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Real Estate Finance

MIF Program

Assignment #3: Sub-case #2 **US Direct Property Investment**

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Literature overview

One of the most important assets in investors' portfolios is the owner-occupied housing. The investment in housing varies for various types of investors. The investment assets trading in financial markets usually demonstrate a positive relationship between risk and return. For example, more volatile small-cap stocks show the higher returns over the long run than large-cap stocks. Canon, Miller, and Pandher (2006) investigate such a relation if exists in the US housing market where housing has the dual role of investment and consumption and where transaction costs and liquidity risk are also high. Their findings include a positive relation between housing returns and volatility, a positive but diminishing price effect on returns and that the stock market risk is priced directionally in the housing market.

Real Estate investors have typically tried to diversify portfolios through a process of naïve diversification. Modern Portfolio Theory has been considered to be the most rational approach to construction of real estate portfolios to identify the best mix of assets to hold in the portfolio. (Lee, 1992). The importance of each asset is evaluated in terms of its individual relative risk and return characteristics, as measured by its mean and standard deviation, and its portfolio risk as characterized by its correlation with other assets. Given these parameters Modern Portfolio Theory will find a mix of assets which will offer the highest level of return for each level of risk. It uses typically historic *ex-post* data to test the effectiveness of such portfolio strategies. We also know that the historic data are certain and portfolio holdings are the best that may have been achieved in the past.

The use of a portfolio selection procedure based on historical parameters that ignores the estimation risk due to the uncertain in mean returns is likely to produce sub-optimal results in subsequent periods. Indeed previous work on the application of MPT to the real estate portfolio shows this to be the case, Meyer and Webb (1991), Mueller and Laposa (1995) and Pagliari, Webb and Del Casino (1995).

Within the real estate market some studies have looked at the performance of MPT portfolio allocations in the subsequent periods. Meyer and Webb (1991) analyzed a ten year period from 1978 to 1988 using NCREIF returns for Office, Retail, R&D/office, and Warehouses. Their portfolio optimizations found different mixes for different time periods. Warehouse and R&D/office was the strongest in the 1978 to 1983 sub-period, while during the 1983 to 1988 period Warehouse and Retail had the best risk/return. They concluded that returns move differently during different time periods and thus a single portfolio allocation strategy may not be optimal during different sub-periods.

In another study, Mueller and Laposa (1995) investigated what allocation institutional investors should make to the different property-types: Retail, Office, Apartments and Warehousing using quarterly data in the US. They argue that property-type returns have shown some cyclicity in the past and estimating future returns depends on the cyclic movement within each property-type. In order to identify which property-type to invest in, the future investors need to be aware of how each property-type as performed in various phases. The authors therefore divided the NCREIF returns data into different periods based on three cyclic indicators: total returns, capital appreciation and GDP growth. They then constructed efficient frontiers in each of the sub samples and found different allocations for assets chosen and for portfolio weights during the different periods. Mueller and Laposa concluded that in developing their future allocations, investor's need to be aware of the current and future phases of the cycle in order to determine future portfolio compositions.

Yet in another study, Pagliari, et al (1995) went to test whether the strict application of Modern Portfolio Theory offered superior returns to naive or average-mix (market weight) strategies for institutional investors. He divided the 15 years quarterly data in three, five-year sub periods. The authors showed that while MPT yields optimal *ex-post* portfolios, its use as an *ex-ante* portfolio allocation strategy could lead to mixed results, which ideally meant that the portfolios constructed from ex-post data and extrapolated into future periods may or may not outperform naive and average-mix strategies. Accordingly, the authors noted that while it is easy to determine the best portfolios *ex-post* determining the correct mix in the future is more difficult. In other words the studies show that the effective application of an *ex-ante* MPT based portfolio strategy depends heavily on the accuracy of the portfolio inputs.

During 1970s and 1980s, the literature about real estate concludes that real estate provides a higher risk-adjusted return compared to other alternative investments. Considering real estate part of the portfolio decreases the portfolio risk substantially and moreover, real estate is found to be the hedge against the inflation. Recent studies have shown the more modest real estate performances using the most recent data. This is probably due to cyclicity of sample effects as well as isolated changes in the real estate market. In case of real estate market data is not available, so appraisals are used to represent market values in order to generate the rate of return index.

Several difficulties are identified which restrict the usefulness of such appraisal data. One of the allegation is that aggregate real estate rate of return index is smoothed because it employs smoothed individual property appraisals. A smoothed index reduces the variability and thus variances relative to sample of sale transactions. This leads to the problem of underestimation of the riskiness of the real estate asset class and distortion of correlations with rates of returns of other assets.

The researchers have suggested methods to unsmooth indexes. There have been some efforts to model index errors via simulations like Quan and Quigley (1989); Giacoitto and Clapp(1992).

Quan and Edelstein (2006) answer the question of biasness created in real estate returns measurement by the appraisal smoothing. They evaluate the relationship between individual property appraisal error and the aggregate rate of return index and derive the statistical measure of confidence for an aggregate index based upon appraisals instead of transactions. Further, they utilize this confidence interval to adjust and correct the estimators for the mean and standard deviation of real estate returns. The empirical results show that one, appraisal based mean rate of return for data sample as well as NPI index are likely biased downwards, thus underestimating true rate of return for real estate. Second, the adjusted estimated rate of return for real estate for the sample period is comparable to those achieved for CRSP and S&P stocks but lower than those of small cap stocks. Third, variance for appraisal based return index for their data sample is understated by perhaps 50 to 80%.

Unsmoothing returns

NCREIF index is subject to a smoothing basis, so before using any optimization procedures we unsmooth returns. We do this analysis implying that unsmoothed returns should behave in accordance with weak form of market efficiency (no autocorrelation in returns). We use the same procedures as Geltner, Miller, Clayton, Eichholtz in “Real Estate Analysis and Investments”.

Procedure

Step 1

The procedures implies using AR(2) model for returns (\mathbf{R}_T) with lags in 1st and 4th month:

$$\mathbf{R}_T = \mathbf{C} + \mathbf{C}_1\mathbf{R}_{T-1} + \mathbf{C}_2\mathbf{R}_{T-4} + \mathbf{e}_T$$

Step 2

After estimating model for returns, we unsmooth returns using the following equation:

$$\tilde{\mathbf{R}}_T = \mathbf{u} + \mathbf{w} \cdot \hat{\mathbf{e}}_T$$

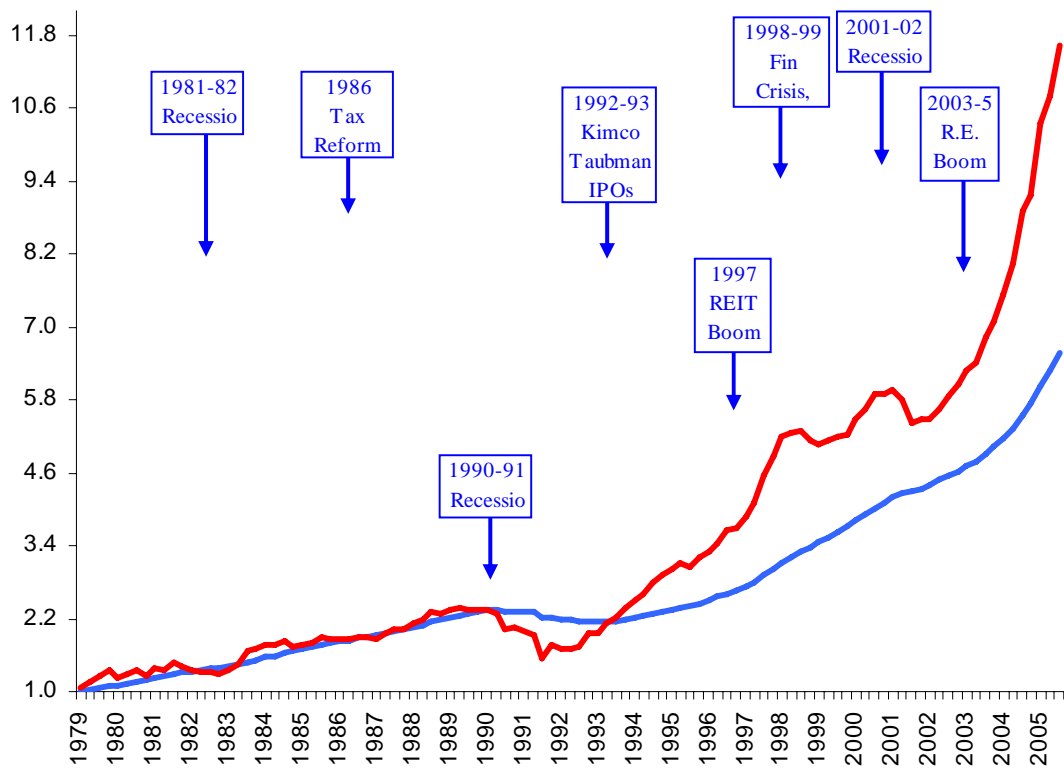
, where $\tilde{\mathbf{R}}_T$ is a unsmoothed returns, \mathbf{u} – the average returns, which is estimated from the sample, \mathbf{w} — scaling factor for st.deviation, $\hat{\mathbf{e}}_T$ — residuals from AR(2) model. Scaling factor is used as in

the Geltner, Miller, Clayton, Eichholtz: $\mathbf{w} = \frac{\sqrt{V(\hat{\mathbf{e}}_T)}}{5\%}$

Data

We unsmooth returns on regional and type (apartment, office, etc.) basis.

Below you can find the graph of smoothed and unsmoothed returns for national data. As one can find, unsmoothed returns are more volatile and react more heavily on major events (e.g. crisis). Moreover, our estimates show that NCREIF underestimated severely returns for real estate. Part of this can be explained by a fact that model might have time-varying delagging (See Brown and Matysiak, 2000).



Portfolio Optimization

We use the unsmoothed returns in all further portfolio optimization problems.

We approached the case in several steps.

1. First we calculated the returns and volatility in annual equivalent for all regions available. We also constructed an equally weighted portfolio and compared its performance with performance of investments in particular types of properties.
2. We also did the calculations described in (1) for three subsample periods. What we find is high difference in both the return and volatility if compared among subsamples.
3. After that we constructed an efficient frontier based on two samples: one including the whole period, and another including only the latest period of six years. The results are strikingly different when based on different samples. In one case we find that it's worth investing about 20% of portfolio (varies according to the return required) in West, but the estimations based primarily on the latest sample show that it's not worth investing in the West at all.
4. We repeated the whole procedure for the various types of properties. (Although we know that our company invests only in West, we don't have any additional data for the types of property returns exactly in the West, what we have is the data aggregated for the whole country.
5. The main finding of all previous steps is very simple: an equally weighted portfolio is doing really well, which means that it delivers average returns (as it should by construction), but the risk (measured as volatility) is significantly reduced. In all cases the portfolio appeared very close to the efficient frontier.

Please find all the calculations in corresponding Excel files. The organized graphs can be also found in the presentation.