

THE ECONOMICS OF HOMELESSNESS: THE EVIDENCE FROM NORTH AMERICA

John M. Quigley and Steven Raphael

ABSTRACT

It is generally believed that the increased incidence of homelessness in the US has arisen from broad societal factors – changes in the institutionalization of the mentally ill, increases in drug addiction and alcohol usage, etc. This paper reports on a comprehensive test of the alternate hypothesis that variations in homelessness arise from changed circumstances in the housing market and in the income distribution. We utilize essentially all the systematic information available on homelessness in US urban areas – census counts, shelter bed counts, records of transfer payments, and administrative agency estimates. We use these data to estimate the effects of housing prices, vacancies, and rent-to-income ratios upon the incidence of homelessness. Our results suggest that simple economic principles governing the availability and pricing of housing and the growth in demand for the lowest quality housing explain a large portion of the variation in homelessness among US metropolitan housing markets. Furthermore, rather modest improvements in the affordability of rental housing or its availability can substantially reduce the incidence of homelessness in the US.

KEYWORDS

Homelessness, de-institutionalization, income distribution,
housing conditions

1. INTRODUCTION

The increased visibility during the 1980s of those apparently without shelter led to several efforts in North America to survey the incidence of homelessness and its trends. These efforts have included those of government agencies (e.g., US Department of Housing and Urban Development 1984; US Bureau of the Census 1990) as well as the efforts of non-profit research centers (e.g., Burt and Cohen 1989, of the Urban Institute) and university-based scholars (e.g., Rossi 1989).

By the mid-1980s, the concern with those apparently homeless had extended throughout Western Europe as well. In 1987 the European Parliament adopted a report on homelessness (European Union 1987), and in

1989 the first meeting of European housing ministers was held. In 1991 the European Federation of National Organizations Working with the Homeless (FEANTSA) was established with its headquarters in Brussels. During the past decade, FEANTSA has sponsored research on the extent and trends in homelessness.

On both sides of the Atlantic, research findings purporting to identify the extent of homelessness have been controversial. In Europe, FEANTSA has reported that homelessness may extend to 5 million people (Daly 1993), while in the US a popular newsmagazine estimated homelessness at 3 million (Matthews 1992). Often these numbers have a political significance which exceeds their reliability.

Notwithstanding the debates surrounding enumeration on both sides of the Atlantic, identifying the time trend has been considerably more successful than uncovering the underlying causes of homelessness and apportioning blame. Commonly offered explanations of homelessness in the US include the de-institutionalization of the mentally ill, the crack cocaine epidemic of the mid-1980s, and the relatively high cost of low-quality housing. Several prominent social scientists (in particular, Jencks 1994) have downplayed the role of housing affordability, placing greater emphasis on de-institutionalization and the ravaging consequences of increased drug usage. A similar emphasis, and the rejection of housing market explanations, is even more apparent in the European literature on homelessness. See Fitzpatrick (1998) for a survey.

In the North American case, there are reasons to question these conventional explanations. For example, the onset of the crack epidemic in the US is often dated to the mid-1980s, nearly five years after increases in homelessness were noticeable (Reuter *et al.* 1990). Concerning the de-institutionalization hypothesis, the decline in mental hospital populations has been largely offset by increases in the numbers of the mentally ill confined in other institutional settings. Hence, the number of mentally ill that are 'institutionalized,' broadly speaking, may not exhibit much of a strong trend. The flaws in these conventional arguments suggest that researchers who wish to understand the determinants of homelessness should focus their attention elsewhere. O'Flaherty (1996) refocuses the debate on housing costs, offering a model of urban housing markets that, when combined with the well-documented increase in income inequality during the 1980s, points to an increase in the incidence of homelessness.

This paper reports on results from a systematic analysis of all the survey data available in the US on the incidence of homelessness. The data come from a variety of sources – sample surveys of individuals, shelter bed counts, administrative records, and estimates produced by knowledgeable officials in different geographical areas using a consistent format.

We find that rather straightforward conditions in US housing markets – not complex social pathologies, drug usage, or deficiencies in mental

health treatments – are largely responsible for variations in rates of homelessness. We find that rather modest changes in housing markets, in vacancy rates and rents for example, have substantial effects upon the incidence of homelessness. We conclude that public policies to make housing markets freer to respond to housing demand, especially for low quality housing services, could yield a large payoff in reducing homelessness.

2. HOUSING MARKETS AND HOMELESSNESS

The tendency to downplay housing availability as an explanation for US homelessness appears to be justified by the traits of the US homeless population. Research describes a group suffering disproportionately from mental illness, drug and alcohol addiction, and extreme social isolation. Nearly one-third of the US homeless suffer from mental illness, and one-half abuse drugs or alcohol. Three-quarters of the homeless have been institutionalized (Burt and Cohen 1989; Shlay and Rossi 1992). In addition, point-in-time counts of the homeless (or ‘point-prevalence’ estimates) suggest that the homeless constitute a small fraction of the population (0.1 to 0.3 per cent). Given this confluence of personal problems and the relatively low incidence of homelessness, it is tempting to dismiss explanations of homelessness that focus on housing market conditions.

However, this statistical portrait of the homeless may be misleading for several reasons. Point-prevalence estimates fail to account for turnover among the homeless and thus understate the likelihood of experiencing a homelessness spell. In fact, period-prevalence estimates, describing the number of people who experience homelessness over a given period of time such as a year, exceed considerably point-in-time estimates. The turnover among the homeless suggested by the disparity between point-in-time and period-prevalence estimates suggests that the snapshot descriptions of the ‘typical homeless person’ disproportionately reflects the characteristics of individuals suffering long spells (see Culhane *et al.* 1994; Phelan and Link 1999). Given the greater incidence of homelessness than that implied by point-in-time counts, such characterizations are surely misleading.

One commonly offered explanation for the rise in homelessness is the drastic reduction in mental hospital in-patient populations. The number of in-patients in US mental hospitals declined by almost 80 per cent between 1971 and 1993, from 148 to 30 per 100,000. The timing of de-institutionalization, however, suggests that the conventional wisdom concerning its effect on homelessness is incorrect. While homelessness increased substantially during the 1980s, in-patient hospitalization rates have declined steadily since the mid-1950s. Indeed, the 67 per cent reduction during the 1970s (from 148 per 100,000 in 1971 to 58 in 1980) was much larger than the 38 per cent reduction occurring during the 1980s (from 58 in 1980 to 36 to 1990).

A further qualification to the de-institutionalization hypothesis relates to the definition of 'institutionalization.' Defined solely in terms of mental hospitals, institutionalization rates declined sharply during the 1980s. However, if we define institutionalization to include confinement in nursing homes, jails, and prisons, then even the *direction* of recent changes in the institutionalization rates is unclear. Figure 1 demonstrates that the decline in mental hospital populations has occurred concurrently with stark increases in prison and jail populations. Moreover, it is reported that the incidence of mental illness among prison and jail inmates is considerably higher than that for the non-institutional population, suggesting that the de-institutionalized mentally ill have been re-institutionalized in prisons and jails.

To explore this argument more thoroughly, Table 1 presents linear regressions that test for a substitution effect between prison populations and mental hospital populations within US states. The table presents US state-level panel models regressing incarceration rates in state prisons on hospitalization rates in state mental hospitals and on many other presumed correlates of prison populations – including demographic conditions, poverty rates, the age distribution of the population, measures of crime, and police activity. The regressions cover various time periods between 1970 and 1993.

The table indicates that, holding constant the other factors affecting the level of criminal activity and the size of the prison population, variations in the rate of institutionalization of mental patients are reflected in variations

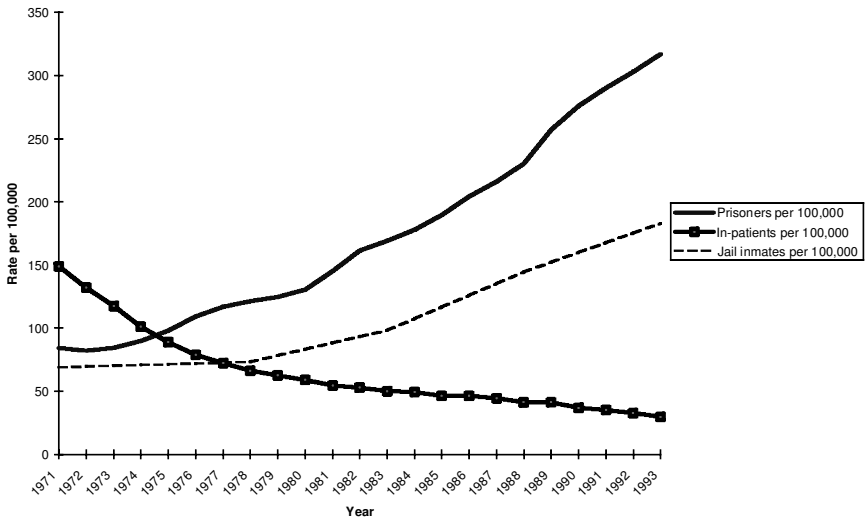


Figure 1 Rates of confinement in prisons and jails, and state and county mental hospital patients by year, 1971–93

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Table 1 Panel regressions of state prison populations on state in-patient populations in state and county mental hospitals (both institutional populations are measures per 100,000 state residents)

	<i>Includes state Effects</i>			<i>Includes State and Year Effects</i>		
	(1) 1972-81	(2) 1982-93	(3) 1980-90	(4) 1972-81	(5) 1982-93	(6) 1980-90
In-patients	-0.166 (0.042)	-0.724 (0.158)	-0.632 (0.155)	-0.117 (0.043)	-0.734 (0.150)	-0.384 (0.142)
% Black	-0.212 (2.351)	-21.004 (5.1240)	-16.390 (4.546)	0.599 (2.283)	-21.514 (4.949)	-15.734 (4.764)
% Metro	2.904 (1.868)	-4.052 (2.263)	-1.719 (2.223)	3.023 (1.817)	-5.889 (2.136)	-5.274 (2.003)
% Poor	0.351 (0.621)	1.289 (0.834)	2.682 (0.798)	0.086 (0.694)	1.389 (0.794)	1.402 (0.753)
Police per 100,000	-0.022 (0.054)	0.700 (0.133)	0.688 (0.129)	0.013 (0.053)	0.457 (0.130)	0.419 (0.123)
Violent crime	-18.874 (6.456)	67.523 (15.130)	34.876 (13.443)	-6.793 (6.631)	42.635 (15.137)	9.293 (12.918)
Property crime	5.536 (8.033)	-155.239 (21.092)	-150.246 (22.237)	-26.495 (10.613)	-208.952 (22.24)	-169.686 (20.997)
% <15 years	-2,201.51 (385.11)	-1,376.11 (557.50)	-608.68 (506.32)	-692.96 (431.88)	-878.46 (527.31)	1,138.22 (498.58)
% 15 to 17	-5,943.59 (700.75)	-2,827.66 (957.18)	-1,368.36 (876.78)	-3,564.38 (954.61)	-2,141.23 (1,233.73)	1,133.78 (1,271.13)
% 18 to 24	-974.81 (537.93)	-2,746.47 (705.56)	-1,830.00 (609.66)	-1,305.27 (557.68)	-1,198.49 (710.26)	689.42 (630.64)
% 25 to 34	-1,766.21 (415.19)	-1,728.71 (664.45)	-443.65 (583.74)	-2,201.68 (426.73)	-2,047.27 (715.15)	-861.13 (597.25)
% 35 to 44	-1,130.73 (522.01)	-1,663.61 (863.490)	-477.09 (750.60)	-346.28 (625.96)	-5,869.22 (1,028.63)	-4,542.03 (856.76)
% 45 to 54	748.87 (530.19)	-333.62 (852.94)	1,563.85 (805.74)	2,577.74 (570.66)	-2,638.91 (1,021.63)	537.21 (899.84)
% 55 to 64	-2,083.57 (832.66)	-4,920.86 (935.87)	-4,934.40 (830.84)	-748.12 (834.86)	-369.33 (1,084.59)	66.05 (1,084.03)
N	509	555	559	509	555	558

Notes: Standard errors are in parentheses. Observations for these regressions are state-years. Data on state mental hospital populations comes from the Center for Mental Health Services. Data on state prison populations and crime rates come from the Bureau of Justice Statistics. All other state data come from the US Census Bureau. Source: Raphael (2000).

in prison populations. Depending upon the time period and the model, a one-unit decrease in the hospitalization rate is predicted to increase the prison incarceration rate between 0.17 and 0.73.

A simple thought experiment using the regression results in Table 1 can be used to demonstrate the implausibility of the proposition that the de-institutionalization of the mentally ill was the driving force behind the increase in US homelessness observed during the 1980s. Table 2 illustrates the extent of US de-institutionalization between 1980 and 1990. The hospitalization rate declined over this period by 22 in-patients per 100,000 residents. Given the growth in the US population (presented in the second column), this translates into 41,482 fewer mental hospital in-patients by the end of the decade.

Table 2 Change in mental hospitalization rate, US population, in-patient population, and projected in-patient population if hospitalization rate were maintained at 1980 level, 1980–90

	<i>In-patients per 100,000</i>	<i>US population (100,000)</i>	<i>Total in-patient population</i>	<i>In-patient population if rate did not change</i>
1980	58.94	2,265.49	133,550	133,550
1990	36.91	2,493.97	92,058	147,018
Change	-22.03	228.48	-41,482	13,468

To be sure, this figure understates the degree of de-institutionalization, since the declining hospitalization rate occurred during a period of population growth. To account for this, the final column shows what the mental hospital in-patient population would have been, had the hospitalization rate been maintained at the 1980 level. These figures indicate that the mental hospital population would have increased by 13,468. If we add this counterfactual increase to the actual decrease, we arrive at the estimate that 54,960 individuals were effectively de-institutionalized during the 1980s. Thus, the size of the population at risk of becoming homeless as a result of changes in mental health care policy is roughly 55,000 people.

The large inter-institutional substitution effects reported in Table 1, however, suggest that this is a gross over-estimate of the de-institutionalized population at risk of becoming homeless. Table 3 simulates the effects of incarceration upon the size of the population facing the risk of homelessness. Using the regressions for the period 1980–90, and the estimated substitution effects of -0.632 and -0.384 , the table suggests that between 21,000 and 35,000 of the 55,000 mental health patients de-institutionalized during the period were subsequently re-institutionalized in the prison system. This leaves only 20,000–34,000 at risk of homelessness. Given that homelessness increased by well over 100,000 during this period and the fact that a portion of the de-institutionalized are likely to have stable support networks of family and friends, these numbers indicate that de-institutionalization cannot be the driving force behind the observed increases in homelessness.

Table 3 Estimates of the number of mentally ill individuals de-institutionalized during the 1980s who were re-institutionalized in prisons and the numbers not in institutions facing the risk of homelessness (thousands)

	<i>High estimate of substitution effect (-0.632)</i>	<i>Low estimate of substitution effect (-0.384)</i>
De-institutionalized	54,960	54,960
Subsequently incarcerated	34,734	21,104
Facing risk of becoming homeless	20,226	33,856

Thus, we must look elsewhere. O'Flaherty's work (1996) offers a theoretical model of housing markets that, when combined with increasing income inequality, provides insight into the changing incidence of homelessness. New housing construction occurs above a certain quality threshold, and housing units filter down through the quality hierarchy and, in turn, down the rent distribution through depreciation. Below a minimum quality, rents do not justify maintenance costs, leading to abandonment by landlords or conversion of units to other uses. At the bottom of the income distribution, individual consumers must choose between the minimum quality of housing available and homelessness. Holding preferences constant, the richest, rational homeless person is just indifferent between consuming 'abandonment-quality' housing at the market-determined rent, on the one hand, and homelessness at zero rent on the other hand. Homelessness in this model results from decision-making under extreme income constraints and not from a preference for the 'homeless lifestyle.' The Hobson's choice is between consumption of very low quality housing that absorbs a large portion of income, or increased consumption of other necessities with zero housing expenditures. These theoretical arguments are supported by the empirical findings of Honig and Filer (1993) who found strong relationships between measures of housing costs and informed opinion about the incidence of homelessness.

Changes in the distribution of income affect the level of homelessness through the price of abandonment-quality housing. An increase in income inequality around a stable mean (corresponding roughly to the course of incomes during the 1980s in the US) reduces the demand for middle-quality housing and increases the demand for low-quality housing. Households whose incomes have declined reduce their demand for housing, enter the lower quality housing market, and bid up prices at this end of the market. Higher rents for abandonment-quality housing imply a higher cutoff-income level, below which homelessness is preferred to conventional housing.

These arguments can be illustrated with a simple model of housing choice. Assume that individuals maximize a well-behaved utility function, $U(H, C)$, subject to the constraint, $Y = P(H) + C$, where H is the quality of housing consumed, C is a composite consumption good with a unitary price, $P(H)$ is the price of housing of quality H , and Y is income. Homelessness occurs when $H = 0$. The bid-rent function, $B(H, Y)$, gives the price for housing of quality, H , at which an individual is indifferent between homelessness and consuming H , and is defined by the condition

$$U(0, Y) = U(H, Y - B[H, Y]) \quad (1)$$

Define the function, $d(H, Y)$ as the bid rent for housing of quality, H , less the market price of such housing, or $d(H, Y) = B(H, Y) - P(H)$. A person of income Y will be homeless if and only if

$$\max_H d(H, Y) < 0. \quad (2)$$

Figure 2A graphically depicts this decision for two income levels and a linear price function.¹ The function $B(H, Y)$ increases in housing quality at a decreasing rate.² Note that the bid-rent function is defined only over the range where $B(H, Y)$ is less than or equal to income, Y . Note also that $B(H, Y)$ is increasing in Y ; workers with higher incomes will bid more to avoid homelessness.³

The price function for housing, $P(H)$, is determined by demand and supply in the housing market; price increases with housing quality. Tighter markets are represented by higher price schedules. Housing suppliers must abide by minimum standard regulations (for example, regulations requiring that all units must have an indoor toilet), so the market will not offer housing below some quality threshold. The price schedule has a discontinuity at some positive price.

In Figure 2A, households of income Y_1 are indifferent between homelessness and consumption of H^* . These households have income levels that are just high enough to place them in conventional housing. Households of income Y_0 will prefer homelessness to any housing available in the market since they cannot 'afford' housing of any quality offered in the market. In Figure 2B, households of income Y_2 are indifferent between homelessness and consumption of H^* housing at prevailing prices. However, for housing quality levels below H^* and above H_{\min} , by buying housing in the market these households would attain even higher utility levels than at H^* (as is clear from the difference between the amount they are willing to pay to avoid homelessness and the market price).

This simple demand model yields several empirical predictions. For example, the model suggests that a greater disparity between the distributions of housing rents and income (measured, for example, by the ratio of median rents to median income) leads to a higher incidence of

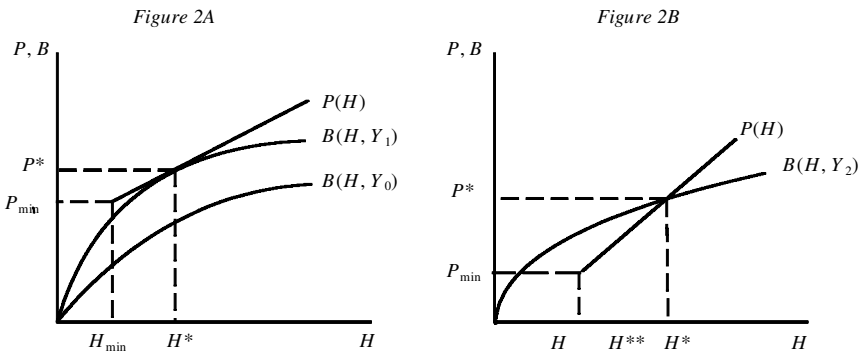


Figure 2 Consumers' bid rent for housing and the market-determined price structure

homelessness. When combined with a model of housing supply, this simple model predicts that, holding constant the distribution of housing costs, the incidence of homelessness will be greater if household income is more unequally distributed.⁴ We next outline several empirical tests that explore these possibilities.

3. EXPLORING THE DETERMINANTS OF HOMELESSNESS

We rely upon four sources of US data in investigating the link between housing market conditions and homelessness. The first two data sources are national in coverage (the US Census and Shelter Counts assembled by Martha Burt) while the other two describe homelessness in California counties (Official Estimates and Administrative records from the State Welfare program).

Table 4 summarizes the various data sources available for analysis. From the US Bureau of the Census, estimates of homeless rates are available for 270 metropolitan areas. Estimates of shelter availability have been gathered for 116 metropolitan areas by researchers at the Urban Institute. Official estimates for fifty-eight California counties are available separately for single individuals and also for families with children. Also for California counties, records are available on the number of households qualifying for 'permanent' assistance (i.e., for assistance in moving into a rented dwelling from temporary quarters) and also for 'temporary' assistance (i.e., short-term assistance in hotels or rooming houses) through the state welfare system. These data are available annually for the period 1989–96 for each of the

Table 4 Summary of data sources on US homelessness

<i>Data source</i>	<i>Homeless rate per 100,000*</i>	<i>Observations</i>
US Census, 1990	11.12 (0.47)	270 metropolitan areas
Shelter counts, 1989	25.54 (1.32)	116 metropolitan areas
Official estimates, 1993	73.69 singles (1.32)	50 California counties
	44.02 families (6.20)	50 California counties
Administrative records, 1989–96	13.98 permanent (0.01)	522 county-years
	17.51 temporary (0.01)	522 county-years

Note. *Standard deviations in parentheses.

Source. See Quigley *et al.* (2001b) and Rosenthal (2000) for detailed descriptions of each source and for commentary on the strengths and limitations of these data.

fifty-eight counties in the state. These data vary substantially in quality and coverage. The data are discussed more fully in Quigley *et al.* (2001b) and Rosenthal (2000).

We stack these four data sets to analyze the determinants of homelessness within a single regression framework. We analyze models relating homelessness to housing market conditions using a logarithmic specification. The logarithmic specification (which relates percentage changes) thus abstracts from the very different averages reported in the data. For each specification, we also include separate dummy intercept variables for five of the six types of data reported in Table 4. We also include dummy variables for each California county and for each year. In this way we control in a quite general way for the fixed effects associated with the source and type of data, the year, and the geographical origin of the estimate.

We test for relationships between homelessness and several variables. We analyze the effects of housing vacancy rates and median rents on homelessness. If homelessness is a housing market problem, one expects a negative effect of vacancy rates and a positive effect of rents upon the incidence of homelessness. We also explore the effects of measures of household or per capita income, and local unemployment rates. To the extent that homelessness is determined by insufficient income or slack labor markets, homelessness should be positively correlated with the unemployment rate and negatively correlated with median incomes.

We also present a specification intended to reflect the mismatch between the distribution of housing prices and the distribution of incomes. We include a regressor measuring the ratio of median rent to median household income. Higher rents relative to income should be positively correlated with the cross-sectional incidence of homelessness.

We include a number of additional covariates in our models. In various models, we control for January temperature, and the incidence of federally provided disability income in each market. Since homelessness is a less attractive option in colder areas, we expect a positive relationship between January temperatures and homelessness. The effect of the disabled population is unclear since a larger recipient population may indicate either a larger population at risk, or a greater effectiveness of local service providers in connecting the potentially homeless to available program support.

Table 5 presents the regression estimates. Column 1 reports the results using only housing market measures as explanatory variables. The results confirm the importance of these measures in explaining variations in rates of homelessness. The vacancy rate is negative, and its coefficient is almost five times its standard error. Similarly the effect of rents upon homelessness is large and statistically quite important. Holding other things constant, a 10 per cent increase in rents is associated with a 6.5 per cent increase in the incidence of homelessness.

Column 2 adds three control variables to the analysis. Metropolitan areas

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Table 5 Logarithmic regressions of homeless rates on measure of housing availability, rent-to-income ratios, and metropolitan area (and county) variables

	(1)	(2)	(3)	(4)
Rental vacancy rate (per cent)	-0.312 (0.051)	-0.392 (0.058)	-0.601 (0.052)	-0.668 (0.057)
Rents ^a (dollars)	1.464 (0.089)	1.361 (0.108)	-	-
Rent/income	-	-	0.776 (0.160)	0.352 (0.201)
January temperature (degrees Fahrenheit)	-	0.106 (0.051)	-	0.401 (0.052)
Unemployment rate (per cent)	-	-0.131 (0.094)	-	-0.304 (0.098)
Disability pension recipients (per 10,000)	-	-0.184 (0.065)	-	-0.194 (0.072)
R ²	0.975	0.976	0.969	0.973
N	1,404	1,396	1,404	1,396

Notes. Standard errors are in parentheses. The data combine the four homelessness data sets described in Table 4. Fixed effects for each data set as well as fixed effects for county and year (for the California data sets) are included in each regression.

(a) Rents are measured by either median gross rents for the metropolitan area or Fair Market Rents as determined by the Department of Housing and Urban Development.

or counties with milder winters experience higher levels of homelessness. There is little evidence that homelessness varies with the local unemployment rate or the incidence of those receiving disability pensions. Importantly, the magnitude and significance of the housing market variables is unchanged when these additional control are used.

Column 3 reports a different specification of housing market conditions. In this specification, we include rental vacancy rates and the ratio of median rents to median incomes as explanatory variables. In this specification the rental vacancy rate is much larger, and its *t*-ratio is about ten. A 10 per cent increase in vacancy rates (from 6.7 per cent, on average, to 8.4 per cent) is associated with a 6 per cent reduction in rates of homelessness. The rent-to-income variable is highly significant, indicating quite clearly that in housing markets where rents are high, relative to ability to pay, the incidence of homelessness is higher.

Column 4 adds the other controls to the analysis. The qualitative nature of the results is unchanged (but the magnitude of the rent-to-income variable is reduced substantially).

4. INTERPRETATION AND CONCLUSION

The results presented in Table 5 exhibit several consistent patterns. Tighter housing markets are positively associated with higher levels of homelessness. In each of the models estimated, the rental vacancy rate exerts a

negative and statistically significant effect on homelessness, while measures of housing costs such as median rents and rent-to-income ratios exert positive and significant effects. We find a consistent negative effect of weather conditions on the incidence of homelessness: colder weather is clearly associated with lower rates. These findings support models of homelessness that emphasize rational choice among the extremely poor.

The quantitative analysis suggests that relatively small changes in housing market conditions can have substantial effects upon rates of homelessness. Consider, for example, a reduction in the rate of homelessness by one-fourth. The quantitative results suggest that this could be achieved in these housing markets by a 1 percentage point increase in the vacancy rate (from an average of 8.4 per cent) combined with a decrease in average monthly median rent-to-income ratios from 17.5 to 16.8 per cent. Given the nature of the underlying data, the accuracy of these precise estimates is open to question. Nevertheless, the calculations suggest that modest changes in housing market conditions can have substantial effects upon the incidence of homelessness.

These consistent statistical results and simulations contrast with the conventional wisdom regarding the causes of homelessness. In particular, the results suggest that a simple economic model of the tough choices faced by households and individuals in the extreme lower tail of the income distribution goes a long way towards explaining the problem. Most importantly, our findings suggest that homelessness may be combated by modest supply policies combined with housing assistance directed to those for whom housing costs consume a large share of their low incomes. Homelessness can be reduced by attention to the better functioning of housing markets.

*John M. Quigley and Steven Raphael,
University of California, Berkeley, CA, USA
e-mails: quigley@econ.berkeley.edu; raphael@socrates.berkeley.edu*

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NOTES

¹ In general, the housing price function need not be linear, and homelessness depends solely on the maximum of $d(H, Y)$. For simplicity, however, we depict linear price functions in Figures 2A and 2B.

² Equation (1) implies $0 = U_H - U_C B_H$ or $B_H = U_H / U_C$. The RHS is the absolute value of the marginal rate of substitution. With diminishing marginal utility, B increases in H at a decreasing rate.

³ To see this, differentiate (1) with respect to Y , yielding $U_{C|C=Y} = U_{C|C<Y} (1 - B_Y)$

or $B_Y = 1 - (U_{ClC=Y}) / (U_{ClC<Y})$. With diminishing marginal utility, $U_{ClC=Y} < U_{ClC<Y}$ and B_Y is always positive.

⁴ This result depends upon a filtering model of housing supply in which high quality housing is built and low quality housing is produced by depreciation and maintenance policies (called 'cheap construction' by O'Flaherty 1996). See Mansur *et al.* (2000) for a more complete discussion.

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