

Predicting Future Real Estate Investment Trust Returns





Guiding Questions

1. What is an REIT?
2. What REITs will we be analyzing?
3. Is one type of REIT more volatile than another?
4. How does a diversified REIT compare to the S&P 500?
5. Can we predict a diversified REIT using multiple “pure” REITs?



What is an REIT?

- REITs, or real estate investment trusts, are companies that own or finance income-producing real estate across a range of property sectors.
- Commercial REITs focus mainly on commercial property. Office spaces, storefronts, and other commercial spaces are all examples of property owned.
- Residential REITs focus on residential property. They often own and lease out apartment buildings, single-family homes, and other residential property.
- We wanted to examine a diversified REIT, one that holds both property types, to see if we can predict its performance based on other REITs with “composite” holdings.

Commercial REIT #1

Prologis, Inc (PLD)



Prologis Inc. is an REIT located in San Francisco, CA and founded in 2011 via a merger with another REIT company. PLD invests mainly in commercial logistics facilities. As of 2021, they currently hold an estimated \$58.49 billion in total assets.

PLD follows the S&P 500 relatively closely, but is somewhat more volatile and the overall returns are ultimately higher

Commercial REIT #2 Equinix (EQIX)



In 2021, Revenues were \$6.6 billion and EBITDA was at \$2.7 billion.

EQIX follows the S&P relatively closely, with seemingly higher volatility. EQIX had a 0.52 correlation with the S&P 500.

Equinix's core business model is providing space, power, cooling, and security for its customers' servers within data centers.

Equinix also provides services relating to digital infrastructure to their customers.



Residential REIT #1

Mid-America Apartment Communities(MAA)



MAA seems to follow the S&P 500 closely until mid 2021

Became more volatile but maintaining higher value than S&P 500

Mid-America Apartment Communities is an investment trust invests in Southeastern and Southwestern US containing 100,490 apartment units.

Residential REIT #2

Camden Property Trust (CPT)

Camden Property Trust is primarily engaged in the ownership, management, development, redevelopment, acquisition, and construction of multifamily apartment communities. They currently acquire only Class A property and had \$1.15B in revenues in 2021.



Green is CPT and Blue is S&P 500
% change in the last year

CPT seems to track somewhat closely,
definitely more volatile and is at least
somewhat disconnected from the market



Mixed REIT

JBG SMITH Properties (JBGS)

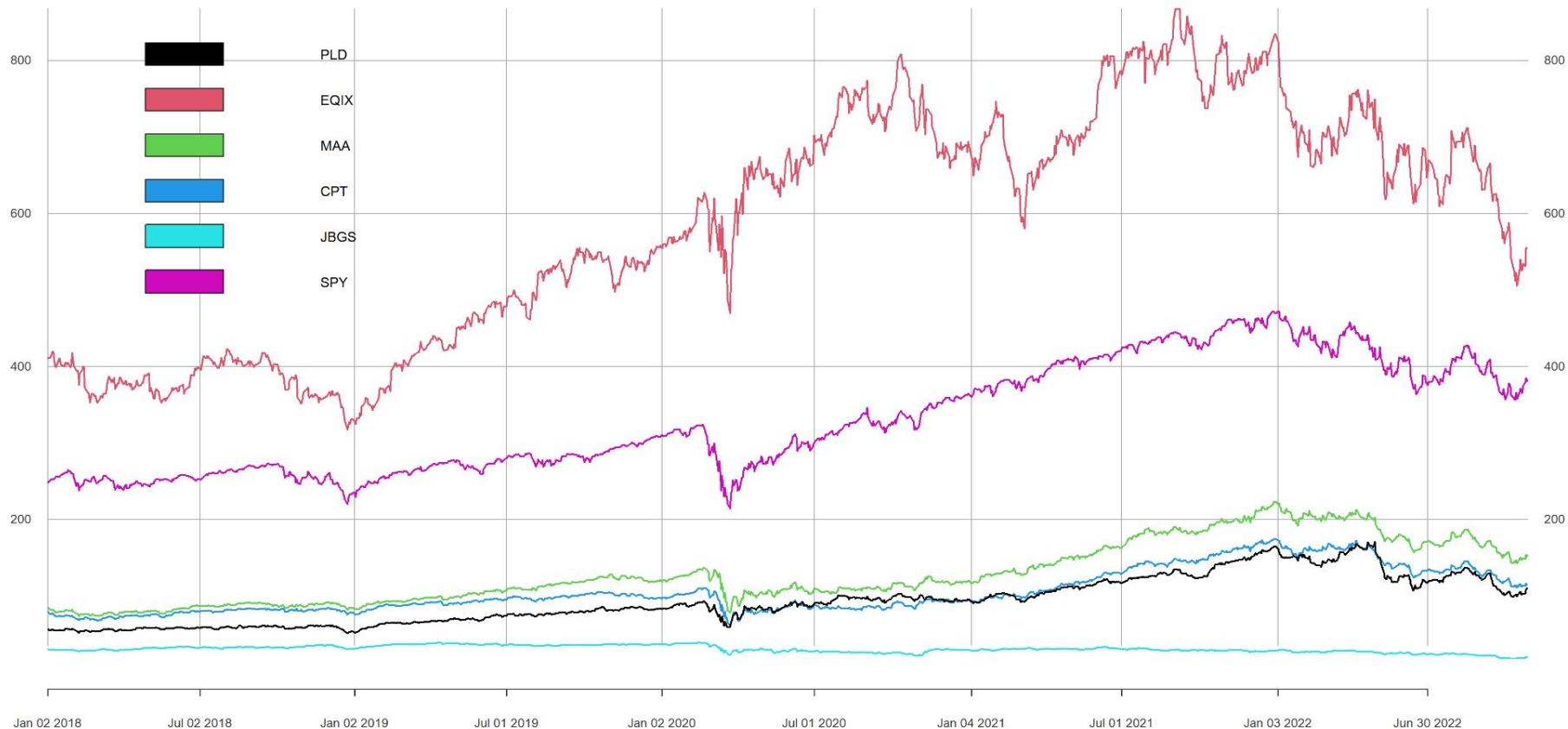


JBG Smith Properties is an REIT located in Bethesda, MD. They were founded in 1957 and currently hold a little over \$6 billion in total assets. JBGS invests in mainly managed office, multifamily, and retail properties mainly around the Washington D.C. area.

Prices Since 2018

prices

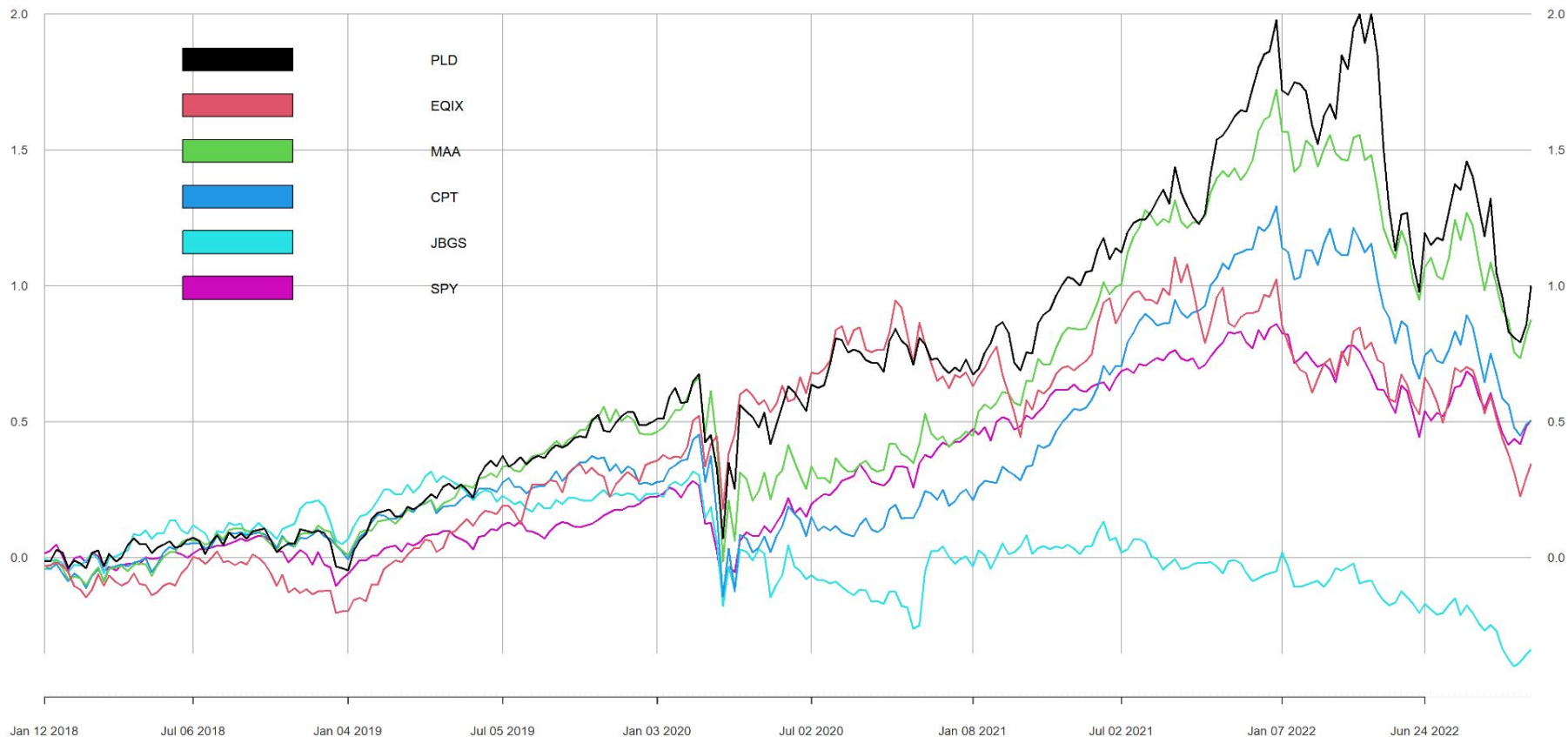
2018-01-02 / 2022-10-27



Cumulative Returns Since 2018

as.xts(return_cumul)

2018-01-12 / 2022-10-27





Measure Weekly Return Volatility & Mean since 2018 in R

Ticker	PLD	EQIX	MAA	CPT	JBGS	SPY
SD	4.41%	4.00%	4.34%	4.15%	4.37%	2.86%
Mean	0.37%	0.20%	0.35%	0.25%	-0.07%	0.20%



Correlation Matrix

	PLD	EQIX	MAA	CPT	JBGS	SPY
PLD	1.0000000	0.7022881	0.8168137	0.8113427	0.6065719	0.7473808
EQIX	0.7022881	1.0000000	0.6451775	0.6003332	0.3811067	0.5699907
MAA	0.8168137	0.6451775	1.0000000	0.9541007	0.7358816	0.7090101
CPT	0.8113427	0.6003332	0.9541007	1.0000000	0.7215072	0.7112852
JBGS	0.6065719	0.3811067	0.7358816	0.7215072	1.0000000	0.6354419
SPY	0.7473808	0.5699907	0.7090101	0.7112852	0.6354419	1.0000000



Testing and Training Data

```
return_cumul <- cumprod(1+weekly_returns)-1
```

```
weekly_returns$JBGS.fut <- c(weekly_returns$JBGS[0:-1], 0.0)
```

```
train.cut <- 2 * N %/% 3
```

```
returns.train <- weekly_returns[1:train.cut, -6]
```

```
returns.test <- weekly_returns[(train.cut+1):N, -6 ]
```



Linear Regression

Call:

```
lm(formula = JBGS.fut ~ ., data = returns.train)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-0.251469	-0.017940	0.000534	0.019826	0.279770

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.002584	0.003617	0.714	0.4760
PLD	0.197576	0.170984	1.156	0.2496
EQIX	0.014098	0.130307	0.108	0.9140
MAA	-0.658525	0.280847	-2.345	0.0203 *
CPT	0.072342	0.282239	0.256	0.7980
JBGS	0.204174	0.126690	1.612	0.1090

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

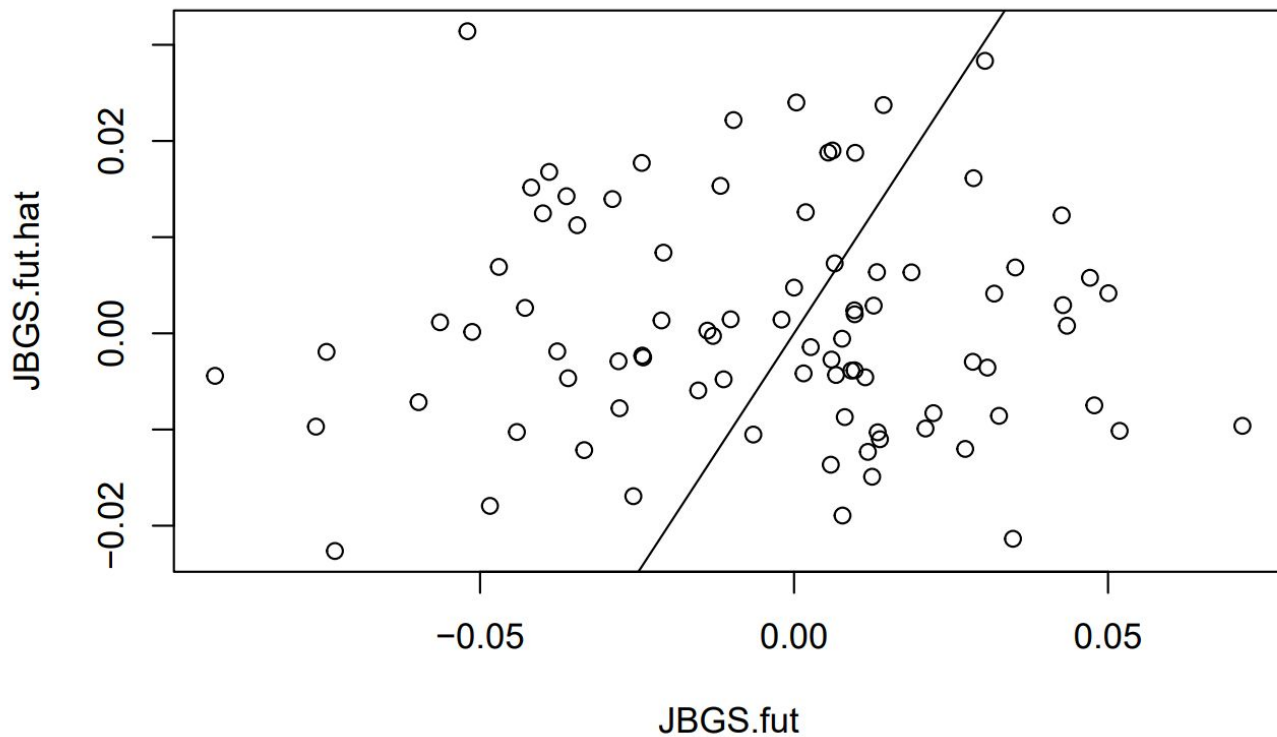
Residual standard error: 0.04615 on 160 degrees of freedom

Multiple R-squared: 0.1036, Adjusted R-squared: 0.07556

F-statistic: 3.697 on 5 and 160 DF, p-value: 0.00341



Linear Regression Prediction Accuracy





Logistic Regression #1

```
Call:
glm(formula = JBGS.Direction ~ ., family = binomial, data = returns.train)
```

Deviance Residuals:

Min	1Q	Median	3Q	Max
-2.42064	-0.79360	-0.00005	0.80288	2.13760

Coefficients:

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-0.2494	0.2020	-1.235	0.2168
PLD	32.3672	11.0149	2.938	0.0033 **
EQIX	-15.9515	8.2225	-1.940	0.0524 .
MAA	8.6958	17.1348	0.507	0.6118
CPT	42.5438	18.1868	2.339	0.0193 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 230.12 on 165 degrees of freedom
Residual deviance: 155.81 on 161 degrees of freedom
AIC: 165.81

Number of Fisher Scoring iterations: 6

Actual Direction of JBGS

GLM Pred		Down	Up
	Down	26	12
	Up	13	34

Accuracy: 70.59%

Guessing all Up: 54.12%



Logistic Regression #2

```
Call:
glm(formula = JBGS.Direction ~ . - MAA, family = binomial, data = returns.
train)
```

Deviance Residuals:

Min	1Q	Median	3Q	Max
-2.36176	-0.78846	-0.00009	0.81599	2.16478

Coefficients:

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-0.2403	0.2011	-1.195	0.23217
PLD	33.2641	10.9013	3.051	0.00228 **
EQIX	-15.4357	8.1537	-1.893	0.05835 .
CPT	49.5698	11.9913	4.134	3.57e-05 ***

signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 230.12 on 165 degrees of freedom
Residual deviance: 156.07 on 162 degrees of freedom
AIC: 164.07

Number of Fisher Scoring iterations: 6

Actual Direction of JBGS

GLM Pred		Down	Up
	Down	26	11
	Up	13	35

Accuracy: 71.76%

Guessing all Up: 54.12%



Logistic Regression #3

```
Call:
glm(formula = JBGS.Direction ~ . - MAA - EQIX, family = binomial,
    data = returns.train)
```

Deviance Residuals:

Min	1Q	Median	3Q	Max
-2.20315	-0.77263	0.00002	0.82106	2.22754

Coefficients:

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-0.2543	0.1991	-1.277	0.2017
PLD	24.0562	9.5662	2.515	0.0119 *
CPT	44.0874	11.1880	3.941	8.13e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 230.12 on 165 degrees of freedom
Residual deviance: 159.86 on 163 degrees of freedom
AIC: 165.86

Number of Fisher Scoring iterations: 6

Actual Direction of JBGS

GLM Pred		Down	Up
	Down	27	17
	Up	12	29

Accuracy: 65.88%

Guessing all Up: 54.12%



Naive Bayes

A-priori probabilities:

Y

Down Up
0.5 0.5

Conditional probabilities:

PLD

Y [,1] [,2]
Down -0.01499156 0.03591985
Up 0.02373569 0.04459653

EQIX

Y [,1] [,2]
Down -0.006796445 0.03954353
Up 0.013954933 0.03864115

MAA

Y [,1] [,2]
Down -0.01655082 0.04493646
Up 0.02500726 0.04217178

CPT

Y [,1] [,2]
Down -0.01781324 0.04279372
Up 0.02341770 0.03851273

Actual Direction of JBGS

NB Class		Down	Up
	Down	29	16
	Up	10	30

Accuracy: 69.41%

Guessing all Up: 54.12%



Overall Findings and Portfolio Recommendation

Why is the regression so accurate?

- High correlations between selected REITs
 - Similar portfolios of property, similar margins, similar operations, similar management, etc.
- Having a small set of data could create a stronger regression than reality. Although we split the data into a training and testing set, the testing set is quite small.
- Bullish market could produce similar returns among similar companies, thereby producing an artificially high accuracy



Overall Findings and Portfolio Recommendation



Why does this matter?

- We may be able to make money!
 - Buy when next day prediction is up, sell when next day prediction is down.