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An Analysis of the Relationship between Producer Price Indexes and Restaurant Industry Stock Values

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Abstract

Due to constantly changing food prices, in this paper I've explored the extent producer price index by commodity for food items affects restaurant stock values. My findings resulted in the determination that my model suffered from violating many assumptions, though it still has the potential to show significance. With a working model, this significance could be used to show relationships between restaurant stock price and PPI, allowing for a new way to understand stock prices.

Introduction

For the public to make strategic investment decisions, it is helpful to understand correlative relationships between variables. The main goal of this paper is to explore those correlations as they relate to production price indexes by commodity of various food products and the restaurant industry. The production price index measures the average change over time in the selling prices received by domestic producers for their output[1]. Determining the effect these PPI's have on a restaurant's stock price could possibly provide significant insight into innovative ways to predict them.

While there are many studies that show the relationships between various broad macroeconomic factors such as inflation, GDP, Interest rates, etc and stock prices in general, there is very limited research available that explore specific factors in relation to the restaurant industry. I believe this level of specificity can add an additional beneficial aspect when determining stock investments. While it would be difficult to gain an exact understanding of the restaurant industry as a whole, I have selected a subset of companies that provide a general overview of the industry. By completing a regression model on each of these companies and comparing the results a common theme may emerge describing the restaurant industry in its entirety.

This regression analysis is accomplished by analyzing four peripheral variables (Various PPI's) and 3 core variables: Consumer Sentiment, Unemployment Rate, and Central Bank Interest Rate. These variables were chosen based on a mix of educated curiosity and a review of other related research.

A paper written by Manisha Singal goes in depth about the relationship between Consumer Sentiment and stock prices in the hospitality industry [2]. The unemployment rate was determined to be a core variable based on the significance determined in another paper which

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[1] U.S. Bureau of Labor Statistics, "Producer Price Index (PPI)," accessed April 25, 2017, https://www.bls.gov/ppi/.
[2] Manisha Singal, "Effect of Consumer Sentiment on Hospitality Expenditures and Stock Returns," *International Journal of Hospitality Management* 31, no. 2 (June 2012): 511–21, doi:10.1016/j.ijhm.2011.07.009.

looked at various macroeconomic and non-macroeconomic variables on hospitality stock returns [3]. I am also using the Central Bank Interest Rate because interest rates have been determined in the past to be predictors of stock prices [4].

I chose a combination of these three variables believing that together they would have significant correlations with the stock prices and allow for the determination of the effect the peripheral variables have. In this paper we have Production Price Indexes for dairy products; flour, flour based mixes, and dough; table salt, pepper, and other spices; and meats, poultry, and fish. These four PPI's have been selected based on the understanding that most restaurants use these various products, so analyzing them satisfies an educated curiosity: most restaurants use these food items, so the prices of these items should influence a restaurant's stock price.

Theory and Hypothesis

Going into this study I had one main hypothesis regarding my peripheral variables. I believe that an increase in the producer price index by commodity for a specific food commodity will correlate with a decrease in a restaurants stock price. I came to this conclusion based on the assumption that an increase in the PPI would increase a company's cost of materials, thus increasing its expenses and having a chain effect causing a decrease in the company's net income. This chain effect I believe would have a relationship with the ending stock price in the company. Thus, H_0: β_1, β_2, β_3, $\beta_4 < 0$ showing that there is a negative relationship between PPI and Stock Price. This hypothesis is somewhat supported by the research done by Prem Jain who found the overall producer price index to be almost significant when modeling the Standard and Poor's 500 Stock Index [5]. The fact that the overall PPI was very close to being significant on the S&P makes me believe that PPI by commodity for food items would be significant on specific restaurant stock prices. The alternative hypothesis, in this case, would be PPI has no statistically significant effect on restaurant stock prices, represented by H_a: β_1, β_2, β_3, β_4=0.

In addition to my main hypothesis, previous studies have shown relations with my core variables and stock valuations. Singal found a statistically significant positive relationship between consumer sentiment index and hospitality stock returns [6]. Singal's research on

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[3] Ming-Hsiang Chen, Woo Gon Kim, and Hyun Jeong Kim, "The Impact of Macroeconomic and Non-Macroeconomic Forces on Hotel Stock Returns," *International Journal of Hospitality Management* 24, no. 2 (June 2005): 243–58, doi:10.1016/j.ijhm.2004.06.008.
[4] Nai-Fu Chen, Richard Roll, and Stephen A. Ross, "Economic Forces and the Stock Market," *The Journal of Business* 59, no. 3 (1986): 383–403.
[5] Prem C. Jain, "Response of Hourly Stock Prices and Trading Volume to Economic News," *Journal of Business*, 1988, 219–231.
[6] Singal, "Effect of Consumer Sentiment on Hospitality Expenditures and Stock Returns."

hospitality stock returns leads me to believe I should find a similar positive relationship in my model for restaurant stock returns in regards to consumer sentiment.

The unemployment rate has produced statistically significant negative relationships with stock returns in past data, specifically in a 2005 paper that regressed multiple macroeconomic variables on hotel stock returns. In this paper, the authors found unemployment rate to be significant at the 10% confidence level [7]. Previous findings have led me to believe that unemployment rate will act similarly in my model and produce a significant negative relationship with restaurant stock returns.

The final variable in my model is the central bank interest rate. This rate is equivalent to the federal funds rate set by the central bank of the United States. My theory is that an increase in the central bank interest rate will lead to a decrease in restaurant stock prices due to higher interest rates dictating less business spending. This is supported by research done during the 80s, where authors analyzed various economic forces on the stock market and found interest rates to have a negative relationship with individual stock returns [8].

Data and Empirical Models

Empirical Model

Five models have been specified for this research paper. Multiple models were needed to show an overview of the restaurant industry instead of effects on only one restaurant. I have used a multiple linear regression model with four peripheral variables and three core variables, with the coefficients in each model being estimated using the ordinary method of least squares following the Gauss-Markov Theorem. All of the calculations have been completed through the R statistical software package.

My general model is as follows:

$$RCSP= \beta_1+\beta_2 PPIF+\beta_3 PPID+\beta_4 PPIMPF+\beta_5 PPIS+\beta_6 URATE+\beta_7 CBPR+\beta_8 CSI+ui$$

This model is similar across all five regressions, with only the expected variable RCSP (Restaurant Closing Stock Price) changing in order to accommodate the different restaurants. In this model, β indicates the coefficient while each variable is labeled separately.

Variables

In my model, I have four peripheral explanatory variables, three core explanatory variables, and five explained variables represented by separate similar models. Starting from the left, RCSP represents Restaurant Closing Stock Price. This variable will change with each model, the five

[7] Chen, Kim, and Kim, "The Impact of Macroeconomic and Non-Macroeconomic Forces on Hotel Stock Returns."
[8] Chen, Roll, and Ross, "Economic Forces and the Stock Market."

stocks I am covering are Darden Restaurants (DRCSP) which include Olive Garden, LongHorn Steakhouse, Bahama Breeze, Seasons 52, Eddie V's Prime Seafood, The Capital Grille, and Yard House; Yum! Brands (YBCSP): Taco Bell, KFC, Pizza Hut, WingStreet; Cracker Barrel (CBCSP); Dine Equity (DECSP): IHOP and Applebee's; and McDonald's (MDCSP). By doing a regression on various restaurants encompassing both dine-in and fast-food companies, a more accurate view of the restaurant industry as a whole can be obtained.

The next variable in my model is PPIF which stands for Producer Price Index by Commodity for Processed Foods and Feeds: Flour and Flour Base Mixes and Doughs. Next, we have PPID, Producer Price Index by Commodity for Processed Foods and Feeds: Dairy Products. The third peripheral explanatory variable is PPIMPF, Producer Price Index by Commodity for Processed Foods and Feeds: Meats, Poultry, and Fish. My last peripheral variable is PPIS, Producer Price Index by Commodity for Processed Foods and Feeds: Table Salt (Evaporated), Pepper (White and Black), and Other Spices. These various PPI's have been included because they make up a majority of the ingredients that permeate much of the restaurant industry, so I believe changes in these PPI's will have impacts on a restaurant's stock price.

In addition to the four peripheral variables in my model, I include three core variables. URATE is the unemployment rate for the United States, CBPR stands for the Central Bank Policy Rate, and CSI represents Consumer Sentiment Index. These three variables have been included to account for the majority in stock price fluctuations in order to get a better view of the effect the peripheral variables have.

Data collection

The data for this article has been collected through various sources. The various Producer Price Indexes and Consumer Sentiment have been collected from the Federal Reserve Bank of St. Louis, FRED. Fred monitors various economic and financial literature to collect data and aggregate it into one place. The PPI's were recorded originally from the U.S. Bureau of Labor Statistics, while the Consumer Sentiment Index data was taken from the University of Michigan. The other two core variables in my model, unemployment rate and central bank policy rate, were both retrieved from the international monetary fund. The IMF hosts a collection of macroeconomic and financial data that affect global stability.

While all the explanatory variables I have collected were recorded back to various points in time, I made the decision to cut the time frame at my shortest variable to get complete data for each. The data was collected on a monthly scale ranging from June 1991 through February 2017, giving a total possibility of 309 data points. Though I attempted to maximize this data, I was constricted to using publically traded companies, three of which were not listed through the entire range. I collected the monthly average closing stock price through Yahoo Finance for each restaurant, going back as far as possible to utilize my data's timeframe. Darden Restaurants ranges from May 1995, Yum! Brands from September 1997, and Dine Equity from July 1991. Cracker Barrel and McDonald's both cover the entire 6-1991~2-2017 timeframe.

Although each restaurant doesn't cover the same timeframe, they each still have enough data points to generate accurate statistical significance.

Violations of Assumptions

Violation of Assumption possibilities

Considering the fact that I am conducting a multiple linear regression using OLS estimators, there are many assumptions that my model has the possibility of violating. The main assumptions that show concern in my model would be assuring my model is homoscedastic, the assumption of no autocorrelation, and that my regression model is correctly specified. A correctly specified model would follow Occam's razor principle of parsimony in that my model is as simple as possible while still being correct; be in the correct form; and not suffer from omitted variable bias. Another possible violation that must be kept in mind regarding my model would be multicollinearity, correlations between the explanatory variables.

Violation of Assumption tests

Model Misspecification

The first test I ran on my models was the Mackinnon-White-Davidson (MWD) test in order to determine whether a linear or a log-linear model specification would be better suited. In order to conduct this test, I began by estimating model one and obtaining the fitted variables for model one,$\boldsymbol{\hat{y}_t}$. I then created a second model applying the natural log to each variable in model one and obtained the fitted values $\widehat{\boldsymbol{ln y_t}}$. I then defined Z_{1t} as $\widehat{\boldsymbol{ln y_t}} - \boldsymbol{\hat{y}_t}$ and added the new variable to my regression model ones. To test the log linear form, I defined Z_{2t} as $\boldsymbol{e^{\widehat{ln y_t}}} - \boldsymbol{\hat{y}_t}$ and added this new variable to my model twos. The results for each of my model are as follows:

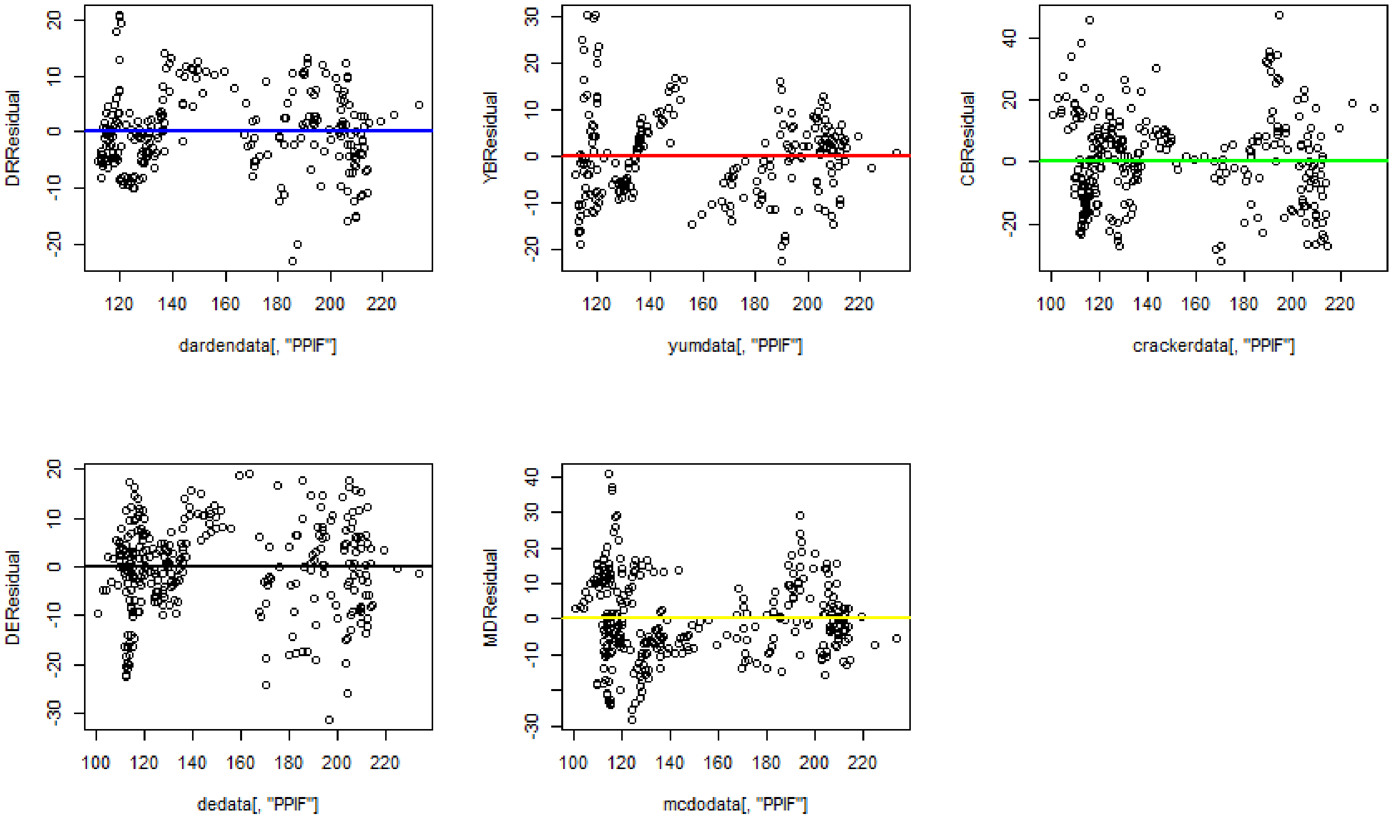
Restaurant Model	Z_{1t} t-Statistic (Linear)	Z_{2t} t-Statistic (Log-Linear)
DRCSP	3.551***	-8.215***
YBCSP	-3.830***	-2.266*
CRCSP	-8.360***	-3.201***
DECSP	-6.133***	-1.309
MDCSP	-5.063***	-3.374***

Significance Codes: "." 10%, "*" 5%, "**" 1%, "***" 0.1%

The t-statistics I have evaluated for each of my models shows that unfortunately almost none of them are specified correctly. These t-statistics being significant show that I should reject the model specification related to said statistic. The misspecification errors can be corrected through specifying the model differently, perhaps in a form that is non-linear. This assumption has been violated and I have continued with a linear model despite its specification errors. By continuing with incorrectly specified models, my model is open to many consequences. This misspecification can create biased, inconsistent variables that make for unreliable hypothesis tests and confidence intervals.

Heteroscedasticity

The second assumption that was tested for in my model was homoscedasticity. Homoscedasticity states that the variance of the error term is constant along the regression line, while heteroscedasticity would mean the variance changes along the regression line. In order to test for this, we began by examining the residual plots looking for systemic patterns in the plot. Systemic patterns appearing in these residual plots would be indicative of heteroscedasticity in the model.



While there are no obvious patterns appearing in these residual plots, I still performed the Park test for heteroscedasticity on my model. This is performed by regressing the log of the squared residuals of my model against the log of the fitted values of the model. A significant t-value appearing on β_1 in this model would indicate heteroscedasticity is present. I've conducted this test on each model, and the results are as follows.

Restaurant Model	Log(Fitted) t-Statistic
DRCSP	1.808 .
YBCSP	-0.788
CRCSP	-0.05
DECSP	2.630 **
MDCSP	-1.585

Significance Codes: "." 10%, "*" 5%, "**" 1%, "***" 0.1%

The results from the Park test indicate there is heteroscedasticity present in two of my models, DRCSP (10% level) and DECSP (1% level). By having heteroscedasticity present in my model, there are possibilities that my OLS estimators will not be efficient and hypothesis testing will be unreliable. In order to fix heteroscedasticity, we would have to try to make the errors more homoscedastic which can be done if you know its form of heteroscedasticity.

Multicollinearity

Multicollinearity is defined as correlation between explanatory variables and can cause many issues in a model [9]. While I gained a preliminary estimate of multicollinearity looking at the R^2 and t-statistics, I felt it necessary to run a test for multicollinearity to be certain. I ended up running the VIF function in R in order to find the variance inflation factors for each model, essentially how inflated the variances of OLS are as a result of multicollinearity. Based on industry standard, a VIF greater than ten is indicative of multicollinearity. I've included all the variance inflation factors for each model below.

Model VIF's	PPIF	PPID	PPIMPF	PPIS	URATE	CBPR	CSI
DRCSP	13.148	1.127	12.104	13.012	2.463	4.029	3.804
YBCSP	12.761	4.341	11.723	19.649	2.685	3.638	4.925
CRCSP	14.684	2.140	12.015	17.907	2.483	3.741	3.422
DECSP	14.680	2.114	12.219	17.191	2.491	3.769	3.431
MDCSP	14.684	2.140	12.015	17.907	2.483	3.741	3.422

Based on the various variance inflation factors we can gain an understanding of the multicollinearity present in my model. It seems for all 5 models there is multicollinearity present between PPIF, PPIMPF, and PPIF. This multicollinearity is understandable, as all three variables are PPI's for food items. What's more curious though is the fact that dairy does not have a VIF greater than 10. This indicates dairy is not correlated with the other PPI's for food in the model. In order to correct for multicollinearity, I would need to drop the collinear variables until it disappears, specify my model differently, acquire an additional proxy variable, change the time frame of my data, or transform my data somehow to account for the multicollinearity issue. By having multicollinearity issues in my model, my estimators become very sensitive to

[9] Damodar N. Gujarati and Dawn C. Porter, *Essentials of Econometrics*, 4th ed (New York: McGraw-Hill/Irwin, 2010).

slight changes in my data, they may have incorrect signs/significance levels, and they would produce smaller t-statistics possibly causing me to fail to reject my null hypothesis.

Omitted Variable Bias

Omitted variable bias is one of the assumptions that requires more research. It is caused by an important core variable being omitted from your model. In response, the model compensates for the missing variable by over or underestimating one of the other variables. I've used the Ramsey Reset Test to test my models for omitted variable bias, and have included the results below.

Model	dF1	dF2	Reset F-Statistic	Table F-Statistic
DRCSP	2	250	42.385	3
YBCSP	2	222	1.8748	3
CRCSP	2	297	35.179	3
DECSP	2	296	0.12223	3
MDCSP	2	297	10.007	3

Since the F-statistic corresponding with 2 numerator degrees of freedom and 120+ denominator degrees of freedom is 3, these statistics show that my models DRCSP, CRCSP, and MDCSP all suffer from omitted variable bias. This could possibly be corrected by finding more relevant models that would correlate with my explained variable, Restaurant stock price, such as inflation or perhaps growth variables.

Autocorrelation

Autocorrelation is correlation that considers time lags between variables, thus can have high impact time-series data such as the data used in this paper [10]. When autocorrelation is present, there are similar consequences as heteroscedasticity. The presence of autocorrelation can cause serious unreliability in the resulting t-statistics, even though the OLS estimates are still unbiased and linear. This is because these estimators are no longer efficient, therefore they are no longer BLUE estimators (Best linear unbiased estimator). I have tested for autocorrelation in my model using the Durbin-Watson d test and have interpreted said results below.

Model	d-Statistic	d_L-Critical	d_U-Critical
DRCSP	0.23696	1.707	1.831
YBCSP	0.31902	1.707	1.831
CRCSP	0.22458	1.707	1.831
DECSP	0.34105	1.707	1.831
MDCSP	0.19405	1.707	1.831

[10] Gujarati and Porter, *Essentials of Econometrics*.

The Durbin-Watson test produces a d-Statistic, which itself can give you an idea of correlation but must be interpreted in relation to a set of critical values. The critical values for the d statistic can be obtained from a table that included the number of regressors (7 in my model) and the sample size (all my samples are greater than 200, so we use the last row in the table). These factors produce a lower d critical value of 1.707 and an upper d critical value of 1.831. Autocorrelation can be estimated on a scale; 0= perfect positive correlation, 2=no autocorrelation, and 4= perfect negative correlation. Considering all my d-statistics have been determined to be closer to 0, we can assume they will be closer to having positive autocorrelation. They are also all below the critical lower d-statistic, which shows us that there is statistically significant evidence that my models suffer from positive autocorrelation. Considering my models suffer from omitted variable bias as well, we can assume this is one of the reasons for the autocorrelation in my model as one of the main reasons of autocorrelation is having omitted variables. In this case, my omitted variables likely have a positive correlation with the explained variable in my model.

Results

To collect my results, all five of my regression models were run in R and I analyzed the summary of each model. The models have been analyzed under the guise that all the assumptions of the linear regression model have held true despite my tests finding otherwise. While under normal circumstances, I would completely scrap my models or change their specification into some other configuration, they have been conducted as is to show understanding. Model results are as follows.

DRCBP Model			
Coefficients	Estimates	Standard Errors	t-Statistics
(Intercept)	-30.419	7.174	-4.240***
PPIF	-0.113	0.042	-2.675**
PPID	-0.004	0.022	-0.198
PPIMPF	0.193	0.052	3.736***
PPIS	0.412	0.048	8.656***
URATE	-0.159	0.045	-3.516***
CBPR	-0.056	0.064	-0.871
CSI	-0.142	0.064	-2.206*

Significance Codes: "." 10%, "*" 5%, "**" 1%, "***" 0.1%

Degrees of Freedom	Adjusted R^2	F-Statistic
254	0.8338	188

Model: $DRCSP = -30.419 - 0.113PPIF - 0.004PPID + 0.193PPIMPF + 0.412PPIS - 0.159URATE - 0.056CBPR - 0.142CSI$

Right off the bat, we notice that the model doesn't make much sense, as it says that the base stock price is -30.419 when all other variables are 0. In addition, one of the core variables consumer sentiment level is shown as having an inverse relationship with the Darden restaurants stock price. Based on previous research, a positive correlation should have been found [11]. If the results are interpreted as is, then PPIF, PPIMPF, PPIS, URATE, and CSI all are shown to be statistically significant at various levels ranging from 5% to .1%. This model would suggest for example that a 1 percentage point increase in the unemployment would correlate with a $0.159 decrease in Darden's stock price. Three of my main peripheral variables have turned out significant in this instance, showing that the Producer Price Index by commodity for flour; meat, poultry, fish; and spices all have a significant relationship with a restaurants stock price, with flour having a negative relationship and the rest having positive relationships. Also, the URATE variable matches with previous research through its significant negative correlation. The negative relationship fits my hypothesis, as I believed an increase in PPI by food commodity would correlate with a decrease in the restaurants stock price. Overall, the R^2 value for this model states that 83.38% of the variation in a restaurants stock price is explained by my model. This R^2 is fairly large, which led me to look into more violations of assumptions of the linear regression model.

YBCBP Model			
Coefficients	Estimates	Standard Errors	t-Statistics
(Intercept)	-50.05731	11.46592	-4.366***
PPIF	-0.09961	0.05833	-1.708 .
PPID	1.01453	0.33335	3.043**
PPIMPF	0.49126	0.07379	6.657***
PPIS	0.07594	0.08608	0.882
URATE	-0.05591	0.06419	-0.871
CBPR	-0.02495	0.09142	-0.273
CSI	0.16425	0.10148	1.619

Significance Codes: "." 10%, "*" 5%, "**" 1%, "***" 0.1%

Degrees of Freedom	Adjusted R^2	F-Statistic
226	0.7188	86.08

Model: $YBCSP = -50.057 - 0.01PPIF + 1.015PPID + 0.491PPIMPF + 0.076PPIS - 0.056URATE - 0.025CBPR + 0.164CSI$

This model copies the first model in the fact that the intercept of -50 doesn't make sense. In addition, the statistically significant (due to t-statistics) PPI's on dairy and meat-poultry-fish also do not make sense due to this model suggesting a rise in PPI correlates with a rise in yum brands stock price. These were the only statistically significant variables in this model, and it's relatively high R^2 of 0.7188 and few significant variables suggest multicollinearity issues as spoke about in the violation of assumptions section.

[11] Singal, "Effect of Consumer Sentiment on Hospitality Expenditures and Stock Returns."

CBCBP Model			
Coefficients	Estimates	Standard Errors	t-Statistics
(Intercept)	-163.01	13.78083	-11.829***
PPIF	-0.30175	0.08336	-3.62***
PPID	0.44492	0.03024	14.714***
PPIMPF	0.73654	0.09784	7.528***
PPIS	0.68892	0.0921	7.48***
URATE	-0.47765	0.08342	-5.726***
CBPR	-0.73434	0.1233	-5.955***
CSI	0.55613	0.12234	4.546***

Significance Codes: "." 10%, "*" 5%, "**" 1%, "***" 0.1%

Degrees of Freedom	Adjusted R^2	F-Statistic
301	0.8474	245.2

Model: $CBCSP = -163.01 - 0.302PPIF + 0.445PPID + 0.737PPIMPF + 0.689PPIS - 0.478URATE - 0.734CBPR + 0.556CSI$

Again, this cracker barrel model starts off badly with a -163 intercept value. In this model, every statistic came up statistically significant and generated an R^2 of .8474. This would suggest a great model, though raises some concerns regarding assumptions as stated above. Again the PPID, PPIMPF, and PPIS variables in the model have gone against my hypothesis of there being a negative correlation with restaurant stock prices, though the relationships of URATE, CBPR, and CSI all match previous research done. This R^2 value suggests 84.74% of the variation in restaurant stock prices would be explained by our model.

DECBP Model			
Coefficients	Estimates	Standard Errors	t-Statistics
(Intercept)	-118	8.66	-13.626***
PPIF	0.182	0.0525	3.457***
PPID	0.103	0.0190	5.436***
PPIMPF	0.602	0.0621	9.694***
PPIS	0.000315	0.0580	0.005
URATE	-0.272	0.0525	-5.168***
CBPR	-0.0785	0.0780	-1.006
CSI	0.590	0.0770	7.661***

Significance Codes: "." 10%, "*" 5%, "**" 1%, "***" 0.1%

Degrees of Freedom	Adjusted R^2	F-Statistic
300	0.8381	228

Model: $DECSP = -118 + 0.182PPIF + 0.103PPID + 0.602PPIMPF + 0.00032PPIS - 0.272URATE - 0.0785CBPR + 0.590CSI$

In my DECSP model, every variable appeared to be statistically significant at the 5% level except for CBPR and PPIS. Again though, the estimates of the PPI's do not match my null hypothesis, instead, they show that as PPI by Commodity for food items increase, the stock price for DineEquity increases as well showing a positive correlation. The R^2 for this model shows that 83.91% of the variation in Dine Equity's stock price can be explained by my model, though the signs may be indicative of a specification error as spoken about in the violation of assumptions section above.

MDCBP Model			
Coefficients	Estimates	Standard Errors	t-Statistics
(Intercept)	-145.436	11.06011	-13.15***
PPIF	0.21601	0.0669	3.229**
PPID	0.35606	0.02427	14.672***
PPIMPF	-0.15358	0.07853	-1.956 .
PPIS	0.78822	0.07392	10.664***
URATE	0.19812	0.06695	2.959**
CBPR	0.107	0.09896	1.081
CSI	0.50586	0.09819	5.152***

Significance Codes: "." 10%, "*" 5%, "**" 1%, "***" 0.1%

Degrees of Freedom	Adjusted R^2	F-Statistic
301	0.8259	209.8

Model: $MDCSP = -145.436 + 0.216PPIF + 0.356PPID - 0.153PPIMPF + 0.788PPIS + 0.198URATE + 0.107CBPR + 0.506CSI$

The last model that I analyzed was on McDonald's stock price. In this model, every variable except for CBPR shows as significant at various levels, with everything except PPIMPF being significant at the 1% or .1% levels. With an R^2 of .8259, these variables would suggest that roughly 83% of the variation in McDonald's stock price is covered by my model. Again though, the signs on my OLS estimators in this model suggest that I may have model specification errors which have not been corrected for, so along with the other assumptions that have been violated about these results are unreliable.

Conclusions

While my results initially looked promising based on their t-statistics and R^2 values, due to them violating multiple assumptions I found them completely unreliable. In the future, I would like to correct each assumption and retest my model to see if there is actual significance. This can be done through a combination of transforming my data, specifying my models differently, and including other relevant variables to correct for the various violations my models suffer from.

Unfortunately, nothing significant can be learned from my models due to their unreliability, but had multiple assumptions not been violated due to the significant t-statistics on most of my variables I could have learned that PPI by commodity did have a significant impact on restaurant stock prices. With the R^2 values hovering around 80% for each of my models, had they been reliable my model would have covered 80% of the variation in restaurant stock prices and have had strong correlations to draw conclusions from.

Despite the unsatisfactory findings through my models, I still believe there is value in analyzing the producer price index by commodity against a restaurants stock price as I believe the change in price should have a statistically significant effect. This can be analyzed in further research as no current research touches on PPI by commodity specifically as it relates to stock prices. I would like to continue researching this, but I would first need to gain a better understanding of diverse ways to specify models to correct for assumption violations.

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