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ABSTRACT In recent years, permanent supportive housing (PSH) has emerged as the preferred intervention for addressing chronic homelessness in the United States. However, almost all prior studies examining the effectiveness of PSH have been conducted at the individual level, with only minimal attempts to empirically test the relationship between PSH and chronic homelessness at the community level. This study uses longitudinal data collected by the US Department of Housing and Urban Development (HUD) and several other sources to model the relationship between measures of community investment in PSH and rates of chronic homelessness. The results show modest negative associations between increased investment in PSH and rates of chronic homelessness over time. We discuss the implications of these findings for ongoing efforts to address chronic homelessness and future research.

According to the most recent estimates, on any given night in the United States, roughly 93,000 individuals, or about 23 percent of the single adult homeless population, are chronically homeless (HUD 2013). According to the federal definition shared by the US Department of Housing and Urban Development (HUD), the US Department of Health and Human Ser-

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vices (HHS), and the US Department of Veterans Affairs (VA), a *chronically homeless person* is "an unaccompanied homeless individual with a disabling condition or an adult member of a homeless family who has a disabling condition who has either been continuously homeless for a year or more, or has had at least four episodes of homelessness in the past three years" (HUD 2011*b*, 11).[1] The majority of individuals experiencing chronic homelessness have a serious mental illness, substance abuse disorder, physical disability, or chronic disease (Burt 2002), and the complex, and often multiple, disabling conditions that affect chronically homeless persons frequently manifest themselves in a pattern of frequent use of emergency shelter, use of acute health care, use of behavioral health care, criminal justice involvement, and use of social services, which can cost tens of thousands of dollars per individual annually (Culhane, Metraux, and Hadley 2002; Martinez and Burt 2006; Perlman and Parvensky 2006; Gilmer, Manning, and Ettner 2009; Larimer et al. 2009; Poulin et al. 2010; McLaughlin 2011). Not only are chronically homeless persons a highly vulnerable group with complex needs but their continued homelessness comes at great cost to society.

Permanent supportive housing (PSH) is defined broadly as subsidized housing matched with ongoing supportive services. Although there is not one specific PSH program model, the underlying theory is that the residential stability provided by permanent housing is essential to clients' success in all dimensions of their lives. Programs falling under the PSH umbrella generally share a set of key elements. They emphasize client choice and control over housing and the receipt of supportive services. They also functionally separate housing and support services, so tenants can maintain housing without having to participate in mental health, substance abuse, or other treatments or services (HUD 2004). In this regard, PSH stands in contrast to the more traditional residential linear continuum model, which views substance abuse, mental health disorders, and other serious difficulties as obstacles that must be addressed in order for the person to be deemed ready for placement in permanent housing. Furthermore, as its

1. This definition was only recently expanded to include adults who are part of a homeless family, and separate enumerations of the number of chronically homeless persons in families were made available for the first time by HUD in 2013. These estimates indicate that only a small portion (15 percent) of the chronically homeless population was composed of persons in families.

name implies, PSH provides permanent housing with no time limits for residency, and therefore PSH tenants are not counted as homeless.

In recent years, PSH has emerged as the preferred intervention for addressing chronic homelessness (HUD 2011*a*). There is a substantial and growing body of evidence supporting the effectiveness of PSH for improving the housing stability of individuals. Studies have consistently shown that 2-year housing retention rates in PSH are above 80 percent and that the cost of providing PSH to chronically homeless people can be partially or completely offset by reductions in their use of health, mental health, criminal justice, emergency shelter, and other public services following placement in housing (Shern et al. 1997; Tsemberis and Eisenberg 2000; Culhane et al. 2002; Rosenheck et al. 2003; Tsemberis, Gulcur, and Nakae 2004; Martinez and Burt 2006; Padgett, Gulcur, and Tsemberis 2006; Perlman and Parvensky 2006; Siegel et al. 2006; Gilmer et al. 2009; Larimer et al. 2009; Leff et al. 2009; Sadowski et al. 2009; McLaughlin 2011).

This body of research has been an important driver in policy makers' well-documented efforts to achieve the goal of ending chronic homelessness (Burt 2002; Culhane and Byrne 2010; US Interagency Council on Homelessness 2012). Hundreds of communities throughout the country have developed 10-year plans to address chronic homelessness, and many have specified the goal of ending chronic homelessness through the expansion of PSH. At the national level, "Opening Doors," which was released in 2010, constitutes the first-ever federal plan to prevent and end homelessness; it identified ending chronic homelessness within 5 years as one of its four key goals and called for an expansion in the supply of PSH as a key strategy to achieve this goal (US Interagency Council on Homelessness 2010). In addition, the substantial growth of the joint HUD and VA Supportive Housing program has been a key strategy in ongoing efforts to address homelessness among veterans (VA 2009).

Recent trends indicate that many communities have followed through on their stated goal of expanding the supply of PSH. Between 2007 and 2013, the number of PSH units nationwide grew by about 50 percent from 189,000 to 284,000 (HUD 2013). This recent increase in PSH units has coincided with decreases in chronic homelessness. The number of persons experiencing chronic homelessness on a given night nationwide decreased by 25 percent, from roughly 124,000 to about 93,000, between 2007 and 2013 (HUD 2013). It is unclear whether, and to what extent, the recent declines in chronic homelessness can be attributed to the rapid expansion

in PSH, or other factors, especially since only a small proportion of units are targeted specifically to individuals experiencing chronic homelessness (HUD 2013).

Almost all prior studies evaluating the effectiveness of PSH have been conducted at the individual level, with only minimal attempts to empirically test the relationship between PSH and chronic homelessness at the community level. To date, only one unpublished study (US Interagency Council on Homelessness 2012) has examined the relationship between PSH and chronic homelessness using community-level data. That analysis found increases in a community's inventory of PSH over time to be significantly associated with decreases in its sheltered, but not total or unsheltered, rates of chronic homelessness. Nonetheless, that study was limited because it used raw, rather than population-adjusted, measures of chronic homelessness and PSH units. More importantly, it did not account for several factors that prior studies have shown to be important determinants of variation in the rates of homelessness across communities, including housing market and economic conditions (Troutman, Jackson, and Ekelund 1999; Quigley and Raphael 2002; Lee, Price-Spratlen, and Kanan 2003; Raphael 2010), the adequacy of social safety net programs (Honig and Filer 1993; Grimes and Chressanthis 1997; Hudson 1998; Quigley, Raphael, and Smolensky 2001), community demographic composition (Quigley 1990; Lee et al. 2003), and climate (Quigley 1990; Appelbaum et al. 1991; Lee et al. 2003; Raphael 2010). Thus, in the absence of a more comprehensive analysis, the extent to which investment in PSH is associated with the rate of chronic homelessness at the community level remains unclear.

It is important to expand research on homelessness at the community level for several reasons. First, examining the relationship between community investment in PSH and chronic homelessness would help policy makers assess whether efforts to expand PSH have achieved their intended result, and hence, whether the significant public resources invested in creating new units of PSH are being put to effective use. Second, although chronic homelessness has declined in recent years, the nation is not on track to meet the federal strategic plan's goal of ending chronic homelessness by 2015. Improved understanding of the relationship between PSH and chronic homelessness at the community level would help policy makers set accurate targets for the future expansion of PSH units by identifying the number of units needed to achieve stated goals. Third, state and local governments are increasingly experimenting with innovative ways to fund large-scale

expansions of PSH. For example, Massachusetts has initiated a process in which the proceeds from Social Impact Bonds sold to private investors would be used to finance the development of new units of PSH (Finn and Hayward 2013), and New York is planning to allocate more than $90 million of its 2013–14 Medicaid budget for capital, costs, and other expenses to create new PSH units (Doran, Misa, and Shah 2013). Findings from research on the relationship between PSH and chronic homelessness at the community level could help inform these new initiatives. In short, research on the relationship between PSH and chronic homelessness using community-level data has the potential to provide valuable information for macro-level resource allocation decisions and planning processes that cannot be obtained from individual-level studies.

Is greater community investment in PSH associated with reductions in chronic homelessness over time? To address this question, we use 6 years of data from a large set of American communities to conduct a longitudinal analysis examining the relationship between PSH and chronic homelessness at the community level, while also controlling for a range of additional community-level variables that prior research suggests are likely to be associated with variation in rates of chronic homelessness across communities.

METHOD

SAMPLE

The study sample is composed of 372 Continuums of Care (CoCs) in the United States. CoCs are geographic units in which administrators of homelessness assistance programs share federal resources and work collaboratively to develop strategic plans to address homelessness within their jurisdictions. As is detailed below, CoCs are required by HUD to conduct enumerations of the homeless population within their jurisdictions. Although CoC boundaries do not cross state lines, they vary in size and composition and can be composed of single cities, individual counties, several counties, or entire states.

As the universe of active CoCs is not constant across years, our sample is initially limited to the 416 CoCs in continuous existence from 2007 to 2012, this study's observation period. We dropped four CoCs located in Guam, Puerto Rico, and the US Virgin Islands from this sample and also excluded the Detroit, Los Angeles, and New Orleans CoCs due to documented prob-

lems with their enumerations of the homeless population over the course of the study period (HUD 2010). Obtaining measures of community-level characteristics at the CoC level is difficult due to the irregular geographic composition of CoCs, and consequently, we construct several CoC-level independent variables from county-level measures using a two-step process. First, we used geographic information systems (GIS) mapping software to superimpose county centroid points on a map of CoC boundaries to link all counties with their appropriate CoC. Second, we statistically adjusted county-level measures where necessary using either population-weighted means or sums to transform them into CoC-level variables. Additional details about this procedure are available elsewhere (Byrne et al. 2012). In a few cases, these geospatial procedures necessitated the merging of several CoCs into a single, larger CoC, and this further reduced the effective number of CoCs in the sample from 409 to 376. Finally, as the climate data described below are unavailable for Alaska and Hawaii, the four CoCs located in those states were dropped, resulting in a final sample of 372 CoCs located in 48 different states.

DATA AND MEASURES

We construct a longitudinal data set that includes CoC-level measures of chronic homelessness and PSH for each year from 2007 to 2012, and we supplement these measures with data from various sources to construct CoC-level measures of factors that have been identified by prior research as important predictors of homelessness, such as social safety net variables, economic characteristics, housing market characteristics, demographic characteristics, and climate. Specific study measures, including the data source for each, are summarized in table 1 and described in more detail below.

Dependent Variables

We collected CoC-level estimates of chronic homelessness for each year between 2007 and 2012 from point-in-time (PIT) homeless count data available from HUD, and the dependent variables for this study are the total, sheltered, and unsheltered rates of chronic homelessness per 10,000 adults in a CoC's general population for each year in the study period. As part of the application process for federal homeless assistance funding

TABLE 1. Community Safety Net, Housing, Economic, Demographic, and Climate Characteristics

	Mean	SD	Source
Safety net:			
Per capita Medicaid expenditures from state general fund ($)	1,102.2	294.3	Kaiser Foundation State Health Facts
Per capita public assistance expenditures from state general fund ($)	38.1	54.2	Kaiser Foundation State Health Facts
Housing market:			
Median rent, efficiency unit ($)	669.2	193.9	HUD-FMR
Vacancy rent (%)	11.8	6.2	ACS
Renter households (%)	31.4	8.0	ACS
Economic measures:			
Unemployment rate (%)	7.4	1.7	ACS
Poverty rate (%)	13.1	4.5	ACS
Demographic measures:			
African American (%)	11.7	11.9	ACS
Hispanic (%)	10.6	12.3	ACS
Single-person households (%)	27.4	4.2	ACS
Veterans (%)	10.9	2.6	ACS
Baby Boomers (%)	25.8	2.4	ACS
Climate:			
Average January temperature (F°)	32.7	14.9	USHCN
Average precipitation in January (inches)	2.1	1.6	USHCN
Metro (%)	67.7		USDA

Note.—$N = 372$. HUD-FMR = US Department of Housing and Urban Development Fair Market Rent data set, ACS = US Census Bureau 2005–9 or 2006–10 5-year American Community Survey (ACS) estimates, USHCN = US Historical Climatology Network monthly data set, USDA (US Department of Agriculture) Economic Research Service definitions of rurality.

from HUD, CoCs are required to conduct PIT counts of persons experiencing homelessness within their jurisdiction. These counts must take place during a single night in the last week of January, and they must enumerate certain subgroups of the homeless population, including persons experiencing chronic homelessness. In addition, CoCs are required to report separate counts of the number of persons in each subgroup who are in unsheltered situations, as well as those who are sheltered in either emergency shelters or transitional housing programs on the night of the count. Although CoCs develop their own processes for conducting PIT counts, they must use a methodology that meets HUD-established guidelines (HUD 2008). HUD also provides extensive technical support to communities to improve the methodological rigor with which PIT counts are conducted. Many CoCs conduct their PIT counts on an annual basis, but HUD only requires such counts to be conducted on a biennial basis, with mandatory counts for all CoCs occurring in odd-numbered years. As a result, the

dependent variables are set to missing in the study's data set in even-numbered years for communities that did not conduct counts.

While recent changes have expanded the federal definition of chronic homelessness to include homeless families, only those who were homeless as individuals (i.e., not part of a family with children) were defined as chronically homeless during this study's observation period. Consequently, our counts of chronic homelessness only capture homeless individuals. No persons experiencing chronic homelessness as part of a family with children are included in the present study's chronic homelessness measures.

Independent Variables

The primary independent variable of interest in this study is community investment in PSH, which is measured as the number of PSH units designated specifically for individuals (i.e., those who are not part of a family with children) per 10,000 adults in each CoC for each year from 2007 to 2012. We obtain this measure from HUD's Housing Inventory Chart (HIC), which is updated annually and which provides the number of emergency shelter and transitional housing beds and PSH units within each CoC, stratified by whether the beds/units are intended for homeless individuals or homeless families with children.

Control Variables

Previous research indicates that a range of community-level factors, including the adequacy of the social safety net, housing market and economic conditions, demographic characteristics, climate, and the availability of emergency shelter, are important determinants of variation in rates of homelessness across communities. Consequently, we use measures of each of these factors to control for their potential association with a community's rate of chronic homelessness. The above-described geospatial matching procedures allowed us to construct many of the CoC-level control variables from county-level data. However, we obtained the majority of these control measures from the US Census Bureau's American Community Survey (ACS), which only provides data for every county in the United States as part of its 5-year estimates, which pool data collected over a 5-year period to produce one single estimate. Thus, for the control variables that use the ACS, data from the 2005–9 5-year estimates serve as proxies for baseline community characteristics. To be consistent with this, and with the

exception of the shelter availability measures, we use 2009 data for the few control variables that do not rely on ACS data.

Safety Net, Housing Market, and Economic Factors

This study uses several measures to control for the adequacy of social safety net programs, the housing market, and economic conditions. First, prior studies show a negative relationship between spending on social safety net programs and homelessness (Honig and Filer 1993; Grimes and Chressanthis 1997; Hudson 1998; Troutman et al. 1999; Quigley et al. 2001). We use data from the Kaiser Foundation State Health Facts to construct measures of per capita spending from state general funds on Medicaid and public assistance. These two variables are measured at the state level rather than the CoC level, as data for smaller geographic units are unavailable.

Second, tight housing market conditions characterized by high rent levels, larger numbers of renter households, and low rental vacancy rates have been linked to higher rates of homelessness (Quigley 1990; Bohanon 1991; Burt 1993; Honig and Filer 1993; Grimes and Chressanthis 1997; Early and Olsen 2002; Lee et al. 2003). To account for housing market conditions, we apply HUD's Fair Market Rent data set to create a CoC-level variable measuring the median rent for an efficiency apartment. We also use ACS data to construct CoC-level measures of the rental vacancy rate and proportion of households that are renters.

Third, prior studies have identified positive relationships between poverty and unemployment rates and rates of homelessness (Appelbaum et al. 1991; Burt 1993; Culhane, Lee, and Wachter 1996; Early and Olsen 2002; Gould and Williams 2010). Using ACS data, we create CoC-level measures of the poverty and unemployment rates as indicators of economic conditions.

Finally, since African Americans, veterans, and members of the baby boom generation are overrepresented in the homeless population (Culhane and Metraux 1999; Burt et al. 2001; HUD 2011*a*) and Hispanics are underrepresented, the relative share of each of these groups in a community may have a relationship with its rate of homelessness (Baker 1996). Similarly, communities with relatively more single-person households have been shown to have higher rates of homelessness (Lee et al. 2003). To account for the community demographic composition, we include CoC-level variables derived from the ACS data for the number of African Americans, Hispanics, and baby boomers (those between the ages of 45 and 64) as a proportion of the overall population, as well as measures of the proportion

of veterans in the adult population and the proportion of households composed of single persons.

Climate

Climate has been frequently hypothesized as an important determinant of the scope of homelessness in a particular community under the theory that warmer, drier climates attract homeless persons from outside communities and may lead to relatively more people experiencing homelessness in unsheltered situations (Lee et al. 2003). Existing research lends empirical support for the importance of climate, as several studies have shown that areas with higher temperatures and less precipitation have higher rates of homelessness (Quigley 1990; Appelbaum et al. 1991; Grimes and Chressanthis 1997; Raphael 2010).

We use the US Historical Climatology Network's (USHCN) monthly data set (Menne, Williams, and Vose 2012) for CoC-level measures of temperature and precipitation. USHCN is a subentity of the National Weather Service. The USHCN data provide historical information on monthly temperature and precipitation collected from roughly 1,200 weather stations located throughout the contiguous United States. To construct our climate variables, we use GIS software to identify the USHCN weather station located closest to the geographic center of each CoC. The average monthly temperature and total inches of precipitation for January are then abstracted from the USHCN data for each of these weather stations, and these serve as this study's climate variables. January temperature and precipitation data are used because, as noted above, the chronic homeless measures are also collected in January.

Metropolitan versus Nonmetropolitan CoCs

Homelessness is largely an urban phenomenon, with the most recent estimates indicating that roughly two-thirds of the homeless population is located in principal cities (HUD 2011*a*). We therefore use the US Department of Agriculture (USDA) Economic Research Service's rural-urban continuum codes (USDA 2012) to classify CoCs as either metropolitan or nonmetropolitan. The USDA classifies all counties on a scale stretching from 1 (counties in metro areas of 1 million people or more) to 9 (counties that have less than 2,500 urban population and are not adjacent to a metro area). We calculate a population-weighted average rural-urban continuum score for each CoC that contains more than one county. We then

use the CoC-level score to create a dichotomous variable identifying each CoC as a metro (scores less than 3) or nonmetro (scores 3 and above) CoC. Metro CoCs are assigned a value of 1 and nonmetro CoCs a value of 0.

Shelter Availability

Using data from HUD's HIC, we construct two measures of shelter availability: the number of emergency shelter beds and the number of transitional housing beds for homeless individuals (persons who are not homeless as part of a family with children) per 10,000 adults in the general population for each year between 2007 and 2012. Given that the number of emergency shelter and transitional housing beds in a CoC should theoretically be a function of the demand for beds based on the size of the community's homeless population, it may seem counterintuitive to include these two measures. There are two important reasons for including them in this study. First, some have argued that the amount of shelter and transitional housing in a community is determined in no small part by its willingness and ability to fund and maintain homeless assistance programs (Early and Olsen 2002; Lee et al. 2003). Thus, larger numbers of shelter and transitional housing beds may contribute to higher rates of homelessness, as those in the worst housing situations may choose to enter homelessness and reside in a shelter rather than remain in their present housing situation (O'Flaherty 1996; Troutman et al. 1999; Early and Olsen 2002). Second, communities with a relatively more developed homelessness assistance system, characterized by a greater number of emergency shelter and transitional housing beds, are also likely to have a relatively larger stock of PSH units. Persons residing in emergency shelter and transitional housing are counted as homeless, while those in PSH units are not. Failing to account for the availability of emergency shelter and transitional housing in a community may result in a spurious relationship between PSH and homelessness.

ANALYSIS

We first use descriptive measures to explore the characteristics of CoCs included in the sample and community-level trends in both chronic homelessness and PSH over time. We then use multilevel Poisson regression models to assess the relationship between community investment in PSH and the rate of chronic homelessness over time. Multilevel regression models, with multiple observations at different time points for each unit of analy-

sis, are commonly employed to analyze longitudinal data because they are able to account for the violation of independence resulting from the correlation of repeated measures within subjects (Hox 2010). An additional advantage of using multilevel models for longitudinal data is that they can accommodate unbalanced data structures in which data may be missing for certain subjects at one or multiple time periods (Snijders and Bosker 2012), as is the case for the data in the present study for those CoCs that did not conduct enumerations of their homeless populations in even-numbered years.

The data in the present study have a three-level structure, with measurement time periods (each year between 2007 and 2012) serving as the first level, CoCs serving as the second level, and states serving as the third level. Specifically, we estimate a series of three-level Poisson regression models, in which we allow for random intercepts at the CoC and state level in all models. Because the raw count of individuals experiencing chronic homelessness in a community depends on the size of its underlying population, we construct the dependent variables in all models as a rate per 10,000 adults in order to adjust for differences in population between communities. This is achieved in Poisson regression models through the use of an offset term (Agresti 2013). The inclusion of an offset term allows a count variable (in this case, the number of individuals experiencing chronic homelessness) to be expressed as a rate by including the logged value of an exposure variable, which is the denominator in constructing the rate and in this case is the number of adults in a community, on the right-hand side of the regression equation. Thus, in following well-established procedures for Poisson regression, we include an offset term equal to the log of the total adult CoC population divided by 10,000 in all models. Dividing the number of adults by 10,000 allows us to express the dependent variables as a rate per 10,000 adults.

We estimate separate models using the total, sheltered, and unsheltered rates of chronic homelessness as the dependent variables. Following established procedures for multilevel models with longitudinal data (Singer and Willett 2003), for each of these dependent variables we first estimate a model that only includes time as predictor, which is commonly known as an unconditional growth model (model 1). Preliminary analysis of the trend in the total rate of chronic homelessness over time shows a zigzag pattern, with the observed rate generally higher in odd-numbered years when communities are required to enumerate their homeless population (see fig. 1).

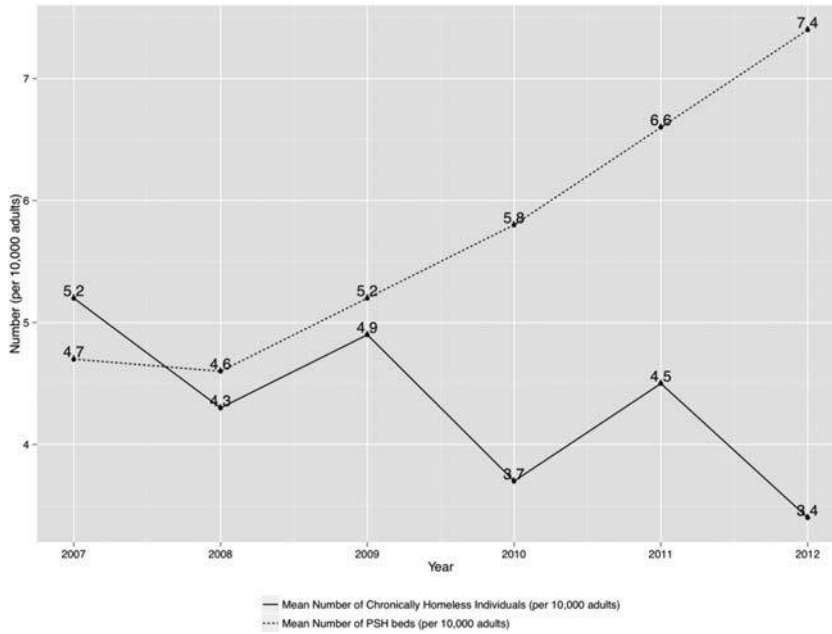

FIGURE 1. Mean rate of chronic homelessness and number of permanent supportive housing units per 10,000 adults, 2007–12.

In light of this pattern, a dummy variable for whether a specific year was a mandatory or nonmandatory count year is then added to the model (model 2). We then construct a model that includes time, the mandatory count year dummy variable, and all of the CoC- and state-level control variables described above (model 3). Variables in this controls-only model that are significant at the $p < .20$ level are then retained in a model that also includes the number of PSH units per 10,000 adults as a time-varying covariate (model 4). This time-varying PSH measure is included as a level-1 predictor, and it provides an assessment of the relationship between the availability of PSH and the rate of chronic homelessness within communities. We then estimate a model that includes an interaction term between the time variable and the PSH measure, which allows for an assessment of whether the relationship between the availability of PSH and the rate of chronic homelessness varies over the course of the study period (model 5). We then estimate a final model that adds the time-varying emergency shelter and transitional housing measures to account for the potential association between shelter availability and a community's rate of chronic homelessness (model 6).

We first estimate the models described above using concurrent measures (i.e., measured during the same year of the study period) of PSH and chronic homelessness. As a robustness check on the results of these concurrent models, we estimate an additional set of models using a lagged PSH measure to assess the relationship between the rate of chronic homelessness in a given year and the relative number of PSH units in the previous year. To accommodate the introduction of this lagged PSH measure, the lagged models only use data from 2008 to 2012.

RESULTS

SAMPLE CHARACTERISTICS

Table 1 presents descriptive information about the characteristics of the social safety net, housing market, economy, demography, and climate of the 372 communities included in the final study sample, as well as information about the share of metropolitan and nonmetropolitan communities in the sample. Comparisons of the CoCs included and excluded from the sample show no statistically significant differences with respect to these background characteristics. Figure 1 plots both the mean total rate of chronic homelessness and the mean number of PSH beds per 10,000 adults for each year of the study period. The figures show an increasing trend in the number of PSH beds over time, with the mean number of PSH beds per 10,000 adults increasing by 57 percent between 2007 and 2012, and a decreasing trend in chronic homelessness, with the mean total rate of chronic homelessness decreasing by 35 percent over that same period. Although not shown, the sheltered and unsheltered rates of chronic homelessness also exhibited a clear downward trend over time.

RELATIONSHIP BETWEEN COMMUNITY INVESTMENT IN PSH AND CHRONIC HOMELESSNESS: CONCURRENT MODELS

Table 2 presents the results of the multilevel Poisson regression models for the total rate of chronic homelessness. For ease of interpretation, the coefficient estimates are presented as incidence rate ratios (IRRs). These IRRs are analogous to adjusted odds ratios in logistic regression, with values below 1 indicating a negative relationship between the covariate of interest and the outcome variable and values above 1 indicating a positive relationship.

TABLE 2. Results of Multilevel Poisson Regression Models of the Relationship between Permanent Supportive Housing (PSH) and the Total Rate of Chronic Homelessness

	Models (IRR)					
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	2.917***	2.961***	.031***	.049***	.051***	.058***
Year	.959***	.958***	.958***	.964***	.996	.994
PSH units (per 10,000 adults)				.988***	1.006***	.996*
Emergency shelter beds (per 10,000 adults)						1.026***
Transitional housing beds (per 10,000 adults)						1.015***
Medicaid spending per capita (in $1,000s)			.549*	.619	.617	.637
Public assistance spending per capita (in $100s)			1.188			
Median rent (in $100s)			1.066	1.076*	1.072*	1.084**
Rental vacancy rate			1.01			
% renters			1.038***	1.037***	1.036***	1.032***
Unemployment rate			1.021			
Poverty rate			1.01			
% black			.992	.995	.995	.994
% Hispanic			1.01	1.014**	1.015**	1.013*
% single-person household			1.055***	1.074***	1.071***	1.063***
% veteran			1.058**	1.076***	1.076***	1.072***
% Baby Boomer			1.026			
			1.005			
January temperature			1.045	1.057	1.06	1.061
January precipitation			1.296*	1.172	1.167	1.145
Mandatory count year		.981***	.983***	.986***	.984***	.987**
Year × PSH units (per 10,000 adults)					.994***	.995***
Log likelihood	−14,203.11	−14,191.49	−14,033.20	−13,995.66	−13,881.11	−13,675.96
AIC	28,418.22	28,396.98	28,110.40	28,025.33	27,798.22	27,391.92
BIC	28,451.42	28,435.71	28,231.97	28,119.27	27,897.69	27,502.44

Note.—$N = 372$. Model 1 only includes time as a predictor. Model 2 is adjusted for whether communities were required to conduct counts of the homeless population in the given year. Model 3 is adjusted for community social safety net, housing, demographic, and climate variables. Model 4 retains control variables statistically significant at $p < .20$ level from model 3 and adds community investment in PSH variable. Model 5 includes time by PSH interaction variable. Model 6 adjusts for emergency shelter and transitional housing capacity. IRR = incidence rate ratio, CoC = Continuum of Care, AIC = Aikake information criterion, BIC = Bayesian information criterion.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Model 1 in table 2 shows a statistically significant decline in the total rate of chronic homelessness over the study period, with the total rate of chronic homelessness in a community decreasing by about 4 percent each year. Model 2 shows that this time trend is unchanged after adjusting for whether communities were required to conduct counts of their homeless populations in the given year. Model 3 includes the set of community safety net, economic, housing, demographic, and climate control variables. Consistent with expectations, there are statistically significant, positive relationships between the relative number of renter households, single-person households, and veterans and the total rate of chronic homelessness, while higher per capita Medicaid spending is significantly associated with lower total rates of chronic homelessness. Model 3 also shows that metropolitan communities have significantly higher total rates of chronic homelessness than nonmetropolitan communities. Model 4 retains these and other control variables that were significant at the $p < .20$ level in model 3, while also adding the community investment in PSH variable. The results of this model show a statistically significant, negative relationship between PSH and the total rate of chronic homelessness. Specifically, the coefficient for the PSH variable indicates that an increase of one PSH unit per every 10,000 adults in a community is associated with a 1 percent decrease in its total rate of chronic homelessness per 10,000 adults. Model 5 tests a year by PSH interaction term, and the results of a likelihood ratio test indicate that the inclusion of this term results in a model that is a significantly better fit than model 4 (χ^2 [1] = 229.11, $p < .001$), and consequently the interaction term is included in all subsequent models. The statistically significant negative coefficient for the interaction term in model 5 indicates that the relationship between the number of PSH beds and the total rate of chronic homelessness varies across years in the study period. Specifically, the positive coefficient for the first-order PSH term indicates a positive relationship between the relative number of PSH units in a community and its rate of chronic homelessness in the first year of the observation period, while the negative year by PSH units interaction suggests a negative relationship between a community's relative number of PSH units and its rate of chronic homelessness in subsequent years. Model 6 adds the emergency shelter and transitional housing variables. In contrast to model 5, the results of model 6 indicate that, after adjusting for emergency shelter and transitional housing capacity, there is a statistically significant, negative re-

lationship between PSH and chronic homeless in the first year of the study period and that this relationship becomes more pronounced in subsequent years to the point that, in the last year of the study period, an increase of 1 PSH unit per 10,000 adults in a community is associated with roughly a 3 percent decrease in its total rate of chronic homelessness.

Figure 2 helps illustrate the association between PSH and the total rate of chronic homelessness over time. The figure uses the results from model 6 of table 2 to plot the predicted total rate of chronic homelessness in each year of the study period for two hypothetical communities, allowing the values for the PSH measure to vary over time for the two communities but holding all other variables constant at their mean values for both communities. In the first year of the study period, the number of PSH beds per 10,000 adults is set to be equal in both communities at the median value in for the entire sample in that year. In order to illustrate the relationship between increased community investment in PSH and chronic homeless-

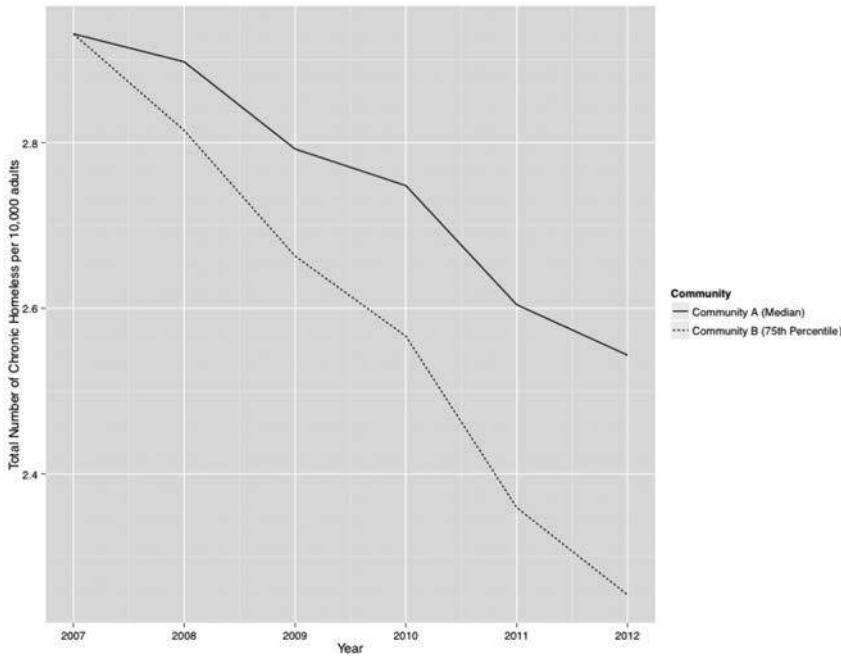

FIGURE 2. Predicted total rate of chronic homelessness based on concurrent model for communities with varying amounts of permanent supportive housing.

ness over time, the PSH measure is then set to a value corresponding to the median for community A and to the 75th percentile for community B in subsequent years.

Figure 2 shows that, while the predicted total rate of chronic homelessness declines in both communities over time, the decline is much steeper for the community with relatively more PSH units. By the end of the study period, the predicted total rate of chronic homelessness in Community B is 2.54 per 10,000 adults, compared to 2.25 for Community A. In a city of 600,000 (roughly the size of Las Vegas, Louisville, Milwaukee, or Oklahoma City), this would correspond to about 17 fewer people experiencing chronic homelessness on a given night in Community B. By the end of the study period, however, the relative number of PSH units at the 75th percentile is nearly double that of the median value (8.52 vs. 4.45 per 10,000), which in a city of 600,000 would translate into a difference of about 244 PSH units, suggesting a fairly modest relationship between PHS and chronic homelessness over time.

Tables 3 and 4 present the results of the models that use the unsheltered and sheltered rates of chronic homelessness as their outcome measures, respectively. The results of the models for the unsheltered rate of chronic homelessness, shown in table 3, are largely consistent with those for the total rate of chronic homelessness. In model 6, which controls for community characteristics and shelter availability, an increase of 1 PSH unit per every 10,000 adults in a community is associated with a 2 percent decrease in the unsheltered rate of chronic homelessness in the initial year of the study period, and the negative coefficient on the year by PSH interaction term indicates that the negative relationship becomes stronger in subsequent years.

The results of the sheltered models, shown in table 4, also show a significant negative relationship between PSH and the sheltered rate of chronic homelessness. However, the results of model 6 for the sheltered outcome differ slightly from the corresponding models for the total and unsheltered rates of chronic homelessness (shown in tables 2 and 3, respectively). In particular, in the first year of the study period, there is a significant positive relationship between the relative number of PSH units and the sheltered rate of chronic homelessness, although the negative coefficient for the time by PSH interaction term in this model indicates that the relationship is negative in subsequent years.

TABLE 3. Results of Multilevel Poisson Regression Models of the Relationship between Permanent Supportive Housing (PSH) and the Unsheltered Rate of Chronic Homelessness

	Models (IRR)					
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	1.016***	1.032***	.002***	.009***	.009***	.009***
Year	.935***	.934***	.935***	.943***	.963*	.961*
PSH units (per 10,000 adults)				.983***	.993**	.981***
Emergency shelter beds (per 10,000 adults)						1.005*
Transitional housing beds (per 10,000 adults)						1.016***
Medicaid spending per capita (in $1,000s)			.491	.626	.627	.651
Public assistance spending per capita (in $100s)			.999			
Median rent (in $100s)			1.192**	1.141**	1.14**	1.149**
Rental vacancy rate			1.014			
% renters			1.044*	1.056***	1.056***	1.055***
Unemployment rate			1.059			
Poverty rate			1.033			
% black			.982*	.987*	.987*	.986*
% Hispanic			1.01			
% single-person household			1.036	1.046*	1.045*	1.045*
% veteran			1.078*	1.074**	1.075**	1.074**
% Baby Boomer			1.036			
January temperature			1.021**	1.028***	1.028***	1.028***
January precipitation			1.045			
Metro CoC			1.261	1.086	1.085	1.081
Mandatory count year		.981***	.985**	.99	.988*	.991
Year × PSH units (per 10,000 adults)					.996***	.998***
Log likelihood	−12,155.20	−12,149.45	−12,020.52	−11,984.89	−11,964.00	−11,963.72
AIC	24,322.40	24,312.90	24,085.03	24,001.78	23,962.01	23,963.44
BIC	24,355.60	24,351.63	24,206.61	24,090.20	24,055.95	24,062.91

Note.—$N = 372$. Model 1 only includes time as a predictor. Model 2 is adjusted for whether communities were required to conduct counts of the homeless population in the given year. Model 3 is adjusted for community social safety net, housing, demographic, and climate variables. Model 4 retains control variables statistically significant at $p < .20$ level from model 3 and adds community investment in PSH variable. Model 5 includes time by PSH interaction variable. Model 6 adjusts for emergency shelter and transitional housing capacity. IRR = incidence rate ratio, CoC = Continuum of Care, AIC = Aikake information criterion, BIC = Bayesian information criterion.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

TABLE 4. Results of Multilevel Poisson Regression Models of the Relationship between Permanent Supportive Housing (PSH) and the Sheltered Rate of Chronic Homelessness

	Models (IRR)					
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	1.32***	1.365***	.043***	.054***	.057***	.079***
Year	.977*	.974*	.973*	.98	1.032**	1.031**
PSH units (per 10,000 adults)				.987***	1.018***	1.01***
Emergency shelter beds (per 10,000 adults)						1.046***
Transitional housing beds (per 10,000 adults)						1.011***
Medicaid spending per capita (in $1,000s)			.535**	.532**	.522**	.562**
Public assistance spending per capita (in $100s)			1.271	1.344**	1.329*	1.326**
Median rent (in $100s)			.991			
Rental vacancy rate			1.001			
% renters			1.035**	1.039***	1.038***	1.028***
Unemployment rate			.995			
Poverty rate			.993			
% black			1.001	.997	.997	.998
% Hispanic			1.009			
% single-person household			1.08***	1.084***	1.079***	1.068***
% veteran			1.056*	1.048*	1.049*	1.044*
% Baby Boomer			1.016			
January temperature			.99*	.991*	.991*	.991*
January precipitation			1.022			
Metro CoC			1.348*	1.42***	1.415***	1.401***
Mandatory count year		.959***	.957***	.96***	.956***	.962***
Year × PSH units (per 10,000 adults)					.99***	.991***
Log likelihood	−11,254.05	−11,224.88	−11,056.89	−11,035.59	−10,887.86	−10,703.34
AIC	22,520.09	22,463.75	22,157.77	22,103.19	21,809.72	21,444.69
BIC	22,553.29	22,502.48	22,279.35	22,191.60	21,903.67	21,549.69

Note.—$N = 372$. Model 1 only includes time as a predictor. Model 2 is adjusted for whether communities were required to conduct counts of the homeless population in the given year. Model 3 is adjusted for community social safety net, housing, demographic, and climate variables. Model 4 retains control variables statistically significant at $p < .20$ level from model 3 and adds community investment in PSH variable. Model 5 includes time by PSH interaction variable. Model 6 adjusts for emergency shelter and transitional housing capacity. IRR = incidence rate ratio, CoC = Continuum of Care, AIC = Aikake information criterion, BIC = Bayesian information criterion.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

RELATIONSHIP BETWEEN COMMUNITY INVESTMENT IN PSH AND CHRONIC HOMELESSNESS: LAGGED MODELS

Table 5 presents the results of the models that predict the total rate of chronic homelessness in a given year as a function of the PSH measure in the previous year. Model 1 shows no statistically significant relationship between the total rate of chronic homelessness and the lagged number of PSH units per 10,000 adults. But a likelihood ratio test indicates that the addition of a year by PSH interaction term results in a significant improvement in model fit (χ^2 [1] = 8.64, p = .003). The results of the model with this interaction term included (model 2) indicate that the relative number of PSH units in the first year of the study period is associated with higher total rates of chronic homelessness in the second year of the study period, although the negative coefficient for the time by lagged PSH interaction term indicates that this relationship weakens over time. This same pattern

TABLE 5. Results of Multilevel Poisson Regression Models of the Relationship between 1-Year Lagged Measure of Permanent Supportive Housing and the Total Rate of Chronic Homelessness

	Models (IRR)		
	(1)	(2)	(3)
Intercept	.069***	.069***	.077***
Year	.955***	.966*	.972*
1-year lagged PSH units (per 10,000 adults)	1.002	1.008***	1.008***
Emergency shelter beds (per 10,000 adults)			1.007**
Transitional housing beds (per 10,000 adults)			1.01***
Medicaid spending per capita (in $1,000s)	.524**	.523**	.525**
Median rent (in 100s)	1.078*	1.076*	1.079*
% renters	1.03***	1.03***	1.028***
% black	.993	.993	.993
% Hispanic	1.011*	1.011*	1.011*
% 1-person household	1.071***	1.071***	1.066***
% veteran	1.078***	1.078***	1.077***
January temperature	1.049	1.049	1.051
Metro CoC	1.212	1.211	1.2
Mandatory count year	1.005	1.005	1.007
Year × lagged PSH units		.998***	.997***
Log likelihood	−5,431.344	−5,427.025	−5,402.96
AIC	10,896.69	10,890.05	10,845.92
BIC	10,984.99	10,983.55	10,949.81

Note.—N = 372. Model 1 shows relationship between total rate of chronic homelessness and lagged number of PSH units per 10,000 adults. Model 2 adds a year by PSH interaction term. Model 3 includes emergency shelter and transitional housing variables. IRR = incidence rate ratio, CoC = Continuum of Care, AIC = Aikake information criterion, BIC = Bayesian information criterion.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

holds true in the model that includes the emergency shelter and transitional housing measures (model 3), and the coefficients for the main effect of the PSH variable and its interaction with the year variable indicate that by the end of the study period, an increase in the lagged PSH measure of one PSH unit per 10,000 adults is associated with a 0.4 percent decrease in the total rate of chronic homelessness.

Figure 3 uses the results of model 3 of table 5 to plot the predicted rates of chronic homelessness across the study period, again using two hypothetical communities that both start with the median value for the lagged PSH measure but then are assumed to have different numbers of PSH units in subsequent years. As the figure shows, higher values of the lagged PSH measure initially predict higher total rates of chronic homelessness, but by the end of the study period, communities with relatively more PSH units in one year are predicted to have slightly lower total rates of chronic homelessness in the subsequent year. This relationship is once again modest, with a community in the 75th percentile in terms of number of PSH

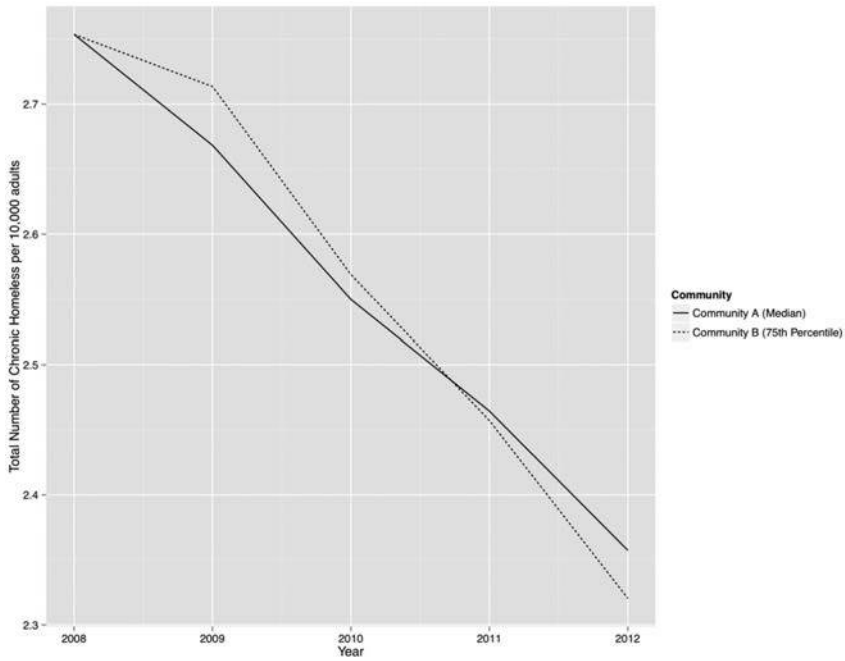

FIGURE 3. Predicted total rate of chronic homelessness based on lagged model for communities with varying amounts of permanent supportive housing.

units having a predicted total rate of chronic homelessness of 2.32 per 10,000 adults, compared to 2.36 for a community with the median number of PSH units. In a city of 600,000, this would translate into a difference of about 2.4 chronically homeless individuals for a corresponding difference of 244 PSH units.

While not shown here, the results of the models examining the relationship between the lagged PSH measure and the sheltered rate of chronic homelessness follow a similar pattern as the models for the total rate of chronic homelessness. Nonetheless, the models for the unsheltered outcome measure do not find a statistically significant relationship between the lagged PSH variable and the unsheltered rate of chronic homelessness after controlling for the full set of covariates.

SUMMARY AND CONCLUSION

Examining the relationship between PSH and chronic homelessness using community-level data reveals that communities that add relatively more PSH units show steeper declines in chronic homelessness over time. This is the case both in the models that use concurrent measures of community investment in PSH and chronic homelessness and in the models that use a lagged PSH measure, albeit to a lesser extent. These findings are consistent with the fairly sizable number of individual-level studies that have shown PSH to be a highly effective intervention for improving the housing stability of individuals experiencing chronic homelessness. In addition, the results of this study provide some tentative evidence that the recent and rapid growth in the supply of PSH, which has been a top policy priority in the homelessness arena over the past decade, has helped achieve its intended goal of reducing the aggregate number of persons experiencing chronic homelessness. In this respect, the study's findings are encouraging, suggesting that concerted community-level efforts can lessen chronic homelessness through the expansion of PSH. This information is particularly timely, as jurisdictions like Massachusetts and New York are developing ambitious and innovative plans to scale up the availability of PSH.

With that said, it is also important to note that the observed relationships between community investment in PSH and chronic homelessness are fairly modest in strength, especially in the models that use a 1-year lagged PSH measure. One potential explanation for the relatively weaker association between PSH and chronic homelessness in the lagged models

is that the lagged PSH measure does not capture new units of PSH in a community that were added after the PIT count occurred in one year but prior to the PIT count in the subsequent year. Much of the change in chronic homelessness in a community from one year to the next may come from new units of PSH added between two PIT counts, and therefore a 1-year lag may be too long of a time period to model the relationship between PSH at one point in time and chronic homelessness at some later point. Unfortunately, both the PSH and chronic homelessness measures are only available on an annual basis, and it was therefore not possible to test shorter time lags.

More generally, the relatively modest associations between PSH and chronic homelessness in both the concurrent and lagged models may suggest that communities are using a large number of PSH units to house individuals who do not meet the criteria for chronic homelessness. This may be partly explained by a process known as creaming, in which individuals with less intensive needs who are expected to have the best outcomes are selected over chronically homeless individuals for placement in PSH. Although we are not aware of any prior research that has specifically examined this in the context of the provision of PSH, the way in which PSH units are allocated at the community level likely plays a role in the magnitude of the relationship between PSH and chronic homelessness. By the end of the study period in 2012, only 27 percent of PSH units nationwide were designated explicitly for individuals experiencing chronic homelessness. While it is highly likely that some portion of units not designated specifically for those experiencing chronic homelessness are used to house individuals experiencing chronic homelessness, findings from this study point to the need for a better understanding of how PSH units are allocated at a community level and how this may be related to the rate of chronic homelessness in a community. Future research should address this question more closely to assess whether communities that develop coordinated strategies to aggressively target PSH to individuals experiencing chronic homelessness have greater success in reducing aggregate rates of chronic homelessness, and if so, which specific targeting strategies are the most effective.

In addition to its substantive findings, this study makes an equally important methodological contribution. While a sizable number of previous studies have examined community-level determinants of homelessness using cross-sectional data, the present study is, to our knowledge, only the second after the study by John Quigley and colleagues (2001) to do so using

longitudinal data and the first to use national-level longitudinal data.[2] As the PIT counts of homelessness used to construct the outcome measures in the present study will continue to be made available by HUD on an annual basis, there will be ample opportunities to expand and improve upon the methods employed in the present study with an even richer time series. Such research could be facilitated by the Homelessness Analytics Application, a web-based data tool recently launched jointly by the VA and HUD (VA and HUD 2013), from which most of the measures used in the present study are readily available for download. In short, the present study might serve as a useful model for future efforts to measure the success of PSH or other interventions against community-level homeless outcome measures. Such efforts could help policy makers and stakeholders to develop performance goals for the expansion of PSH or other programs and in turn to monitor the extent to which such expansions are meeting their established performance targets.

There are a number of limitations to this study that should be noted. First, while methodologies for enumerating the homeless population have improved in recent years, thanks in large part to the expansion of computerized databases that track emergency shelter utilization, counting the number of persons experiencing homelessness remains fraught with challenges and with room for error. Thus, the use of the HUD PIT counts in this study is a limitation, as these counts are undoubtedly imprecise to a certain, but unknowable, extent. Second, the use of PIT counts to assess changes in chronic homelessness over time may be less desirable than annual estimates of chronic homelessness. Indeed, recent evidence suggests that the majority of persons experiencing chronic homelessness meet the criteria for chronic homelessness by experiencing multiple episodes of homelessness over a several year period (Poulin et al. 2010), and therefore PIT counts may miss a significant portion of persons who are chronically homeless but who may be housed on the specific night of the count. Unfortunately, data on the number of persons who experience chronic homelessness over the course of a year were not available for the current study. Fortunately, a large number of communities now have robust homeless-

2. The study by John Quigley and colleagues used 8 years of data on the number of households served by a California program that provided grants for emergency shelter and permanent housing to families facing homelessness, and it only included counties located in California.

ness management information systems that track shelter utilization over time, and it may be possible in the future to replicate the present study using annual estimates of chronic homelessness. Finally, this study only includes persons who are homeless as individuals in its dependent variables, as it is only recently that estimates of the number of chronically homeless families have become available. As a result, our findings cannot be generalized to chronically homeless families. Given that 85 percent of the chronically homeless population is composed of individuals (HUD 2013), the results of this study are relevant for the population that accounts for the overwhelming majority of the chronically homeless population. In addition, as HUD has recently expanded the definition of chronic homelessness to include families and now provides separate enumerations of the number of persons in families experiencing chronic homelessness, future research could add to knowledge on the role community investments in PSH units may play in curtailing rates of chronic homelessness among families.

Bringing an end to chronic homelessness has been the signature homelessness-related policy goal at all levels of government over the past decade. In this context, findings from this study of a relationship between increased community investment in permanent supportive housing and reductions in chronic homelessness at the community level should be encouraging for policy makers and other stakeholders. Future research that builds on the present study could provide even more concrete insights as to how communities might refine their efforts to end chronic homelessness. As persons experiencing chronic homelessness are among some of the most vulnerable members of society, this ought to be seen as both a policy and a moral imperative by policy makers, service providers, and society at large.

NOTE

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