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Keywords

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Disciplines

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USING GOVERNMENT DATA TO PREDICT THE PRICE AND RETURNS OF TIMBER REAL ESTATE INVESTMENT TRUSTS

By

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Abstract

Timber REITs are an understudied asset class with many direct drivers of value not seen in other REITs. With only a few Timber REITs listed on the NYSE, the idiosyncrasies between each stock means that it is difficult to draw conclusions at a non-stock-specific levels. Unlike other types of REITs, it may be feasible to predict value-metrics for Timber REITs based on readily available historical government data. This data can predict the behavior of the REITs' stock movements without accounting for market conditions but is not useful when using an excess return model based on a market-benchmark approach. However, the selection of an appropriate benchmark for Timber REITs may not be clear-cut.

Background

Real Estate returns are generally derived from the actual or expected cash flows generated from rents and the dispositions of assets. Broadly speaking, since the creation of publicly traded Real Estate Investment Trusts (REITs), we can split the returns of real estate into the returns from portfolios of privately-held real estate debt and equity (direct real estate) and publicly traded real estate debt and equity. REITs and other securitized real estate vehicles are thought to sensitize to fundamental shocks in the real estate market quicker than private real estate vehicles (Hoesli, Oikarinen, and Serrano 2015, 105). This phenomenon is in part theorized to be because transactions and trades in the public market happen at a fast rate, lower fixed and variable costs to change positions, and the existence of securities markets. These characteristics increase "Informational efficiency". Informational efficiency refers to the time it takes for markets to react to new information that should fundamentally alter an asset's price or value (Barkham and Geltner 1995, 21). Based on this research of securitized real estate markets in the early 1990s, public securitized real estate markets were found to be more informationally efficient than their private counterparts (Barkham and Geltner 1995).

In addition to this lag, the correlation between REIT returns and the broader public market has become stronger. Over a 15 year period from 1990 to 2005, REIT

and corporate equities' prices (but not commodities) became more integrated (Chong, Miffre, and Stevenson 2009, 183).

Despite this strong relationship between overall REIT returns and the broader market, there is evidence that Timber REITs do not conform to this finding and that there doesn't exist a long term trend between them and indices such as the S&P 500 (La and Mei 269-274). This along with the fact mentioned above that commodities have remained unintegrated with REIT values means that despite the evidence that the average REIT is a leading indicator of private data, there may be an opportunity to use private data to predict specifically Timber REITs due to the nature of Timber REITs' reliance on commodities (timber, paper products).

Introduction

The goal of this research paper is to confirm a statistically significant link between historical variables and future Timber REIT return metrics. Specifically, the scope of this project is to individually evaluate how the stock price and returns of three of these REITs responds to changes in private-sector data relating to the timber industry. This research is important because REITs are an attractive asset class for pension, fixed income focused, and sovereign wealth funds. If these fund managers believe that Timber REITs can add uncorrelated returns to other REITs and the market to their portfolios, then they will change their funds' allocation strategies.

Timber REIT predictor variables like construction permits, which should influence demand for timber and thus REIT price, are sought before any interaction with a timber REIT. A timber REIT would know the number of permits filed at the same time the public would. This is unlike most REITs, which have access to day-by-day retail data/information before data is released to the public in the form of monthly metric aggregation or news reports. Because the drivers of Timber REITs' values are uncharacteristically-for-REITs forward looking, historical publicly available data has predictive power on Timber REITs' stock price.

REIT Overviews

Timber REITs are specialty REITs focused on owning and operating timberlands. Timber REITs' operations can include the acquisition and disposition of properties, leasing land for recreation or to businesses, selling timber, capitalizing on natural resources present on the land, or selling other manufactured wood-based products. Timber REITs generally harvest pulpwood or sawwood. Pulpwood is often used in the manufacture of paper and paper based products, while sawwood is used for more traditional uses of timber such as for construction, industrial use , and manufacturing.

CTT - CatchMark

CatchMark was started in 2007 and controlled 496,800 acres of commercial timberlands with a product mix of 51% pulpwood and 49% sawtimber by volume coming from a 74%/26% pine/hardwood mix of trees. It primarily operated in the southern US with most of its acreage existing in Georgia, Alabama, and South Carolina. CTT creates value (proxied using Adjusted EBITDA) mostly through Timber Operations (70%) and Land Sales (30%). CTT has been aggressive in acquiring more acreage in the years 2013- 2016, increasing from less than 35 tons to over 40 tons in the time span. Additionally, their sawtimber to pulpwood composition has changed considerably over the last few years, going from a 30/70 split for

sawtimber to pulpwood between 2011-2013 to a 38/62 split between 2014-2016. The firm during the analysis period was not under operational or financial distress due to the capital structure.

** Information taken from 2007 Investor Relations Presentation*

WY - Weyerhaeuser

Weyerhaeuser has approximately 13 million acres of timberland distributed across the West (2.9M acres), South (7.0M acres), and North (2.5M acres) of the United States and 14M acres in Canada. Weyerhaeuser's sources of income come from timber delivery, log delivery, recreational, leases, and seed and seedling sales. By area during the time of the analysis, most of WY's inventory was hardwood. The firm during the analysis period was not under operational or financial distress due to the capital structure.

** Information taken from 2007 10K*

RYN - Rayonier Inc.

Rayonier has 2.7 million acres situated in the southern US, Pacific North West, and New Zealand (433K acres) focusing primarily on softwood. A large portion (60%) of RYN's product mix was exported to foreign markets during the analysis period. Additionally, they were very active in acquiring and disposing of timberland in the

analysis period, with $1.3 billion acquired and $680 million sold. The firm during the analysis period was not under operational or financial distress due to the capital structure.

** Information taken from 2007 Investor Relations Presentation*

Methodology and Data Collection

Data Collection

In order to collect the monthly stock price of each REIT, data was collected from the Ziman REIT Data Series as part of the Center for Research in Security Prices research umbrella. This dataset included each REIT's price as of the last trading day of the month.

A wide range of data was chosen as independent variables, with all datasets originating from the Federal Reserve Economic Data (FRED) database system. The following datasets from FRED were collected:

1.) Monthly Supply of Houses in the United States, Months' Supply, Monthly, Seasonally Adjusted
2.) Price Indexes of New Single-Family Houses Under Construction
3.) Total Construction Spending, Millions of Dollars, Monthly, Seasonally Adjusted Annual Rate
4.) New Private Housing Units Authorized by Building Permits, Thousands of Units, Monthly, Seasonally Adjusted Annual Rate
5.) Export Price Index (End Use): Linerboard, newsprint, and other paper/paperboard, Monthly, Not Seasonally Adjusted
6.) 30-Year Conventional Mortgage Rate, Percent, Monthly, Not Seasonally Adjusted

All independent variable datasets were populated with monthly data as of the 1st of each month. In order to control for general market conditions on returns and price, average monthly total weighted returns of equity REITs was gathered also from the Ziman REIT Data Series.

The rationale for choosing each independent variable was as follows:

1.) Timber REITs depend on the sale of timber used in the construction of homes. With increases in the supply of new homes and permits for future developments you would expect the demand for timber to have increased during the time period, causing an upward trend on price, resulting in higher revenue for the REIT reflected in either increased earning or share price appreciation.

2.) Similarly, for housing price-indices, paper-price indices, and construction spending, we would expect that an increase in price would mean the inventory of the Timber REITs was attractive and their dollar per unit of timber sold increased.

3.) Finally, when interest rates are low, it becomes more attractive to build homes because the cost of debt on an individual level becomes cheaper. We would expect this to lead to an increase in demand for drivers of Timber REIT value.

Methodology

For this research paper an Ordinary Least Square (OLS) multiple linear regression model with a dependent variable of REIT monthly stock price or REIT

excess total returns and a set of independent variables relating to the timber industry was used. The analysis period for each REIT was set beginning at the initial listing date of the REIT on the NYSE and ending as of September 1st 2016. There was a natural lag of approximately 1 month between each monthly REIT ask price and each corresponding independent variable due to the fact that the REIT prices were as listed at the end of the month while the independent variables were listed as of the start of the month. Because it is not expected that the information from the dependent variable would influence stock price instantaneously, and one month is the smallest time frame available to analyze with the data, this one month lag is the "base case".

In order to account for the fact that general market conditions will have an effect on returns and stock prices, returns in excess of the benchmark chosen (average monthly total weighted returns of equity REITs) were used in the regression analysis. This is the market model approach to control for movements due to the general environment applied using a REIT index instead of a broad market index like the S&P 500 (MacKinlay 16).

The returns for each REIT of the benchmark were calculated as follows:

$$r_b(t) = \frac{p(t)f(t) + d(t)}{p(t-1)}$$

Where:

t is the trading month

t-1 is the previous trading month

$r_b(t)$= *benchmark security's return for month t*

p(t) = last sale or closing bid/ask for month t

f(t) = Ziman's price adjustment factor for month t

d(t) = cash adjustment for month t (including dividends paid)

The returns of the 3 Timber REITs were calculated as following:

$$r_e(t) = \frac{p(t) + d(t)}{p(t-1)}$$

Where

t is the trading month,

t-1 is the previous trading month.

$r_e(t)$= *security's return for month t*

p(t) = last sale or closing bid/ask for month for the Timber REIT

d(t) = Ordinary Dividends paid for month t

Excess Returns were calculated as follows:

$$r_r(t) = r_e(t) - r_b(t)$$

Where $r_r(t)$ is the excess return of that REIT's return on month t.

Using the python statistical modules libraries SciPy and Scikit-learn , three datasets , each corresponding to the monthly REIT prices of a timber REIT along with the corresponding dependent variables indexed by date, were standardized. Standardization of all the variables was done because many of the variables were on different scales. This ensures that differences in scaling will not affect the regression. For each REIT, a multiple linear regression model was fitted using all of the independent variables in their base case. After running this initial regression, any variables which were not significant at the 95% confidence level [p value< 0.05] were removed from the regression to compare effects. Insignificant variables were also lagged, in order to account for the fact that timing may affect the relationship between variables or removed.

Results

TABLE 1. Regression Results for REIT Stock Prices with Unchanged Variables	CTT	RYN	WY
Constant	1.2375	0.3132	0.2495
	(0.042)	(0.113)	(0.093)
Monthly Supply of Houses	-0.2483	0.0054	-0.1017
	(0.185)	(0.160)	(0.138)
Price Index of New Single-Family Houses Under Construction	0.1021	0.2026	0.7613*
	(0.404)	(0.249)	(0.288)
Total Construction Spending	-1.1858**	-0.9379***	-0.6871
	(0.356)	(0.201)	(0.270)
Monthly Permit Approvals	0.03663	0.4966***	0.8087***
	(0.273)	(0.187)	(0.219)
Paper Export Sales	-0.7085**	0.2772*	-0.6988***
	(0.315)	(0.161)	(0.118)
Mortgage Rates	0.1893	0.4647***	0.5085***
	(0.304)	(0.117)	(0.099)
R-Squared	0.583	0.570	0.581
Adjusted R-Squared	0.487	0.552	0.547

Standard errors are reported in parentheses

,,*** indicates significance at the 90%,95%, and 99* level, respectively.*

^ indicates insignificant F-statistic

First line of each variable is coefficient

The results above show the initial regression without any change to the variables chosen to be included in the model. For CTT, the independent variable mix was able to explain 48.7% of the movement in stock prices based on the model's

Adjusted R^2 Value. However only two of the independent variables were significant (p<5%), Total Construction Spending and Paper Exports.

RYN had a higher Adjusted R^2 Value (55.2%) and more significant independent variables. Specifically, those variables which were at least at the 95% confidence level were Mortgage rates, Monthly Permit Approvals, and Total Construction spending. Monthly Permit Approvals' coefficient is intuitive, however both Construction Spending and Mortgage Rate have inverse signs from the expected.

In the case of WY, we have an Adjusted R^2 of 54.7% which is similar to the other REITs. All the variables were significant except for Monthly Housing Supply and Total Construction.

In accordance with the methodology, insignificant variables were dropped from the model, and the regressions (seen below) were completed again to see if the overall model's predictiveness would improve.

TABLE 2. Regression Results for REIT Stock Prices with Some Initial Insignificant Variables Dropped	CTT	RYN	WY
Constant	1.3139 (0.292)	21.2461 (18.356)	0.2173 (0.081)
Monthly Supply of Houses	-0.2526 (0.181)		
Price Index of New Single-Family Houses Under Construction			0.7679* (0.287)

Total Construction Spending	-1.1875**	0.000***	-0.7594**
	(0.350)	(0.000)	(0.250)
Monthly Permit Approvals	0.3817	0.0126***	0.9078***
	(0.262)	(0.002)	(0.172)
Paper Export Sales	-0.7485**	0.4694***	-0.6992***
	(0.267)	(0.134)	(0.118)
Mortgage Rates	0.149	5.9686***	0.465***
	(0.254)	(0.980)	(0.080)
R-Squared	0.582	0.568	0.578
Adjusted R-Squared	0.505	0.556	0.549

Standard errors are reported in parentheses
*,**,*** indicates significance at the 90%,95%, and 99* level, respectively.
^ indicates insignificant F-statistic

Removing the insignificant variable of Price Indices of New Houses for CTT increased the predictive power of the model to an Adjusted R^2 of 58.2%. However, removing the other insignificant variables lowered the Adjusted R^2, and the unintuitive coefficient signs for Paper Exports and Total Construction remained. Lagging all variables from a range of 1 to 3 months from the base case made the Price Index of New Single Family Homes Under Construction and Monthly Permit Approvals significant within the model, but gave a lower overall R^2.

For RYN, removing the insignificant variables increased the R^2only slightly, but made all remaining independent variables significant. RYN is heavily exposed to exports, so paper exports becoming significant with the re-running of the

regression seems congruent. Lagging variables from 1 to 3 months also had no effect on increasing R^2 or the significance/insignificance of the variables.

Removing Monthly Supply of Houses for WY made all variables significant with a slight increase in Adjusted R^2. However, the "wrong" signs remain on Mortgage Rate, Paper Exports, and Total Construction coefficients. Lagging up to 3 months did not result in any noticeable results.

In terms of modeling excess returns, the regression model does a much worse job (seen below), with the Prob(F-statistic) indicating that it is very likely none of the coefficients are significantly predictive in any of the REITs. This is compounded by the negative Adjusted R^2 values for the REITs and the fact that no single variable is statistically significant at even the 90% confidence interval level. Lagging did not noticeably affect the p values of the coefficients noticeably or the predictiveness of the model.

TABLE 3. Regression Results for REIT Excess Returns	CTT^	RYN^	WY^
Constant	5796 (0.444)	-0.5633 (1.636)	0.4836 (0.136)
Monthly Supply of Houses	-0.1802 (0.194)	0.3667 (0.416)	0.0405 (0.202)
Price Index of New Single-Family Houses Under Construction	-0.229	0.1022	0.1409

	(0.424)	-(0.853)	(0.422)
Total Construction Spending	0.2164	0.588	-0.3172
	(0.373)	(1.491)	(0.394)
Monthly Permit Approvals	0.017	0.2047	0.1843
	(0.287)	(0.544)	(0.320)
Paper Export Sales	0.2745	0.435	-0.1102
	(0.330)	(0.587)	(0.173)
Mortgage Rates	-0.2737	0.1884	-0.1004
	(0.319)	(0.837)	(0.145)
R-Squared	0.164	0.178	0.033
Adjusted R-Squared	-0.029	-0.644	-0.046

Standard errors are reported in parentheses

*,**,*** indicates significance at the 90%,95%, and 99* level, respectively.

^ indicates insignificant F-statistic

General Discussion

The results from each type of regression (excess returns/stock price) indicate some clear trends. For the regressions with stock price as the dependent variable the R^2 values were somewhat predictive ranging between 48.7% and 55.6% with significant variables in all models. The predictors were also lagged to varying degrees, with none of them improving the model toward meaningful significance

In the case of Paper Exports, CTT has significant pulpwood operations which are a fundamental part of the paper-manufacturing value chain making the fact that Paper Exports was significant initially unsurprising. However intuitively, we would expect to see the significance of paper exports be reflected with a positive coefficient, rather than the negative 0.7085 in the model. Similarly, it would be expected to see the significance of Total Construction spending to be reflected with a positive coefficient, rather than the negative 1.1858 in the model.

The variables which were significant in both the base regression and the altered regression on RYN's stock price matches its expected output. RYN operates primarily selling softwood, which is used primarily in construction. This lines up with the results that Total Construction Spending, Monthly Permit Approvals, and Mortgage Rates were all significant at a confidence interval level of 99%. Softwood is not used in the production of paper, so we would not expect paper exports to be as significant, which was the case.

Weyerhaeuser is the largest of the Timber REITs and seems to be the most mature in terms of scaling operations and the product/service mix it utilizes for revenue. In this sense, having many of the predictors be significant lines up with the notion that the predictor variables should reflect the majority of the drivers of timberland value and it may be that WY is the only REIT of the three mature enough in terms of revenue streams for this hypothesis to be realized.

There was a general lack of significance with the Monthly Housing Supply variable. Of all variables, Monthly Housing Supply was probably the most backward-looking and in many ways is a function of some of the other variables such as Permit Approvals and Construction Spending.

In terms of modelling excess returns, all models were insignificant, many having negative Adjusted R^2 values, and no significant variables. This could signify two important things. Firstly, the results of the stock price regressions were misleading, and that most of reason why the R^2 values explain the stock price is because the independent variables are correlated with the broader health of the economy. Certainly, construction material use, a function of demand for housing and general construction, correlates with the market. Historically, this average correlation has been high at 38.26% (Aswath Damodaran). Thus, this explanation is certainly possible. Secondly, the components of the excess return variable may not accurately reflect the relationship between the benchmark index and timber REITs. As stated in

the background, research indicates that Timber REIT returns behave differently to other REITs, so benchmarking against an index of the returns of REITs on average which may be uncorrelated would undue any natural correlation between Timber REITs and the independent variables.

Empirical Challenges

There were some empirical challenges to the study. Firstly, although the significant variables varying in terms of coefficient size between REITs was unsurprising due to the varying compositions of each REIT's revenue sources, all of the REITs would be expected to respond to the same variables because all of the predictors related to the fundamental operations of Timber REITs.

Additionally, in some of the regressions, removing insignificant variables made the model less predictive. This could be evidence of collinearity among the independent variable mix or using too many regressors in the initial regression, resulting in the model itself being somewhat predictive with some of the non-significant variables being predictive but not enough by themself to attain a low individual p-value as variables.

Furthermore, and importantly in the case of the significant variables in the stock price regressions, many of the coefficients were unexpectedly the "wrong" sign. Specifically, for the variables of price indices or spending, it's possible that because there was a natural 1 month lag in the regression, the price had increased/decreased initially on the onset of the information and then immediately increased/decreased on the onset of new information. If the months generally were cyclical (in the sense that price/spending tended to revert toward the mean over the months of the analysis), then that may be a possible explanation for the unexpected signs. Outside of this

explanation, multicollinearity may also be the issue in this, due to some of the predictors directly relating to each other: housing permits will become new houses or price indices may predict future magnitude of aggregate spending.

Conclusion

Looking at the results of both sets of regression predicting stock price for each REIT, model was predictive one month after the historical data was published. Based on the stock price regressions, to varying degrees, it was successful in explaining the movement of the REITs over the analysis period. However, the usefulness and validity of the prediction is hard to quantify due to the unclear reasons why the coefficients are unintuitive. However, if the initial results are indicative of a significant relationship between the historic value drivers and future REIT price, then Timber REITs are indeed an outlier in terms of stock behavior relative to other traditional REITs, and the prices of Timber REITs fail to adjust immediately to public data about their revenue drivers.

On the other hand, the regressions of excess returns were clear. There was no predictive power of the independent variables, and this lines up with the result we would expect based on previous research on the informational efficiency of public real estate equities. The point of contention is that the excess returns using a REIT index may not be an accurate way to control for market conditions. If some of the contemporary research on REITs is correct in that Timber REITs are not strongly correlated with the broader market while other REITs are, then using a broad REIT index as the benchmark will probably yield unreliable results.

Bibliography

Works Cited

Aswath Damodaran. *Total Betas by Sector (for Computing Private Company Costs of Equity) - US.*, 2020. Print.

Barkham, Richard, and David Geltner. "Price Discovery in American and British Property Markets." 1995: 21+. *Gale Academic Onefile; Gale.* Web. <https://link-gale-com.proxy.library.upenn.edu/apps/doc/A17311582/AONE?u=upenn_main&sid=AONE&xid=a07a34c7>.

Chong, James, Joëlle Miffre, and Simon Stevenson. "Conditional Correlations and Real Estate Investment Trusts." *Journal of Real Estate Portfolio Management* 15.2 (2009): 173-84. Web.

Hoesli, M., and Elias Oikarinen. "Are REITs Real Estate? Evidence from International Sector Level Data." *Journal of International Money and Finance* 31 (2012): 1823-50. Web.

Hoesli, Martin, Elias Oikarinen, and Camilo Serrano. "Do Public Real Estate Returns really Lead Private Returns?" 2015: 105+. *Gale General OneFile; Gale.* Web. <https://link-gale-com.proxy.library.upenn.edu/apps/doc/A433011007/ITOF?u=upenn_main&sid=ITOF&xid=286498d1>.

La, Le, and Bin Mei. "Portfolio Diversification through Timber Real Estate Investment Trusts: A Cointegration Analysis." *Forest Policy and Economics* 50 (2015): 269-74. Web.

MacKinlay, A. C. "Event Studies in Economics and Finance." *Journal of Economic Literature* 35.1 (1997): 13-39. *JSTOR.* Web.

Sicotte, Diane, and Samantha Swanson. "Whose Risk in Philadelphia? Proximity to Unequally Hazardous Industrial Facilities*." *Social Science Quarterly* 88.2 (2007): 515-34. Web.