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HEADSHIP RATES AND LONG-TERM HOUSING FORECASTS: SOME REGIONAL EVIDENCE

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INTRODUCTION

The demographic approach to long-term forecasts of housing units posits that over the long run the number of households equals the number of housing units. This simple approach has been widely adopted without much attention to its theoretical underpinnings or to the empirical assumptions necessary for its forecasting accuracy. Numerous forecasters in trade publications (Goodkin, 1987; Kennedy, 1994; Peach, 1990; Wilson, 1992) as well as in scholarly journals (Crone and Mill, 1991; Mill, 1991; Myers, 1987; Plattner, 1990; Smith, 1984) have used population demographics[1] to forecast long-run housing units. These forecasters largely have ignored theoretical issues and simply have employed the model as a forecasting device. The idea that every household needs a unit in which to live and, therefore, that the number of households equals the number of housing units seems logical.

Nonetheless, evidence occasionally has surfaced that suggests weaknesses in this paradigm. Crone and Mill (1991), using quarterly data from 1965 to 1989, conclude that the housing stock and various measures of the adult population are not cointegrated,[2] although they

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[1] *Demographic* is used in two different senses in the housing literature. First, demographic characteristics such as race, age, marital status, etc. play a role in tenure choice and the quantity of housing services demanded by households. [See Goodman (1990) and Ekanem (1990).] The term also refers to the relationship between changes in the population and changes in the demand for housing units regardless of their quality, size, etc. It is this second sense of the word demographic that is discussed throughout this paper.

[2] To some extent, this may result from the small size of their sample and the nature of the population data they use. Timmerman (1995) shows that even where two series by construction are cointegrated there is a

find some support for a long-run relationship between owner-occupied housing and population. But when Mankiw and Weil (1989) employed a demographically driven housing price model to predict that real housing prices would fall 47 percent over the next 20 years, the debate about the role of demographics intensified dramatically. Mankiw and Weil argue that if the baby boom generation caused housing prices to rise in the 1970s, as their empirical results suggest, then the baby bust generation will cause the opposite to happen in the 1990s and thereafter. Hamilton (1991), Holland (1991), Hendershott (1991), and Woodward (1991) reject the Mankiw and Weil forecasts. They conclude that in addition to various econometric shortcomings,[3] the Mankiw and Weil model ignores such nondemographic factors as real interest rates, permanent income, and the long-run price elasticity of housing. Including these other variables significantly reduces the importance of demographic factors and essentially negates the Mankiw and Weil prediction.

Demographic housing forecasters have ignored the above debate. Their interest centers on forecasts of housing units and not value *per se*. These forecasters contend that changes in the number of housing units mirror changes in the adult age population. Smith (1984) takes exception to that view, suggesting that in Canada housing demand depends not only on the size and age composition of the population, but on its proclivity to form housing demand units. Smith shows that in Canada the crucial variable, household formation rates, is not constant and differs both with respect to time and various household types. Smith also finds empirical support for the proposition that economic variables influence household formation rates. Smith's findings challenge the validity of the basic assumption made by Crone and Mill (1991) and Mill (1991) that a relatively stable, proportional relationship exists between the adult population and the number of households. If headship rates are unstable (as Smith's findings imply), then population changes are insufficient to guarantee accurate long-term housing unit forecasts.

This paper empirically investigates the stability of the headship rate across the 50 states and the District of Columbia from 1960 to 1990. Forecasts conditioned on population changes provide information showing the degree to which instability in headship rates increases

high probability of falsely accepting the hypothesis of no cointegration, particularly where the driving variable (in this case population) has a great deal of persistence from one period to the next. It is hard to imagine that quarterly population data would not be highly persistent (correlated) from one quarter to the next.

[3] Critics of the Mankiw and Weil forecasts point out that their error term is serially correlated, that they rely heavily on a trend variable for their forecasts, and that the time series used in their regressions is nonstationary and should be first differenced to achieve stationarity.

forecasting errors. These forecasts attempt to determine whether the instability of headship rates over time is significant enough to invalidate the demographic approach. Results imply that one decade ahead forecasts, in most instances, are not compromised severely by instability in headship rates. Over two or three decades headship rates exhibit more volatility, more change, and become more problematic to forecasting accuracy.

THEORETICAL BASIS FOR A DEMOGRAPHICALLY DRIVEN HOUSING MODEL

An argument theoretically can be made that long-run changes in the housing stock depend solely on changes in population. To demonstrate the conditions necessary for this outcome, consider the following general market model.

(1) $D = D(P, N, Z)$

(2) $S = S(P, W)$

where:

- D = Quantity demanded of housing per time period;
- S = Quantity supplied of housing per time periods;[4]
- P = Price;
- N = Population;
- Z = Nonpopulation exogenous demand variables such as income, real interest rates, etc.; and
- W = Exogenous supply shift factors such as lumber costs, construction labor wages, technology, etc.

If the conditions necessary for the implicit function theorem hold,[5] then the equilibrium quantity of housing is given as

(3) $\bar{Q} = Q(N, Z, W)$

[4] The demographic housing model implicitly defines quantity demanded and supplied in physical housing units regardless of their size, quality, or other amenities. This definition corresponds to the Department of Commerce's concept of housing starts.

[5] These conditions simply require that the sum of the slopes of the demand and supply curves is nonzero (i.e., a nonzero Jacobean determinant) and that, in the vicinity of equilibrium, demand and supply are continuous functions of the exogenous variables in the system. [See Chiang (1984), pp. 205-211.]

and changes in $\bar{Q}$ as:

$$(4)\ d\bar{Q} = \frac{S_P(D_N\,dN + \Sigma D_i dZ_i) + D_P(\Sigma S_i dw_i)}{S_P - D_P}$$

where:

D_p and S_p = The partial derivatives of the demand and supply curves with respect to price;

D_N and D_i = The partial derivatives of demand with respect to N and Z_i; and

S_i = The partial derivative of the supply with respect to W_i.

Holding constant exogenous supply effects (i.e., $dW_i = 0$), equation (4) becomes

$$(5)\ d\bar{Q} = \frac{S_P}{S_P - D_P}\,(D_N\,dN + \Sigma D_i dZ_i).$$

The extent to which $\Sigma D_i dZ_i$ influences $\bar{Q}$ depends largely on how $\bar{Q}$ is defined. If $\bar{Q}$ is defined in terms of units of housing services which, in turn, depend on characteristics such as size, quality, age, location, etc., then $\bar{Q}$ becomes a function of such variables as permanent income and real interest rates, and equation (5) holds. Alternatively, if $\bar{Q}$ is measured as simple physical units regardless of their characteristics, then as Crone and Mill (1991) write "the number of units is more likely related to a simple population variable," and the equation for $\bar{Q}$ reduces to

$$(6)\ d\bar{Q} = \frac{S_P}{S_P - D_P}\,(D_N\,dN)\,.$$

The presence of the term

$$\frac{S_P}{S_P - D_P}$$

in equation (6) indicates that, at least in the short run, the link between changes in population and changes in housing units depends, in part, on the sensitivity of supply and demand to changes in price. Given that $D_p < 0$, the impact on $\bar{Q}$ of changes in N in the short run would be muted by these price responses, perhaps significantly so if S_p were small. Crone and Mill (1991, p. 14) find that little of the quarter-to-quarter growth in the housing stock is explained by changes in population.

In the long run, the term

$$\frac{S_P}{S_P - D_P}$$

may be close to one, thereby allowing a much closer correspondence between $\bar{Q}$ and N. Evidence presented by Muth (1983) and used by Woodward (1991) and Hendershott (1991) in their critique of the Mankiw-Weil forecast implies that in the long-run S_p is large so that conceivably

$$\frac{S_P}{S_P - D_P} \rightarrow 1 \text{ and}$$

$$(7)\ d\bar{Q} = \frac{S_P}{S_P - D_P}(D_N dN) \rightarrow D_N dn$$

or alternatively

$$(8)\ \bar{Q}_t = \beta_t N_t$$

where $\beta_t = D_N$. Equation (8) represents the basic equation of the demographic approach. It suggests a proportional relationship between $\bar{Q}$ and N, with the factor of proportionality β_t. The parameter, β_t, has been termed the *headship rate* and is estimated empirically from the equation

$$(9)\ \beta_t = \frac{HH_t}{N_t}$$

where:

HH_t = The number of households at time t; and
N_t = The adult age population.[6]

The validity of the demographic forecasting approach rests on the stability of β_t because, as seen in equation (10), changes in $\bar{Q}$ depend on both changes in N and changes in β_t:

$$(10)\ \ \Delta\bar{Q}_{t,t+1} = \beta_t \Delta N_{t,t+1} + N_t \Delta\beta_{t,t+1} + \Delta\beta_{t,t+1}\, \Delta N_{t,t+1}$$

$$\Delta\bar{Q}_{t,t+1} = \beta_t \Delta N_{t,t+1} + N_{t,t+1} \Delta\beta_{t,t+1}.$$

Proponents of the demographic approach ignore the term $N_{t+1}\Delta\beta_{t,t+1}$ in equation (10) by assuming that headship rates are relatively stable. Large values of $\Delta\beta_t$ violate this assumption and potentially generate

[6] The inverse of the headship rate is the number of adults per household. Low (high) headship rates signify more (fewer) adults per household.

large forecasting errors. Hence, the stability of β_t determines the validity of the demographic approach.

THE STABILITY OF HEADSHIP RATES

No clear consensus emerges from the literature on the stability of headship rates (i.e., the size of $\Delta\beta_t$). Mills (1991) and Crone and Mills (1991) argue that headship rates are relatively stable, at least since 1973. As Mills writes: " ... the HPA [the headship rate adjusted for vacancies] has varied only slightly since 1973, ranging from a high of 0.562 in 1980 to a low of 0.550 in 1987." Myers (1987) assumes that headship rates vary across demographic groups but remain constant over time. But for other analysts, changes in household formation rates, and hence headship rates, critically influence future housing market dynamics, possibly even more than do population trends. *American Demographics* (1987, p. 6) notes that an important impact on the housing market stems from the fact that the number of elderly who live alone should grow and that households headed by persons age 75 and over should increase faster than those headed by individuals 65 to 74 years of age. In addition, Kennedy (1994) concludes that "for contractors household [formation] trends may be more important than population trends in determination of growth potential." Finally, an article in *Building, Design, and Construction* (1994) speculates that weakening long-run housing demand could be offset in part by changes in immigration and cohabitation patterns, where the latter depend on economic growth.

Smith (1984) presents the most compelling evidence of the instability of headship rates. He writes:

> ... economists have been concerned with the relationship between housing market activity, postwar population growth, and the aging of the baby-boom generation. On the other hand, they have devoted little attention to an equally important demographic phenomenon—the growth in and changing composition of Canadian age-specific headship rates ... An appreciation of this phenomenon, however, is critical for a full understanding of demographic impacts upon the housing market since household formation, and thus housing demand, depend not only upon the size and age composition of the population but upon its proclivity to form itself into housing demand units. This proclivity may in turn depend upon such economic variables as the affordability and availability of housing (p. 180).

Not only does Smith show in the case of Canada that headship rates for different types of households (e.g., single, unrelated individuals, married, divorced, elderly, etc.) have changed considerably over time, but he also presents empirical evidence indicating that variables such as divorce rates and housing affordability play some role.

How applicable are Smith's findings for the United States? The nation as a whole has experienced relatively stable headship rates since the mid to late 1970s, so Smith's results may be irrelevant. National data hide wide state-to-state differences, however. Figures 1 through 3 allow comparisons of headship rates across states and over time.[7] Those figures reveal that forecasts for individual states based on national data would lead to large errors, as some states are significantly above the average and others significantly below it. Regardless of time period, states such as Hawaii and New Hampshire tend to have relatively lower headship rates (implying larger numbers of adults per household) in comparison to states such as Colorado, Nevada, Oklahoma, Oregon, and Wyoming that have relatively higher headship rates. Figures 1 through 3 also reveal that some states have experienced dramatic shifts in the headship rate over time, particularly over the 1960 to 1990 period. Alaska, for example, had one of the lowest headship rates in both 1960 and 1970 but by 1980 had a rate typical of most other states. California, in contrast, had a rate in 1970 similar to many other states but by 1990 had a headship rate well below the average. Yet the data in Figures 1 through 3 indicate that most across state differences persist for the 30 year period. States with relatively low (high) headship rates in 1960 exhibit relatively low (high) headship rates in 1990. Spearman rank correlations computed for the data in Figures 1 through 3 indicate sizable rank correlations of 0.85 between 1980 and 1990 headship rates; 0.71 between 1970 and 1990 headship rates; and 0.71 between 1960 and 1990 headship rates. These correlations imply a reasonable amount of stability over time. In addition, the regression of headship rates for individual states (i.e., the data used to construct Figures 1 through 3) against a constant and a trend variable[8] indicates that 41 of the 51 regression coefficients on the trend variable are statistically significant at the 95 percent confidence level or better, with the mean value for all 51 regression coefficients

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[7] Data used to generate Figures 1 through 3 represent households and population collected from the decennial censuses for the years 1960, 1970, 1980, and 1990. Headship rates are calculated for each decade and for each state and the District of Columbia.

[8] Smith (1984) uses time series data to examine the relationship between headship rates and economic variables in Canada. Such a time series analysis is precluded in this study by the fact that headship rates are only available for individual states at the decennial censuses. To obtain information on the stability of headship rates for individual states, 51 regressions of the form

$$H_{it} = \hat{\beta}_0 + \hat{\beta}_1 \, TIME_t + e_t$$

are run where H_{it} is the headship rate of the ith state at time period t, t = 1960, 1970, 1980, 1990, TIME = 1 for 1960, 2 for 1970, 3 for 1980, and 4 for 1990. When necessary, regressions are corrected for serial correlation.

Figure 1—Headship Rates by State 1960 and 1990

	ST
1	AL
2	AK
3	AZ
4	AR
5	CA
6	CO
7	CT
8	DE
9	DC
10	FL
11	GA
12	HI
13	ID
14	IL
15	IN
16	IA
17	KS
18	KY
19	LA
20	ME
21	MD
22	MA
23	MI
24	MN
25	MI
26	MO
27	MT
28	NE
29	NV
30	NH
31	NJ
32	NM
33	NY
34	NC
35	ND
36	OH
37	OK
38	OR
39	PA
40	RI
41	SC
42	SD
43	TN
44	TX
45	UT
46	VT
47	VA
48	WA
49	WI
50	WV
51	WY

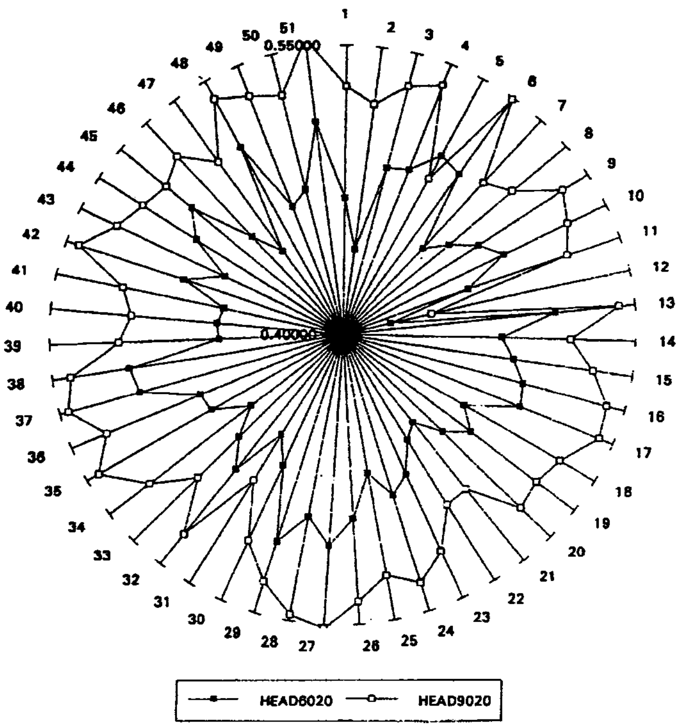


Figure 2—Headship Rates by State 1970 and 1990

	ST
1	AL
2	AK
3	AZ
4	AR
5	CA
6	CO
7	CT
8	DE
9	DC
10	FL
11	GA
12	HI
13	ID
14	IL
15	IN
16	IA
17	KS
18	KY
19	LA
20	ME
21	MD
22	MA
23	MI
24	MN
25	MI
26	MO
27	MT
28	NE
29	NV
30	NH
31	NJ
32	NM
33	NY
34	NC
35	ND
36	OH
37	OK
38	OR
39	PA
40	RI
41	SC
42	SD
43	TN
44	TX
45	UT
46	VT
47	VI
48	WA
49	WI
50	WV
51	WY

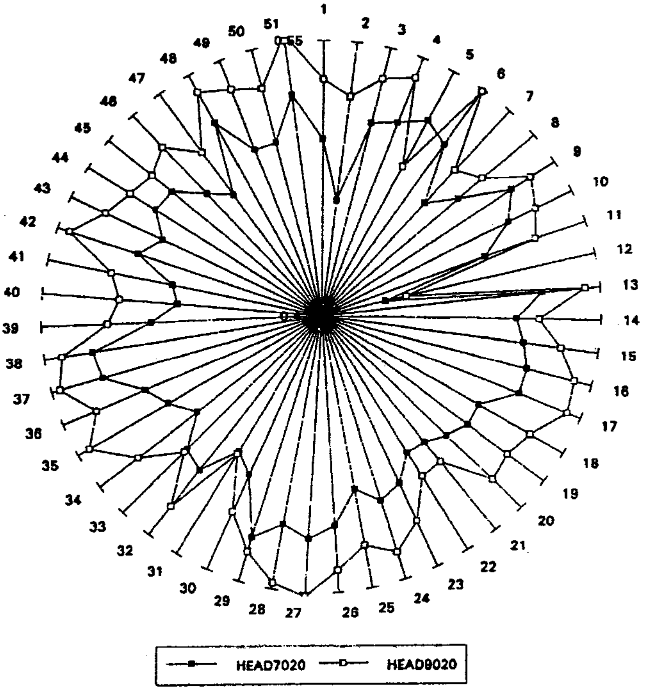
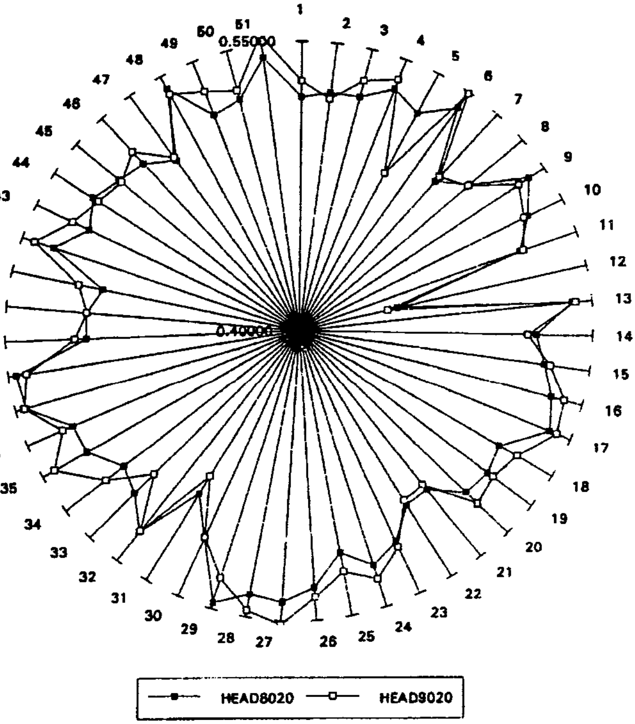


Figure 3—Headship Rates by State 1980 and 1990

	ST
1	AL
2	AK
3	AZ
4	AR
5	CA
6	CO
7	CT
8	DE
9	DC
10	FL
11	GA
12	HI
13	ID
14	IL
15	IN
16	IA
17	KS
18	KY
19	LA
20	ME
21	MD
22	MA
23	MI
24	MN
25	MI
26	MO
27	MT
28	NE
29	NV
30	NH
31	NJ
32	NM
33	NY
34	NC
35	ND
36	OH
37	OK
38	OR
39	PA
40	RI
41	SC
42	SD
43	TN
44	TX
45	UT
46	VT
47	VI
48	WA
49	WI
50	WV
51	WY



0.0154 which indicates headship rates were increasing at about 0.3 percent per year.[9]

Some analysts have argued that economic growth plays a major role in cohabitation and headship rates, perhaps playing its role through housing affordability, female labor force participation rates, divorce rates, medical care for the elderly, and the like. Given the small number of observations available for each state based on decennial censuses, it is not statistically possible to test these hypotheses. Nonetheless, investigation of the individual regression coefficients lends some support to this position. States with the greatest increases in headship rates (near 0.02 or higher per decade) have experienced significant economic development since 1960. Many of these are southern states that have industrialized during the 1970s and 1980s such as Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, Virginia, or other newly industrialized states such as North Dakota and South Dakota.[10] But in a few instances, factors other than economic growth appear to have played some part. States with the smallest changes in headship rates since 1960 such as California, District of Columbia, Hawaii, Illinois, New York, and Utah tend to possess ethnic, racial, or religious characteristics associated with relatively large households and/or extended families. States such as California, Texas, and Illinois also have experienced relatively large inflows of immigrants, mostly Hispanics who, on the average, have relatively larger households.[11]

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[9]To test the accuracy of the figure 0.0154, this figure is multiplied by three and then added to the 1960 average headship rate of 0.481 to obtain a prediction of the rate in 1990. This prediction is within 0.001 of the actual 1990 average rate by 0.526.

[10] Industrialization is measured by the percentage growth in manufacturing employment from 1960 to 1990. For the entire United States manufacturing employment grew 12.7 percent between 1960 and 1990. The following are the growth rates for 1960 to 1990 for the states experiencing the greatest increases in headship rates: Alabama 61.3 percent; Georgia 66.4 percent; Kentucky 61.3 percent; Mississippi 102.2 percent; North Carolina 75.2 percent; Tennessee 69.5 percent; Virginia 57.4 percent; North Dakota 174.2 percent; and South Dakota 152.7 percent (Source: University of Maryland Inforum database).

[11] Ethnic differences affect the headship rate because the number of persons per household tends to be higher for nonwhite households. For example, in 1988 there were 2.64 persons per households for all U.S. households. For Hispanic, black, and Hawaiian households the comparable numbers are 3.4, 3.2, and 2.87, respectively. In addition, only 1.4 percent of white households have seven or more persons, while 4.4 percent of black households and 5.2 percent of Hispanic households have seven or more persons. Furthermore, 42.7 percent of white households have two persons, while only 33.4 percent of black households and 25.5 percent of Hispanic households have two persons (*Statistical Abstract of the United States: 1990*, Tables 65 and 66).

HEADSHIP RATES AND HOUSING STOCK FORECASTS

The evidence that headship rates have changed over time is not necessarily a condemnation of the demographic forecasting method. Even if such changes were ignored, they may not significantly worsen the housing stock forecasts. To test for the importance of instability in headship rates, forecasts are generated with and without changes in headship rates from equations 11(a) and 11(b)

$$(11a)\ Q_{t+1} = Q_t + \beta_t^* \Delta N_{t,t+1}$$

$$(11b)\ Q_{t+1} = Q_t + \beta_t^* \Delta N_{t,t+1} + N_{t+1} \Delta \beta_{t,t+1}^*$$

where:

β_t^* = The headship rate adjusted for vacancies.[12]

Data required to make each forecast are β_t^* in t and t + 1, the adult age population at t, changes in the adult age population over the forecast interval, the initial housing stock, and (because β_t^* depends on the vacancy rate) vacancy rates in t and t + 1.[13] To test for the importance

[12] The adjustment for vacancies is necessary because the theoretical model that generates equations (9) and (10) assumes housing market equilibrium. Rewriting equation (9) as

$$Q_t = \beta_t N_t + v_t$$

where:

v_t = The number of vacant units,

and defining

$$v_t = \gamma_t Q_t,$$

where:

γ_t = The vacancy rate,

then

$$Q_t = \beta_t^* N_t$$

where:

$$\beta_t^* = \frac{\beta_t}{1 - \gamma \beta_t^*} .$$

[13] Although short-run vacancy rates are a function of short-run demand and supply conditions and represent disequilibrium in the housing mar-

of $\Delta\beta^*_{t+1}$, actual values of all of the variables and parameters are used in the forecasts discussed below. In practice only β^*_t, N_t, and Q_t would be known with certainty, however.[14]

Twelve forecasts are made for each state and the District of Columbia covering various intervals from 1960 to 1990, as well as two measures of the adult population. Table 1 contains the mean absolute percentage forecasting errors (MAPEs) with and without the change in headship rates. Including the change in headship rates reduces the error to virtually zero for every state, a vindication in one respect of the demographic approach. Equation (11b) is the end result of a housing market model developed under various assumptions about the role of nonpopulation exogenous demand and supply shift factors and the long-run price elasticity of supply. If those assumptions were grossly violated, the model presumably would generate large forecasting errors. That equation 11(b) predicts so accurately lends some support to the underlying validity of the demographic approach and suggests that nonpopulation exogenous variables have little, if any, impact on the long-run number of housing units.

Forecasting errors arise from equation 11(a) which assumes headship rates are constant. Table 1 contains these errors, and Figures 4 and 5 show them graphically. These errors are calculated from the formula:

$$\text{(12) MAPE} = \frac{\dfrac{\Sigma|HS_{i,t+1} - \hat{HS}_{i,t+1}|}{HS_{t+1}}}{51} \times 100$$

where:

i = The ith state.

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ket, long-run changes in the vacancy rate, such as those from decade to decade, are assumed to represent changes in the percentage of housing units being used as vacation or second homes. If over the long run the vacancy rate increases because of more second and year-round vacation homes, then more total housing units will correspond to any given number of adults in the population. Nevertheless, whether the housing stock in any particular state increases or decreases over time will depend largely on whether $\Delta N_{t,t+1}$ is negative or positive.

[14] The rationale for using actual values of the exogenous variable rests on an attempt to determine the accuracy of the demographic model without the confounding errors that may arise from incorrect forecasts of the exogenous variable. Obviously, the total forecasting error would be dependent also on the accuracy of the prediction of the exogenous population variable.

Table 1—Mean Absolute Percentage Forecast Errors, 50 States and the District of Columbia

Forecast Interval	Population Age Group	$\Delta\beta_t^* = 0$	$\Delta\beta_t^* \neq 0$
80-90	20	4.6	0.1
80-90	25	2.6	0.1
70-90	20	9.1	0.02
70-90	25	6.3	0.02
60-90	20	15.6	0.02
60-90	25	15.8	0.02
70-80	20	5.1	0.15
70-80	25	6.0	0.15
60-70	20	7.4	0.02
60-70	25	10.5	0.02
60-80	20	12.11	0.15
60-80	25	15.8	0.15

1. The values found in columns 3 and 4 are determined by using equations 11(a) and 11(b) in the text to forecast the housing stock for each state in period t + 1. These forecasts provide information on the absolute percentage error for each state and the mean absolute percentage error over the 50 states and the District of Columbia

2. Forecasts based on $\Delta\beta_t^* = 0$ assume that headship rates are constant between t and t + 1

3. Forecasts are generated for two measures of the adult age population: 20 years of age and older and 25 years of age and older

For one decade ahead forecasts MAPEs range from about 3 percent to around 10 percent, depending on the decade and the measure of adult population used. Forecasts two or three decades out have much larger MAPEs, about 16 percent for a 30 year forecast. These forecasting errors roughly mirror what is found in Figures 1 through 3. Comparison of headship rates between 1980 and 1990, for instance, reveals that regardless of state, headship rates have not changed dramatically. In contrast, comparisons of headship rates between 1960 and 1990 show much larger differences. A rough rule of thumb seems to be that MAPEs increase about five percentage points for each decade increase in the forecast interval. No rough rule of thumb applies to which population measure leads to the most accurate forecast, however. Mill (1991) and Crone and Mill (1991) argue for the 25 year and older population as the best predictor. This appears valid in more recent years. But in earlier

Figure 4—MAPE by Length of Forecast Population > 20

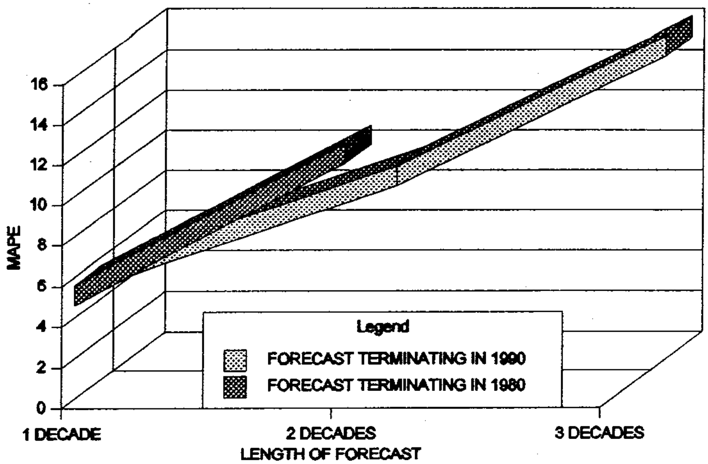
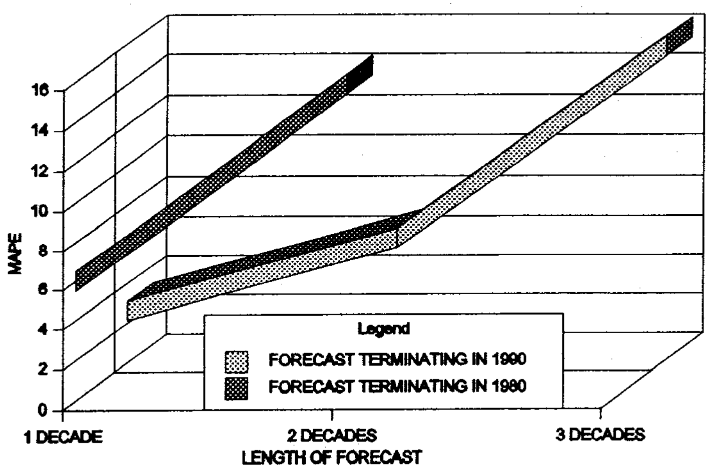


Figure 5—MAPE by Length of Forecast Population > 25



periods use of the 20 and over population measures provides the most accurate forecasts.

To further investigate the nature of the errors, MAPEs are calculated for the states with the ten largest errors. As shown in Table 2 these big error states have MAPEs of about 10 percent for a one decade forecast, 15 percent for a two decade forecast, and 20 percent for a three decade forecast. In extreme cases the model results in errors as high as 17 percent, 22 percent, and 30 percent for the one, two, and three decades forecast, respectively. Errors are about twice as large for these states as the overall average for the one decade forecast; nonetheless, they appear to follow the rule of thumb that an increase in the forecast interval of one decade adds about five percentage points to the forecasting error.

Many of the same states appear over and over again in Table 2 as having the largest errors. Alaska, Arizona, Maine, New Hampshire, North Dakota, South Dakota, and Wyoming emerge, for example, six or more times. All of these states have one thing in common: an exceptionally large change over time in the adjusted headship rate. No single pattern surfaces that accounts for this, however. In the cases of North Dakota and South Dakota the increases are mostly due to above average increases in the headship rate. Alaska, Maine, and Vermont, on the other hand, have both above average increases in headship rates and above average increases in vacancy rates. Arizona, New Hampshire, and Wyoming have average increases in headship rates but far above average increases in vacancy rates. As noted above, combinations of ethnic and economic changes probably account for abnormal increases in headship rates. Above normal vacancy rates may signal housing market disequilibrium but also may signal increases in year round unrented second homes.

CONCLUDING DISCUSSION

The demographic approach to forecasting long-term housing units has gained wide popularity and has become the dominant forecasting tool for those in housing-related industries. Two factors account for this. The model is parsimonious with only one parameter, the adjusted headship rate, and one driving variable, changes in the adult population. Moreover, in contrast to more complex forecasting systems, the model tells a simple and easy to understand story—each household must have a unit in which to live, so changes in households must equal changes in units. This paper addresses three questions related to this model. First, is there a theoretical basis for this seemingly *ad hoc* forecasting approach? Second, is the key parameter, the vacancy-adjusted headship rate, stable at the level of the individual state? Third, to the extent instability exists in this key parameter, can it be ignored without serious loss of forecasting accuracy?

Table 2—Mean Absolute Percentage Forecast Errors, Ten States With Largest Errors

Forecast Interval	Age Group	States	$\Delta\beta_t^* = 0$	Range
80-90	20	VT, ME, NH, WY, AZ, MT, WV, MN, WI, ND	9.8	6.6-15.8
80-90	25	VT, ME, HI, CA, NH, NV, OR, AZ, WA	7.9	3.9-12.6
70-90	20	AK, VT, ME, AZ, WY, NH, SD, CO, ND, DE	14.8	12.3-19.0
70-90	25	VT, ME, AZ, NH, WY, SD, DE, ND, AK, FL	11.5	8.9-15.4
60-90	20	VT, AK, ME, NH, ND, WY, AZ, NC, WV, SD	22.3	18.5-28.5
60-90	25	VT, ME, NH, NE, AD, DE, WY, AZ, WI, NC	21.8	18.5-29.9
70-80	20	AK, SD, HI, FL, RI, DE, AZ, NV, DO, NC	8.5	6.9-13.5
70-80	25	SD, AK, ND, DE, WY, CO, FL, AZ, HI, ID	9.0	7.6-12.3
60-70	20	VT, ME, MS, AK, NH, ND, DC, NM, AR, WV	10.4	9.2-12.9
60-70	25	VT, DC, ME, NH, AD, ND, MS, VA, AR, MO	13.4	11.7-16.8
60-80	20	AK, DC, ND, SD, VT, NC, HI, MS, NM, DE	15.6	13.9-22.4
60-80	25	AK, ND, SD, VT, DC, DE, MS, WY, NC, NE	18.8	16.9-21.7

1. The values found in the last two columns are determined by using equations 11(a) and 11(b) in the text to forecast the housing stock for each state in period t + 1. These forecasts provide information on the absolute percentage error for each state and the mean absolute percentage error over the 50 states and the District of Columbia

2. Forecasts based on $\Delta\beta_t^* = 0$ assume that headship rates are constant between t and t + 1

3. Forecasts are generated for two measures of the adult age population: 20 years of age and older and 25 years of age and older

The results suggest a qualified yes to the first question and answers to the second and third questions dependent on the length of forecast. Starting from a fairly general market model, the basic demographic forecasting equation can be derived under reasonable assumptions. The result depends on two factors. First, units must be defined without any attention to their characteristics. Those using this approach accept this condition. And second, the headship rate, which links changes in population to changes in housing units, must remain relatively constant. Significant changes in headship rates force nondemographic variables to reenter the forecasting equation through their impacts on household formation rates. Nationally, headship rates have been fairly constant since the early 1970s, but the evidence for their stability weakens somewhat for individual states. At any point in time wide state-to-state differences in headship rates exist, but these differences persist for long time periods. Some exceptions exist, but most states have not experienced drastic changes in their headship rate within the period of one decade. Thus, one decade ahead forecasts, in most instances, are not severely compromised by ignoring the change in the adjusted headship rate. Over two or three decades headship rates exhibit more volatility and more change. Ignoring these changes in two and three decade ahead forecasts becomes more problematic and, in some cases, leads to relatively large forecasting errors.

Future work on this topic could concentrate on two main areas. First, most of the work on the forecasting ability of the demographic housing model has been done at the national, regional, or state level. Thus, a test of this same model for specific housing markets, such as for standard metropolitan areas, is a reasonable next step. Second, and perhaps in conjunction with this microlevel of analysis, a more detailed examination could be undertaken to uncover the long-run determinants of the headship rate, particularly over long periods of time such as two or three decades. Time series on headship rates for states or cities do not exist. Pooled cross-sectional and time series data based on decennial censuses may allow, nonetheless, some statistical analyses. Ideally, such analyses would focus on the possibility of improving long-run housing market forecasts using a two step procedure that first forecasts headship rates as a function of such variables as rates of economic development, divorce rates, female labor force participation rates, housing cost, immigration, etc. and then combines these forecasted rates with changes in population.

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