**Literature Review**

Existing literature concerning the relationship between macroeconomic variables and real estate valuation, addressed in this paper through examination of capitalization rates, is extensive and thorough. More narrow is the work that has been done concerning the *predictability* of real estate capitalization rate movement using macroeconomic variables. This literature review casts a wide net to first communicate the landscape of work assessing the relationship between inflation, GDP and capitalization rates, and then highlights work that has attempted to parse a specific, predictive relationship between the three aforementioned variables.

We divide our literature review into roughly …. (tbd)

*1. Macroeconomic Variables and Capitalization Rates*

The relationship between macroeconomic variables and cap rates has been explored in literature spanning several decades. This research has yielded mixed results.

**Froland (1987)** examines ACLI national appraisal-based cap rates for both multifamily and non-residential properties and finds a strong correlation between cap rates, mortgage rates, 10-year bond rates, and the S&P 500 P/E ratio, ultimately asserting that the cap rate is a function of these variables. Importantly, Froland identifies a negative correlation between cap rates and indicators of inflation, including capacity utilization, vacancy rate, and percent change in real GNP. Froland’s research indicates that inflation expectations should produce downward movement in cap rates.

**Evans (1990)** uses the same quarterly ACLI cap rate and S&P 500 P/E data spanning 1975 to 1988 to model the relationship between cap rates and P/E ratios using a Box-Jenkins transfer model. Evans finds a strong association between the two data series using a one-quarter lag from P/E ratio change to corresponding cap rate movement, suggesting that real estate capital markets are slower to react to changes in the business cycle than public equity market. Embedded in this conclusion is the notion that changes in the business cycle have statistically significant relationship with changes in cap rates.

**Ambrose & Nourse (1993)** [AN] analyze ACLI cap rate data spanning 1966 to 1988. AN approach the ACLI data set with greater specificity by segmenting cap rates according to property type and accounting for five general location variables. Using the spread between the U.S. Treasury bill index and the long-term government bond index as a proxy for expected inflation rate and using S&P 500 P/E ratio, AN do not report a statistically significant relationship between inflation or P/E ratios and cap rates. AN finds that differences across property types are statistically important for evaluating cap rates; however, AN does not find location to be a statistically significant factor.

**Jud & Winkler (1995)** [JW] use a weighted average cost of capital (WACC) framework to argue that cap rates, which resemble WACC, are determined by debt and equity spreads, and that cap rates respond, with significant adjustment lag, to a change in these spreads. Additionally, JW find statistical evidence that real estate markets are segmented by metropolitan area.

**Sivitanidou and Sivitanides (1999)** [SS] analyze office cap rate data to explore the magnitude of national capital markets influences in determining cap rates across geographic areas. SS use 1985 – 1995 National Real Estate Index office cap rate data in their study. SS conclude that local market influences are substantially stronger than national capital markets influences in determining office cap rates, with said cap rates exhibiting statistically significant fixed differences across markets.

**Chandrashekaran & Young (2000)** [CY] examine whether a model with macroeconomic capital market variables or lagged cap rates is more accurate in determining current cap rates. CY find weak relationship between cap rates and macroeconomic capital markets variables.

* **Data used**: National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index 1984 – 1999 – database of institutional-grade, commercial property owned by or on behalf of public and corporate pension plans
  + As of year-end 1999 the NCREIF data contained operating information on 2,469 properties across four property types: Apartment, Industrial, Office and Retail
* **Type of model**: two predictive regression models
  + Employ macroeconomic variables as independent variables in predictive regression model
  + Based on implications of first predictive model, seek improvement with the use of four lags of the first difference of capitalization rates over successive quarters
* **Why different**:
  + Use database of actual property operating statistics
  + Examine difference among property types across three temporal aggregations of implied cap rates: four-quarter, two-quarter, one-quarter
  + Value-weighted results

**Sivitanides, et. al. (2001)**: finds that increase in economy-wide inflation lowers cap rate. Argue that 1% inflation increase lowers cap rates by 46bps (see pg. 16). Variables work best when lagged by year or two

* Tries to answer question: *Do appraisals generate valuation estimates that move with the opportunity cost of capital, and that reflect realistic expectations about future income growth and risk?*
* **Data used**: APPRAISAL BASED, spanning 16 years across 14 metropolitan markets
  + NCREIF database
* **Type of model**: Panel-based, rather than just time series
  + Addition of cross-section variation to time series gives greater data richness and yields robust statistical results
* **Why different**:
  + First to systematically examine NCREIF cap rates at the local level
* **More findings**:
  + NCREIF cap rates move exactly as PE ratios do, but only if appraisers form expectations about future income growth by looking backward, not forward (i.e. past income/rent growth seems to be extrapolated forward)
  + Suggest it is possible to forecast appraisal-based cap rates

**“A Structural Model For Capitalization Rate”**

**An & Deng (2009)** [AD]: demonstrate that cap rates are significantly related to expected future returns and expected rental growth (each of which is inherently a function of macroeconomic variables)

* **Data used**: covered on pp 16-17, the data is choppy and pulled from multiple sources
  + NCREIF quarterly cap rate, property return, NOI growth and vacancy data
    - 1978 – 2008(?)
      * Retail and industrial data only available 1990+
      * Returns data only available 1984+
  + Real Estate Research Corporation (RERC)
  + Real Capital Analytics (RCA)
    - 2001+
  + Federal Reserve
* **Type of model**: Dynamic structural cap model with Kalman filter. Links cap rate to multi-period expected returns and rent growth
  + Cap rate: weighted average of all future growth-adjusted discount rate
  + Compare structural model estimates to VAR estimates to show that structural model captures the relationship between cap rate and NOI growth that is not captured by reduced-form models
* **Why different**: find that investors weight near term future expectations of return more heavily than long term future expectations of return

**“Capital Markets Impact on Commercial Real Estate Cap Rates: A Practitioner’s View”**

**Peyton (2009)**: asks question, *How can commercial real estate cap rates be predicted in short and long term*? Finds that, over the short run, capital and financial market influences, such as inflation, are useful in prediction of cap rates.

* Model directed toward identifying ***signal variables*** that point to impending changes in CRE risk pricing, as embodied in cap rates
* In an integrated capital market, all investments must compete for funds by covering generic real rate of return plus expected inflation premium
* Model investigates the relationship between four sets of factors and the **cap-rate spread** (defined as NCREIF NPI quarterly transactions cap rate minus the 10-yr UST average for quarter) pricing of commercial real estate:
  + Macroeconomic and interest rate fundamentals:
    - Corporate profits growth after taxes
    - Core CPI and CPI
    - 10-yr UST rate levels
    - Term spread between 2 and 10-yr UST
    - Debt flows / GDP ratios
* Finds that inflation variables negatively correlate with cap rates
* Finds that higher debt-to-GDP ratios are associated with lower cap rates
* Ultimate conclusion: cap rate spread can be predicted using macroeconomic factors
* **Data used**: (defined on pg. 8 of PDF) quarterly from 1997 Q1 – 2009 Q1
  + Cap rates: NCREIF quarterly
  + CPI: Consumer Price Index, seasonally adjusted
  + CoreCPI: Consumer Price Index less food and energy
  + Debt-GDP: 4 different debt types over GDP:
    - Federal government debt
    - Financial sector debt
    - Household sector debt
    - Non-financial sector debt
* **Type of model**:
  + Long-Term model: Simple linear regressions that layer in proposed signal factors in sequential fashion and seek those that are most effective
  + Short-term model: Uses first differences and the Clayton-Ling-Naranjo (2008) error correction method to address the lack of stationarity

**“Transaction-Based and Appraisal-Based Cap Rate Determinants”**

**Chaney & Hoesli (2012)** [CH]: test the idea that Investors (transaction-based) are more concerned with the opportunity cost of capital than are appraisers; transaction cap rates are more closely linked to capital markets than are appraisal cap rates, which are more typically anchored to property characteristics (what can be observed)

* Helps explain appraisal smoothing phenomenon
* Paper findings suggest that appraisers overweight factors that can be easily observed (location, building condition) at neglect of macroeconomic variables
* **Data used**: median appraisal-based and transaction-based cap rates in Switzerland over period 1995 – 2010 (IAZI database, largest RE database in Switzerland)
* **Type of model**: unclear
* **Why different**:
  + First to investigate differences of appraisal based and transaction based cap rates
  + Test for statistical significance of micro-property attributes such as % of regulated rents, existence of easements, tenant diversification, etc.
  + Incorporates 20,000 cap rate observations across 1,000 cities in Switzerland, a market that has previously not been used in cap rate literature

**“Real Estate Valuation, Current Account and Credit Growth Patterns, Before and After the 2008-2009 Crisis**

**Likely not useful**

**Aizenman & Jinjarak (2013)**: determine that the most economically significant variable in accounting for changes in real estate valuation is ***lagged real estate valuation appreciation*** (defined as real estate inflation minus CPI inflation), followed in importance by lagged declines of Current Account / GDP (i.e. Current Account divided by GDP)

**“The Other (Commercial) Real Estate Boom and Bust: The Effects of Risk Premia and Regulatory Capture Arbitrage**

**Duca & Ling (2015)** [DL]: find that cap rates are *positively* correlated with inflation (via risk premia), and negatively correlated with rent growth expectations (via GDP)

* Split into short run stationary testing and Long-run testing
* Expected rent growth has a negative significant relationship with cap rates (p.19); risk premia and real Treasury rates drive cap rates, not the converse
  + Conforms with broader finance view that asset valuations are most reflective of shifts in discount factor (i.e. required rate of return) rather than change in cash flows
* **Data used**: Real Estate Investment Survey cap rates, published quarterly by Real Estate Research Corporation (RERC)
  + RERC focuses on institutional grade assets owned by pension/endowment funds life co’s etc
  + Four major property types
  + 1996-2014
* **Type of model:** unclear to me – decomposition of estimated long run equilibrium factors

***GDP FOCUSED PAPERS***

**“Global Real Estate Markets – Cycles and Fundamentals**”

**Case, et. al. (2000)**: find that international property returns move together in dramatic fashion. Attribute substantial amount of correlation across world property markets to effects of changes in GNP

* RE business distinguished by fact that its “product” is not portable – all competition is local. Thus, would naturally expect correlation of changes in property values to diminish as distance between spaces increases. However, paper finds that there is material co-movement in property returns at the international level
* Find that correlations of real estate are due in part to common exposure to fluctuations in the global economy, as measured by an equal-weighted index of international GDP changes
* **Data used**: multiple sources stitched together, time span 1987 – 1997 (p.5)
  + International Commercial Property Associates dataset (dissolved and formed into ONCOR International)
  + Hillier Parker European survey
* **Type of model**: remove effect of country’s own GDP on its property return series through univariate linear regressions of the return series on contemporaneous GDP changes
  + Then, for each property type, compare correlation matrices of raw returns and of the regression residuals

**“Follow the Leader: How Changes in Residential and Non-residential Investment Predict Changes in GDP”**

**Green (1997)**: employs ***Granger causation*** model to test whether residential and non-residential investment Granger cause GDP, or vice versa. Finds that, under a wide variety of time series specifications, residential investment causes GDP, while non-residential investment *is caused by GDP* (note: the paper uses phrasing “causes GDP” which is a little non-intuitive, but as I understand it, it means to cause creation of Gross Domestic Product)

* Perhaps residential investment is merely a predictor of GDP, rather than causer
* Can extrapolate from this “flow of funds” analysis to potentially apply to what happens when or is implied by reduced GDP / lower GDP growth
* **Note**: this paper seems written to combat proposed changes to the tax code that would have hampered residential investment benefits
* **Data used**: from Citibase spanning 1959-1992, all series in 1987 dollars
  + Real GDP
  + Real private domestic non-residential investment
  + Real domestic residential investment
* **Model type**: Granger tests / Granger causality