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# The Baby Boom, "Pent-Up" Demand, and Future House Prices*

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Real house prices are forecast to rise over the next two decades by about the same amount they rose over the past two decades. The longer-run positive trends in real incomes and population size and the advance of the baby boom into ages of greater effective demand for houses are forecast to raise real house prices 10%. Simulation indicates that the demand for houses, and thus the prices of houses, may *fall* when baby boomers reach adulthood, because the effects of the larger population may be more than offset by the effects of the lower individual real incomes of young workers. As boomers age, their changing preferences and rising incomes raise simulated house prices above their initial levels. Simulated house prices remain above their initial levels until the baby boom generation has died off. 

## I. INTRODUCTION

It has long been thought that the unusually large cohort of individuals born between 1946 and 1964, commonly referred to as the "baby boom" generation, would have a substantial impact on the demand for houses

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(Russell, 1982; Wascher *et al.*, 1986). The maturation of baby boomers to typical homebuying age was expected to raise the demand for houses, and therefore either the stock or the price of houses (or more likely, both). Recently, some observers have suggested that the demand for houses may decline relative to its recent trend (primarily because of slowing growth of the population entering housing markets) and that the slower growth of demand may cause real house prices to decline substantially over the next two decades (Mankiw and Weil, 1989).

We offer a different perspective on how baby boomers—as they enter adulthood and continue to age—can affect the price of houses. Though the demand for shelter, especially rental apartments, will almost certainly rise when a baby boom cohort enters adulthood, we argue that house demand and prices may *fall*. Demand for owner-occupied housing (houses) may initially decline when an additional supply of young workers steepens age–earnings profiles. The lower earnings of baby boomers directly reduce the demand for homeownership and indirectly reduce the demand for houses through income effects on household formation, marital status, and family size. Steeper age–earnings profiles further reduce individual baby boomer's demand for houses to the extent the steeper profiles lead to tighter borrowing constraints associated with down-payment requirements and ceilings on payment-to-income ratios.

If the large-cohort effect on their incomes dissipates over time (and assuming aggregate labor productivity holds steady over time), baby boomers will move up atypically steep age–earnings profiles. As they age—and their incomes rise toward their permanent incomes and they accumulate financial assets—some unleashing of deferred demand for houses can be expected. In brief, baby boomers' effective demand for owner-occupied housing can be expected to start lower, but rise faster, than past age–ownership profiles would suggest.

Below, we analyze differences between house price data series and in the reduced-form specifications for house prices introduced by Peek and Wilcox (1991) and by Mankiw and Weil (1989). In particular, we examine the effects of age–earnings profiles on housing demand. A simulation indicates that, in response to a baby boom, house prices may follow a "J-curve": After an initial decline, house prices rise above their prebaby boom levels and then gravitate toward their original levels as the baby boom generation dies off. We also use our estimates to forecast house prices and to delineate the contribution of several factors in raising house prices over the next two decades.

## II. THE SUPPLY AND DEMAND FOR HOUSES

In the "P-W model" (Peek and Wilcox, 1991) we specify house prices as a function of the demand for and supply of the stock of owner-occupied housing (houses). In its reduced form, the model implies that real house prices are a function of the cyclical unemployment rate, incomes, demographics, costs of financing house purchases, and costs of construction materials. The model reflects the widely presumed effects of the size and age distribution of the population on house prices. It also allows demographics to affect house prices via their effects on age–earnings profiles. We abstract from supply- and demand-side dynamics stemming from time-to-build considerations, adjustment costs, and expectations, which may be important determinants of house prices over the short run.

Following the P-W model, the real stock supply of houses (1) responds positively to real house prices (P) and negatively to the real price of construction materials (RPCON):

$$\underset{\phantom{(+)}}{\mathrm{SS}} = \mathrm{s}(\underset{(+)}{\mathrm{P}}, \underset{(-)}{\mathrm{RPCON}}). \tag{1}$$

The real stock demand for houses (2) depends positively on the real income per household of a given age (INC) and the size and age distribution of the population or of households (HH), and negatively on real house prices (P), the cyclical component of the unemployment rate (UGAP), and homeowners' expected real after-tax borrowing costs (REATMTG). Because financing costs can also affect the supply function for housing, the reduced-form coefficient associated with financing costs reflects both influences, though we expect the demand effect to dominate.

The ratio of households headed by persons 20–29 years old to households headed by persons 30–54 years old (HH20s) is also included in the real stock demand to allow for the possibility that the entry of an atypically large age cohort into the labor market steepens the age–earnings profiles of members of that cohort and thereby affects the demand for houses. To the extent an atypically large cohort depresses the real income of its members relative to "normal" (as captured by INC and HH), the impact of HH20s will be negative:

$$\mathrm{DD} = \mathrm{d}(\underset{(-)}{\mathrm{P}}, \underset{(-)}{\mathrm{UGAP}}, \underset{(-)}{\mathrm{REATMTG}}, \underset{(+)}{\mathrm{INC}}, \underset{(+)}{\mathrm{HH}}, \underset{(-)}{\mathrm{HH20s}}). \tag{2}$$

Equating demand and supply produces the following reduced-form equation for real house prices:

$$\mathrm{P} = \mathrm{p}(\underset{(+)}{\mathrm{RPCON}}, \underset{(-)}{\mathrm{UGAP}}, \underset{(-)}{\mathrm{REATMTG}}, \underset{(+)}{\mathrm{INC}}, \underset{(+)}{\mathrm{HH}}, \underset{(-)}{\mathrm{HH20s}}). \tag{3}$$

A house can be thought of as a bundle of attributes. Although each of those attributes can be priced according to the form given in (3), the magnitudes of the parameter values are likely to differ across attributes because of differences in their price elasticities of supply (Gill and Haurin, 1991). As a result, even though each attribute may be thought of as being priced according to the form given by (3), the prices of different houses will react differently to the arguments in (3). On the presumption that there have not been important nationwide shifts in the relative distributions of attributes across categories that differ by price elasticities of supply, we use (3) to assess the determinants of house prices in the aggregate.

## III. QUALITY CHANGE, TRUNCATION BIAS, AND LAND VALUE

Peek and Wilcox (1991) have constructed an index of the price of the existing stock of houses (defined to include land value) adjusted for quality change. This national-average, annual measure covers the years 1950 through 1989. It is based on FHA data for the period 1950–1969 and on Federal Home Loan Mortgage Corporation (Freddie Mac) data for 1970–1989. The FHA data are the median appraised value of single-family homes. The Freddie Mac data are a weighted repeat-sales price index based on series from the four U.S. Bureau of the Census regions. National Association of Realtors weights for 1987 are used to construct the national Freddie Mac index (Abraham and Schauman, 1990). The two series are adjusted for the *net* change in the quality of existing houses resulting from expenditures on, and otherwise-unmeasured investments of time in, maintenance and improvement. The mnemonic for the log of this index of upgrade-adjusted, real house prices is FREDMAC. (Real prices and incomes are constructed by dividing by the GNP deflator.)

Transactions above FHA and Freddie Mac ceilings are censored from the respective datasets, making both series subject to truncation bias. Such bias can be present if the prices of higher-price houses rise at a faster rate than lower-price houses. Before 1970, nominal house prices rose relatively little and the FHA median house price generally declined relative to the maximum amount covered by FHA mortgage insurance. Therefore, as Greenlees (1982) found, truncation bias is not likely to be a serious problem for the pre-1970 data.

During the 1980s, the prices of lower-price houses rose more than those of higher-price houses, reducing the potential for truncation bias in the Freddie Mac data (Abraham and Schauman, 1990; Pollakowski *et al.*, 1991; Poterba, 1991). Simulations by Abraham (1990) indicate that biases in the Freddie Mac series are likely to be small. For example, he found that biases associated with loan limits are likely to be on the order of less than $\frac{1}{2}$% per year.

Because it has so often been used as a proxy for house prices, we also analyze the determinants of the National Income and Product Accounts' implicit price deflator for residential investment expenditures. RESDEF is the mnemonic for the log of the real residential investment deflator. Though this series attempts to hold constant the quality of structures being priced, it has some important drawbacks as a measure of house prices. First, it covers only the flow of new construction, not the standing stock of residential structures. Second, RESDEF includes prices of multifamily structures as well as of single-family homes. Its primary shortcoming for the purpose at hand, however, is that it excludes land value.

Differences in land's share of the value of houses (structure plus lot) account for much of the variation in house prices across locations and over time. Since the end of World War II, for example, the price of land relative to the price of structures has changed considerably. As a result, between 1949 and 1988, the real residential investment deflator rose less than 1% while an index of the real residential investment deflator plus land rose more than 20%. Thus, including land value is not simply desirable *a priori*; doing so dramatically changes the measured pattern of house prices over the period. By virtue of its exclusion of land value, RESDEF is more akin to an index of prices of construction materials and labor. Thus, RESDEF may be a better substitute for the materials costs proxy in the explanation of house prices than a house price measure to be explained.

Figure 1 plots FREDMAC and RESDEF for 1950–1989. (The data in the figures are in levels, not logs.) Although the two series have similar

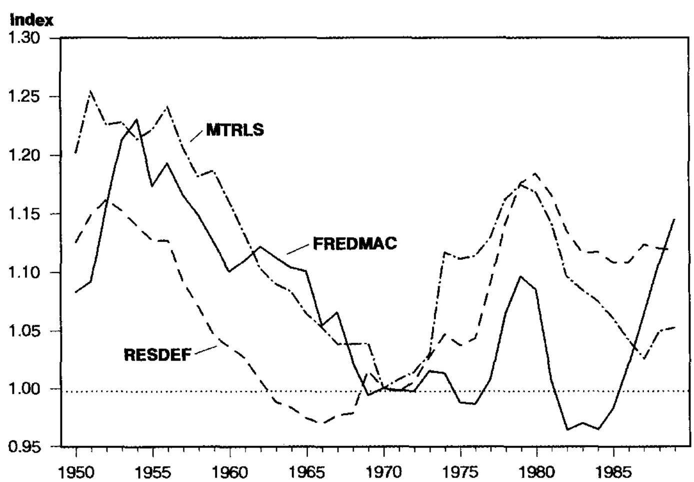


FIG. 1. Real house prices and construction materials costs, 1950–1989; 1970 = 1.00.

average growth rates, the simple correlation of their (real, logged) levels over the entire period is only 0.22; in many instances, they behave very differently. Both measures fell markedly until the early 1970s, a fact that is often underappreciated. RESDEF then rose steadily through the 1970s. After retreating in the early 1980s, it has changed little over the past 10 years. FREDMAC, in contrast, rose little during the early and mid-1970s. In the latter 1970s it, too, moved up sharply, but during the 1980s it traced out a fairly steep V-shape.

## IV. SPECIFICATION OF THE REDUCED FORM

Figure 1 also plots MTRLS, the real PPI for intermediate-stage materials and components for construction (Council of Economic Advisers, 1990). The log of MTRLS, RPCON, represents shifts in the supply of houses (1) driven by changes in the cost of construction materials. MTRLS's path over the past four decades was much like that of RESDEF. MTRLS fell fairly steadily through the 1950s and 1960s before surging in the latter 1970s. It declined from the latter 1970s through the mid-1980s, but changed little from the mid-1980s to the end of the 1980s.

The cyclical component of the unemployment rate, UGAP, may affect the demand for houses because of borrowing constraints and income uncertainty (Haurin, 1991). UGAP, plotted in Fig. 2, was calculated as the difference between the unemployment rate and the Congressional Budget

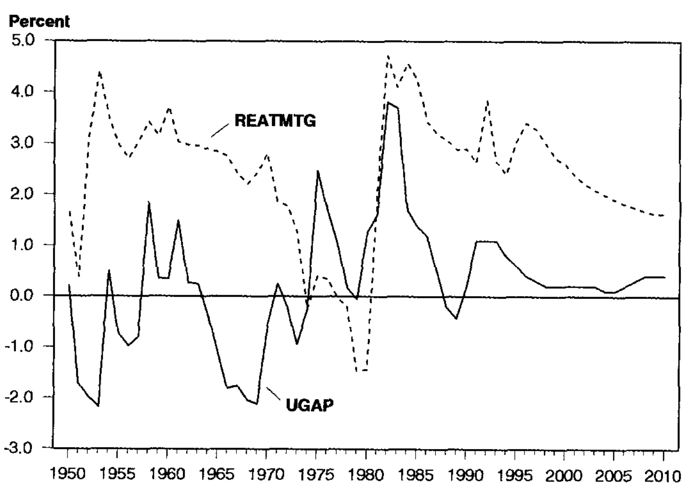


FIG. 2. Cyclical unemployment and expected real after-tax mortgage rates: actual, 1950–1989; forecast, 1990–2010.

Office's (1988) estimate of the non-accelerating-inflation rate of unemployment. As such, UGAP's peaks correspond to business cycle troughs. (The derivation of the 1989–2010 forecasts for this and other states are explained below.)

Demand for owner-occupied housing is also likely to be affected by real after-tax mortgage rates. The nominal after-tax mortgage interest rate was calculated as the secondary-market yield on FHA mortgages, multiplied by one minus the average marginal federal income tax rate calculated by DRI. In the absence of a data series for the expected *long-term* inflation rate, the expected real interest rate was calculated by subtracting the Livingston survey measure of the inflation rate expected for the upcoming year from the after-tax mortgage interest rate. (Peek and Wilcox, 1991, found their model's estimates robust to various proxies for the expected real after-tax mortgage interest rate.) The resulting series, REATMTG, is also plotted in Fig. 2. The three-decade slide of this mortgage rate was undone by an increase of more than 500 basis points early in the 1980s. Since then, rates have again trended down.

INC and HH were designed to capture, respectively, the effects of income and of the number and composition of households on the demand for homeownership. Demand for houses rises fairly steeply with real income per household and with age (Hendershott, 1988a; Haurin, 1991; Moore, 1991). INC is intended to measure real income per household over time, apart from the change in income associated with changes in age–earnings profiles. Therefore, INC was specified as the logarithm of real median annual income of families that have a head of household between 45 and 54 years of age (U.S. Bureau of the Census, Series P-60). This median income was considered to be the income of a constant-age family old enough to be little affected by the entrance of baby boomers into the labor market.

The demand for houses also rises as a cohort's members age and as they marry. Homeownership rates increase with age, and they rise particularly quickly at young ages. Among young adults, married couples are more than three times as likely to own their own homes as are unmarried individuals. To reflect the effects of the size, age, and marital status of the population on the demand for houses, HH was specified as the logarithm of the number of households weighted by long-run average homeownership rates classified by age and marital status.

Because we want the measure that combines the number and composition of households and their tendency to own homes to reflect the typical age–earnings profile that each age and marital status group has faced, HH was based on long-run average homeownership rates. Long-run average homeownership rates by age and marital status are averages of rates calculated from the 1960, 1970, and 1980 decennial censuses (Hendershott, 1988b). Data for number of households by age and marital status are from the U.S. Bureau of the Census (Series P-20).

The positive trends in HH and INC make the correlation between the two series extremely high. That collinearity, as well as the presumed similarity of their elasticities of demand, led us to sum INC and HH to form INCHH; *t* tests did not reject the hypothesis that the elasticities with respect to INC and HH were the same. The increase in INCHH due to the scale effect of baby boomers reaching adulthood would be tempered to the extent that their entrance into the labor market, by increasing the aggregate supply of labor, reduces real wages for all workers. Any such offsetting effect would be reflected in changes in the real incomes of workers 45–54 years old. The effect would likely be minor, however. By contrast, the incomes of baby boomers appear to have been affected substantially by the size of their cohort.

## V. AGE-EARNINGS PROFILES AND "PENT-UP" DEMAND

### *Effect of a Baby Boom on Age–Earnings Profiles*

A baby boom can affect housing markets indirectly through its effects on labor markets. Though the entrance of boomers into the labor force may have a relatively minor impact on the aggregate wage rate, the size of their cohort may affect the incomes of baby boomers considerably. By raising the ratio of the number of (imperfectly substitutable) young members to older members of the labor force, a demographic bulge may depress the per capita real incomes of baby boomers. Such a reduction in real incomes apparently has occurred for individual members of the 1946–1964 baby boom generation (Freeman, 1979; Welch, 1979; Bryan and Byrne, 1990). Baby boomers' incomes appear to have been lowered relative to the incomes of their elders, the incomes of the young workers that preceded them, and their own future incomes. For example, the real median income of year-round, full-time workers age 25–29 years was lower throughout the 1980s than it was in 1970 (U.S. Bureau of the Census, Series P-60).

Once baby boomers become older, more skilled, and less distinguishable from (and thus closer substitutes for) other, even older workers, the large-cohort effect on their labor incomes may dissipate. If so, the incomes of these large-cohort workers will rise substantially faster later in their careers and faster than the incomes of preceding (and, likely, succeeding) generations; that is, baby boomers will have steeper age–earnings profiles. While some have suggested that the large-cohort effect on boomers' earnings does, in fact, shrink, others suggest that it may change little as the boomers age (Berger, 1985).

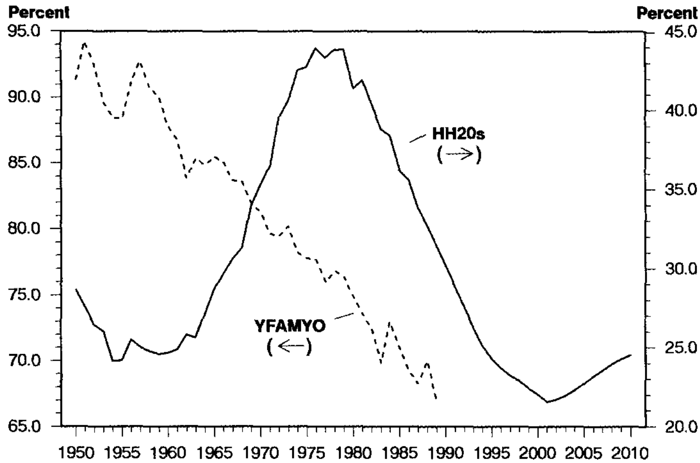


FIG. 3. Ratio of young to old households and ratio of young to old incomes: actual, 1950–1989; forecast, 1990–2010.

Figure 3 plots HH20s, the ratio of households headed by a person 20–29 years old to households headed by a person 30–54 years old. HH20s is intended to capture changes in age–earnings profiles due to changes in the age structure of the labor force. HH20s began to rise as the oldest baby boomers entered their twenties in the late 1960s. It reached its highest values around 1975 and then receded as boomers swelled the ranks of the 30–54 year old group. An alternative to HH20s, the ratio of the population age 20–29 years to that of age 30–54 years, averaged about 20 percentage points higher than HH20s. The two ratios move similarly over our sample, the correlation between them being 0.98. Regression results obtained with the alternative series also were very similar to those based on HH20s.

Figure 3 also plots YFAMYO, the ratio of the median income of families headed by a person 25–34 years old to the median income of families headed by a person 45–54 years old. Until the 1980s, the proxies for the relative supply and incomes of young workers were strongly negatively correlated. This led many observers to expect that the decline in HH20s in recent years would lead to an upturn in YFAMYO. However, the upturn has not occurred yet. (For the entire sample, however, the correlation is still −0.76.) Several recent papers have addressed this issue (Bound and Johnson, 1989; Katz and Murphy, 1990; Murphy and Welch, 1992). Though demand shocks may have clouded the bivariate relation between labor supply and earnings during the 1980s, many observers regard the negative partial correlation between labor supply and earnings as remaining intact. Therefore, we retain HH20s as a proxy for the effect of labor supply on relative incomes.

*Earnings and Ownership*

The entry of baby boomers into adulthood is all but certain to increase both the number of households and aggregate real income and, thus, the demand for (rental plus owner-occupied) shelter. Such an influx is likely to raise the demand for, and the price of, rental housing. At the same time, the influx may *lower* the demand for *houses*. The total demand for owner-occupied housing will fall if the product of the income elasticity of boomer's demand for houses and the elasticity of their per capita incomes with respect to their cohort size exceeds 1.

The income elasticity can be viewed as the sum of a number of components. The income elasticity of homeownership demand may be substantial, even apart from the effects of income that operate through household formation, marital status, and childbearing (Haurin *et al.*, 1988). Second, the income elasticities of these factors further boost the total income elasticity of demand for owner-occupied housing. For example, lower wage offers may deter formation of households (Haurin *et al.*, 1992).

Social conventions may aggravate the decline in young adult boomers' demand for houses. For example, "disequilibrium" in the marriage market can develop when cohort sizes change. Persistence of the typical pattern of women marrying men a few years older than themselves may lead to a "marriage squeeze" as women born early in a baby boom face an atypically high ratio of women to older men. Until conventions adapt, the marriage rate may decline and the age of first marriage may rise.

In fact, relative to their parents' generation (known as the Great Depression baby bust), baby boomers, on average, delayed age of first marriage, childbearing, and homeownership. From 1964 to 1988, the average age of first marriage rose by 3.3 years for males and by 3.2 years for females. The average age of first-time homebuyers rose from 28 in 1976 to 31 in 1990. One manifestation of these changes is that baby boomers have been more likely than their predecessors to continue living with their parents: The percentage of adults aged 25–34 living in their parents' home rose from 8.0 in 1970 to 11.5 in 1990 (U.S. Bureau of the Census, Series P-20).

Even for baby boomers who do become homeowners, lower real income means lower demand for shelter, resulting in their buying smaller or otherwise-lower-quality houses. Thus, individual young adult baby boomers would be expected to exhibit lower demand for houses than is typical for individuals in smaller cohorts at the same income and the same stage of their working lives.

*Baby Boomers' Pent-Up Demand for Houses*

While baby boomers are young adults, their demand for houses may be further restrained to the extent their steeper age–earnings profiles result in tighter financing constraints. Lenders typically set payment-to-(current) income ceilings with little regard to the individual borrower's age or to the steepness of the borrower's age–earnings profile (Artle and Varaiya, 1978; Linneman and Wachter, 1989; Jones, 1990). Thus, baby boomers' demand may be more constrained (relative to their tastes, wealth, and expected mean and variance of future income streams) than the demand of young adults in smaller cohorts by lending institutions' ceilings on loan-to-value and payment-to-income ratios. Though these constraints are unrelated to inflation, they do stem from the interaction of level-nominal-payment mortgages and upward-tilting income paths (Dokko *et al.*, 1990).

Were it not for transaction costs, a young adult's effective demand for houses might be determined by current income and availability of a down payment. As its current income rose each year, a household could sell its house and purchase another that delivered housing services equal to the original proportion of its higher income. Consider, for example, a house purchase equal in value to three times household income with all-inclusive transaction costs of 10% of the house price. For a household having a 10% saving rate, each transaction would cost three years' savings. These substantial transaction costs, when coupled with ceilings on payment-to-current income ratios and steeper age–earnings profiles, may lead baby boomers to postpone house purchases or to bypass the traditional starter home. In part because of this delay, the demand for houses may decline relative to current income when age–earnings profiles steepen.

The need for a down payment can also cause baby boomers' demand for houses to be deferred to relatively later ages, that is pent up. To the extent that households attempt to smooth consumption over periods of years, the length of time that households take to accumulate a down payment equal to a given proportion of permanent income or wealth is likely to vary positively with the steepness of their age–earnings profile. Because young adult baby boomers face steeper age–earnings profiles, their saving rates as a fraction of their current incomes are unlikely to rise sufficiently to offset the decrease in the ratio of current income to permanent income. On the contrary, their saving rates may be atypically low as they attempt to smooth consumption intertemporally. As a result, the time required to accumulate a sufficiently large down payment may be considerably longer for baby boomers.

The idea that financing limits may have impinged on young adults more severely during the past two decades than in earlier decades may be surprising in light of the increase in aggregate debt ratios and the decline in aggregate saving rates—but these facts are not inconsistent. To the extent that they have faced steeper age–earnings profiles, baby boomers may have had lower saving rates than otherwise. At the same time, incompletely flexible lending policies may have restrained boomers' borrowing and prevented them from saving even less than they did.

To the extent that aging boomers become closer substitutes for other, older workers, their incomes can be expected to rise faster than historical age–earnings profiles would indicate. As their incomes approach their permanent incomes and they accumulate net worth, borrowing constraints on boomers will ease and previously pent-up demand will be unleashed. Demand for owner-occupied housing will be greater than predicted by specifications that ignore this catch-up of baby boomer incomes and savings.

## VI. MODEL ESTIMATES AND COMPARISONS

In this section we present estimates to facilitate comparison of our data, model, and forecast for house prices with those of Mankiw and Weil (M-W, 1989). Tables I and II give the results for 1950–1989 of estimating the M-W and P-W specifications for house prices. In each row in Table I, (the log of) a measure of real house prices is regressed on a constant term (Constant), a linear trend (TIME), and the log of demand (DEMAND). The data for DEMAND, taken from Mankiw and Weil (1989), are based on population size and structure and on their estimate of the age-specific demand for housing. Because the Durbin–Watson statistics associated

TABLE I
Mankiw–Weil Model of Real House Prices, 1950–1989

| House price measure | Constant | TIME | DEMAND | MA(1) | AR(1) | $\bar{R}^2$ | S.E.E. | D.W. |
|---|---|---|---|---|---|---|---|---|
| 1. RESDEF | −62.4 | −0.064 | 4.58 | 0.592 | 0.542 | 0.955 | 0.013 | 2.00 |
| | (12.54) | (12.25) | (12.52) | (2.82) | (4.53) | | | |
| 2. RESDEF | −65.9 | −0.067 | 4.84 | | 0.741 | 0.946 | 0.014 | 1.18 |
| | (7.40) | (7.20) | (7.39) | | (7.18) | | | |
| 3. RESDEF | −62.4 | −0.063 | 4.58 | | | 0.875 | 0.022 | 0.50 |
| | (16.40) | (16.13) | (16.38) | | | | | |
| 4. FREDMAC | −21.7 | −0.027 | 1.66 | 0.609 | 0.677 | 0.840 | 0.028 | 1.93 |
| | (1.33) | (1.57) | (1.39) | (2.94) | (5.45) | | | |
| 5. FREDMAC | −11.0 | −0.015 | 0.87 | | 0.872 | 0.802 | 0.031 | 1.02 |
| | (0.34) | (−0.42) | (0.36) | | (7.24) | | | |
| 6. FREDMAC | −17.4 | −0.023 | 1.34 | | | 0.436 | 0.051 | 0.37 |
| | (1.97) | (2.47) | (2.07) | | | | | |

*Note.* $t$ statistics are in parentheses.

TABLE II
Peek–Wilcox Model of Real House Prices, 1950–1989

| House price measure | Constant | UGAP | REATMTG | INCHH | HH20s | RPCON | MA(1) | AR(1) | $\bar{R}^2$ | S.E.E. | D.W. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. RESDEF | −4.07 | 0.049 | −0.01 | 0.170 | 0.00 | 0.448 | 0.266 | 0.905 | 0.948 | 0.014 | 1.96 |
| | (3.45) | (0.20) | (0.02) | (1.87) | (0.00) | (2.94) | (1.35) | (12.43) | | | |
| 2. RESDEF | −4.74 | 0.070 | 0.05 | 0.205 | 0.01 | 0.502 | | 0.917 | 0.946 | 0.015 | 1.53 |
| | (3.64) | (0.26) | (0.15) | (1.99) | (0.06) | (3.47) | | (15.80) | | | |
| 3. RESDEF | −7.23 | −0.748 | 1.47 | 0.125 | 0.21 | 1.230 | | | 0.728 | 0.033 | 0.63 |
| | (9.16) | (1.62) | (2.78) | (4.59) | (1.24) | (9.79) | | | | | |
| 4. FREDMAC | −2.88 | −0.742 | −0.92 | 0.097 | −1.03 | 0.648 | 0.755 | −0.198 | 0.867 | 0.025 | 2.06 |
| | (5.18) | (2.22) | (2.36) | (4.90) | (8.47) | (7.51) | (2.59) | (0.72) | | | |
| 5. FREDMAC | −1.70 | −0.365 | −0.67 | 0.067 | −0.95 | 0.458 | | 0.579 | 0.853 | 0.026 | 1.56 |
| | (1.45) | (0.87) | (1.28) | (1.57) | (4.34) | (2.42) | | (3.28) | | | |
| 6. FREDMAC | −2.92 | −0.863 | −1.08 | 0.100 | −1.05 | 0.652 | | | 0.826 | 0.028 | 1.33 |
| | (4.24) | (2.14) | (2.34) | (4.20) | (6.91) | (5.97) | | | | | |

*Note*. $t$ statistics are in parentheses.

with the OLS results in rows 3 and 6 of Table I are low, we estimated the M-W and P-W models with either ARMA or AR error terms. In general, the point estimates in Table I are not very sensitive to whether ARMA or AR error terms are specified.

Table I shows that the size and significance of the time trend and of demographically driven demand effects are, however, sensitive to the series being explained. RESDEF responds substantially and reliably to both TIME and DEMAND. Row 2 corresponds closely to the AR(1) specification estimates presented by Mankiw and Weil (1989). These trend and demographic variables affect FREDMAC in the same direction they affect RESDEF. However, FREDMAC responds much less vigorously and significantly to these variables than does RESDEF.

Table II presents estimates of the P-W model over the same 1950–1989 period. In each row, real house prices are regressed on a constant term, the cyclical component of the unemployment rate (UGAP), the level of the real after-tax mortgage interest rate (REATMTG), the measure that represents the number, demography, and incomes of households (INCHH), the fraction of households headed by young adults (HH20s), and the log of real construction materials prices (RPCON).

Table II, like Table I, shows that both the size and the statistical significance of some of the determinants of house prices are sensitive to house price series. Rows 1 and 2 show that RESDEF responds to our income and households measure and to materials costs; INCHH is significant at about the 5% level, and RPCON is significant at a lower level. However, not cyclical unemployment, nor the mortgage rate, nor the demographic variable HH20s significantly affects RESDEF. Thus, the P-W model offers little explanation of the residential investment deflator other than that it is associated (unsurprisingly) with materials costs.

The P-W model is better at explaining FREDMAC than at explaining RESDEF. FREDMAC declines with increases in unemployment rates and real after-tax mortgage interest rates. Higher real per capita incomes, more, older, married households (as measured by INCHH), and higher materials costs lead to higher house prices. The RPCON coefficients are significant and not far from materials' share (about one-half) of total construction costs. Split-sample estimates reveal few signs of a structural break and an $F$ test of the OLS specification in row 6 does not reject the hypothesis of coefficient stability over a mid-sample split. By contrast, Hendershott (1992) reports that, with the M-W specification, the estimated TIME coefficient is unstable and is insignificant after 1970.

The estimated effect of a younger work force, as measured by HH20s, is uniformly significant and *negative*. The implication is that, given the size and typical homebuying proclivities of various age and marital status groups, the younger the average age of the labor force, the *smaller* the demand for houses.

The results in Table II are consistent with our earlier arguments that the long-run effects on house prices of changes in the aggregate demand for houses operate primarily through changes in the price of land. In the M-W model, in contrast, the residential investment deflator responds significantly to DEMAND. In our specification for house prices, the residential investment deflator, which excludes land value, consistently responds significantly only to RPCON, the proxy for shifts of the supply curve. Whereas neither after-tax real interest rates, nor long-run or short-run changes in income, nor our demographic factors had statistically significant effects on RESDEF, FREDMAC responded significantly to each of these variables. The sensitivity of a number of the *t* statistics to the specification of the error term should be noted, however, because judgments about some of the effects may depend on which error process is deemed most appropriate.

## VII. A "BABY BOOM J-CURVE"?

The complicated dynamic effects of a baby boom, which affects the number and typical characteristics of households and the relative share of young people in the labor force, make it difficult to assess directly the effect on house prices of an unusually large birth cohort. To illustrate the estimated net effect on house prices of a baby boom, we simulated a representative baby boom and calculated the implied values for the two variables in the model that are affected by such a demographic shock, INCHH and HH20s.

The simulation started with a population whose composition, in terms of size, age, and marital status, was constant over time. In Year 0, the birth rate was raised to a level 10% above its original level; the rate was maintained at that level for 10 years and then returned to its original level. INCHH and HH20s were unaffected until after years 16 and 20, respectively, when baby boomers began to enter the labor force and to form households. The variable based on constant-age income and weighted households, INCHH, was constructed by applying the long-run average rates of household formation, marital status, and homeownership to the population for each age. Real income per demographically constant household (with the head 45–54 years old) was held constant to isolate the effects on INCHH solely of the demographic change.

Figure 4 plots simulated values for HH20s, starting and ending at a steady-state value of about 0.41. The maximum value of about 0.45 occurs when all the baby boomers are in their twenties. When the baby boomers are between 30 and 55 years old, HH20s falls below its steady-state value to 0.40, because during that time the atypically large number of older workers lowers the share of the labor force that is young. By construc-

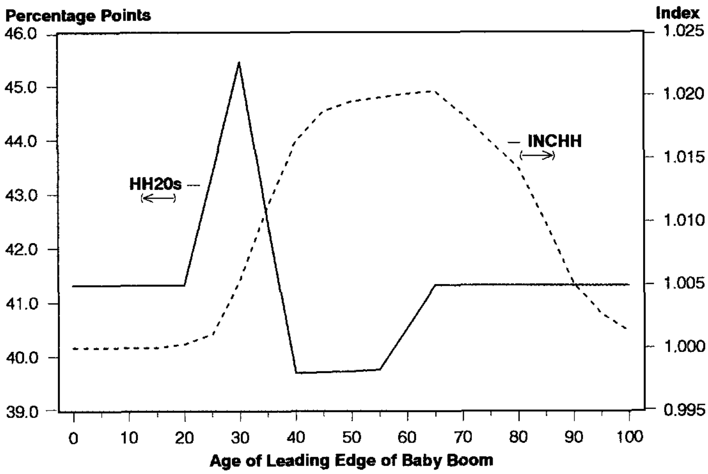


FIG. 4. Simulated effects of a baby boom on INCHH and on HH20s.

tion, HH20s returns to its steady-state value after the youngest members of the simulated baby boom reaches age 55.

Figure 4 also shows that INCHH, indexed to equal 1 at the beginning of the simulation, begins to rise slightly after the first members of the baby boom cohort reach age 16. It rises much more rapidly over the next two decades as the boomers continue to enter adulthood and, in fact, continues its rise for about *half a century* as the atypically large cohort moves into ages of progressively higher homeownership rates. At its peak simulation value, INCHH is about 2% higher than its steady-state value. It then tapers off, moving toward its steady-state value as the baby boom generation dies off.

We calculated the cumulative net percentage change in house prices attributable to the baby boom by applying the coefficient estimates in row 6 of Table II to the simulated values of INCHH and HH20s. The simulated baby boom *lowered* house prices until the oldest baby boomers were almost 40 years old. Until then, the depressed relative incomes of individual boomers apparently more than offset the elevating effects on demand for owner-occupied housing of their greater numbers. Thirty years after the beginning of the simulated baby boom, all the boomers were in their twenties, and the cohort's depressing effect on its members' real per capita incomes was specified to be at its maximum. At that point, the simulation indicated that demand was weakened sufficiently to lower house prices by about 4%.

As the boomers aged and progressed up unusually steep age–earnings profiles, house prices rebounded, roughly tracing out a "J-curve," as

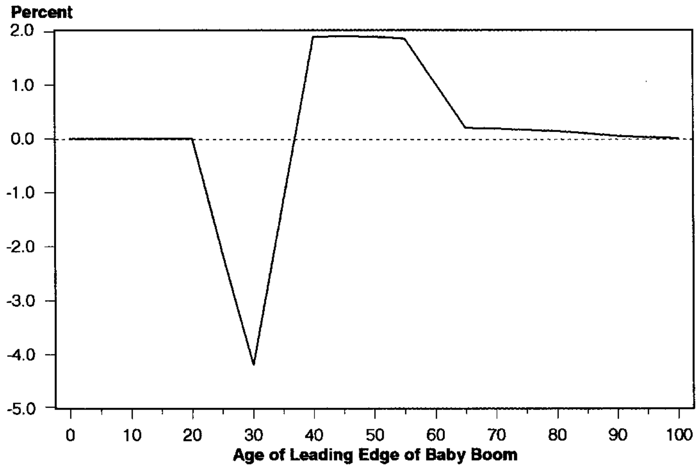


FIG. 5. Simulated effects of a baby boom on real house prices.

shown in Fig. 5. Ten years after their low point, real house prices had risen an estimated 6%, to a level about 2% higher than their initial level. They remained near that level for about 15 years and then began to move back down toward their initial level as the boomers gradually died off and the population reverted to its original size and age distribution.

Of course, house prices may not fall when a baby boom enters adulthood. Although the point estimates imply a J-curve response of house prices to a baby boom, the confidence interval for the simulation in Fig. 5 surrounds the baseline level of house prices. Differences in the size or form of the baby boom simulated or in model estimates may alter the simulated path of house prices in important ways. But Fig. 5 does indicate that the reverberations of a baby boom through the labor market may significantly offset, and may even overwhelm, the increase in the demand for houses resulting from a population increase.

## VIII. HOUSE PRICE FORECASTS, 1989–2010

We used the model estimates to forecast real house prices from 1989 through 2010 (Table III). The forecasts are based on AR(1) estimates from the M-W model (rows 2 and 5 in Table I) and OLS estimates from the P-W model (rows 3 and 6 in Table II). We obtained future values of the explanatory variables required to calculate the forecasts in Table III from several sources. Projected values for DEMAND came from Mankiw and

TABLE III
Forecasted Percentage Change in Real House Prices, 1989–2010

| House price measure | Model | |
|---|---|---|
| | Mankiw–Weil | Peek–Wilcox |
| RESDEF | −53.7 | 0.2 |
| FREDMAC | −23.2 | 11.0 |

Weil (1989). Real income per household was assumed to grow 1.1% annually from 1989 through 2010, consistent with the WEFA (1990) projection. Projections of the future population, by age, came from the middle series projection made by the U.S. Bureau of the Census (Series P-25). The weighted household series was calculated from 1988 rates of household formation, marital status, and homeownership. Forecasts of the nominal mortgage interest rate and of the actual and non-accelerating-inflation rate of unemployment for 1990 through 2010 are from WEFA (1990). Because WEFA projects that the share of the government in the economy will be fairly steady over the next two decades, income tax rates for 1990–2010 were set equal to the 1989 value. No data on the long-term expected inflation rates covering this period were available. Therefore, the WEFA projection of one-year-ahead inflation rates was used as a proxy for expected inflation. We assumed that the real price of construction materials would remain unchanged over the forecast horizon.

Slowing growth of DEMAND and an estimated annual negative TIME coefficient of nearly 7% in the M-W model combine to produce a forecasted decline in RESDEF of nearly 54% over the next two decades, akin to the Mankiw and Weil (1989) forecast. The same specification, coupled with the coefficient estimates in row 5 (Table I), forecast a milder decline of 23% in FREDMAC. By contrast, the P-W specification predicts that RESDEF will be flat, on average, over the next two decades, and that FREDMAC will rise 11% from 1989 through 2010, about the same amount it rose over the past two decades.

Table IV presents the P-W model's forecast of real house prices and the sources of change for subperiods 1989–2000 and 2000–2010. To obtain the change in house prices attributable to each source during each subperiod, the coefficient estimates from row 6 of Table II were applied to future values of the explanatory variables individually. (The table shows predicted changes in the logarithms, which are approximately percentage changes.) In real terms, house prices are forecast to *rise* by more than 10% over the next two decades. Nearly all the increase is expected by the end of this decade. Prices are forecast to drift up only slightly in the next decade.

TABLE IV
Sources of Forecasted Real House Price Change, 1989–2010

| Source | 1989–2000 | 2000–2010 |
| --- | --- | --- |
| Total change | 10.1 | 0.4 |
| UGAP | −0.5 | −0.2 |
| REATMTG | 0.3 | 1.0 |
| INCHH | 2.7 | 2.1 |
| HH20s | 9.8 | −2.6 |
| 1989 Residual | −2.2 | |

The number of households, weighted by homebuying propensity, rises through the 1990s, both because of continuing positive, albeit slower, population growth and because of the shift of the age distribution toward the ages of greater homeownership. Further, the share of the total population that is age 20–29 years falls until the next century, as the last of the large-cohort boomers enter their thirties and a relatively small age cohort (the "baby bust" generation) follows them into the labor force. The reduced share of the work force that is young may flatten age-earning profiles for the baby busters relative to what they would otherwise be, thereby reducing some of the constraints on the busters' demand for houses.

## IX. CONCLUSION

Suggesting that the baby boom drove down house prices certainly runs counter to conventional wisdom. We argue that, because of their steeper age–earning profiles, young adult baby boomers may have chosen to demand less owner-occupied housing. They are also likely to have been more constrained in their borrowing than their successors, the "baby bust" generation, will be. To the extent that the large-cohort effect on their incomes dissipates, baby boomers' pent-up demand for houses can be expected to be unleashed. In that event, boomers may then exhibit more typical social and homeownership patterns.

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