The Moody's Analytics Case-Shiller Home Price Index Forecast Methodology

ICAAP Workshop, JPMorgan Chase

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Why Do Housing Prices Matter? -1

Housing is a Large and Important Part of the Economy

Housing plays a major role in the growth of the United States economy. Housing contributes to both the **investment** and **consumption** components of the GDP, through **residential construction** (investment) and the **services** provided by existing housing units (consumption).

Historically, residential construction has contributed about 5% of GDP while housing services have averaged between 12 and 13 percent of the GDP. These proportions tend to vary over the business cycle. Housing's contribution to the GDP depends on the stage of the housing cycle. [2]

During the recent downturn, residential fixed investment (RFI) peaked at 6.3 percent of GDP in the fourth quarter of 2005—the highest level since 1951—and then plummeted to a record low of just 2.4 percent in the second quarter of 2009.[2]

Housing is a Leading Indicator of the Economy

Historically, changes in residential fixed investment (RFI) have contributed significantly to both pushing the economy into recession and lifting it out.

- Since 1947, drops in RFI have shaved off an average of one-quarter of a percentage point from the percentage change in real GDP in the two quarters leading up to contractions and one percentage point from the percentage change in real GDP in the first quarter of contractions.
- During the first two quarters of each recovery since 1947, RFI growth contributed an average of 1.3 percentage points of the percentage growth in GDP. With total GDP growth averaging 6.9 percentage points, RFI growth alone constituted an average of 19 percent of GDP growth in these periods.
- These impacts represent only the direct contributions of changes in RFI to GDP growth. Indirect multiplier effects created by spending income earned from RFI magnify its impacts going into and coming out of recessions. In addition, when home prices turnaround, pressure on bank balance sheets eases and the depressing impact of falling prices on consumer spending turns positive.

[1] NAHB.org "Housing and GDP"
[2] Joint Center for Housing Studies of Harvard University, August 2009

Why Do Housing Prices Matter? -2

"A house is the largest single asset of most households, and assets whose value is linked to residential real estate represent an important component of the aggregate portfolio of financial intermediaries. The behavior of house prices, therefore, influences not only business cycle dynamics, through their effect on aggregate expenditure, but also the performance of the financial system, through their effect on the profitability and soundness of financial institutions. Understanding this behavior is thus of key interest to central banks charged with maintaining price and financial stability."

[1] Tsatsaronis and Zhu) "What Drives Housing Price Dynamics: Cross-Country Evidence."
   Bank for International Settlements Quarterly Review (Mar. 2004): 65-78. 15 Dec. 2008 https://www.bis.org/publ/qtrpdf/r_qt0403f.pdf.

Why Do Housing Prices Matter to JPMC?

Housing is a Large and Important Part JPMC's Balance Sheet and Income
Housing impacts JPMC's income and balance sheet, impacting loss forecasting, reserving and capital requirements.

Income is derived from the following sources:

New Mortgage Lending and Refinance. Record low rates spur refinance activity, but economic factors such as unemployment and uncertain future prospects may slow new mortgage lending growth.

Mortgage Servicing Rights – Mortgage origination creates a mortgage servicing asset, an approximately ~13$ billion book of business. Servicing income derived from both Base and Excess servicing. The servicing asset is retained, no market for sale, adversely affected by default and foreclosure costs which have soared over the past year.
Q32011 Net corporate profit was $4.26 BN, roughly 5% of this from loan production net of losses due to repurchase (314M) and servicing losses (153M).

Balance Sheet
Nominal House Prices Rising: LTV declines, subprime borrowers can refinance or sell
Nominal House Prices Falling: When prices fall enough so that the outstanding mortgage balance plus the costs of selling exceeds the proceeds from a sale, borrowers in trouble cannot sell their way out of it. As prices fall further and more homeowners cannot sell their way out of trouble, lender losses become greater because larger shares of loans default and the amounts lenders can recoup after foreclosing on a property and selling it become smaller.

What Factors Drive Home Price Dynamics?
Supply vs Demand

Driver	Factor
Economic	Includes short and long term interest rates, inflation rates, unemployment rates, expectations of job creation, equity markets, government programs, supply and demand, building permits, home prices, home sale, consumer preferences, business cycle factors (supply of foreclosed homes in a market), regulation, expected home price growth, consumer confidence
Demographic	Population growth, aging, immigration
Financial	Housing affordability, mortgage rate, availability of credit/lenders underwriting standards, real personal disposable income, risk adjusted return to housing and other household assets, taxes (user cost of housing)

Forecasting Home Price Growth - 1

| Method	Description	Pros	Cons
Econometric	Forecast based on time series of home prices	Relatively simple to implement	Relies on history, can't predict events that haven't happened, etc
Leading Indicator	A leading indicator predicts future economic activity, turning down before the economy enters a recession and up before the expansion begins. Applied to Home Price Forecasts, leading indicators are used to econometrically identify variables that have historically led changes in housing values (eg: intention to build in the future measured by building permits/housing starts)	Given good information on indicators with strong predictive value, the leading indicator approach should be relatively easy to implement.	Drawbacks include identification of leading variables, structural models may perform poorly as forecasting tools as such models required projective future values of the exogenous variables. Uses historical values to forecast future. Muticollinearity, number of lags to use etc.
Structural	Considers market fundamentals. In structural econometric models, economic theory is used to develop mathematical statements about how a set of observable "endogenous" variables, y, are related to another set of observable "explanatory" variables, x. May involve statistical assumptions regarding joint distributions between variables and unobservables.	Considers market fundamental, can , provide the magnitude and timing of a change in house price in addition to the direction of that change.	Forecasts are only as accurate as the forecasts of the drivers, cannot predict events that haven't already happened, may not include all factors affecting housing demand, supply and prices. The fact that a structure is defined does not mean the model is valid, regime shifts etc.

A History of Home Values

The Yale economist Robert J. Shiller created an index of American housing prices going back to 1890. It is based on sale prices of standard existing houses, not new construction, to track the value of housing as an investment over time. It presents housing values in consistent terms over 116 years, factoring out the effects of inflation.

The 1890 benchmark is 100 on the chart. If a standard house sold in 1890 for $100,000 (inflation- adjusted to today's dollars), an equivalent standard house would have sold for $66,000 in 1920 (66 on the index scale) and $199,000 in 2006 (199 on the index scale, or 99 percent higher than 1890).

DECLINE AND RUN-UP Prices dropped as mass production techniques appeared early in the 20th century. Prices spiked with post-war housing demand.

BOOM TIMES Two gains in recent decades were followed by returns to levels consistent since the late 1950's. Since 1997, the index has risen about 83 percent.

JULY 2006
CURRENT BOOM

WORLD WAR I
GREAT DEPRESSION
WORLD WAR II
1970'S BOOM
1980'S BOOM
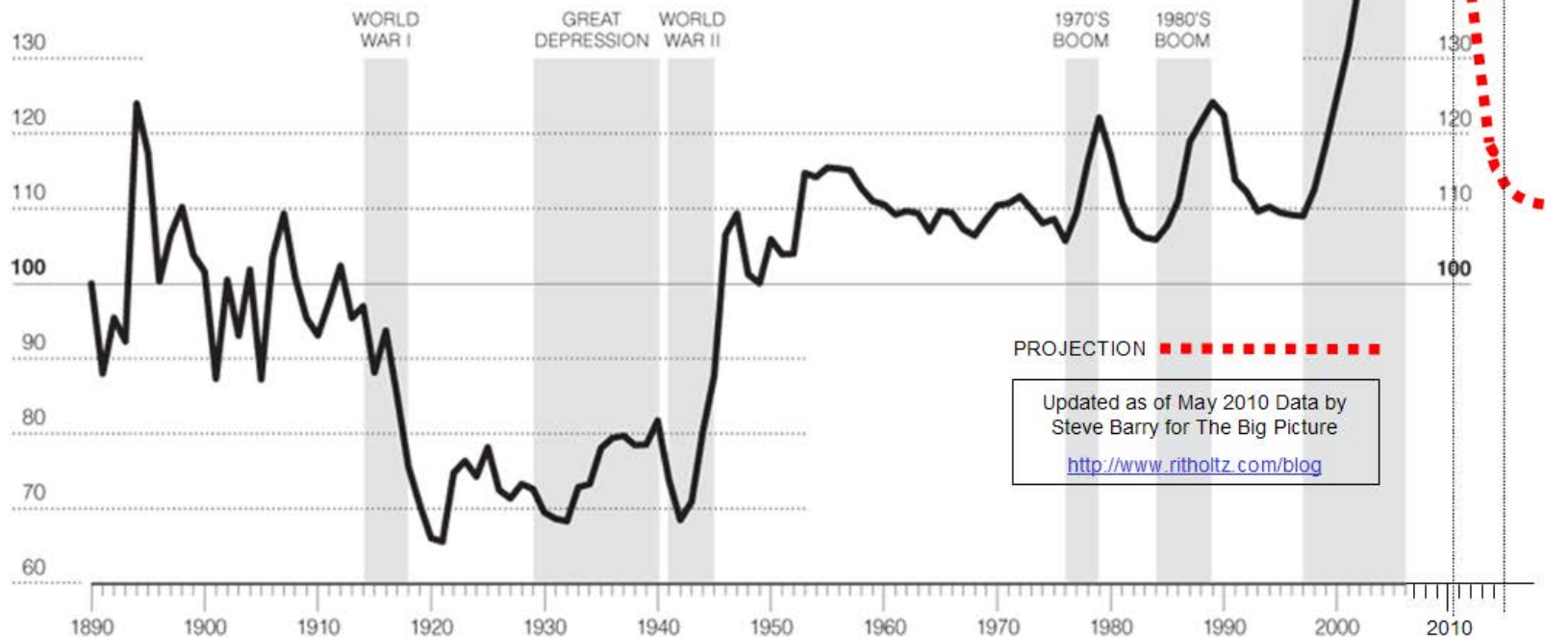
PROJECTION ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

Updated as of May 2010 Data by Steve Barry for The Big Picture

http://www.ritholtz.com/blog

Source: "Irrational Exuberance," 2nd Edition, 2006, by Robert J. Shiller

Bill Marsh/The New York Times

Steve Barry New York Times.

Case-Shiller National Index vs S&P500 USGG30YR, Dec2006 - Dec2011

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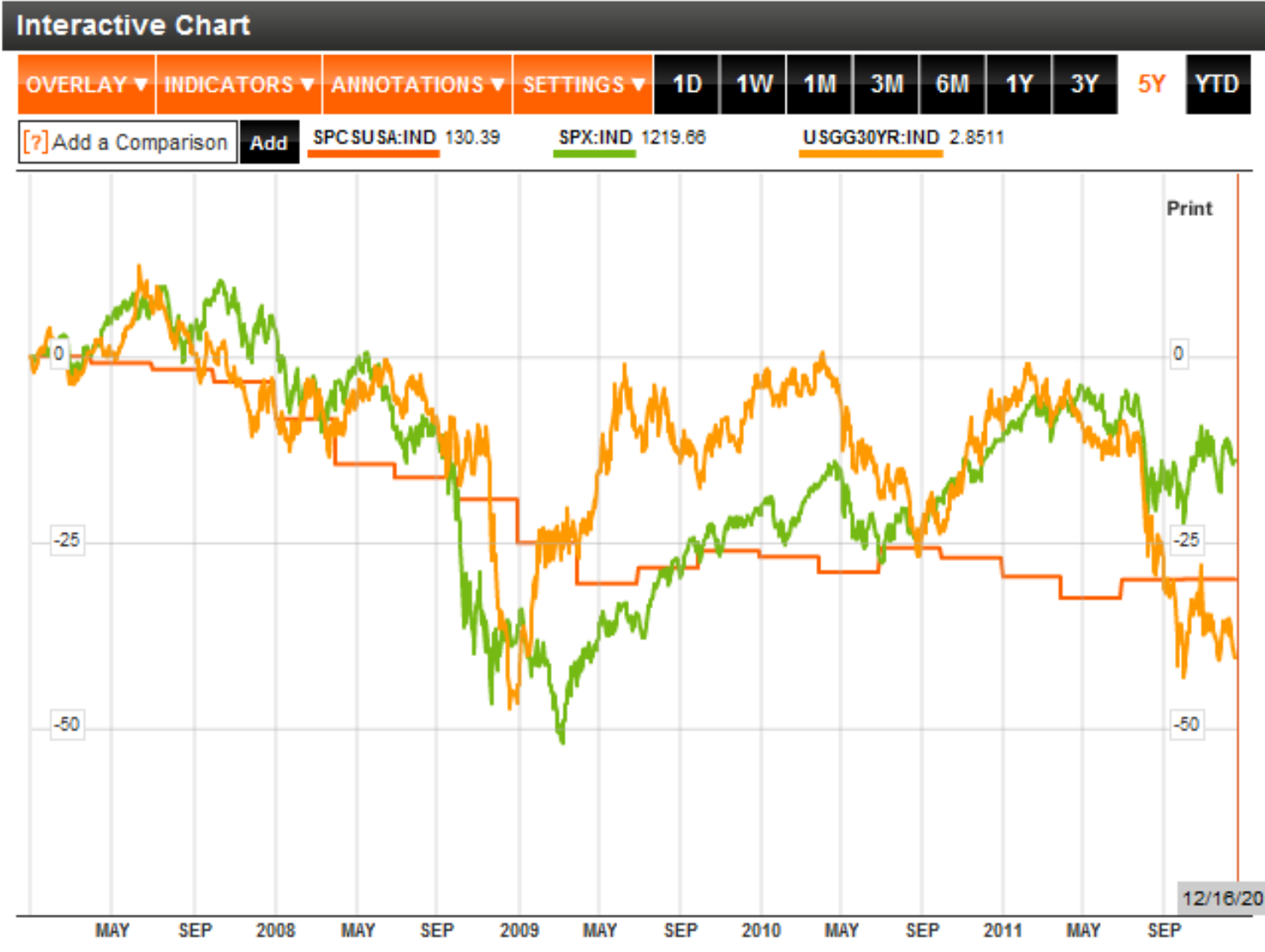
Forecasting Home Price Growth - 2

Moody's HPI Forecast is based on Case-Shiller Indices and combines structural and econometric methods in a "structural econometric" model. Case-Shiller provides historical data, Moody's overlays a forecast based on this data. *The general approach of Moody's Analytics is to rely primarily on the results of a fully specified structural model while incorporating adjustments based on information from leading indicators and other models as well as forward-looking changes in housing policy, mortgage markets and consumer preferences.*

Case-Shiller Indices based on repeat sales of the same home. This allows control for home quality. The index family includes a National Index, Composite and City Indices.

The National Index is based on nine US Census divisions. Trades as a forward OTC instrument under the indicator SPCSUSA . Coverage goes beyond the 20 MSAs making up the composites.

Composite and City Indices: Twenty Metropolitan Area indices and two composite indices as aggregates of the metropolitan areas (CSXR: 10 top Metropolitan Statistical Areas and SPCS20R, 20 top MSAs, ranked by population.)

The indices are normalized to have a value of 100 in Q1:2000 and are three month moving averages. They are updated monthly.   Value weighted repeat sales transactions (no appraisal bias), filter out non-arms length sales. Scenarios are updated quarterly

Forecasting Home Price Growth - 3

Overview of Moody's Structural Econometric Model of Housing demand, supply and price

- Allows for serial correlation and mean reversion.
- Mean reversion implies that in the long run, housing markets move towards equilibrium values based on fundamental supply and demand factors.
- **Reduced Form of Long Run Housing Supply and Demand.** In each metro area k and each time period t, it is assumed that there is a long run equilibrium value for the unit price P^*_{tk} of housing space determined by $P^*_{tk} = f(x_{tk})$ where x_{tk} is a vector of explanatory variables affecting either supply or demand. The dependent variable in the model is log of real house prices from the Case-Shiller Index (CSI) .
- **Explanatory Variables** can include factors such as real household income, real household non-housing wealth, population growth, age and ethnic composition of the population, regulatory conditions, structural changes in lenders' underwriting standards, consumer preferences, and the long-run, risk-adjusted return to housing and other household assets.

Model Methodology: Moody's Analytics' metro area house price model is a structural econometric model of housing demand and supply that allows for serial correlation and mean reversion. The model is estimated as an error correction model, pooling metro area data over 33 years of history, using a fixed effects panel regression. It allows for metro area-specific effects as well as broader region-specific relationships (East Coast, Florida, South ex-Florida, California, West Coast ex-California, Mountain West and Inland) between house prices and driver variables. The driver variables for the price forecasts are all forecasted in Moody's Analytics' simultaneous equation macroeconomic model and large scale regional economic forecast models.

Forecasting Home Price Growth - 4

- For example for Q4 2010, the sample included 121 quarterly observations from 1980 – 2010, using pooled ELGS method on cross sectional weights to estimate
- $P^*_{tk} = f(x_{tk}) = 2.2874 - .0032\beta_1 + \ldots + 0.0351\chi_1 + \ldots + .0017\delta_1 + \ldots + 0.9327\varepsilon_1 + \ldots + 0.6402\phi_1 + \ldots$ where β_1 = market portfolio vs. housing returns, East Coast; χ_1 = HELOC share of bank assets, East Coast; δ_1 = vacation home share interacted with pop share ages 50-64, East Coast; ε_1 = log 5-year population growth, Florida; ϕ_1 = log real per capita income, East Coast, etc. In total 134 cross sections were included with $R2 = 0.935$, standard error of regression 0.130 and F statistic = 1411

Historical Data The structural model is based on Case-Shiller repeat-purchase home price index. Combines house price data with other historical housing market, economic and demographic data measured at national, state and metro area levels.

Equilibrium Equation
- The model estimates the equilibrium equation in two steps.
- **Stage 1:** The equilibrium house price P^*_{tk} is estimated.
- **Stage 2:** Change in real house prices is estimated via adjustment equation

$$\Delta P_{tk} = a_k \Delta P_{t,k-1} + b_k(P^*_{t-1,k} - P_{t-1,k}) + c_k \Delta P^*_{tk} + D_{tk}$$

where the first term a_k is the serial correlation coefficient, b_k is the rate of mean reversion, c_k is the immediate adjustment to changing fundamentals. D_{tk} is a vector including various business cycle factors.

Forecasting Home Price Growth - 5

The most important explanatory variable in the equilibrium house price equation, P^*_{tk} was real per capita income, particularly in the East Coast, Mountain, and Pacific Northwest regions.

Price Elasticity On average, a 1% increase in real per capita income in a metro area in these regions leads to an approximately nine-tenths of a percentage point increase in real house prices. This means that households are buying 9% more housing when incomes rise 10%. Equilibrium house prices have also been affected by a significant shift in mortgage lending underwriting standards in recent years. (During the boom years for housing, subprime and alternative-A mortgages, interest-only, and option ARMs grew rapidly along with second liens and home equity lines of credit, expanding the availability of mortgage credit to households that did not previously have access to any type of credit; HELOCs, piggy back loans etc. also made expensive homes available to borrowers who might not otherwise have access to these, resulting in reduced down payment and avoidance of PMI.)

Forecasting Home Price Growth - 5

How well does the model work?

<u>Validation</u>: The model was validated by determining the degree to which metro area house prices were overvalued or undervalued in the late 1980s, and comparing this to actual house price performance through the early 1990s. This historical period was chosen to validate the model as it is the last time house prices rose sharply in large parts of the country and were subsequently followed by sharp price declines. For the purpose of comparison, price dynamics during the recent subprime mortgage lending crisis are also included. House price overvaluation and actual price performance from 2006 to present are included even though the price correction continues.

<u>Calibration</u>: The housing market is a complex interaction of supply and demand forces with transactions costs, regulations and policies that can also influence both the equilibrium values and the speed at which a market reaches equilibrium. The models are based on the historical relationships between factors and therefore will not fully capture broader macroeconomic trends within the economy nor will they be able to incorporate information on future policy changes. Moody's Analytics produces a broader macroeconomic model on a monthly basis with multiple equations that can account for the interactions and feedback effects among key factors within the economy such as energy prices, labor markets and migration flows that can have an impact on the national housing market. Moody's Analytics leverages the additional information contained in this broader model by calibrating the weighted average forecasts across metros from the structural housing model to the U.S. forecasts generated by the macroeconomic models as necessary.