Honors Thesis Research Proposal

Cash Flow Variability and Portfolio Diversification:

Should REIT Investors care about cash flow variability?

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1. Introduction and Motivation

Cash flow is among one of the important metrics investors will look at for company valuation. A positive cash flow impacts a company's ability to grow, as when a company is limited in its ability to generate cash to cover debt and expense obligations, it is less likely to invest cash into promising initiatives. Equilibrium models of asset pricing relate the current value of future cash flows to their exposures to macroeconomic risks. Such connection is encapsulated in the Gordon Growth Model (Campbell and Shiller 1988),

$$P_t = \frac{CF_{t+1}}{k - g}$$

where the asset price at time t depends on a discounting factor of its expected future cash flow. Investors care about cash flow as it forms the basis of earning and thus dividend, which is closely related to the stock return. However, the smoothness of the cash flow is equally important. Agency cost hypothesis mentioned in Bradley (1998) believes firms with volatile cash flows will on average pay out a greater proportion of their cash flows in the form of a dividend, while Corporate Risk Theory (Minton and Schrand 1999) suggests shareholders are better off if a firm maintains stable cash flows, as cash flow volatility affects a firm's investment policy by increasing the costs of raising external capital and therefore firms with smoother cash flows should be valued higher. Both theories connected a firm's cash flow variability with valuation, but with a different direction.

While there are empirical studies followed the above two theories and measured the direction of cash flow variability to the stock return, like Routree (2005) and Bradley

(1998), such connection becomes insufficient when investors instead hold a portfolio of assets, as more than a single dimension of assets need to be considered to evaluate the benefits from the inclusion or the exclusion of a particular asset from a portfolio. An example is Boudry's (2015) use of wealth compensation ratio built from a utility framework, which takes investor's risk aversion level into consideration. Modern portfolio theory brings the concept of portfolio diversification. The rationale behind it is that a portfolio composed of different kinds of investments will yield higher returns and meanwhile pose a lower risk level than any of its individual portfolio components do. The comparison between mean-variance approach and the minimum-variance approach in finding the optimal asset allocation for portfolio diversification (Frahm and Wiechers 2011) indicated it is in fact the diversification effect among the different assets, not the individual asset return-risk pattern, that seems to contribute to the portfolio performance. Therefore, we are interested if there is a connection between an asset's diversification effect and its cash flow variability.

In our study we will examine the impacts of cash flow variability upon the benefits to diversification for investors allocating their funds across REIT property types. The attention to a single industry reduces unobserved heterogeneity arisen from the cross-industry effects. We focus on REITs because their operating features making them a suitable investment vehicle for addressing our main question of interest.

A unique feature for REIT industry is that by law a REIT company is required to distribute at least 90% of their taxable income to shareholders annually in the form of dividends. In

other words, REITs pass along almost all of their earnings to investors, suggesting that company earnings and cash flows are better proxies for investor earnings. The high distribution limits out retained earnings while offering REIT stockholders more profitability, making the cash flow and earning information more informative to investors. REIT's income and cash flow are also predictable derived from rents paid to the owners of commercial properties whose tenants sign leases for long periods of time. Therefore, higher cash flow variability could potentially signal an uncertainty in the lease contracts and other normal operating activities.

Boudry (2015) assessed the diversification benefits of REITs by separating REIT common stock and REIT preferred stocks. We will instead look at equity REITs by its underlying property type. Like real assets, equity REITs is classified by property type. National Association of REIT categorizes REITs into 12 sectors, including Office REITs, Industrial REITs, Retail REITs, Lodging REITs, Residential REITs, Timberland REITs, Healthcare REITs, Self-Storage REITs, etc. Investors would look at property type because it is one of the factors that provides information to the premiums or discounts from net asset value (Capozza 1995), a valuation tool for REITs. Moreover, property type is a natural proxy for cash flow variability, partly because the typical length of the lease contracts varies by REIT sector. Intuitively, Lodging (Hotel) REITs normally have lease lengths on a daily basis and their cash flow variability could therefore be substantial. On the other hand, Storage REITs lease their properties normally over 10 years. Therefore, the cash flow variability could be less significant.

The remaining parts of the proposal are organized as follows: section 2 reviews the relevant literature on cash flow variability for asset pricing and quantitative measures of the degree of diversification. Section 3 provides the tentative methodology and model, followed by some preliminary data analysis.

2. Literature Review

2.2 The use of cash flow and cash flow variability in asset pricing

Using cash flow as an informative content for stock return and asset pricing is not uncommon. Though whether cash flow is the best estimator for asset valuation has been doubted in Liu (2007), it has still been utilized as one important valuation tool. Routree (2005) found a negative relation between cash flow volatility and firm's performance, measured by Tobin's q whose positive relation with the average subsequent stock return was proven in Ian (2012); Da (2009) shows the change in the expected cash flow partly drives the cross-sectional variation in stock returns. Inspired by the earlier dynamic Gordon Growth model (Shiller 1998), Boudry (2015) found cash flows are informative in pricing CMBS and inferred it can be applied to other types of thinly traded assets, including commercial real estate. Prior literatures focused on FFO, funds from operation, as a proxy for REIT cash flow. The unique industry specifics of REITs, like FFO (funds from operations) and FAD (funds available for distribution), are typically utilized for REIT valuation and to represent the cash flow, which provides better clues about how safe the dividend is as traditional valuation metrics like book value and P/E does not perfectly apply for REITs because of their required dividend payout and the distortion of GAAP to deduct

deprecation and amortization from net income. Bradley (1998) and Graham (2000) regarded FFO as a standard measurement for REIT cash flow and found its significance over traditional GAAP measures like CFO and EBITDA in REIT valuation. Vincent (1999) also admitted that FFO provides insight in REIT asset pricing. Our study will move on and address whether the variability of cash flow, estimated by FFO (or FFO per share) volatility, is equally important. Minton (1999) suggests shareholders are better off if a firm maintains smooth cash flows. Rountree (2005) extends it and suggests smooth financials should be valued higher. His findings indicate that investors value firms with smooth cash flows at a premium relative to firms with more volatile cash flows and the magnitude of the effect is substantial with one standard deviation increase in cash flow volatility resulting in approximately a 32% decrease in firm value. In contrast with the traditional stock market, whose cash flow payout ratio are inconsistent across the whole industry, REITs have to distribute a fixed percentage of their taxable income to shareholders, making the cash flow volatility information more valuable. Bradley (1998) connects future cash flow uncertainty with the dividend policy, which signals stock return. His regression model follows as: $R_t - R_t^f = a + b\left(R_t^{fm} - R_t^f\right) + cD_t + d\Delta D_t + eI_t$, with R_t and R_t^f representing stock return and risk-free return, whereas $D_t = f + gE_tY_{t+1} + hE_t\sigma_Y$ and $E_t\sigma_Y$ represents anticipated volatility of cash flow available to shareholders. His findings show there is a negative relation between the cash flow volatility and the REIT dividend payout.

2.2 Portfolio Diversification and measure of diversification benefits

As asset return itself becomes less dominant when investors need to consider the correlations among the assets, assessing the performance of a portfolio with its risk-adjusted criteria provide better information to investors. Khule (2014) considered the maximum utility function for REIT portfolios, and concluded REIT common stocks generate additional utility at low-medium risk aversion levels. Boudry (2015) referenced the same mean-variance optimal allocation method and used wealth compensation ratio to estimate the reduction of the diversification effects after removing REIT common stocks from a mixed-asset portfolio in relative to remove both REIT common and preferred stocks. Both precedents show that the return itself is insufficient to evaluate the benefits from the inclusion or exclusion of a particular asset from a multi-asset portfolio. This statement was briefly mentioned in DeMinguel and Lorenzo (2009) and Frahm (2011), who reviewed mean-variance and minimum-variance approaches in setting up optimal portfolios and indicated it is the diversification effect among the different assets that contribute to the portfolio performance. Therefore, we will test the diversification benefits of an asset when add or remove it from a multi-asset portfolio. Different from Boudry (2015), we classified REITs by their property sector instead of common stock versus preferred stock, and see if REIT diversification effects can be explained by cross-sectional cash flow variability.

Literature precedents record the quantitative measures of diversification effects, with one of the earliest conducted by Woerheide (1993), who recommended Portfolio Herfindahl Index, Rosenbluth Index and Entropy Exponential as three estimators. Later literatures improved those index measures by overcoming the deficiency of using only the number of assets and their weights in computation: Rudin (2006) coined Portfolio Diversification

Index; Meucci (2009) extends Rudin's use of covariance matrix and created Diversification Distribution*;* Frahm (2011) considered the ratio of non-avoidable return variation to overall return variation as a new theoretically viable diversification measure; Kirchner (2011) extended information entropy and proposed a diversification measure based on the negative information entropy of the probability distribution of the final portfolio value; Anand (2015) proposed the Generalized Herfindahl-Hirschman Index by fixing the missing asset correlation consideration in the traditional HHI measure. In our study, we would use Rubin's Portfolio Diversification Index and the widely applied Diversification Ratio to prevent the potential estimation bias arisen from using portfolio weights as the only variable for finding the diversification benefits. We would therefore consider both the weights and the covariance structure among all included REIT assets.

The contribution of our study to the asset pricing and portfolio diversification literature is that we provide empirical evidences on both a firm's absolute value of cash flow and its variation of cash flow as explanatory variables to the benefits its stock can provide to a multi-asset portfolio. The benefits are estimated using some quantitative measures of the diversification effects. Our study provides insight if a REIT or real estate investor should care the variation of cash flow while considering whether to include or exclude certain REITs in his portfolio.

3. Data and Methodology

3.1 Potential Methodology

Our basic econometric model follows as

$$DB_{i,t} = \alpha_{0,i} + \alpha_1 * F_{i,t} + \alpha_2 * CFV_{i,t} + \alpha_3 * PT_i + \alpha_4 * PT_i\, CFV_{i,t} + \varepsilon_{i,t}$$

, whereas $DB_{i,t}$ measures the diversification benefits of REIT property type i at time t in a mixed-asset portfolio, $\alpha_{0,i}$ measures the fixed effect, $CFV_{i,t}$ represents the cash flow variability of REIT company i at time t, PT_i stands for the property type categorization a REIT company falls into (hotel REIT, residential REIT, etc.), $PT_i\, CFV_{i,t}$ shows the interactive effect between property type and cash flow variability and $F_{i,t}$ adjusts for other effects. Another variable of interest, the average remaining leasing length (and its interactive effect with cash flow and property type) $\alpha_5 * L_{i,t}$, will only be tested under a certain subset of REITs because of data unavailability and inconsistent measurement across REIT property types. We will look at both the sign and the absolute level of α_2 to find the relationship between cash flow volatility and diversification benefits. A significant positive sign would indicate holding a stock of a company with unstable cash flow is less likely to provide diversification benefits to a portfolio, which is consistent with the corporate risk theory that indicates firm should be highly valued with its smooth cash flow. A significant negative sign would indicate volatile cash flow provides diversification opportunity. α_4 provides additional information whether property type adds additional information for cash flow variability in explaining diversification effects.

The computation of the benefits to diversification requires a portfolio construction. In other words, the investment strategy for such portfolio construction needs to be determined. We

selected Maximum Sharpe Ratio as our objective function for constructing multi-asset portfolios and computing portfolio weights. Sharpe Ratio is defined as

$$\frac{[Rp] - rf}{\sigma p}$$

with Rp and σp representing the portfolio return and variance. Rf represents the risk-free rate, approximated by 30-day Treasury bill return. Proper investment constrains would be applied, including the restriction of borrowing, $\sum w_i = 1$, and the case when short selling is allowed with $-1 \leq w_i \leq 1$[1]. We would find the combination and thus the asset weights that maximize the Sharpe Ratio and further use the weights for computing the diversification benefits.

We focus on the real estate investors who diversify their portfolios across different property types. Therefore, we would assess all-REIT portfolios with REITs as the only investable universe in the portfolio construction. The rationality of the existence of all-REIT portfolios is explained in Khule (1978), which indicates that equity REITs have significantly lower portfolio risk than common stock portfolios does.

Two candidates for the measurement of diversification benefits are Rubin's Portfolio Diversification Index:

$$PDI(d) = 2\sum_{k=1}^{d} k * \omega i$$

[1] Under the normal long-only case, we set $0 \leq w_i \leq 1$

, with $\omega i = \frac{\lambda i^2}{\sum_{j=1}^{d} \lambda j^2}$ the relative strength of the ith principal portfolio and λ the eigenvalue of the covariance matrix, and the Diversification Ratio

$$DR(p) = \frac{\sum_1^N \omega i * \sigma i}{\sigma p}$$

with ωi the optimal weight for asset i. The optimal weights in our case are the weights assigned to individual assets, which maximize the Sharpe Ratio.

We would assess the diversification benefit of one REIT asset by measuring the change of the above ratios when add to or remove it from the multi-asset portfolio. The percentage change in Diversification Ratio, for example when we remove one REIT asset from a portfolio, would be

$\frac{\mathrm{DR}\,(P_{N-1}) - \mathrm{DR}(P_N)}{DR(P_N)}$, with P_n representing a portfolio with n assets and P_{n-1} a portfolio with n-1 assets. The intuition behind it is similar to the concept of wealth compensation ratio in Boudry (2015) and the statistical leave-one-out cross validation for the model's predictive performance.

For the cash flow variables, we would follow mainstream literatures and focus on FFO (fund from operations[2]) and per share FFO as the cash flow indicators. For the variation in the cash flow, we would look at the cash flow uncertainty, estimated by analyst's expectation, and the cash flow volatility, approximated by the standard deviation.

3.2 Data

[2] We would also include Adjusted FFO if available.

CRSP and Thompson Reuter Datastream provide stock return data. IBES provides data for analyst expectation in earning and cash flow. NAREIT and SNL platforms provide a detailed list of the REIT companies by property sector. Due to a difference in REIT classification by brokers and official REIT websites, I would follow my property type categorization in Zicheng (2017) and choose the constituent companies listed by NAREIT. Specifically, I will have Hotel/Lodging, Self-Storage, Industrial, Retail, Residential, Healthcare, Manufactured Homes, Office and Diversified as the 9 REIT sectors. The detail for the cash flow level and other potential variables of interest would be winnowed and extracted from NAREIT REITWatch and also from individual REIT's financial reports (10-K, annual report, quarterly report, etc.). This process takes time and therefore the detailed summary statistics for individual REITs will not be included in this proposal. Instead, we would have the summary statistics for the whole sector.

The absolute value of the most recent FFO by REIT property type[3] from the third quarter 2015 to the second quarter of 2017 is displayed in Table 1, collected from NAREIT T-tracker, which provides the FFO by REIT property type from 2000 to 2017. The absolute value of the FFO accumulation is biased due to the number of the constituent companies. However, we may still look at the change of FFO to see the variation. Table 2 shows the average FFO and variation for each property sector over the last 17 years. A rough proxy for FFO variability computes the standard deviation of the growth in FFO and adjusts[4] it with the mean to exclude the scaling effect. The exact adjustment technique for the scaling effect would be revised in the later stage, but we do observe an existence in the difference

[3] For example, summing up the FFO of all the Residential REITs in the first quarter of 2015 equal to 1541.45.
[4] Namely the coefficient of variation which equals standard deviation divided by mean

in FFO variation: Office (0.29), Residential (0.36) and Storage REITs (0.45) are among the ones with relatively low cash flow variation, while Lodging (0.76) and Healthcare REITs (0.74) seem to have more volatile cash flow.

The empirical existence of a difference in diversification benefits by REIT property type was analyzed in Zicheng (2017) using Boudry's (2015) wealth compensation ratio. Under a utility framework with long-only condition, Self-Storage and Residential REITs seem to provide relatively higher benefits to diversification while Hotel REITs hardly adds benefit to diversification. The lower cash flow variability computed by the coefficient of variation and the higher depicted diversification benefits of Storage REITs (or high cash flow variability and low diversification benefits for Hotel REITs) could intuitively indicate a negative connection between cash flow variability and diversification benefits, but we would need to prove that it is more than coincidental. A different approach will be taken for the portfolio construction and for the quantitative measures for diversification benefits due to a different objective function and research focus than my previous study.

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Appendix

Table 1 The overall Funds from Operations by REIT property type

FFO by REIT sector, in Millions

	2015.3	**2015.4**	**2016.1**	**2016.2**	**2016.3**	**2016.4**	**2017.1**	**2017.2**
Office	1,784.25	1,453.92	1,547.39	1,777.16	1,495.36	1,461.41	1,568.16	1,726.45
Industrial	854.38	730.13	804.00	789.14	911.87	983.12	838.07	954.33
Retail	3,198.51	3,317.52	3,302.06	3,368.18	3,197.70	3,542.91	3,139.34	3,374.40
Residential	1,541.45	1,579.86	1,489.53	1,646.48	1,626.88	1,596.98	1,734.75	1,722.66
Manu Homes	129.78	113.39	142.47	111.45	160.18	135.72	181.51	154.65
Diversified	1,253.97	642.34	815.11	905.77	623.46	1,352.70	979.28	1,098.63
Lodging/Resorts	1,215.13	1,034.96	1,005.33	1,411.34	1,152.58	1,079.55	1,144.44	1,545.24
Self Storage	612.59	592.06	581.19	649.51	691.38	756.98	690.00	700.10
Health Care	1,531.78	883.23	1,743.38	1,829.71	1,743.48	1,724.06	1,795.44	1,714.49

Table 2

Descriptive Statistics for Funds from Operation, by REIT property type

	OFF	IND	RET	RESI	MANU	DIV	LOD	STOR	HEAL
Mean	1034.8	500.7	1833.6	948.8	63.1	480.4	505.5	346.6	672.4
SD	304.4	280.8	757.3	338.5	40.4	290.9	371.56	157.18	509.03
Adjust	0.29	0.56	0.41	0.36	0.64	0.61	0.74	0.45	0.76

Figure 1

Overall FFO by REIT property type from 2000 to 2017, in Millions