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ARE REAL HOUSE PRICES LIKELY TO DECLINE BY 47 PERCENT?

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ABSTRACT

Mankiw and Weil have estimated a demographically-driven real house price equation on annual data from the 1947-87 period and used it to forecast real house prices over the 1988-2007 period. The result is their infamous 47 percent real decline. Their equation really only fits data from the 1950s and 1960s. Not only is the post 1970 fit poor, but the cumulative in-sample forecast for the 1970-87 period is off by a factor of four.

While real house prices seem more likely to decline than increase over the next two decades, the most likely decline is 10 to 15 percent, not 47 percent.

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Are Real House Prices Likely to Decline by 47 Percent?

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The Mankiw-Weil (1989) forecast of a 47 percent decline in real house prices over the next two decades has riled the housing lobby as we had thought only proposals to withdraw the homeowner interest rate deduction could. And well the forecast should. Such a decline would be unpleasant not only for those who own houses, but also for those who sell houses (commissions are generally proportional to values), construct houses (demand will fall in response to the decline in expected house price inflation that raises the real after-tax interest rate), originate and invest in single-family mortgage loans (with lower housing demand, the volume of loans will decline), and insure loans with houses as collateral. Only those recently born, who would first purchase houses at the future low real prices, and proponents of an increase in U.S. saving, which would result from such a decline in U.S. real wealth, would find joy in the forecast.

Critiques of the Mankiw-Weil forecast seem to consist of little more than statements to the effect that the forecast doesn't make sense or that their model is too simple. While I tend to agree that the forecast is silly, I'm a firm believer in the principle of Occam's Razor: if a simple model works well, don't complicate it. Unfortunately, while their key estimation equation explains U.S. real house prices (the residential investment deflator) marvelously well in the 1950s and 1960s, it doesn't explain real prices in the 1970s and 1980s. Put another way, when their equation is estimated on data from the 1950s and 1960s, it doesn't forecast real house prices in the 1970s and 1980s. And an equation that can't forecast the 1970s and 1980s certainly shouldn't be used to forecast the 1990s.

Before analyzing the Mankiw-Weil study, a brief examination of U.S. real house price behavior is probably useful. Figure 1 illustrates three alternative measures. The line plotted for the full 1947-87 period is Mankiw-Weil's measure: the residential investment deflator divided by the GNP deflator. The other two series, again divided by the GNP deflator, relate to single-family housing only and include a land component. They are the constant quality house price series computed by the Bureau of Census (old series through 1977, new one thereafter) and Freddie Mac's repeat-sale index.[1] The three series tell basically the same story during the 1970-85 period. Real house prices rose in the 1970s, especially sharply in the second half (by 13 to 20 percent), and fell in the early 1980s (by 6 to 11 percent). The one data series available before 1970 suggests a 17 percent decline in the 1950s and early 1960s.

After 1985 the series diverge. The residential investment deflator is essentially flat; the constant quality series rises by 6 percent between 1985 and 1987 and is then flat; and the Freddie Mac series explodes, rising by 21 percent between 1985 and 1989. The Freddie Mac series is probably far off the mark in recent years. Prior to 1986, two biases in the series seem to have roughly offset each other. The first bias, which is a problem for any repeat sale index, is that improvements to houses that are resold exaggerate the rate of increase relative to the rate for unimproved houses. The second bias, which is peculiar to the Freddie Mac index, is that Freddie Mac (and Fannie Mae) can purchase only mortgages that are smaller in value than the "conforming loan limit." The existence of the conforming loan limit, which effectively excludes sales of houses that jumped sharply in price from the index, biases the rate of increase downward.[2] Between 1985 and 1989, however, the conforming limit increased by 50 percent in

real terms. This has likely dampened the bias against price increases by progressively larger and larger amounts, leaving only the bias in favor of price increases.

In the empirical work below, I analyze only the real residential investment deflator and I restrict my analysis to 1948-87, the same time period examined by Mankiw and Weil.

The Mankiw-Weil Model

The basic Mankiw-Weil model is amazingly simple. Housing demand is negatively related to real price (P) and positively related to a demand shifter (S), and supply is positively related to real price. Expressing the relationships in logarithms,

$$\ln H^d = \alpha_0 - \alpha_1 \ln P + \alpha_2 \ln S \qquad (1)$$

$$\ln H^s = \beta_0 + \beta_1 \ln P. \qquad (2)$$

Equating supply and demand and solving

$$\ln P = \frac{\alpha_0 - \beta_0}{\alpha_1 + \beta_1} + \frac{\alpha_2}{\alpha_1 + \beta_1} \ln S. \qquad (3)$$

If the elasticity of supply was large, as many would argue, then: β_1 would be large, the constant and the coefficient on lnS in equation (3) would be small, and the real price would vary little. The large variability in P exhibited in Figure 1 implies either that β_1 is small or that the supply equation is misspecified. For example, if supply depends on P-C, where C is the real cost of construction, and C has varied significantly (fell in 1950s and rose in 1970s?), then the real price could exhibit substantial variability even if β_1 were large.

Mankiw & Weil's major innovation is to link S, the demand shifter, to the age distribution of the population and to use projections of the future population of different ages to forecast real house prices. The link is established by regressing the 1970 housing asset demand of 74,565 households on 99 dummy variables representing the possible ages of the people in the household. This yields 99 coefficients reflecting the average housing asset demands for individuals aged 1 to 99. Total asset demand in 1970 is the sum of the products of these coefficients and the number of individuals of each age. The coefficients presumably reflect the differences in lifetime resources of households in each age class. Figure 2 reproduces the Mankiw-Weil figure containing the estimated coefficients from both 1970 and 1980 (in 1970 dollars).

The basic shape of the curves in Figure 2 indicates that parents demand negligible extra housing for their children, holding real income constant (parents might well demand a different housing mix -- more square feet but fewer amenities -- than adults without children).[3] The curves also indicate that at a given point in time (1970 or 1980) older individuals demand less housing than do younger households. This reflects the higher average lifetime resources of younger adults owing to both their greater expected labor force participation and their higher overall productivity. The sharper upward shift in the curve between 1970 and 1980 for the 30-50 age class relative to the 60-80 age class likely reflects the fundamental shift in labor force participation rates in the U.S. between 1970 and 1980, as well as the rise in real house prices in the 1970s. As Figure 3 illustrates, participation rates of those aged 20 to 40 jumped, while rates of those over age 50 actually declined.

Mankiw and Weil hold the age coefficients constant (at the 1970, not 1980, values) over the 1947-87 estimation period and also through

2007 in their forecast. They do augment this variable in equation (3), the real price equation, with real GNP and real after-tax interest rate variables, but these do not significantly change the coefficient on the age demand variable. In any event, Mankiw and Weil base their forecasts on an equation excluding real GNP and the real after-tax interest rate and thus do not need to forecast these variables.

While dropping these variables, Mankiw and Weil add a time trend to equation (3). This is a crucial inclusion; without the time trend, the age demand variable doesn't work.[4] The time trend must come from the underlying demand and supply equations (Mankiw and Weil do not explain its inclusion). On the demand side, the trend might reflect productivity growth and increased labor force participation, i.e., it could proxy for the factors driving real GNP. However, these factors would give the time trend a positive coefficient in the real price equation, and Mankiw and Weil's coefficient is negative. Thus the trend must come from a positive coefficient in the supply equation; holding supply constant, prices decline as time passes. Why this would be true is unclear.[5]

The Basic Mankiw-Weil Empirical Result and Forecast

Mankiw and Weil's key equation, estimated on annual data for the 1947-87 period, is

$$\ln P = \underset{(9.2)}{-63.1} - \underset{(.010)}{.065}\ \text{Time} + \underset{(0.68)}{4.65}\ \ln S + \underset{(.10)}{.77}\rho \qquad R^2 = 0.94,\ DW = 1.29$$

where standard errors are in parentheses. Our attempt to reproduce this result yields

$$\ln P = \underset{(8.6)}{-58.9} - \underset{(.009)}{.060}\ \text{Time} + \underset{(0.63)}{4.34}\ \ln S + \underset{(.11)}{.76}\rho \qquad R^2 = 0.56$$

The differences in coefficients likely reflect different autocorrelation adjustments; our lower R^2 abstracts from the contribution of ρ.

Estimating this equation in first-difference form, we obtain

$$\Delta \ln P = -.064 + 4.69\ \Delta \ln S. \qquad R^2 = 0.32$$
$$\qquad\qquad (.016)\ (1.10) \qquad\qquad DW = 1.36$$

This equation, whose coefficients are almost identical to those of Mankiw-Weil, says that the annual rate of change in real house prices ($\Delta \ln P$) is negative 6.4 percent plus a coefficient times the rate of change in S. Thus if demand (S) were constant, then real house prices would decline at 6.4 percent per year forever.

This long-run property seems most implausible, and it alone would discourage most people from using the equation to forecast far into the future. Some as yet unidentified factor has lowered real house prices by increasing amounts over the 1947-87 period, and the forecast assumes that this factor will continue to depress real prices more and more. Given that we can't identify the factor, the reasonableness of this assumption is unclear. Further, the demand variable coefficient seems implausibly high; a one percent increase in demand causes a 4.7 percent increase in price. One would expect a less than one-for-one response.

Given the 6.4 percent built-in decline in real house prices, it is easy to understand how a slowdown in adult population growth (the baby boomers are all over 20 and some are now reaching the peak Mankiw-Weil housing demand age of 40) can lead to significant declines in real house prices. In Mankiw-Weil's case, the real decline is about 3 percent a year or 47 percent cumulative over two decades.

While Mankiw-Weil report a strong relationship over the 1947-87 period between their age-driven demand variable and real house prices, a close relationship really exists only in the 1950s and 1960s. Figure 7

of the Mankiw-Weil study, reproduced here as Figure 4, indicates the severe deterioration of their equation in the late 1970s and 1980s. The deterioration is even clearer in Figure 5, which plots the rates of change in real house prices and demand (ΔlnP and ΔlnS). The figure shows a strong relationship in the 1950s and 1960s, a weak relationship in the 1970s, and an inverse relationship in the 1980s.

The deterioration in the relationship can be shown econometrically. Estimates for the two subperiods, 1948-69 and 1970-87, are:

$$\Delta \ln P = \underset{(.015)}{-.088} + \underset{(1.15)}{6.75}\,\Delta \ln S \qquad R^2 = 0.63,\ DW = 2.13 \qquad 1948\text{-}69$$

$$\Delta \ln P = \underset{(.050)}{-.063} + \underset{(3.20)}{4.41}\,\Delta \ln S \qquad R^2 = 0.10,\ DW = 0.81 \qquad 1970\text{-}87$$

$$\Delta \ln P = \underset{(.061)}{-.035} + \underset{(3.97)}{2.59}\,\Delta \ln S + \underset{(.22)}{.52}\rho \qquad R^2 = 0.03 \qquad 1970\text{-}87$$

As can be seen, when an autocorrelation adjustment is made, the coefficients on both the constant and demand variable are less than their standard errors for the 1970-87 period and the equation explanatory power is negligible.

A common test of a forecasting equation is how well it forecasts within sample, i.e., an equation is estimated over an initial span of the available data and is used to forecast the rest of the data. Figure 6 illustrates this test for the Mankiw-Weil equation. When the 1948-69 equation is used to forecast the 1970s and 1980s, it forecasts a 41 percent increase in real price versus an actual increase of 10 percent.[6] The usual conclusion when an equation forecasts so poorly in sample is that it should not be used to forecast out of sample.

An Expanded Model

Common sense and visual inspection of Figure 5 suggest that real after-tax interest rates affect house prices, with higher rates lowering prices and lower rates raising prices. The rate of change in real prices in Figure 5 is especially high in the late 1970s, when real after-tax rates fell to historic lows, and is especially low in the early 1980s, when real after-tax rates were surging. The real after-tax rate (RAT) is measured as the after-tax 10-year Treasury bond rate less the average rate of change in house prices during the current and previous two years. The tax rate is an average marginal personal tax rate that rises from 0.24 in 1970 to about 0.30 in the 1978-82 period (bracket creep) and then falls to 0.23 in 1988 (the Reagan tax cuts). The tax rate is set at 0.24 before 1970. Both the level and change in the real after-tax interest rate are added to the constant term and $\Delta \ln S$ as regressors because it is unclear whether real after-tax rates should be affecting the level or rate of change in real house prices.

For the full 1948-87 period, the result is

$$\begin{array}{llll} \Delta \ln P = -.040 + 2.98\ \Delta \ln S - .0057\ \Delta RAT - .0020\ RAT & & R^2 = .52 \\ \qquad\quad (.018)\ (1.31) \qquad\quad (.0020) \qquad\quad (.0011) & & DW = 1.74 \end{array}$$

Both interest-rate variables are statistically significant with the expected negative sign, and both the intercept and the coefficient on the demand shifter are reduced by almost 40 percent. For the 1970-87 period, the result is

$$\begin{array}{llll} \Delta \ln P = -.011 + 1.08\ \Delta \ln S - .0049\ \Delta RAT - .0022\ RAT & & R^2 = .38 \\ \qquad\quad (.076)\ (4.99) \qquad\quad (.0035) \qquad\quad (.0024) & & DW = 1.33 \end{array}$$

The interest-rate coefficients are close to those for the 1948-69 period, but the constant and the coefficient on $\Delta \ln S$ are much smaller in absolute value.

Because the interest rate coefficients are so similar and the constant and age-demand coefficient are so different, the equation is rerun for the entire 1948-87 period allowing shifts in the constant term and coefficient on the age demand variable between 1969 and 1970. In addition, the rate of change in real GNP ($\Delta \ln y$) is added to allow for the impact of the increased labor force participation. The result is:

$$\Delta \ln P = \underset{(.024)}{-.070\ (48\text{-}69)} \underset{(.041)}{-.006\ (70\text{-}87)} + \underset{(1.96)}{4.79\ \Delta \ln S(48\text{-}69)} \qquad R^2 = .69,\ DW = 2.10$$

$$+ \underset{(2.69)}{0.25\ \Delta \ln S(70\text{-}87)} \underset{(.0018)}{-.0037\ \Delta RAT} \underset{(.0012)}{-.0032\ RAT} + \underset{(.081)}{.287\ \Delta \ln y}$$

The income variable works as expected, indicating about a 30 percent elasticity of real prices with respect to real income. Note the differences in the constant terms -- negative 7 percent in the 1950s and 1960s versus negative one-half percent in the 1970s and 1980s -- and the differences in the age-related demand coefficients -- nearly 5 in the 1950s and 1960s versus a quarter in the 1970s and 1980s. The 1970s and 1980s estimates are more plausible; the constant is effectively zero and the age variable elasticity is close to that of real income.[7]

For illustrative purposes real house prices are forecast with this equation. If the real after-tax rate is kept at its 1987 value of 3.18, the growth rate in real income is set at 2.5 percent, and Mankiw-Weil's projection of S is used, a 12 percent decline in real house prices by 2007 is obtained. If the real income growth rate is raised to 3.19 percent, its mean value in the 1947-87 period, the decline is cut to 9 percent. Next the real after-tax interest rate is shifted linearly, over a six year period, to its 1947-87 mean value of 0.24. This

produces real house price increases of 4 percent (2.5 percent real output growth) or 7 percent (3.19 percent real output growth).[8]

While the fact that the baby boomers have come of age suggests that housing demand will not grow as rapidly in the 1990s as it did in the 1970s, this only means that real prices are unlikely to grow as fast in the 1990s as in the 1970s. Real prices could still rise (real demand is not falling, after all), although they seem more likely to fall unless we return to the real growth and real after-tax interest rates of earlier decades. A fall of more than 10 to 15 percent seems unlikely however.

FOOTNOTES

1. More precisely, this is the "Freddie Mac Weighted Repeat Sale Index, aggregated from four Census region series using 1987 NAR weights."
2. Robert Shiller made this point when discussing the Freddie Mac series at the AREUEA Midyear Meetings.
3. This result is inconsistent with many microeconomic studies, e.g., Haurin and Lee (1989) and Henderson and Ioannides (1989).
4. The coefficient on the age demand variable is 0.042 with a standard error of 0.059.
5. In fact, there is some evidence that productivity growth has been below average in the construction industry since 1965, when real house prices began to rise (Hendershott, 1988).
6. When an equation estimated over the 1948-79 period is used to forecast the 1980-87 period, a 6 percent rise is forecast versus a 7 percent actual decline.
7. The measurement of the real after-tax interest rate matters. When Mankiw-Weil's cost of funds variable is used (constant tax rate of 0.3 and expected inflation equal to the average rate of growth in the GNP deflator during the current and previous year), the estimates are

$$\Delta \ln P = \underset{(.024)}{-.092\ (48\text{-}69)} - \underset{(.043)}{.054\ (70\text{-}87)} + \underset{(1.96)}{6.38\ \Delta \ln S(48\text{-}69)} \qquad R^2 = .51,\ DW = 1.68$$

$$+\underset{(2.72)}{3.49\ \Delta \ln S(70\text{-}87)} - \underset{(.0016)}{.0019\ \Delta COF} - \underset{(.0015)}{.0017\ COF} + \underset{(.094)}{.248\ \Delta \ln y}$$

   Those were the only measures of the real after-tax rate tested.
8. David Weil has pointed out that the change in real house prices itself feeds back on the real after-tax rate in a way that would magnify the forecasted changes in real house prices. Anyone making serious real house price forecasts should be aware of this complication.

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Henderson, J. Vernon and Yannis M. Ioannides, "Dynamic Aspects of Consumer Decisions in Housing Markets," Journal of Urban Economics, September 1989.

Mankiw, W. Gregory and David N. Weil, "The Baby Boom, the Baby Bust, and the Housing Market," Regional Science and Urban Economics, May 1989.

Figure 1: Real House Prices

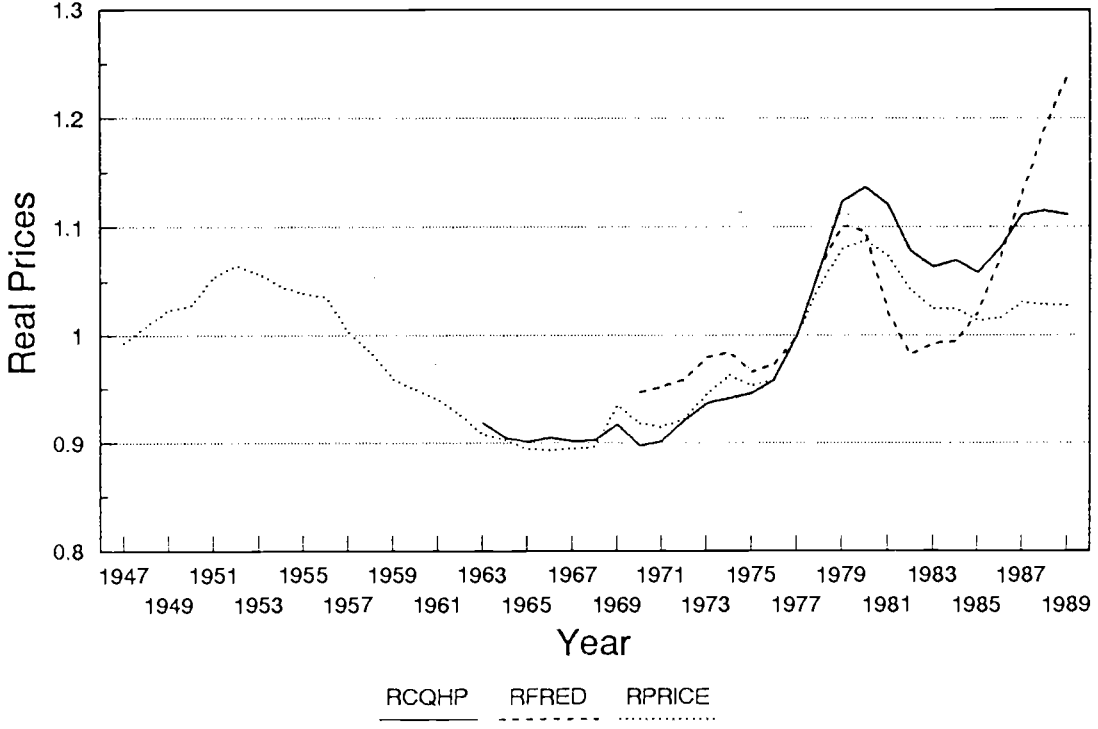
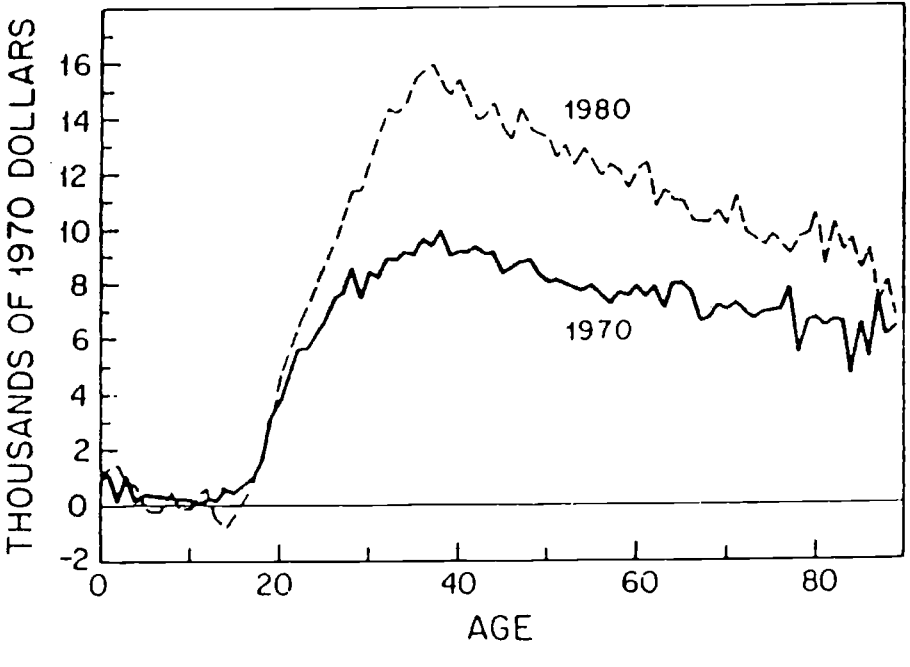


Figure 2: Estimated Housing Demand by Age



Source: Mankiw and Weil, 1988, Figure 3.

Figure 3:
Labor Force Participation Rates

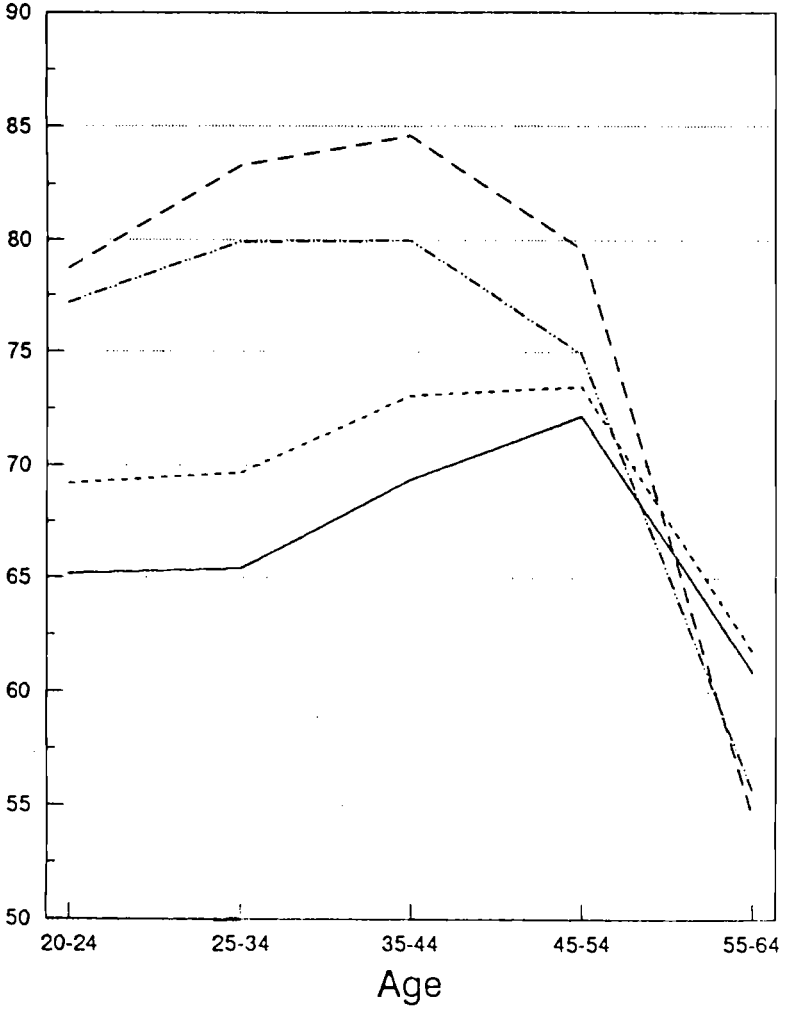
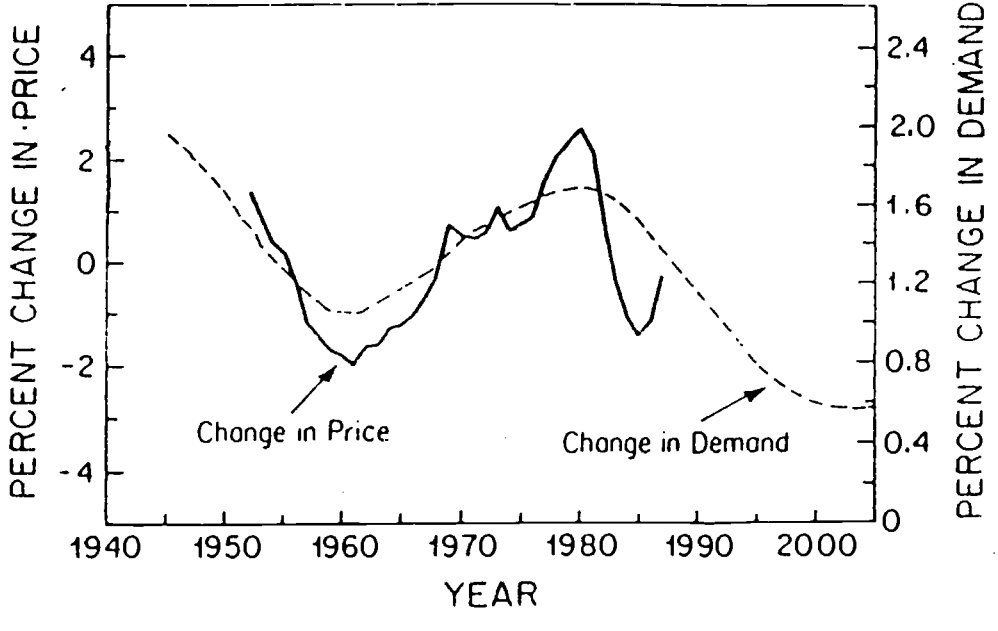


Figure 4: *Rates of Growth in Demand and Price*

(Five year averages)



Source: Mankiw and Weil, 1988, Figure 7.

Figure 5:
Rate of Change in Real Price and Demand

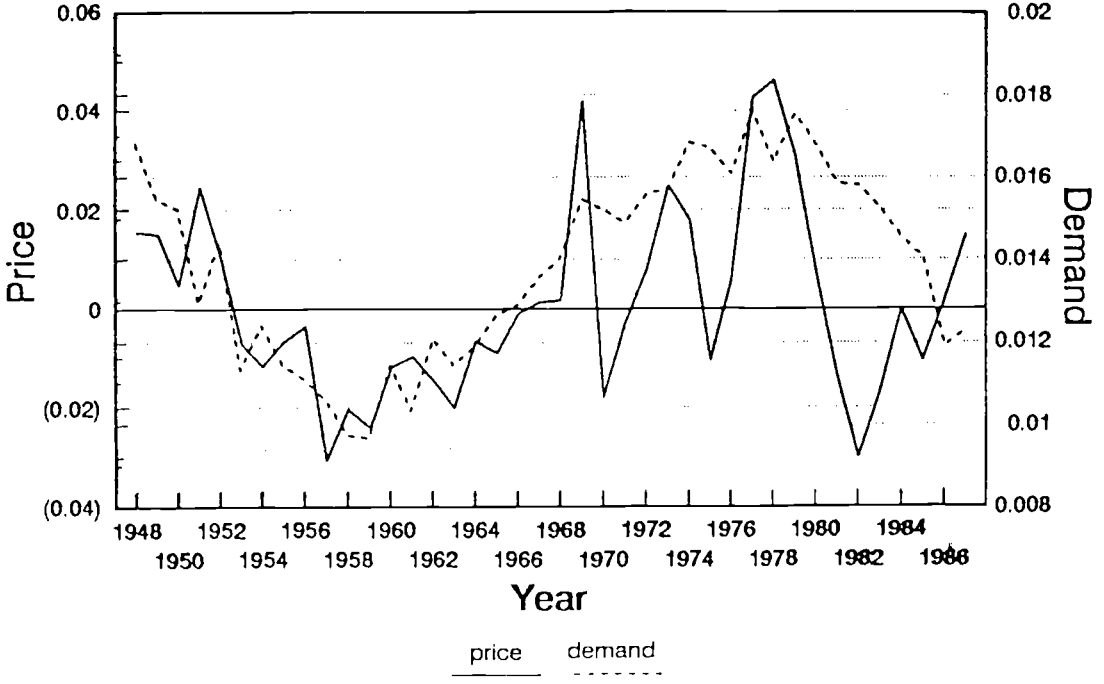


Figure 6: Real Prices - Actual (1948-1969) and Forecast (1970-1987)