THE HOUSING MARKET AND THE U.S. BUSINESS CYCLE

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ABSTRACT

The paper investigates the relationship between the real value of tangible assets, comprised mostly of real estate, and real GDP growth. Perhaps counter-intuitive to some, there is no simple and obvious transmission mechanism in standard macroeconomic reasoning which would allow a change in housing prices to affect output. To test this hypothesis, we develop a forecasting equation of U.S. real GDP growth for 1956-2009. We find that real per capita housing wealth plays no important role once we control for conventional macroeconomic variables.

1 INTRODUCTION

Does the housing market exert an important causal influence on the business cycle? Does semi-exogenous variation in the price of housing, caused perhaps by bubbles, influence the level of real economic activity? If so, then there is perhaps an argument for some sort of regulation or intervention in the housing market.

Such a causal effect on the business cycle would require some nominal rigidity, most obviously nominal wage rigidity, perhaps derived from staggered wage setting of the sort considered by Taylor (1980). If this holds, then variations in the level of demand will create variations in the level of real economic activity. Focusing on consumption, note that if household wealth increases, then households will presumably wish to consume more. This will be so in the event that the wealth increase follows from an increase in the price of houses. But an increase in the price of houses will *automatically* increase the value of consumed housing services at constant real interest rates. With regard to the business cycle, the question is whether the increase in house prices causes an increase in the demand for non-housing goods. In a world where everyone owns one house and lives in one house, a positive change in house prices will increase the value of rents paid (implicit or explicit); but incomes (implicit or explicit) rise by the same amount, so that consumption of *non-housing* goods remains the same. It is as if two cheques cross in the mail, one paying the rent for the house one lives in, one being the rent from the house one owns. This argument has been rigorously presented by Buiter

(2008); see also Sinai and Souleles (2005). Buiter attributes the proposition that "housing wealth is not wealth" to Mervyn King (now Governor of the Bank of England) more than ten years ago.

Be this logic as it may, there is some empirical evidence that increases in housing wealth spill over into consumption of non-housing goods. In a very influential paper, Case *et al.* (2005) show among other things that, for the panel of U.S. states, the growth rate of retail sales is significantly related to the growth rate of housing wealth but not to the growth rate of stock market wealth, controlling for the growth rate of income. See also Carroll *et al*. (2006). More recently, Calomiris *et al*. (2009) have argued that these results are flawed by an endogeneity problem: the residuals in a consumption growth regression will correspond at least in part to current news about future income, which would separately influence both components of wealth. Re-estimating by instrumental variables, they find that the growth rates of stocks and income are statistically significant, but that the growth rate of housing wealth is not. Attanasio *et al.* (2009) conclude from study of British micro data that the evidence is more consistent with standard theory than with an unusual wealth effect from housing.

In this paper we take a slightly different line on the question: we ask whether increases in household tangible assets (80-90% of which is real estate) forecast future GDP growth (relative to trend), controlling for the set of variables suggested by conventional macroeconomic theory (monetary variables, wealth variables net of tax, government consumption). We find that the conventional variables do a very good job in forecasting the U.S. business cycle, including the most recent Great Recession, but that the addition of tangible assets adds little to the forecasts. This approach has the advantage that it concentrates on the variable of principal interest (real GDP) and allows avenues other than consumption demand (such as residential construction) to influence GDP.

The paper is organised as follows. In the next section we review the arguments for and against an important wealth effect from housing to demand. In Section 3 we develop the forecasting model for GDP growth, and see whether growth in housing wealth helps to forecast growth. Section 4 concludes.

2 CONSUMPTION AND THE HOUSING MARKET

Demand effects of an increase in house-prices. There is widespread contention that the recent boom in house-prices led to an increase in non-housing consumption, financed by tapping the increased equity in the family home – people remortgaged their houses to buy Hummers and Plasma TVs, so the story goes. This is also known as the house-as-an-ATM theory of consumption. The theory implies an opposite effect on demand when prices fell, and hence is of particular interest in the current recovery. From a permanent income hypothesis (PIH) perspective, however, it is not clear why this should be so. Consider the inter-temporal budget constraint of household *i*:

(2.1) $$NHA_i + p_H H_i = PV(c_i) + PV(p_h h_i)$$

where *NHA* is net non-housing assets (including the present value of labor income), *H* refers to quantities of housing owned, *c* is the stream of non-housing consumption,[2] and *h* is the stream of housing-services consumed. The prices p_H and p_h refer to the prices of houses and housing-services (rents or implicit rents) respectively. We assume non-housing assets create an income flow at rate ρ, which is the real interest rate used to compute present values. Assume households have preferences over consumption goods and housing-services and, in aggregate,

(2.2) $$p_H H = PV(p_h h)$$

[2] For the remainder of this section "consumption" means non-housing consumption. We emphasise that, as measured in the national accounts, consumption includes an estimate of the consumption of housing services.

i.e. the value of the housing stock is equal to the *PV* of the stream of rents it generates. We take the supply of houses fixed at *H*. The budget constraint then takes the aggregate form

(2.3) $$NHA = PV(C)$$

The aggregate non-housing budget constraint is thus independent of house-prices. Current non-housing consumption of the representative household depends only on *NHA*, and not on the path of house-prices, however these come about, since, for such a household, the flow of housing services is constant over time.

Though this deduction is elementary, it is odd that very few macroeconomists seem prepared to come out of the closet and state baldly that the baseline economic model predicts non-housing consumption is independent of the path of house-prices. By baseline economic model we mean the representative-agent-PIH framework where agents choose a path of consumption subject to an inter-temporal budget constraint, borrowing and lending at the market interest rate. Our own view is that this framework is the first port-of-call in considering a macroeconomic question and one goes to it to get the baseline prediction. It is true that the model is a simplification and that there may be macroeconomic phenomena that it cannot explain, in particular those arising from distributional effects and capital-market imperfections. We turn to these next.[3]

We have analyzed a Koopmans-Cass model with current utility taking the form

(2.4) $$u(c_i, h_i) = \log c_i + \alpha \log h_i$$

where α is a parameter measuring the taste for housing. We allow the initial endowment of housing and other assets to vary across households, as well as the inter-temporal discount rate for future utility δ_i. Note that δ_i is the marginal (and average)

[3] For a discussion of most of the points to be raised below, see Mishkin, 2007. Mishkin is determinedly in-the-closet with regard to the baseline model. He emphasises the demand effects of house-price bubbles, as we shall discuss below.

propensity to consume out of wealth in this model. We find aggregate (non-housing) consumption is given by

$$C = \sum_i \delta_i NHA_i + \frac{\alpha}{\alpha+1} NHA\, Cov(\delta_i, \pi_i^H - \pi_i^{NHA}) \quad (2.5)$$

where the two terms in π stand for the household's portfolio holding of houses as a proportion of all houses in the first case, and non-housing assets as a proportion of all such assets in the second case. The second term in the consumption function will vanish if δ_i does not vary over households (as in the representative agent model) or if households hold the market portfolio of assets ($\pi_i^H = \pi_i^{NHA}$). It is however natural to take the covariance term as negative, since the patient (low δ_i) will tend to be rich (since they accumulate wealth at rate $\rho - \delta_i$) and the rich tend to be long in houses.

The price of houses is endogenous in this framework: one finds that

$$p_H = \alpha NHA / H\,. \quad (2.6)$$

Since house prices are endogenous, one is not at liberty to vary them exogenously but one can consider the effect of an increase in prices caused by a shift in preferences towards housing i.e. an increase in α. Given that the covariance term is negative, such a shift in preferences would be accompanied by a *fall* in consumption. The logic is that the benefits of an increase in the price of houses flow to those who are long on housing: but this group has a lower marginal propensity to consume. The improvident are too busy trying to find the rent to think about Hummers. Note that, with stable preferences, an increase in house prices can arise in this model only if non-housing assets increase. Whether or not it is possible to sustain empirically the argument that the value of non-housing assets drove the recent price-boom is beyond our present scope. Let us note, however, that the consequences of a general increase in confidence in the future can easily lead an observer to give credence to the house-as-ATM-model. Following such an increase, households want more of both houses and Hummers. So the price of houses is bid up and, fortuitously, this provides collateral for the loan to buy the Hummer. An observer can conclude that house-prices went up and this led to extra consumption, but such an observer mistakes effect for cause.

There are arguments for a connection between house prices and consumption that attack the Koopmans-Cass prediction that the propensity to consume out of wealth is independent of the household's present circumstances. Consider a household with wealth comprised largely of future labor income which would like to consume more but has no collateral for loans. In these circumstances the household consumes all its net current income. Such a household will have already consumed all of the equity in any house it owns; an increase in house-prices will increase equity and thus enable increased consumption. What this overlooks is that the increase in house-prices will reduce the consumption of those who have similar future prospects but no home, since their rents will increase.[4] On balance, if this class is largely comprised of people at the beginning of their careers, it is surely likely that those without a home will outweigh those with a home.[5] A related argument is that an increase in house-prices guarantees the retirement income of householders and thus reduces their incentive to save: they plan ultimately to sell the family home and buy or rent a smaller property. This planned reduction in the quantity of housing services consumed creates a surplus which can be spent on current consumption. However the increase in wealth of this household from an increase in house-prices is offset by reductions in the wealth of those to whom the family home will be ultimately sold. Only if these households do not yet exist in the domestic economy will there be an increase in current consumption. As in the Ricardian debate, the net

[4] Note that "rents" here refers to current and future rents.

[5] This reservation would seem to apply as well to models that have some households confronted by higher interest rates because of low collateral, as in Aoki *et al.*, 2002.

effect can turn on the extent to which households seek to guarantee the living standards of their dependent children, and could go either way.

A common objection to this reasoning is the asymmetry between housing wealth and financial wealth: why should the same arguments not apply to the latter? The distinction is that an increase in stock market wealth implies an increase in expected future income, which agents can begin to consume ahead of time without violating their inter-temporal budget constraints.[6]

One avenue for an increase in housing wealth to have real effects is via reduced lending risk. When borrowers have substantial equity in their homes, they face lower interest rates on their borrowings, since the lender is protected from losses arising from debtor-flight or bankruptcy. This should lead to lower equilibrium interest rates, likely to lead in turn to increased consumption. This is analogous to an exogenous increase in honesty throughout the economy, which allows resources to be directed away from the prevention of malfeasance to the satisfaction of fundamental wants. It may be that this is a second-order phenomenon.

Price bubbles imply results more in line with the house-as-an-ATM theory.[7] Write the aggregate budget constraint in the form

(2.7) $$NHA + (p_H H - PV(p_h h)) = PV(C)$$

The term on the left in brackets is the difference between the market value of the housing stock and the present value of the stream of rents it generates. Previously we assumed this was zero but one can take it as a plausible measure of a housing bubble. An increase in

[6] But where would the increased consumption goods come from, if income increases only in the future? To avoid complications associated with varying real interest rates, one could assume a small open economy, for which the real interest rate is parametric. In this case, the consumption goods can be imported, the foreign debt thus incurred being repaid when the future income arrives.
[7] See Barlevy, 2007, for a general review of the theory of bubbles in asset prices

the value of a bubble unambiguously increases wealth to be set against consumption.[8] The ratio of household tangible assets to GDP appears to have been about 20% above trend in 2005 – assume this was all a bubble. Since tangible assets are about two units of GDP and the average marginal propensity to consume out of wealth might be of the order 0.02, the bubble would have added to consumption about 0.8% of GDP in 2005.

The problem we see with the bubble theory of consumption is not that a large part of house-price booms can be sustained by buying pressure from those who extrapolate price increases into the future, but rather that the capital-gains expected by this class of traders would not in practice have a large effect on the demand for *other* goods. If a home-owner plans not to sell, then price increases have no effect on the wealth to be set against consumption of other goods. The increase in the perceived wealth of bubble-traders follows from the presumption that they can unwind their position ahead of a return to fundamentals. They are thus required to take a gamble on house-prices, financed perhaps by leveraged loans, and then to buy Hummers etc. in anticipation of a killing. This would be bold stuff, but surely not typical, even of bubble-traders.

In summary, there is no compelling theoretical reason to expect a change in house-prices of itself to lead to increased or reduced consumption of other goods. In the simple baseline case, there is zero net effect. In the case of liquidity-constrained households, the net effect depends on the proportion of such households owning a house. In the case of households planning ultimately to reduce consumption of housing, the net effect may well be zero, once account is taken is taken of those to whom the house will be sold.

Greenspan and Kennedy (2007) have written an influential paper analysing the uses of equity withdrawn from houses, either when they are sold or as a result of re-

[8] Note that the introduction of exogenous bubbles enables one to consider the effect of increases in house-prices holding constant preferences and non-housing assets, as we were unable to do in the Koopmans-Cass model.

financing.[9] They find that equity withdrawal at the peak of the recent boom (2001-2005) was used to finance about a 1% increase in personal consumption expenditures, compared to the average 1991-2000 (see their Table 2, page 19). Although they specifically exclude interpretation of these results as bearing on the general level of consumption, the findings have been widely seen as evidence for the house-as-ATM theory. This interpretation is dubious. Firstly about two-thirds of equity withdrawal comes at the sale of houses, hardly an ATM transaction. Houses are sold for reasons which are themselves likely to influence consumption of other goods. If a larger house is bought, this indicates an increase in the consumption of housing services, the choice of which would normally be accompanied by the choice of increased consumption of other goods. Both might follow from the prospect of increases in income (e.g. an expanding business or a return to the workforce). This argument applies, perhaps with less force, to re-financing: the precipitating cause may influence consumption directly. Of its nature the sample excludes those home-owners who do not sell or re-finance and, *a fortiori*, those households not owning a house. The inclusion of these would water-down the effect on aggregate consumption. Indeed, exclusion of those short on housing in principle removes from consideration the group with the countervailing negative income effect from an increase in house-prices. Rents as a proportion of average hourly earnings were on average 8% higher 2001-2005 than 1991-2000, suggesting a substantial negative effect on consumption for that third of American households not owning a house.[10]

The discussion so far has been concerned with the effects of house-prices on consumption, but another avenue for them to influence demand is via residential

[9] The paper also contains a useful review of the general literature on the relationship between housing wealth and consumption.

[10] HUD for rents, BLS for earnings. There is no trend in this ratio since the millennium. Presumably increased house-prices pull in one direction, excess supply of rental accommodation pulls in the other. HUD data show that in 1995 only one in four new rental apartments took longer than three months to fill; by 2007, this had risen to one in two.

investment, i.e. the construction of new homes. At first sight it seems obvious that house-building arising from an increase in prices will add to demand, but account must be taken of reduced output in other capital-goods industries, in particular non-residential construction. Table 1 compares residential and non-residential construction over the period of the largest increase in house-building, 2001-2005, and the subsequent collapse.

Table 1: Components of construction as a per cent of GDP

	Residential	Non-residential	Total
Change 2001-2005	0.9	-0.8	0.1
Change 2005-2007	-1.5	0.4	-1.1

Between 2001 and 2005, housing investment increased by 0.9% of GDP, but this was accompanied by a fall of 0.8% in non-residential construction, so the net effect was close to zero. One can also observe crowding-in of non-residential investment 2005-2007 which increased its share of GDP, despite the looming recession.

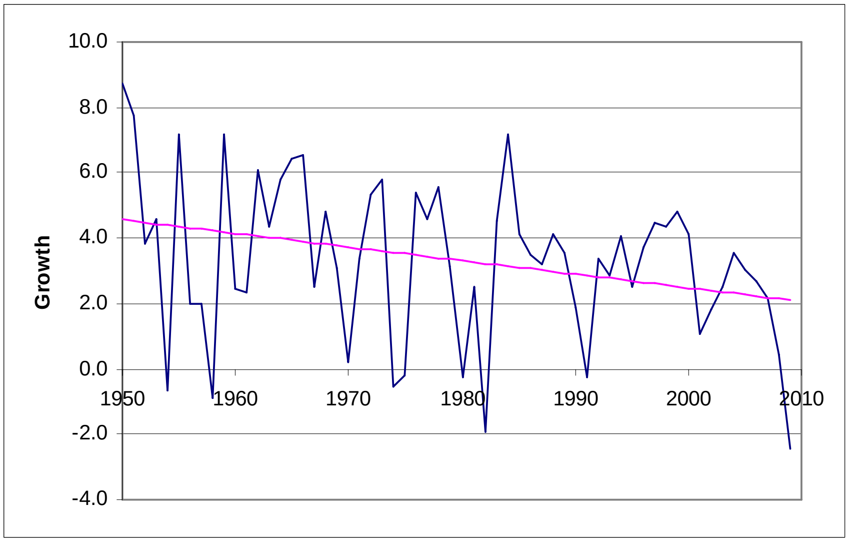
3. FORECASTING U.S. GROWTH

3.1 *The Forecasting Equation*. In this section, we ask whether increases in household tangible assets forecast future GDP growth relative to trend, controlling for the set of variables suggested by conventional macroeconomic theory. Growth and trend growth are set out in Figure 1. Trend growth was high on average (of the order of 4% per annum) in the ‘50s and ‘60s, declining to under 3% in current times.[11] The variance of growth about trend is noticeably smaller after the mid-‘80s (“the Great Moderation”); the largest

[11] Gordon (2008), using a substantially different methodology, finds a 2.8% growth rate in potential GDP for 1997-2007 (see especially Figure 1 in his text). Furthermore, and primarily due to demographic changes, he predicts the growth rate to fall to 2.4% for the next two decades.

events in the growth data are the severe recessions prior to 1960, the recessions in the mid ‘70s and early ‘80s, the mid ‘80s boom, and the current recession.

Figure 1: Growth and Trend Growth in Real GDP, 1950-2009



We shall first estimate a forecasting model of aggregate annual U.S. growth relative to trend (the ordinate differences in Figure 1) based on the demand components of GDP.[12] Specifically, we focus on the determinants of consumption, investment and government spending, ignoring the foreign sector.

Consumption. Keynesian approaches to the consumption function emphasise current income as the key variable, while PIH models emphasise forward-looking agents who base consumption decisions on wealth, the present value of all current and future income. We shall use for forecasts both the growth rates of real disposable income per capita and real financial assets net of liabilities. The latter variable corresponds to the present value of after-tax future profit income. Note that for a production technology with constant shares to the factors, in a PIH model this would be as well a perfect index of after-tax labor income.

[12] One could estimate the model below in quarterly data. However for most purposes one is interested in the growth prospects averaged over some such period as a year.

Investment. The central determinant of aggregate investment expenditure is the vector of current and future real interest rates applying to the various categories of investment. We shall assume the effects of this vector are represented by the federal funds rate relative to the current inflation rate, the spread between BAA and AAA corporate bonds, and the current inflation rate. We interpret the federal funds rate as the risk-free rate, the corporate spread represents risk, and the inflation rate is a predictor of future monetary policy. Leamer (2007) has emphasised the importance of residential investment and housing starts in forecasting recessions. In our framework, this correlation would most likely be expressed by these determinants of interest rates. (See the discussion of Leamer's paper by Smets, 2007.)

Government spending. The demand effect of government spending will be represented by the proportion of total government consumption and investment as a proportion of GDP.

Natural adjustment to equilibrium. The final predictor we consider is the unemployment rate, considered as a measure of macroeconomic disequilibrium. In the absence of macroeconomic disturbances, one might expect disequilibrium to be eliminated as prices adjust by natural means, given sufficient time. Thus, if the unemployment rate is high, future growth should be high, *ceteris paribus*. Proponents of stabilisation policy, Keynes included, typically argue that such forces exist, but act very slowly.

Column 1 of Table 2 sets out forecasting equations for real GDP growth relative to a linear trend, based on the variables we have discussed above.[13] All explanatory variables are dated $(t-1)$. To save on degrees of freedom, we have allowed ourselves some specification search to determine the time filters imposed on some of the explanators. Thus the fact that the federal funds rate appears as a *difference* was suggested by preliminary experiments; in contrast, the effects of the risk spread, the

[13] Other methods of obtaining a trend growth rate are possible, such as that derived from the CBO's potential real output series. As far as we know, estimates and conclusions are not sensitive to this.

inflation rate and the unemployment rate appear to be well represented by their *levels* at $(t-1)$.

Table 2: Forecasting Equations for Growth, 1956-2009

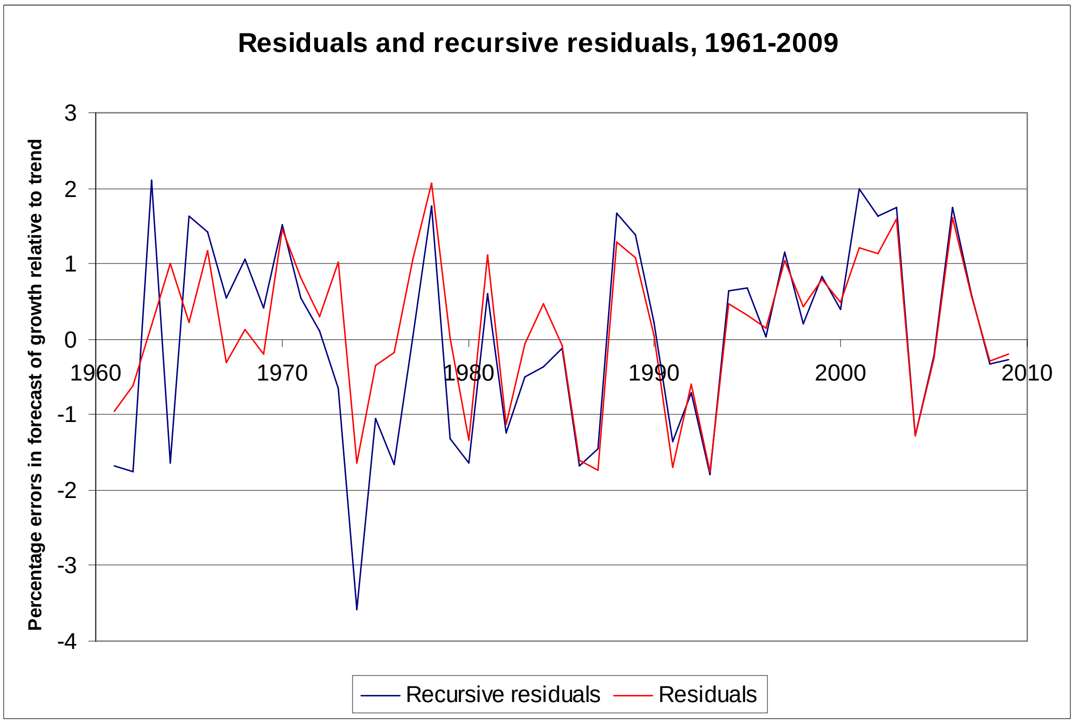
Explanatory Variable	Real GDP growth rate rel. to trend	Real GDP growth rate rel. to trend
Constant	-4.29 (3.8)	-4.45 (3.8)
Federal Funds Rate real, change	-0.45 (3.7)	-0.45 (3.9)
BAA-AAA spread	-1.32 (2.3)	-1.29 (2.3)
Inflation rate	-0.18 (2.6)	-0.19 (2.9)
Financial Assets/head, real, growth rate	0.15 (5.2)	0.14 (5.2)
Disposable income/head, real, growth rate	0.37 (4.0)	0.31 (3.3)
Govt expenditure/GDP change	0.28 (0.7)	0.28 (0.7)
Unemployment rate	0.85 (4.0)	0.87 (4.0)
Tangible assets Real, growth rate	-	0.06 (1.3)
Standard error of regression	1.25	1.25
R^2	0.72	0.73
Durbin-Watson	1.51	1.49

Note: absolute *t*-values in brackets. HAC (Newey-West) standard errors

The regression R^2 is high for a rate-of-change dependent variable and the *F*-statistic for the whole regression is 16.7, significant at any conventional level. All variables have the expected signs and are significant at the 5% level except for the government spending variable.

Figure 2 gives residuals and recursive residuals, 1961-2009. Recursive residuals are the one-step-ahead forecast errors for the model estimated up to each date; thus the fit exploits only knowledge available from correlations observed up to that date. From about 1980 residuals and recursive residuals are substantially the same, an indication of parameter stability over this period. Recessions are fairly well predicted; the last three years, 2007-9 are very accurate. Fitted to 2008, the model forecasts a fall in output of 2.1% in 2009, compared to an outturn of -2.4%. The fall in the real value of 25% of real financial assets per capita 2007-8 contributed a fall of about 3.7% of units below trend in 2009, while the increase in the risk premium of about 100 basis points contributed approximately 1.3%. The model predicts real growth of about 3.3% for 2009-10.

Figure 2: Residuals and Recursive Residuals, 1961-2009.



.We measure housing wealth by tangible assets, typically split around 85:15 between real estate and consumer durables. Column 2 gives the forecasting equation with the inclusion of the growth rate of real tangible assets. One sees that the associated parameter is not significant at conventional levels. At the estimated value, tangible assets contributed about half a percentage point to growth in the boom years 2005-6 and reduced growth by about a third of a point in the bust years 2008-9. These effects are not trivial, but are an order of magnitude less than the contribution of financial assets.

We have used this framework to test whether other variables sometimes said to be important over the business cycle play a separate role in forecasting growth, controlling for the variables in column 1. One such is the price of oil: see Hamilton, 1983, 2003, 2009. We find that the lagged growth rates of both the real price of energy and the tax and import price wedge receive t-statistics of 0.2 and 1.5, respectively. The lag of the growth rate of consumer confidence receives a t-stat of 1.2. This set of variables does not provide compelling reasons to abandon the simpler formulation.

As for the statistical adequacy of the model in column 1, neither the Q-test nor the Breusch-Godfrey test suggests any evidence of serial correlation. The ARCH LM test of serial correlation of error variance has a *p*-level of 0.03, suggesting some persistence in the magnitude of the error variance. The Ramsey RESET test of general misspecification has a *p*-value of 0.7. With regard to parameter stability, the Chow test with the sample split midway gives an *F*-statistic with a *p*-value of 0.23; Chow forecast tests with breaks at 1998 and 1988 are easily passed as well. Both the CUSUM and the CUSUM of squares statistics lie within two-standard-error bands over the whole sample. We find that the recursive residuals have *p*-values smaller than 0.05 only once.

Table 3 examines directly the question of whether the growth rate of real tangible assets helps to predict next year's consumption growth. We report the parameter estimates for this variable; the regressions include as well the two wealth variables from Table 2 (the growth rates of financial assets and disposable income) and allow for an AR(1) residual. One sees there is little evidence for a separate effect from tangible assets on consumption, controlling for disposable income and financial wealth.

Table 3: Forecasts of Consumption and its Components, 1956-2009: The Effect of Tangible Assets

Consumption/head, real, growth rate	0.053 (0.8)
Consumption of durables/head Real, growth rate	-0.015 (0.1)
Consumption of non-durables/head Real, growth rate	0.044 (0.5)
Consumption of services/head Real, growth rate	0.006 (0.2)

Note: absolute t-values in brackets

4. CONCLUSION

There is no serious doubt that the Great Recession had its origin in the housing market. The question addressed in this paper is the transmission mechanism i.e. whether toxic assets created a financial panic impinging on financial wealth and real interest rates via the risk premium; or whether the fall in house prices caused consumers to cut back on their non-housing consumption expenditures. We find that between 1956 and 2009, financial assets and the risk premium are significant forecasts of growth, but that growth on tangible assets is not. This evidence is in favor of the former explanation. There appears to be no compelling reason to allocate a special role in the U.S. business cycle to the evolution of house prices.

DATA

Components of the national accounts were taken from NIPA tables at the Bureau of Economic affairs website. In general, to turn nominal variables into real, we use the consumption deflator from this source. Household balance sheets were taken from the FRB Board Flow of Funds Accounts of the United States at the site www.federalreserve.gov/releases/z1/Current/data.htm. Monetary and interest rate variables were taken from the FRED site at the Federal Reserve at St Louis.

Primary Variables

Variable (symbol)	Notes	Source
Real GDP (*yr*)	Annual, at 2005 prices	NIPA: BEA
Nominal GDP (*yn*)	Annual	NIPA: BEA
Consumption deflator (*pc*)	Annual	NIPA: BEA
GDP deflator (*py*)	Annual	NIPA: BEA
Price of energy (*pen*)	Annual	Economic Report of the President
Federal funds rate (*r*)	Effective rate. Annual averages of monthly values	FRED
Aaa corporate bond yield (*aa*)	Annual averages of monthly values (percent)	FRED
Baa corporate bond yield (*ba*)	Annual averages of monthly values (percent)	FRED
Household assets (*ha*)	Assets of households and nonprofit organisations, observed at fourth quarter	Flow of Funds Accounts of the United States
Household tangible assets (*ht*)	Tangible assets of households and nonprofit organisations, observed at fourth quarter	Flow of Funds Accounts of the United States
Household liabilities (hl)	Liabilities of households and nonprofit organisations, observed at fourth quarter	Flow of Funds Accounts of the United States
Personal disposable income (*pi*)	Personal disposable income, annual	NIPA: BEA
Government expenditure (*g*)	Expenditure on consumption and investment, annual	NIPA: BEA
Unemployment rate* (*ur*)	Annual average of monthly rates	FRED
Population (*pop*)	Population of the United States, annual	U.S. Census Bureau

Constructed variables

Variable (symbol)	Construction
Growth rate (*gr*)	$100 \times (yr_t / yr_{t-1} - 1)$
Trend growth rate (*grtr*)	Linear trend fitted to *gr*, 1950-2009
Growth relative to trend* (*grreltr*)	$gr_t - grtr_t$
Inflation* (*inf*)	$100 \times (pc_t / pc_{t-1} - 1)$
Real federal funds rate (*rr*)	$r_t - inf_t$
Change in real FFR* (*drr*)	$rr_t - rr_{t-1}$
Corporate risk index* (*corprisk*)	$ba_t - aa_t$
Household real financial assets (*hfinr*)	$(ha_t - ht_t - hl_t) / pc_t$
Household real tangible assets (*htr*)	*ht*/*pc*
Growth rate of real tangible assets (*dhtr*)	$100 \times (htr_t / htr_{t-1} - 1)$
Growth rate of U.S. population (*dpop*)	$100 \times (pop_t / pop_{t-1} - 1)$
Growth rate of real financial assets per head* (*dpop*)	$(100 \times (hfinr_t / hfinr_{t-1} - 1)) - dpop_t$
Real personal disposable income (*rpi*)	pi_t / pc_t
Growth rate of real PDI per head* (*drip*)	$(100 \times (rpi_t / rpi_{t-1} - 1)) - dpop_t$
Share of government in GDP (*gsh*)	$100 \times g_t / yn_t$
Change in government share* (*dgsh*)	$gsh_t - gsh_{t-1}$
Tax and import price wedge (*wdg*)	*pc/py*
Real price of energy (*rpen*)	*pen/pc*
Growth rate of wedge (*dwdg*)	$100 \times (dwdg_t / dwdg_{t-1} - 1)$
Growth rate of real price of energy (*drpen*)	$100 \times (rpen_t / rpen_{t-1} - 1)$

* Variables included in main regression.

REFERENCES

Attanasio, O., Blow, L., Hamilton, R., and A. Leicester (2009). "Booms and Busts: Consumption, House Prices and Expectations," *Economica*, 76, 20-50.

Aoki, K., Proudman, J., and G. Vlieghe (2002). "House Prices, Consumption and Monetary Policy: A Financial Accelerator Approach." *Working Paper*, Bank of England, London.

Barlevy, G. (2007). "Economic Theory and Asset Bubbles." *Economic Perspectives*, Federal Reserve Bank of Chicago, Q III: 44-59.

Buiter, W. (2008). "Housing Wealth Isn't Wealth," NBER *Working Paper*, No.14204.

Carroll, J., Otsuka, M., and J. Slacalek (2006) "How Large is the Housing Wealth Effect? A New Approach", NBER, *Working Paper* No 12746.
.

Case, K., Quigley, J., and R. Shiller (2005). "Comparing Wealth Effects: The Stock Market versus the Housing Market." *Advances in Macroeconomics*, 5, pp. 1-34.

Calomiris, C, Longhofer, S., and W. Miles (2009). "The (Mythical?) Housing Wealth Effect" *Mimeo*.

Greenspan, A. and J. Kennedy (2007). "Sources and Uses of Equity Extracted from Homes." *Staff Working Papers* No 2007-20, Finance and Economics Discussion Series, Division of Research & Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C.

Gordon, R. (2008). "The Slowest Potential Output Growth in U.S History: Measurement and Interpretation." Presentation at SCIP Symposium on *The Outlook for Future Productivity Growth*, Federal Reserve Bank of San Francisco, November 14.

Hamilton, J. (1983) "Oil and the Macroeconomy since World War II," Journal of Political Economy 91 (April 1983): 228-248.

Hamilton, J. (2003). "What is an Oil Shock?" *Journal of Econometrics*, 363-98.

Hamilton, J. (2009). "Causes and Consequences of the Oil Shock of 2007-2008," *Discussion Paper*, University of California San Diego.

Leamer E. (2007). "Housing *IS* the Business Cycle." In Federal Reserve Bank of Kansas City, *Economics Symposium, Housing, Housing Finance and Monetary Policy*, Jackson Hole, pp. 149-233. Smets's commentary pp. 235-243.

Sinai, T. and Souleles (2005) *"Owner-Occupied Housing as a Hedge Against Risk"*, *Quarterly Journal of Economics*, 129, 763-789.

Taylor John B (1980) "Aggregate Dynamics and Staggered Contracts" *The Journal of Political Economy*, Vol. 88, No. 1 (Feb., 1980), 1-23