	6.1	37	4.2				Total	82	5.5	28	3.1
	Suburban	Not in a place	50	5.6	26	4.4		Suburban	Not in a place	68	8.4	18	4.4	
		Under 10,000	72	8.4	17	4.2			Under 10,000	83	11.2	19	5.1	
		10,000 to 49,000	63	6.3	27	4.2			10,000 to 49,000	79	7.5	20	3.8	
		50,000 to 99,000	63	11.9	30	8.8			50,000 to 99,000	67	8.0	23	5.6	
		100,000 to 249,000	64	21.4	22	17.2			100,000 to 249,000	65	10.1	26	6.2	
		Total	61	4.1	25	2.7			Total	73	4.6	21	2.4	
		Rural	Not in a place	43	5.7	9			2.7	Rural	Not in a place	50	8.0	16
Under 10,000	38		5.8	19	5.2	Under 10,000	81	13.6	21		6.9			
10,000 to 49,000	84		12.2	22	7.0	10,000 to 49,000	35	11.0	53		13.0			
Total	48		4.4	14	2.7	Total	56	6.5	30		5.7			

Table 2. Standard errors and relative standard errors, 1996-98 and 2008-2010, 3-year average

Standard errors			1996-98	RSE	2008-10	RSE				1996-98	RSE	2008-10	RSE		
Northeast	Urban	10,000 to 49,000	12.8	11.7	8.0	21.9	South	Urban	10,000 to 49,000	5.1	11.5	5.2	24.3		
		50,000 to 99,000	7.4	10.9	5.1	20.4			50,000 to 99,000	7.5	7.7	3.4	13.6		
		100,000 to 249,000	7.1	11.7	7.1	23.8			100,000 to 249,000	5.2	6.9	2.9	12.6		
		250,000 to 499,999	11.6	16.4	8.5	33.2			250,000 to 499,999	4.7	7.4	4.7	12.7		
		500,000 to 999,999	12.0	26.8	13.4	33.1			500,000 to 999,999	6.3	8.9	3.3	13.1		
		1 million +	3.8	7.1	2.0	13.9			1 million +	6.5	11.5	4.9	13.4		
	Total	3.2	5.2	1.9	9.5	Total		2.8	4.1	1.8	6.5				
	Suburban	Not in a place	2.8	7.0	2.0	10.2		Suburban	Not in a place	2.6	4.8	1.3	9.2		
		Under 10,000	4.4	7.7	3.1	12.0			Under 10,000	4.1	7.1	2.3	13.8		
		10,000 to 49,000	3.4	7.3	2.1	13.2			10,000 to 49,000	3.8	5.1	2.0	9.1		
		50,000 to 99,000	6.6	14.1	5.2	26.8			50,000 to 99,000	8.3	12.4	3.9	26.4		
		100,000 to 249,000	8.4	64.6	7.5	45.7			100,000 to 249,000	7.6	16.9	5.6	27.4		
		Total	2.1	4.6	1.4	7.1			Total	2.1	3.4	1.1	6.2		
		Rural	Not in a place	6.2	9.9	4.5			18.9	Rural	Not in a place	2.6	6.7	2.2	11.5
			Under 10,000	8.8	14.6	10.6			23.9		Under 10,000	3.3	10.2	3.0	14.1
10,000 to 49,000			16.5	18.2	9.6	24.3	10,000 to 49,000		5.1		12.7	4.1	17.5		
Total	5.1		7.9	4.1	13.3	Total	2.1	5.5	1.8		8.5				
Midwest	Urban	10,000 to 49,000	8.5	13.7	10.0	15.9	West	Urban	10,000 to 49,000	11.3	8.4	6.2	21.3		
		50,000 to 99,000	7.2	10.3	4.0	13.4			50,000 to 99,000	7.4	10.2	4.6	14.6		
		100,000 to 249,000	6.2	7.8	5.1	12.5			100,000 to 249,000	7.4	8.3	3.4	11.1		
		250,000 to 499,999	10.2	8.2	6.2	14.8			250,000 to 499,999	5.7	7.1	4.0	12.4		
		500,000 to 999,999	8.7	8.5	4.9	17.3			500,000 to 999,999	7.4	8.9	4.2	17.2		
		1 million +	6.7	8.7	6.1	18.7			1 million +	5.3	9.2	3.1	14.1		
	Total	3.7	4.3	2.5	6.9	Total		3.3	4.1	1.9	6.6				
	Suburban	Not in a place	3.4	6.8	2.7	10.1		Suburban	Not in a place	5.1	7.5	2.7	14.9		
		Under 10,000	5.1	7.0	2.5	14.8			Under 10,000	6.8	8.2	3.1	16.1		
		10,000 to 49,000	3.8	6.0	2.6	9.4			10,000 to 49,000	4.5	5.7	2.3	11.4		
		50,000 to 99,000	7.2	11.4	5.3	17.6			50,000 to 99,000	4.9	7.3	3.4	15.1		
		100,000 to 249,000	13.0	20.3	10.4	46.5			100,000 to 249,000	6.2	9.4	3.8	14.4		
	Total	2.5	4.1	1.6	6.5	Total		2.8	3.8	1.5	7.0				
	Rural	Not in a place	3.5	8.0	1.7	19.3		Rural	Not in a place	4.9	9.8	4.8	29.5		
		Under 10,000	3.5	9.3	3.2	16.9			Under 10,000	8.3	10.2	4.2	20.0		
10,000 to 49,000		7.4	8.8	4.3	19.1	10,000 to 49,000	6.7		19.1	7.9	15.1				
Total		2.7	5.5	1.6	11.2	Total	4.0		7.1	3.5	11.7				