Analysis of PepsiCo

Student: Rohan Tiwari

NewZ Analysis

We calculate NewZ for PepsiCo using WRDS data. We have newZ and component financial ratios from 1965 till 2018 for PepsiCo which are plotted in Figure 1. In 2018, the NewZ was 1.83 which is below the critical level. This would imply that the firm is in a grey area in 2018 but it would be interesting to compare it with other related firms as well to understand better.

Examining the plot closely, we see that PepsiCo has NewZ value below critical level of 2.0 for the following years.

	fyear	NewZ
37	1986	1.898413
39	1988	1.934268
40	1989	1.736177
41	1990	1.817207
42	1991	1.891657
43	1992	1.804735
44	1993	1.772088
45	1994	1.950475
49	1998	1.869871
61	2010	1.920553
62	2011	1.908426
63	2012	1.904814
64	2013	1.940477
66	2015	1.950311
67	2016	1.851101
68	2017	1.798914
69	2018	1.832952

Table 1: Years with NewZ scores below critical value of 2.0.

The NewZ scores and the component ratios are used to check the health of PEP relative to other firms in the WRDS universe.

Between 1986-1998 (except 1995-1997) and 2010-2018 (except 2014), the NewZ is below 2.0. In 1996, NewZ was 2.16. In 1997, it jumped to 2.23 but back to below critical level in 1998. But again back to a healthier value of 2.59 in 1999. The NewZ remains above 2.0 during the years of sluggish economy (2007-2008).

Let us analyze what may have caused these dips in NewZ. We look at the component ratios in the NewZ calculations for the years 1965-2018.

	fyear	WC/TA	RE/TA	EBIT/TA	MVE/TL	SA
37	1986	0.034962557	0.2885439	0.1059461	0.3449368	1.1572141
39	1988	-0.054681957	0.3011773	0.1242804	0.3963984	1.1680871
40	1989	-0.009321266	0.2673815	0.1175736	0.3463188	1.0076487
41	1990	-0.040196227	0.2996022	0.1247477	0.4006961	1.0384579
42	1991	0.044953156	0.3089358	0.1221245	0.4191629	1.0443566

43	1992	0.024719348	0.2549114	0.1224130	0.3434132	1.0486273
44	1993	-0.059512862	0.2682044	0.1226071	0.3649832	1.0554674
45	1994	-0.007994514	0.2931793	0.1291223	0.3822557	1.1484511
49	1998	-0.156751986	0.5181377	0.1267432	0.3936896	0.9862312
61	2010	0.024606400	0.4909542	0.1447332	0.4534139	0.8486494
62	2011	-0.009782937	0.4677012	0.1423534	0.3960526	0.9124887
63	2012	0.021852140	0.5047161	0.1308985	0.4267693	0.8774619
64	2013	0.056325667	0.5329642	0.1290947	0.4573264	0.8572111
66	2015	0.078272353	0.5332941	0.1455783	0.2068636	0.9051057
67	2016	0.080319443	0.5207004	0.1393517	0.1763070	0.8471583
68	2017	0.131885620	0.4984963	0.1355822	0.1582175	0.7960127
69	2018	-0.003155265	0.5773233	0.1346719	0.2302763	0.8327452

Table 2: NewZ component financial ratios for years with NewZ below critical level.

The ratios are calculated as follows:
WC/TA = (current assets - current liabilities) / total assets.
RE/TA = (retained earnings) / total assets.
EBIT/TA = (earnings before interest and taxes) / total assets.
MVE/TL = (total shareholder equity) / (total liabilities).
Sales efficiency = S/TA = (sales)/total assets.

For ratio analysis, it is generally a good idea to benchmark against other companies in the industry for a good relative understanding of the firm's health.

Working Capital / Total Assets ratio

WC/TA ratio is low for the years in Table 2. A firm experiencing operating losses will have shrinking current assets in relation to total assets or the firm carries very low working capital. WC/TA ratio has always been on the lower side for PEP with a mean of 0.07 for our dataset. The ratio was lowest in 1998 but bounced back in 1999.The ratio was negative in 1988-1990, 1993-1994, 1998, 2011 and 2018 which would imply low liquidity in these years and hurt the NewZ score.

Current Ratio

If we check the current ratio (current assets/current liabilities), we see that there is a huge drop in 1998 to current ratio and it goes down to 0.55. Current ratio is below 1 between 1988-1990, 1993-1994, 1998, 2011 and 2018 which means current liabilities increased to be larger than current assets and can be seen in Figures 2 and 3. A low current ratio means a concerning financial position but other ratios should also be analyzed. One reason for the low current ratio in 1998 could be the purchase of Tropicana by PEP for $3.3B in cash.

Retained Earnings / Total Assets ratio

RE/TA ratio is a measure of cumulative profitability. The age of the firm is implicitly taken into account here and PEP is an old firm. Firms with high RE relative to TA have financed their assets through retention of profits and not used much debt. Ideally this ratio should be as close to 1 as possible. Mean of this ratio is 0.45 with a minimum of 0.25 and a maximum of 0.78. RE/TA ratio has been consistently below 0.5 mark till about 1996, it jumps back up after that (with another downturn in 2001). It is back to lower than 0.5 in 2010, 2011 and 2017. For these

years where the RE/TA is low, PEP might be more reliant on debt and equity financing and not the profits earned over time.

In Figure 4, we can see that long term debt is gradually increasing till 1996 but after that there is a gradual fall in long term debt till 2003. Long term debt was higher than SEQ between 1986-1996 meaning more of the operations and projects were being financed by long term debt. During 1987-1996 retained earnings were lower than total long term debt.There was a sharp increase in long term debt from 2003 to 2004 of almost 40% followed by more gradual increases. There was a huge jump in long term debt between 2007-2008 and 2009-2010 again followed by more gradual increases with a slight drop in 2018. SEQ is generally higher than long term debt between 1997-2011 but not after 2011. Higher SEQ would mean that the firm is financing its operations more with SEQ compared to debt. 2014 onwards long term debt is way ahead of SEQ meaning that firm is financing operations using debt.

There can be multiple reasons for lower RE/TA ratio. A low RE/TA ratio could mean that there are assets with low profitability which should be retired. Periods of relatively low long term debt (e.g. 1997-2003) would mean that the firm is using retained earnings to retire debt. Low retained earnings would also result if the firm is issuing dividends at a good rate causing a lower RE/TA ratio. We examine dividends in the next section “Corporate Exports”.

Earnings before Interest and Taxes / Total Assets ratio

EBIT/TA is a measure of current profitability of a firm's assets. We would like this value to be as high as possible. This ratio has a mean of 0.15 for PEP. For the years in which NewZ is below the critical level, the EBIT/TA ratio has been below its mean. A low EBIT/TA ratio could mean that there are assets with low profitability which should be retired. To further analyze this ratio let us look at Figure 5.

In 1998, EBIT fell by 2.7% and it corresponds to the drop in NewZ ratio below critical level. There was another drop in EBIT in 2012 by 5.8% but that did not change NewZ score (it continued below the critical level between 2011-2014 as per Table 1). Other than this, EBIT has been mostly steadily increasing over time. Tofurther increase EBIT, either problem assets should be retired or more profitable projects should be undertaken. EBIT/TA is the ratio with the highest coefficient value in NewZ calculation and therefore has the largest effect.

Market Value of Equity / Book Value of Debt ratio

MVE/TL shows how much a firm's assets can decline in value. The mean of this ratio over our for PEP is 0.65. In all the years with low NewZ scores, the MVE/TL is way below it’s mean value This is the least weighted ratio in NewZ. A low score of MVE/TL ratio indicates that firm is close to insolvency. Let us look at Figure 6 below for further analysis.

As can be seen from the above figure, total liabilities have been considerably higher than shareholder equity from 1988-2002. Shareholder equity jumped between 2002-2003. Shareholder equity was close to total liabilities between 2004-2007. Higher shareholder equity indicates confidence in the firm. It also indicates interest free financing as against generating financing from creditors. High liabilities mean that the firm is relying on debt financing more than the shareholder equity for financing its operations in respective years.

Sales / Total Assets ratio

S/TA ratio is the sales efficiency or sales generating ability of the firm. This is an important ratio and ranks second in its contribution to the NewZ score. In the years when NewZ below 2.0, the S/TA ratio has been below 1 after 1998. This would imply assets that are generating sluggish sales. We can look at figure 7 below for further analysis. Sales have been lower than total asset value 2010-2018 but the Sales / Total assets ratio has remained relatively constant during this period. It is interesting to note that when sales drop the EBIT does not drop. In fact, PEP has maintained steady profits even in a sluggish economy (e.g. years 2007-2008) or when the sales drop as can be seen in Figure 7.

Examining correlation between NewZ components

Correlation between NewZ components is given below

	WC/TA	RE/TA	EBIT/TA	MVE/TL	S/TA
WC/TA	1.0000000	-0.0584032	0.2526362	0.6293327	0.6924266
RE/TA	-0.0584032	1.0000000	0.6644561	0.1975920	-0.3256970
EBIT/TA	0.2526362	0.6644561	1.0000000	0.6444473	0.2134080
MVE/TL	0.6293327	0.1975920	0.6444473	1.0000000	0.7016884
S/TA	0.6924266	-0.3256970	0.2134080	0.7016884	1.0000000

Table 3: Correlation between NewZ component ratios.

MVE/TL and S/TA ratios have the highest positive correlation of 0.7 which would indicate that increasing sales and shareholder equity move in the same direction. Shareholders should care a lot about increasing sales. Same can be said about MVE/TL and the high positive correlation with WC/TA and EBIT/TA.

EBIT/TA and RE/TA have a high positive correlation as well which means both move together as is expected.

S/TA and WC/TA have a high positive correlation which means that the firm is generally efficient in using the short term assets in generating sales.

The negative correlation between RE/TA and S/TA is interesting. One would expect that as the S/TA ratio increases so would the RE/TA ratio. The negative correlation seems to imply that the firm is not using some of the assets efficiently or the cost of doing business is relatively high leading to lower retained earnings growth. There is another possible explanation that the firm has been increasing dividends as we will see in section “Corporate Exports”. We can see that the correlation between dividends and sales is as high as 0.95 which would mean that the firm is increasing dividends with increasing sales leading to lower retained earnings.

Let us also look at the correlation between current ratio (current assets/ current liabilities) and NewZ. For PEP, this comes out as 0.73 which means if the firm has high current assets it would probably also have a higher NewZ score.

Comparing to other related firms

We plot NewZ scores of 4 firms related to PEP. We consider Coca Cola (KO), Kellogg (K), Campbell Soup Company (CPB) and Mondelez International (MDLZ). A good way to analyze any firm is to compare it with related firms as just looking at the financial ratios of a firm may not give the complete picture. See Figure 8 below.

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When NewZ score for PEP was below 2.0 between 1986-1994, KO and CPB were above 2.0 but K was actually doing poorer than PEP. This means that the industry as a whole was not facing any problems and the causes of the dip in NewZ for PEP could be firm specific. On the other hand, the dip in 1998 for PEP seems to coincide with the dips in other firms. If we look at more recent years (2010 and later), NewZ for PEP is considerably lower than KO, K and CPB which should be concerning. MDLZ is a new firm and it has a generally low NewZ and is lower than PEP in recent years.

We can use net profit margin (net income / sales) to compare the related firms. Table 3a shows the net profit margin for the related firms between 2009-2018

	fyear	pep	ko	k	cpb	mdlz
1	2009	0.13753701	0.22020006	0.09638171	0.09702083	0.07480315
2	2010	0.10927072	0.33625673	0.10058885	0.10995310	0.08360599
3	2011	0.09688139	0.18408676	0.09327171	0.10428812	0.06487511
4	2012	0.09433213	0.18782931	0.06769036	0.10042818	0.08647722
5	2013	0.10148310	0.18320741	0.12211935	0.05688028	0.11090966
6	2014	0.09767107	0.15431106	0.04333813	0.09893566	0.06377760
7	2015	0.08646283	0.16595927	0.04557601	0.08549864	0.24520853
8	2016	0.10078186	0.15591334	0.05345452	0.07071976	0.06399722
9	2017	0.07645809	0.03524428	0.09819701	0.11242079	0.11283596
10	2018	0.19354789	0.20197137	0.09861962	0.03005181	0.13034929

Table 3a: Net profit margin of related firms

Coca Cola (KO) has consistently high net profit margin indicating its strong profitability and ability to generate high profits per dollar of revenue. This indicates efficient management and low costs in providing sales on part of KO. In the consumer packaged goods industry, one would expect that streamlined production facilities and economies of scale would lead to high net profit margins with lower cost of goods sold. Since KO has a higher net profit margin than PEP, it appears that PEP should look at improving its production facilities to lower costs.

We can also compare firms using current ratios. A current ratio greater than 1 indicates that the firm is in a good position to pay short term debt. Table 3b shows the current ratios for related firms between 2009-2018

	fyear	pep	ko	k	cpb	mdlz
1	2009	1.4357012	1.279134	1.1180070	0.9527027	1.0838047
2	2010	1.1055248	1.165928	0.9155151	0.8169492	1.0358238
3	2011	0.9607249	1.049994	0.9136734	0.9869281	0.8783952
4	2012	1.0954415	1.090112	0.7472916	0.8555556	1.0503597
5	2013	1.2446325	1.125598	0.8518905	0.6767215	0.9180328
6	2014	1.1421070	1.018904	0.7653529	0.7025761	0.8388663
7	2015	1.3102173	1.240067	0.5638613	0.7455453	0.8201795
8	2016	1.2817128	1.281848	0.6571301	0.7467710	0.5881945

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9   2017 1.5133645 1.343863 0.6778299 0.7933194 0.4761603
10  2018 0.9889331 1.048284 0.6970634 0.6388425 0.4543228
```

Table 3b: Current ratios of related firms.

A current ratio below 1 would indicate that the firm would not have enough capital on hand to repay short term debt if it all becomes due at once. Current ratio is not a complete picture of a firm's health and other ratios must also be analyzed.
In table 3b, KO has consistently maintained a current ratio of greater than 1 since 2009. PEP is also doing well with a current ratio of greater than 1 except in 2011 and 2018 where it dropped just below one. The other three firms appear to be in a more concerning position with low current ratios.

We also compare the return on equity (net income / shareholder equity) of the related firms. A higher return on equity indicates that the firm is able to generate profits from the shareholders investment. See Table 3c below.

```
   fyear        pep        ko         k       cpb       mdlz
1   2009 0.11674911 0.27517239 0.5334507 1.0109890 0.11674911
2   2010 0.11480717 0.38089862 0.5778499 0.9114471 0.11480717
3   2011 0.10015050 0.27096570 0.6994318 0.7398897 0.10015050
4   2012 0.09399348 0.27505337 0.3972716 0.8619154 0.09399348
5   2013 0.12093411 0.25876466 0.5097320 0.3763353 0.12093411
6   2014 0.07870270 0.23410290 0.2266045 0.5065015 0.07870270
7   2015 0.25942453 0.28766534 0.2885338 0.5007246 0.25942453
8   2016 0.06593538 0.28301969 0.3633508 0.3691803 0.06593538
9   2017 0.11190686 0.07310216 0.5736890 0.5418448 0.11190686
10  2018 0.13187971 0.37889406 0.5136486 0.1913490 0.13187971
```

Table 3c: ROE for the related firms.

In the years 2009-2018 PEP had a low ROE compared to KO, K and CPB but higher than MDLZ. This indicates that PEP should try to use shareholder's investments more efficiently otherwise shareholders may not see investing in PEP as a profitable venture.

Fundamental determinants of NewZ for PepsiCo

We look at PepsiCo data from 1965-2018 and investigate which of the fundamental variables have a significant impact on NewZ. We will use the total assets (at), total liabilities (lt), shareholder equity (seq), retained earnings (re), earnings before interest and taxes (ebit) and sales (sales) as independent variables. We use these variables because assets, liabilities and shareholders equity form the fundamental accounting equation for any firm and the other three variables i.e., re, ebit and sales are related to the earning capability of the firm.

We first look at determining a contemporaneous relationship between NewZ and the independent variables using OLS. We use `regsubsets` from `leaps` package in R to determine the best possible model for determining this contemporaneous relationship. We take log of all the variables and the first difference to determine how the changes in NewZ are related

to changes in each of the finance variables. We find that the 3 variable model of at, re and sale is the best model with lowest BIC.

```
Call:
lm(formula = DL_NewZ ~ DL_at + DL_re + DL_sale, data = df)

Residuals:
    Min      1Q  Median      3Q     Max
-0.7946 -0.1407 -0.0014  0.1165  0.7084

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.887e+00  6.006e-02 -31.421  < 2e-16 ***
DL_at       -2.120e-05  9.548e-06  -2.221   0.0310 *
DL_re        6.070e-05  1.094e-05   5.546 1.16e-06 ***
DL_sale     -2.197e-05  1.105e-05  -1.989   0.0523 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2464 on 49 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.5585,    Adjusted R-squared:  0.5315
F-statistic: 20.67 on 3 and 49 DF,  p-value: 8.578e-09
```

All three independent variables are statistically significant at the 10% level. The model has a significant f-statistic. We see that DL_re has the highest coefficient and highest t-value. DL_sale has a negative coefficient as does DL_at. Opposite sign for DL_sale is interesting because it seems that as sales increase there are some other inefficiencies that do not let NewZ increase. This seems to indicate that the firm needs to get rid of some of its problematic assets. This is contemporaneous regression and does not have any predictive power.

Next, we run OLS on the lagged variables. We take a 1 year lag of the independent variables and investigate which of the independent variables in question have predictive power for NewZ. We find that the 2 variable model of at and re comes out as the best one with the lowest BIC.

```
Call:
lm(formula = DL_NewZ ~ L1DL_at + L1DL_re, data = df)

Residuals:
     Min       1Q   Median       3Q      Max
-0.50428 -0.16922 -0.02516  0.16028  0.69126

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.766e+00  4.820e-02 -36.646  < 2e-16 ***
L1DL_at     -2.965e-05  5.994e-06  -4.947 9.28e-06 ***
```

```
L1DL_re      4.168e-05  1.076e-05   3.871  0.00032 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2546 on 49 degrees of freedom
  (2 observations deleted due to missingness)
Multiple R-squared:  0.4319,    Adjusted R-squared:  0.4087
F-statistic: 18.63 on 2 and 49 DF,  p-value: 9.619e-07
```

We see that both at and re are statistically significant and the model has a significant f-statistic. The model is able to explain 40% of the variance in NewZ for Pepsico. Since we have used Deltalog-lagged variables here, this model has predictive power.

1998: A Roller Coaster year for PepsiCo

We investigate PEP’s SEC 10-K filing for the fiscal year ending 1998. PEP states 15% of its consolidated operating profit consists of its international operations. As a result, currency exchanges rates fluctuations will affect year-over-year comparability of operating results. From the filing, macroeconomic conditions in Brazil, Mexico, Russia, and Asia Pacific adversely impacted PEP’s results. The most significant event was the economic turmoil in Russia which accompanied the August 1998 devaluation of the ruble. This had a negative impact on PEP’s operations. The firm experienced a significant drop in demand, resulting in lower net sales and increased operating losses. The filling states that net sales rose $1.4 billion or 7% in 1998. Excluding foreign currency impact, net sales would have risen 8%.

We examine specific business segments of PepsiCo and find that Pepsi-Cola International business was most adversely affected by the currency fluctuations. Net sales declined $257 million or 10%. Excluding foreign currency impact, net sales would have declined 7%. Reported operating results declined $75 million. Ongoing operating results declined $11 million. The decline primarily reflects higher losses in Russia. On the other hand, Pepsi-Cola North America and Frito-Lay business segments have seen growth in net sales. Interestingly, Frito-Lay international has also seen some growth in net sales possibly unaffected by Russia’s crisis. After further investigation of the filing, we can see that the Pepsi-cola International business was badly affected by the economic downturn in Russia because the firm has bottling plants in Russia. The Pepsi bottling group operates 11 bottling plants outside of the United States and Canada but the exact number of bottling plants in Russia is not disclosed.

PepsiCo completed the acquisitions of Tropicana for $3.3 billion in cash and The Smith's Snackfoods Company (TSSC) in Australia for $270 million in cash.The purchase prices were largely funded by the issuance of one year notes and commercial paper resulting in an increase in short-term borrowings at year-end 1998 which explains the drop in current ratio in 1998. Acquisitions for the year aggregated $4.5 billion in cash.

Investing Activities			
Capital spending	(1,405)	(1,506)	(1,630)
Acquisitions and investments in unconsolidated affiliates	(4,537)	(119)	(75)
Sales of businesses	17	221	43
Sales of property, plant and equipment	134	80	9
Short-term investments, by original maturity			
More than three months-purchases	(525)	(92)	(115)
More than three months-maturities	584	177	192
Three months or less, net	839	(735)	736
Other, net	(126)	(96)	(214)
Net Cash Used for Investing			

As can be seen from the above snippet taken from the consolidated cash flow statement in the filing, acquisitions and investments have seen a huge jump in 1998 as compared to 1997 and 1996.

Cash and Cash Equivalents - End of Year	$ 311	$ 1,928	$ 307
Supplemental Cash Flow Information			
Interest paid	$ 367	$ 462	$ 538
Income taxes paid	$ 521	$ 696	$ 611
Schedule of Noncash Investing and Financing Activities			
Fair value of assets acquired	$ 5,359	$ 160	$ 81
Cash paid and stock issued	(4,537)	(134)	(76)
Liabilities assumed	$ 822	$ 26	$ 5

We can examine the Cash and liabilities assumed in the above snippet taken from the consolidated cash flow statement in filing. The amount of Cash has drastically reduced while liabilities have drastically increased in 1998 as compared to 1997 and 1996.

Overall, not only the firm was impacted by macroeconomic factors outside of its control but it also chose to strategically invest in acquisitions in 1998.

Corporate Exports (ES)

ES components and ES have been plotted in figure 9. ES for PEP is currently at the highest level than it has ever been before. ES is at $12201 million in 2018.

Dividend policy: PEP has been gradually increasing its dividends over the years. In particular, there was an almost 30% increase in dividends from 2003 to 2004 and a continued steady increase after that. This could be one of the explanations of a lower RE/TA ratio as some of the retained earnings are being used to pay dividends. PEP has given the most dividends in its

history in the year 2018. PEP has been rewarding shareholders with dividends for a long time. Every year in the period of our analysis 1965-2018 has seen dividends from PEP. PEP has been increasing dividends steadily since 1968.

Net equity repurchases: PEP has been consistently repurchasing equity in the more recent years (2010 onwards). PEP did not do any stock repurchases between 1965-1978, 1980-1984, and 1989. In 2009, the value of stock repurchases was very low ($7 million) but the stock issuance value was high ($413 million). In general, the firm has been mostly consistently offering stock repurchases 1990 onwards. In addition to this, the firm has been consistently issuing stock since 1995. PEP has split its stock 4 times in history. It has done three 3-for-1 splits and one 2-for-1 split.

year	split	Old CSHO (Common stock outstanding) in million shares.	New CSHO (Common stock outstanding) in million shares.
1977	3-for-1	24.5	86.5
1986	3-for-1	87.7	260.3
1990	3-for-1	263.6	788.4
1996	2-for-1	788	1545

Table 4: PEP Stock split history

Net debt issued: To examine the effect of net new debt issued on ES, we can first check for years in which ES was particularly low i.e. less than zero. ES has been negative in 1974, 1986, 1991 and 1999 and in all those years there was a sharp increase in net debt issued which means the firm was heavily trying to raise debt financing. Firm has also tried to retire existing debt leading to negative net debt issued and boosting ES. Good examples of years when the firm had negative net debt issued are 1997-2006 and 2018. In 2018, we had the largest debt repurchase boosting ES.

Comparing to other related firms

We plot ES scores of 4 firms related to PEP. We consider Coca Cola (KO), Kellogg (K), Campbell Soup Company (CPB) and Mondelez International (MDLZ). See Figure 10 below. It can be seen that PEP has a higher ES than all the related firms in 2018 which means PEP has exported the most excess corporate cash flows in 2018. KO's ES in 2018 is very close to PEP. PEP had lower ES than KO between 2000-2010 but generally over the period of our analysis PEP's ES has not deviated significantly from related firms. PEP has consistently maintained a higher ES than K and CPB. MDLZ is a relatively newer firm and it has a fluctuating ES score, which fell sharply in 2000 but picked up later. PEP's ES has stayed relatively stable as compared to MDLZ's ES 2000 onwards.

Higher ES for PEP in recent years (e.g. 2018) indicates that the firm is keeping investors happy by paying dividends, stock repurchases and relatively lower debt financing.

Forecasting Net Income and Sales for 2019-2025 period

Forecasting Sales

We plot `ts_sale` and notice that it is not stationary so we go ahead and take the first difference of the series. We notice that the series is more or less stationary after the first difference (see figure 11).

We start with looking at pacf and acf of sales time series (`ts_sale`) and the first difference. We notice that pacf of differenced series does not have any substantial peaks and the same can be said for acf. This could indicate an AR(0), MA(0) model with first difference (or ARIMA(0,1,0)) See Figure 12.

We can first try the ARIMA(0,1,1) model as there is empirical evidence in the last 50-60 years that this model is a good fit. We check the residuals in Figure 13. We can see that residuals have some correlation. The distribution of residuals is not normal and they are not white noise.

We use `auto.arima()` function in R from the `forecast` package to determine the best ARIMA model for Sales based on lowest AIC. This function gives us ARIMA(0,1,0) as the best model. We check out the residuals in Figure 14. Compared to the previous model, we see that the distribution appears closer to normal and not as many residuals with higher correlation as the previous model. The second mode has a slightly lower AIC as well. We use ARIMA(0,1,0) to give a forecast of sales from 2019-2025 in figure 15.

Forecasting Net Income

We plot `ts_ni` and notice that it is not stationary so we go ahead and take the first difference of the series. We notice that the series is stationary after the first difference (see figure 16) and take another difference.

We start with looking at pacf and acf of sales time series (`ts_ni`). See Figure 17 below.

In Figure 17, the original series has some decay in correlation in the ACF and a spike in PACF which implies a need for differencing. note that after differencing PACF does not display any major spike except at lag 1 but ACF has a spike at lag 1. PACF does not seem to cut off after lag 1 in differenced series.

We can first try the ARIMA(0,1,1) model as there is empirical evidence in the last 50-60 years that this model is a good fit. We check the residuals in Figure 18. We can see that residuals have some correlation. The distribution of residuals is not normal and they are not white noise.

We use `auto.arima()` function in R from the `forecast` package to determine the best ARIMA model for Sales based on lowest AIC. This function gives us ARIMA(0,1,2) as the best model. We check out the residuals in Figure 19.

Compared to the previous model, we see that residuals have lower autocorrelation than the previous model and distribution appears normal. We use ARIMA(0,1,2) to give a forecast of ni from 2019-2025.

Beta Estimation and Stock Valuation

We first try calculating Beta using OLS regression but after spotting some outliers (See Figure 21), we try calculating Beta using robust regression. The Beta of PEP stock comes out to be 0.52. T-value = Abs((0.52-1)/0.1317) = 3.64. The Beta is statistically significant from 1. We used robust regression to calculate the beta with default efficiency in R and method="MM". A low beta means that PEP should reduce the overall portfolio beta.

To determine the required rate of return, we will use the CAPM equation. The 90 day Treasury bill rate in Dec 2018 was 2.45%. We take the equity premium of stocks relative to Treasury bills as 8.8% (assuming the value given in the supplemental textbook).

Using the CAPM equation, the market's required rate of return is 7.11% which means we should purchase PEP if we expect the return to be higher than 7.11%. An alternative strategy, yielding the same answer, is to price shares and compare its fair market value to its current stock price.

PEP is a dividend paying firm and has been paying dividends at a steady rate. If we look at the growth rate of dividends between 2010-2018, we see that it is ~7.3% which is higher than the required rate of return. We use the discounted cash flow model to determine the present value of PEP stock. We assume that the growth period lasts for 5 years starting from 2019 till 2024. To determine the growth rate, we use the forecasted net income in the previous section and calculated earnings per share (assuming that the number of outstanding shares in 2018 remains constant between 2019-2024). We discount DPS and EPS by the required rate of return (7.11%) to the present value. This gives us a present value of $50.68.

Price of PEP in Dec 2018 was around $110 which means the stock is overpriced and we should not buy the stock.

We can also take net income data for 2019 from Google.com ($7314 million) and use it to revalue the stock which comes out as $39.79 (this adjusts the growth rate to a lower value). This is still lower than the market price of PEP in Dec 2018 and it does not alter our stock guidance.

Appendix A: Code for calculating NewZ and ES

```
setwd("~/UW/CFRM-502/TermProject/")

data = read.csv("TermProjectData.csv", header=T)

#remove NAs
data$dvt[is.na(data$dvt)]=0
data$dltr[is.na(data$dltr)]=0
data$dltis[is.na(data$dltis)]=0
data$sstk[is.na(data$sstk)]=0
data$prstkc[is.na(data$prstkc)]=0
data$xint[is.na(data$xint)]=0
data$txpd[is.na(data$txpd)]=0


CalcRatios = function(cusip, tic){
  data_stock = data[data$cusip == cusip, ]

  #calculate financial ratios
  data_stock$WC_TA = (data_stock$act - data_stock$lct) /
data_stock$at
  data_stock$RE_TA = (data_stock$re / data_stock$at)
  data_stock$EBIT_TA = (data_stock$ebit) / data_stock$at
  data_stock$MVE_TL = data_stock$seq / (data_stock$lt)
  data_stock$S_TA = data_stock$sale / data_stock$at


  #calculate newZ
  data_stock$NewZ = .717 * data_stock$WC_TA + .847 * data_stock$RE_TA
+
```

```
    3.107 * data_stock$EBIT_TA + .420 * data_stock$MVE_TL +
    .998 * data_stock$S_TA

 #Calculate ES
 data_stock$dividends = data_stock$dvt
 data_stock$interestpaid = data_stock$xint
 data_stock$netequityrepurchased = (data_stock$prstkc -
data_stock$sstk) #stock purchases-stock sales
 data_stock$netnewdebtissued = (data_stock$dltis - data_stock$dltr)
#lt debt issued - debt repurchased
 data_stock$ES = data_stock$dividends + data_stock$interestpaid +
   data_stock$netequityrepurchased - data_stock$netnewdebtissued
 write.csv(data_stock, paste(tic, '.csv'))

 data_stock_small = data_stock[,
c('fyear','WC_TA','RE_TA','EBIT_TA','MVE_TL','S_TA', 'NewZ', 'ES' )]
 names(data_stock_small)[names(data_stock_small) == "WC_TA"] =
"WC/TA"
 names(data_stock_small)[names(data_stock_small) == "RE_TA"] =
"RE/TA"
 names(data_stock_small)[names(data_stock_small) == "EBIT_TA"] =
"EBIT/TA"
 names(data_stock_small)[names(data_stock_small) == "MVE_TL"] =
"MVE/TL"
 names(data_stock_small)[names(data_stock_small) == "S_TA"] = "SA"
 data_stock_small  = data_stock_small[!is.na(data_stock_small$NewZ),]

 write.csv(data_stock_small, paste(tic, 'small','.csv'))

  return(data_stock)
}

data_stock = CalcRatios('71344810', 'PEP')
data_stock  = data_stock[!is.na(data_stock$NewZ),]
newZ_components = subset(data_stock,
select=c("WC_TA","RE_TA","EBIT_TA","MVE_TL","S_TA"))
corr_matrix = cor(newZ_components)
corr_matrix

NewZ_pep = ts(data_stock$NewZ, start = c(1965), end = c(2018),
frequency = 1)
WC_TA = ts(data_stock$WC_TA, start = c(1965), end = c(2018),
frequency = 1)
RE_TA = ts(data_stock$RE_TA, start = c(1965), end = c(2018),
frequency = 1)
```

```
EBIT_TA = ts(data_stock$EBIT_TA, start = c(1965), end = c(2018),
frequency = 1)
MVE_TL = ts(data_stock$MVE_TL, start = c(1965), end = c(2018),
frequency = 1)
S_TA = ts(data_stock$S_TA, start = c(1965), end = c(2018), frequency
= 1)
ret = cbind(NewZ, WC_TA, RE_TA, EBIT_TA, MVE_TL,S_TA)

#Plot NewZ
plot(NewZ_pep, main="NewZ of related firms",
     ylab="NewZ",xlab="financial year",col="red", ylim=c(-1,5), axes
= F )
axis(1, at = seq(1950, 2018, by = 1), las=2)
axis(2, at = seq(1,6, by = 0.5), las=1)
net_margin_ratio_pep = data_stock$ni/data_stock$sale
curr_ratio_pep = data_stock$act/data_stock$lct
roe_pep = data_stock$ni/data_stock$seq

data_stock = CalcRatios('19121610','KO')
data_stock  = data_stock[!is.na(data_stock$NewZ),]
NewZ_ko = ts(data_stock$NewZ, start = c(1950), end = c(2018),
frequency = 1)
lines(NewZ_ko, col="blue")
net_margin_ratio_ko = data_stock$ni/data_stock$sale
curr_ratio_ko = data_stock$act/data_stock$lct
roe_ko = data_stock$ni/data_stock$seq

data_stock = CalcRatios('48783610','K')
data_stock  = data_stock[!is.na(data_stock$NewZ),]
NewZ_k = ts(data_stock$NewZ, start = c(1950), end = c(2018),
frequency = 1)
lines(NewZ_k, col="darkgreen")
net_margin_ratio_k = data_stock$ni/data_stock$sale
curr_ratio_k = data_stock$act/data_stock$lct
roe_k = data_stock$ni/data_stock$seq

data_stock = CalcRatios('13442910','CPB')
data_stock  = data_stock[!is.na(data_stock$NewZ),]
NewZ_cpb = ts(data_stock$NewZ, start = c(1950), end = c(2018),
frequency = 1)
lines(NewZ_cpb, col="orange")
net_margin_ratio_cpb = data_stock$ni/data_stock$sale
curr_ratio_cpb = data_stock$act/data_stock$lct
roe_cpb = data_stock$ni/data_stock$seq
```

```
data_stock = CalcRatios('60920710','MDLZ')
data_stock  = data_stock[!is.na(data_stock$NewZ),]
NewZ_mdlz = ts(data_stock$NewZ, start = c(1999), end = c(2018),
frequency = 1)
lines(NewZ_mdlz, col="purple")
net_margin_ratio_mdlz = data_stock$ni/data_stock$sale
curr_ratio_mdlz = data_stock$act/data_stock$lct
roe_mdlz = data_stock$ni/data_stock$seq


abline(h=2)

legend("bottomleft",
       c("PEP","KO","K","CPB","MDLZ"),
       fill=c("red","blue","darkgreen","orange","purple"))

#Plot ES
data_stock = CalcRatios('71344810', 'PEP')
data_stock  = data_stock[!is.na(data_stock$NewZ),]

data_stock  = data_stock[!is.na(data_stock$ES),]

ES = ts(data_stock$ES, start = c(1965), end = c(2018), frequency = 1)
plot(ES, main="ES of related firms",
     ylab="ES",xlab="financial year",col="red", ylim=c(-10000,20000))
#axis(1, at = seq(1950, 2018, by = 1), las=2)
#axis(2, at = seq(1,6, by = 0.5), las=1)


data_stock = CalcRatios('19121610','KO')
data_stock  = data_stock[!is.na(data_stock$ES),]
ES = ts(data_stock$ES, start = c(1950), end = c(2018), frequency = 1)
lines(ES, col="blue")


data_stock = CalcRatios('48783610','K')
data_stock  = data_stock[!is.na(data_stock$ES),]
ES = ts(data_stock$ES, start = c(1950), end = c(2018), frequency = 1)
lines(ES, col="darkgreen")


data_stock = CalcRatios('13442910','CPB')
data_stock  = data_stock[!is.na(data_stock$ES),]
ES = ts(data_stock$ES, start = c(1950), end = c(2018), frequency = 1)
lines(ES, col="orange")
```

```
data_stock = CalcRatios('60920710','MDLZ')
data_stock  = data_stock[!is.na(data_stock$ES),]
ES = ts(data_stock$ES, start = c(1999), end = c(2018), frequency = 1)
lines(ES, col="purple")

legend("bottomleft",
       c("PEP","KO","K","CPB","MDLZ"),
       fill=c("red","blue","darkgreen","orange","purple"))

net_margin_ratios = as.data.frame(cbind(
  tail(data_stock$fyear,10),
  tail(net_margin_ratio_pep, 10),
  tail(net_margin_ratio_ko, 10),
  tail(net_margin_ratio_k, 10),
  tail(net_margin_ratio_cpb, 10),
  tail(net_margin_ratio_mdlz, 10)
))
colnames(net_margin_ratios) = c("fyear","pep","ko","k","cpb","mdlz")

roe_ratios = as.data.frame(cbind(
  tail(data_stock$fyear,10),
  tail(roe_pep, 10),
  tail(roe_ko, 10),
  tail(roe_k, 10),
  tail(roe_cpb, 10),
  tail(roe_mdlz, 10)
))
colnames(roe_ratios) = c("fyear","pep","ko","k","cpb","mdlz")

current_ratios = as.data.frame(cbind(
  tail(data_stock$fyear,10),
  tail(curr_ratio_pep, 10),
  tail(curr_ratio_ko, 10),
  tail(curr_ratio_k, 10),
  tail(curr_ratio_cpb, 10),
  tail(curr_ratio_mdlz, 10)
))
colnames(current_ratios) = c("fyear","pep","ko","k","cpb","mdlz")
```

Appendix B: Code for PEP ratios and ES analysis

```
setwd("~/UW/CFRM-502/TermProject/")

data = read.csv("PEP .csv", header=T, colClasses = c(fyear =
"character"))

#exclude NA newZ

data  = data[!is.na(data$NewZ),]
#print low newZ years and scores.
lowNewZ = data[data$NewZ < 2, ]
lowNewZ[, c("fyear", "NewZ")]

#checking some years after 1995.
data[data$fyear == '1996',]
data[data$fyear == '1997',]
data[data$fyear == '1999',]

#Check the component ratios
names(lowNewZ)[names(lowNewZ) == "WC_TA"] = "WC/TA"
names(lowNewZ)[names(lowNewZ) == "RE_TA"] = "RE/TA"
names(lowNewZ)[names(lowNewZ) == "EBIT_TA"] = "EBIT/TA"
names(lowNewZ)[names(lowNewZ) == "MVE_TL"] = "MVE/TL"
names(lowNewZ)[names(lowNewZ) == "S_TA"] = "SA"
lowNewZ[, c("fyear", "WC/TA", "RE/TA","EBIT/TA","MVE/TL","SA")]

#current ratio
data$act_lct = data$act/data$lct
cur_ratio = ts(data$act_lct, start = c(1965), end = c(2018),
frequency = 1)
plot(cur_ratio, main="PEP")
data[data$act_lct < 1, c('fyear','act_lct')]

lct = ts(data$lct, start = c(1965), end = c(2018), frequency = 1)
act = ts(data$act, start = c(1965), end = c(2018), frequency = 1)
plot(lct, col='blue', ylab = 'current assets and liabilities',
main="PEP")
legend("topleft", c("lct","act"),fill=c("blue","red"))
lines(act, col = 'red')


#checking RE/TA
data[data$RE_TA < 0.5, c('fyear')]
```

```
longtermdebt = ts(data$dltt, start = c(1965), end = c(2018),
frequency = 1)
plot(longtermdebt, col='red', ylab='longtermdebtissued and seq',
main="PEP")
seq = ts(data$seq, start = c(1965), end = c(2018), frequency = 1)
lines(seq, col='green')
re = ts(data$re, start = c(1965), end = c(2018), frequency = 1)
lines(re, col='blue')
legend("topleft", c("seq","longtermdebt", "re"),fill=c("green","red",
"blue"))


#checking ebit/ta
ebit = ts(data$ebit, start = c(1965), end = c(2018), frequency = 1)
plot(ebit, ylab='ebit', main='PEP')

#checking MVE_TL
mve = ts(data$seq, start = c(1965), end = c(2018), frequency = 1)
plot(mve, col='red', ylab='SEQ and LT', main="PEP")
lt = ts(data$lt, start = c(1965), end = c(2018), frequency = 1)
lines(lt, col='blue')
legend("topleft", c("seq","lt"),fill=c("red", "blue"))

#checking S/TA
sa = ts(data$sale, start = c(1965), end = c(2018), frequency = 1)
plot(sa, col='red', ylab='S and TA', main="PEP")
ta = ts(data$at, start = c(1965), end = c(2018), frequency = 1)
lines(ta, col='blue')
legend("topleft", c("sa","ta"),fill=c("red", "blue"))

#analyze ES
es = ts(data$ES, start = c(1965), end = c(2018), frequency = 1)
plot(es, col='blue', ylab = 'ES and components', main='PEP')
dv = ts(data$dividends, start = c(1965), end = c(2018), frequency =
1)
lines(dv, col='red')
intp = ts(data$interestpaid, start = c(1965), end = c(2018),
frequency = 1)
lines(intp, col='yellow')
nerp = ts(data$netequityrepurchased, start = c(1965), end = c(2018),
frequency = 1)
lines(nerp, col='green')
ndi = ts(data$netnewdebtissued, start = c(1965), end = c(2018),
frequency = 1)
lines(ndi,col='orange')
```

```
legend("topleft",
c("es","dividendspaid","interestpaid","netequityrepurchased","netnewd
ebtissued"),
       fill=c("blue","red","yellow","green","orange"))
```

Appendix C: Code for forecasting PEP sales and net income with output.

```
setwd("~/UW/CFRM-502/TermProject/")
install.packages('forecast', dependencies = TRUE)
library(forecast)


data = read.csv("PEP .csv", header=T, colClasses = c(fyear =
"character"))
data  = data[!is.na(data$NewZ),]

#sale time series
par(mfrow=c(1,2))
ts_sales = ts(data$sale, start = c(1965), end = c(2018), frequency =
1)
plot(ts_sales, ylab="sales", main="PEP")
plot(diff(ts_sales), main="PEP")

#check acf and pacf
par(mfrow=c(2,2))
acf(ts_sales)
pacf(ts_sales)
acf(diff(ts_sales))
pacf(diff(ts_sales))

#check arima(0,1,1)
arima_0_1_1 = arima(ts_sales,order=c(0,1,1))
checkresiduals(arima_0_1_1)

#auto arima
arima_sales = auto.arima(ts_sales)
checkresiduals(arima_sales)

future_sales = forecast::forecast(arima_sales, h=7)
future_sales

plot(future_sales, ylab="sales", main="PEP")

#net income
par(mfrow=c(1,2))
ts_ni = ts(data$ni, start = c(1965), end = c(2018), frequency = 1)
plot(ts_ni, ylab="ni", main="PEP")
plot(diff(ts_ni), main="PEP")

#check acf and pacf
```

```
par(mfrow=c(2,2))
acf(ts_ni)
pacf(ts_ni)
acf(diff(ts_ni))
pacf(diff(ts_ni))

#check arima(0,1,1)
arima_0_1_1 = arima(ts_ni,order=c(0,1,1))
checkresiduals(arima_0_1_1)

#auto arima
arima_ni = auto.arima(ts_ni)
checkresiduals(arima_ni)

future_ni = forecast::forecast(arima_ni, h=7)
future_ni

plot(future_ni, ylab="ni", main="PEP")
```

Sales forecasts

Point	Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2019	65871.40	61841.73	69901.06	59708.56	72034.23
2020	67081.79	61382.99	72780.59	58366.23	75797.36
2021	68292.19	61312.61	75271.77	57617.84	78966.53
2022	69502.58	61443.26	77561.91	57176.91	81828.26
2023	70712.98	61702.38	79723.58	56932.46	84493.50
2024	71923.38	62052.76	81793.99	56827.58	87019.18
2025	73133.77	62472.29	83795.26	56828.44	89439.10

Net income forecasts

Point	Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2019	3129.301	1858.003	4400.599	1185.019	5073.584
2020	7816.875	6416.199	9217.550	5674.726	9959.023
2021	7957.025	6462.529	9451.521	5671.391	10242.660
2022	8097.176	6514.411	9679.941	5676.546	10517.806
2023	8237.327	6570.962	9903.692	5688.842	10785.812
2024	8377.478	6631.512	10123.444	5707.253	11047.702
2025	8517.629	6695.535	10339.722	5730.977	11304.280

Appendix D: Code for Beta estimation with regression output.

```
#for PEP
#Beta estimation using crsp

setwd("~/UW/CFRM-502/TermProject")
```

```
crspbeta=read.csv("CRSPBetaData.csv")

#Select  data
stock_data = crspbeta[crspbeta$cusip == '71344810',]

#Compute beta
#note this is gives statistical significance for beta=0
sp_beta = lm(ret ~ sprtrn, data=stock_data)
summary(sp_beta)
par(mfrow=c(2,2))
plot(sp_beta, main = "OLS regression diagnostics")

#Compute beta using robust regression
library(MASS)
sp_robust_beta=rlm(ret ~ sprtrn, psi=psi.bisquare, method=c("MM"),
                   data=stock_data)
summary(sp_robust_beta)
```

OLS regression output

```
Call:
lm(formula = ret ~ sprtrn, data = stock_data)

Residuals:
      Min        1Q    Median        3Q       Max
-0.082378 -0.020221 -0.001374  0.019582  0.078388

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.005071   0.004609   1.100 0.275780
sprtrn      0.529452   0.130885   4.045 0.000156 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.03474 on 58 degrees of freedom
Multiple R-squared:   0.22,     Adjusted R-squared:  0.2066
F-statistic: 16.36 on 1 and 58 DF,  p-value: 0.0001564
```

Robust regression output

```
Call: rlm(formula = ret ~ sprtrn, data = stock_data, psi =
psi.bisquare,
    method = c("MM"))
Residuals:
      Min        1Q    Median        3Q       Max
-0.082666 -0.020500 -0.001651  0.019290  0.078111

Coefficients:
            Value  Std. Error t value
(Intercept) 0.0053 0.0046     1.1530
sprtrn      0.5298 0.1317     4.0237
```

Appendix E: Code for stock valuation.

```
#Stock valuation
data = read.csv("PEP .csv", header=T, colClasses = c(fyear =
"character"))
data$dvt[is.na(data$dvt)]=0
data  = data[!is.na(data$NewZ),]


#https://www.treasury.gov/resource-center/data-chart-center/interest-
rates/pages/TextView.aspx?data=yieldYear&year=2018
#3 month treasury bill rate in Dec 2018
Rf = 0.0245

#historical equity risk premium on s&p 500
erp = 0.088

k = Rf + (erp)*sp_robust_beta$coefficients[2]
names(k) = ""

dps = data$dividends/data$csho
dps = tail(dps,9)
g_div_backwardlooking = (tail(dps,1)/head(dps,1))^(1/9)

g = (future_ni$mean[5]/future_ni$mean[1])^(1/5)

discounted_dps = 0
i = 1

while(i < 6){
  discounted_dps = discounted_dps+ (tail(dps,1) * (g^i))/((1+k)^i)
  i = i+1
}

discounted_eps = 0
i = 1

while(i < 7){
  eps = future_ni$mean[i] / tail(data$csho,1)
  discounted_eps = discounted_eps + (eps/((1+k)^i))
  i = i+ 1
}

discounted_dps+discounted_eps

#data for 2019
ni_2019 = 7314
g = (future_ni$mean[5]/ni_2019)^(1/5)
```

```
discounted_dps = 0
i = 1

while(i < 6){
  discounted_dps = discounted_dps+ (tail(dps,1) * (g^i))/((1+k)^i)
  i = i+1
}

discounted_eps = 0
i = 1

while(i < 7){
  eps = future_ni$mean[i] / tail(data$csho,1)
  discounted_eps = discounted_eps + (eps/((1+k)^i))
  i = i+ 1
}

discounted_dps+discounted_eps
```

Appendix F: Code for NewZ determinants

```
data = read.csv("PEP .csv", header=T, colClasses = c(fyear =
"character"))

#exclude NA newZ

data  = data[!is.na(data$NewZ),]

customlag = function(x,n) {
  c(rep(NA,n),head(x,-n))
}

library(leaps)

#contemporaneous determinants of NewZ
DL_NewZ = log(data$NewZ)-customlag(data$NewZ,1)
DL_at = log(data$at)-customlag(data$at,1)
DL_lt = log(data$lt)-customlag(data$lt,1)
DL_seq = log(data$seq)-customlag(data$seq,1)
DL_re = log(data$re)-customlag(data$re,1)
DL_sale = log(data$sale)-customlag(data$sale,1)
DL_ebit = log(data$ebit)-customlag(data$ebit,1)
df = data.frame(DL_NewZ,DL_at,DL_lt,DL_seq,DL_re,DL_sale,DL_ebit)
m = regsubsets(
  DL_NewZ ~ DL_at+DL_lt+DL_seq+DL_re+DL_sale+DL_ebit,
```

```
  data=df,
  nvmax = 6,
  method = "seqrep"
)
summary(m)
which.min(summary(m)$bic) #model with 3 variables at,re,sale
summary(lm(DL_NewZ~DL_at+DL_re+DL_sale,data=df))

#Lag 1
L1DL_at=customlag(DL_at,1)
L1DL_lt=customlag(DL_lt,1)
L1DL_seq=customlag(DL_seq,1)
L1DL_re=customlag(DL_re,1)
L1DL_sale=customlag(DL_sale,1)
L1DL_ebit=customlag(DL_ebit,1)
df =
data.frame(DL_NewZ,L1DL_at,L1DL_lt,L1DL_seq,L1DL_re,L1DL_sale,L1DL_eb
it)
m1 = regsubsets(
  DL_NewZ ~ L1DL_at+L1DL_lt+L1DL_seq+L1DL_re+L1DL_sale+L1DL_ebit,
  data=df,
  nvmax = 6,
  method = "seqrep"
)
summary(m1)
which.min(summary(m1)$bic)#model with 2 variables at,re
summary(lm(DL_NewZ~L1DL_at+L1DL_re,data=df))
```

Appendix G: Plots and Figures.

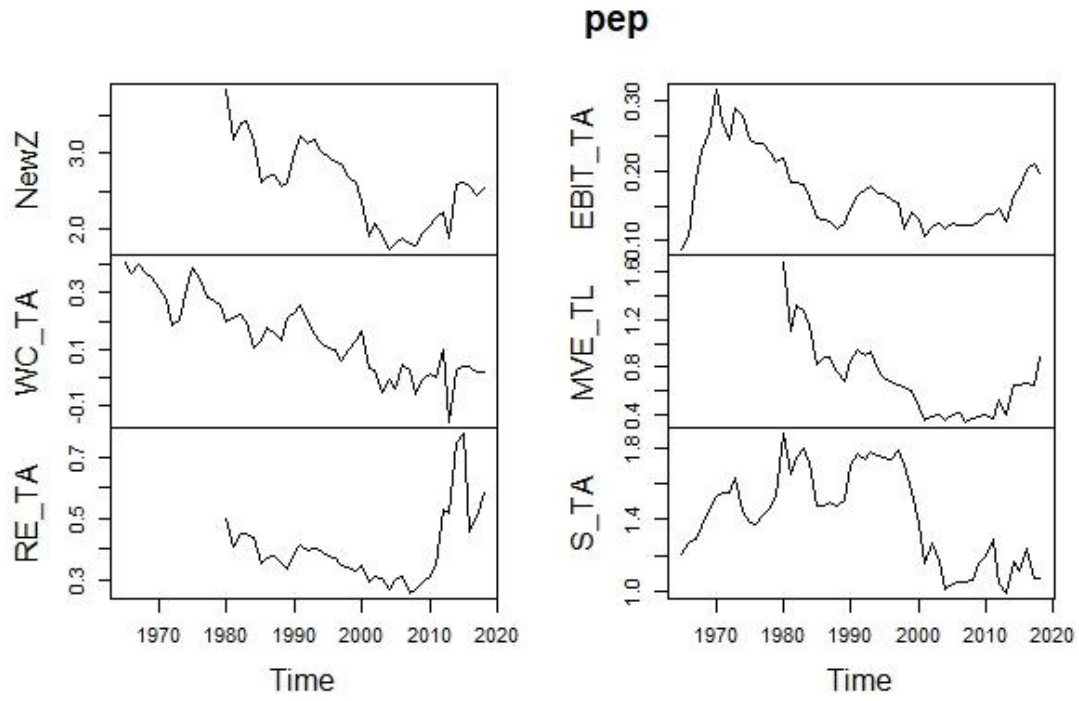

Figure 1: PEP financial ratios 1965-2018

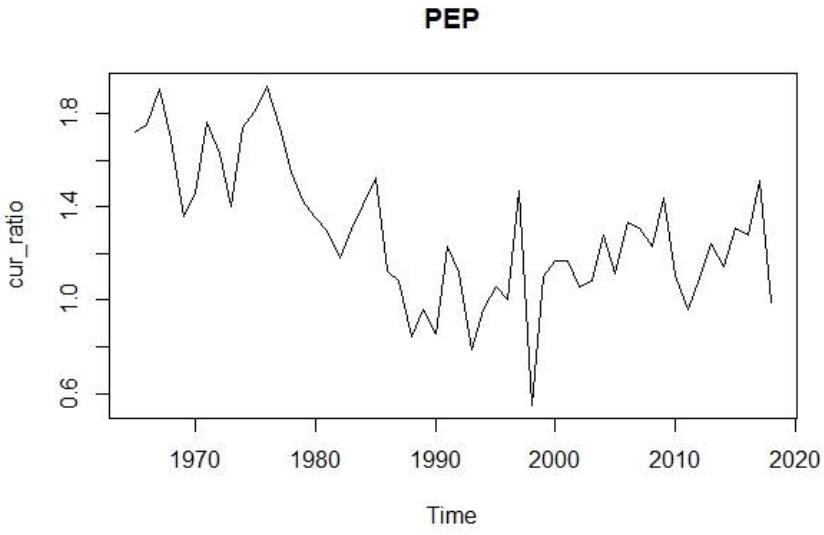

Figure 2: Current ratio for PEP between 1965-2018

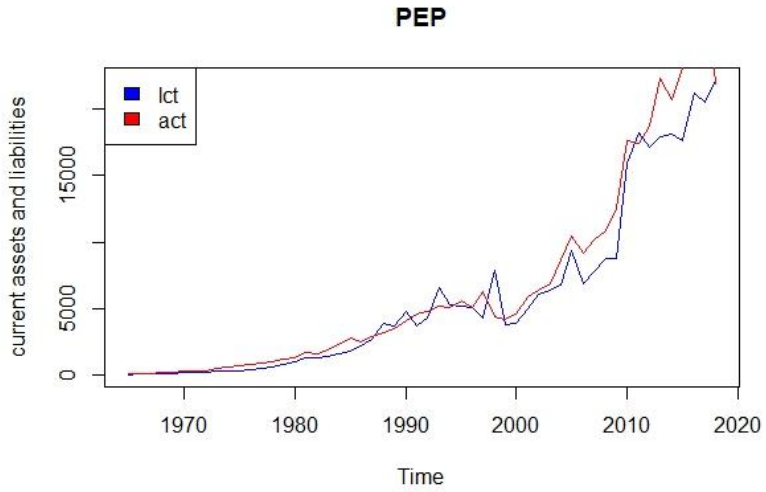

Figure 3: Current assets and liabilities for PEP between 1965-2018

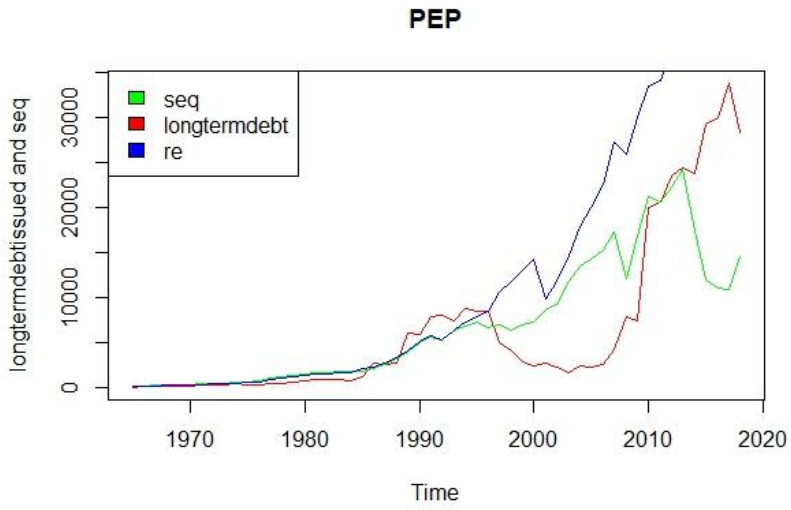

Figure 4: How firm might be financing its operations.

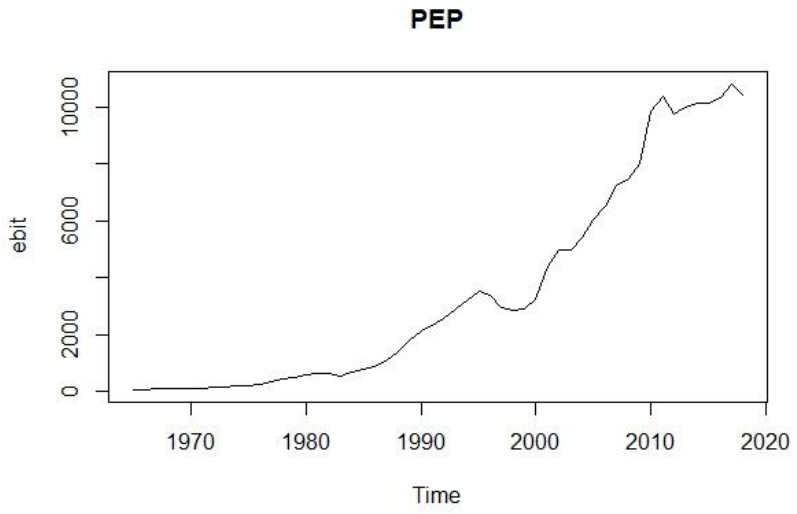

Figure 5: Understanding EBIT between 1965-2018.

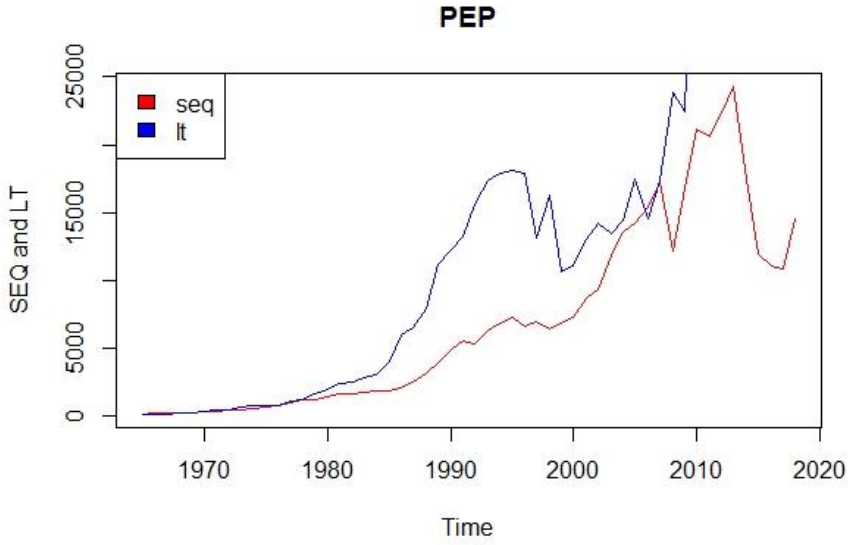

Figure 6: Shareholder equity and total liabilities between 1965-2018

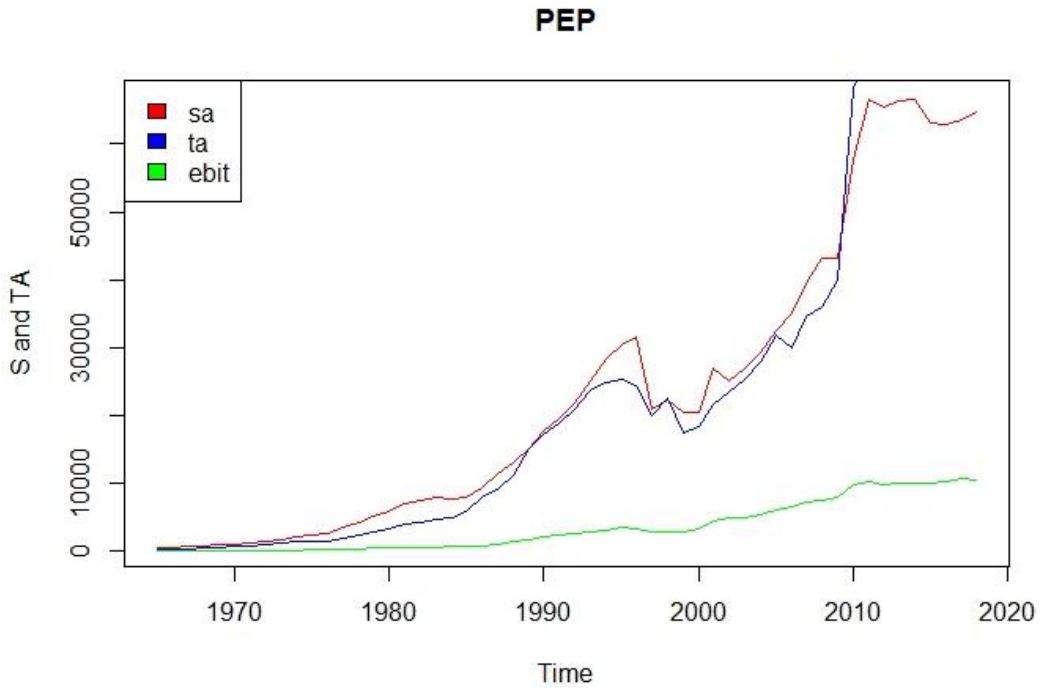

Figure 7: Sales, EBIT and total assets between 1965-2018.

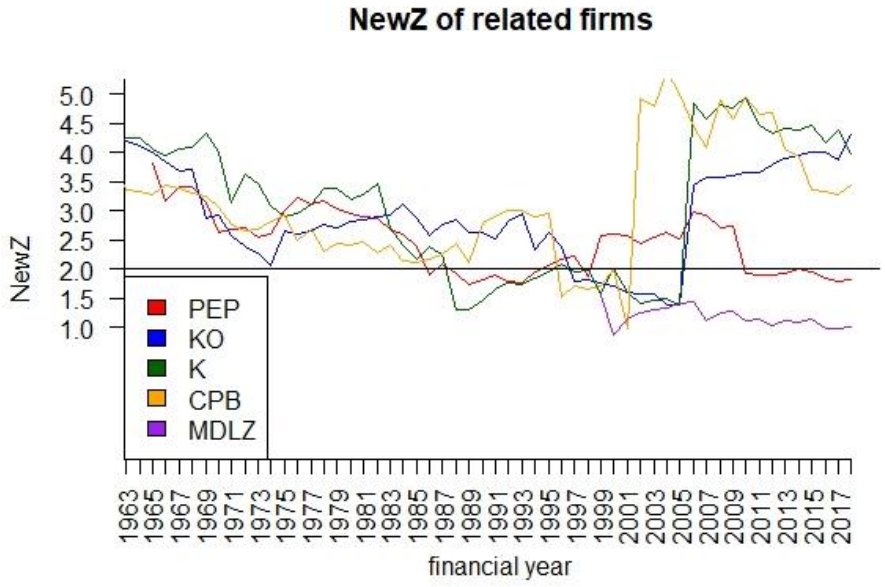

Figure 8: NewZ scores of related firms

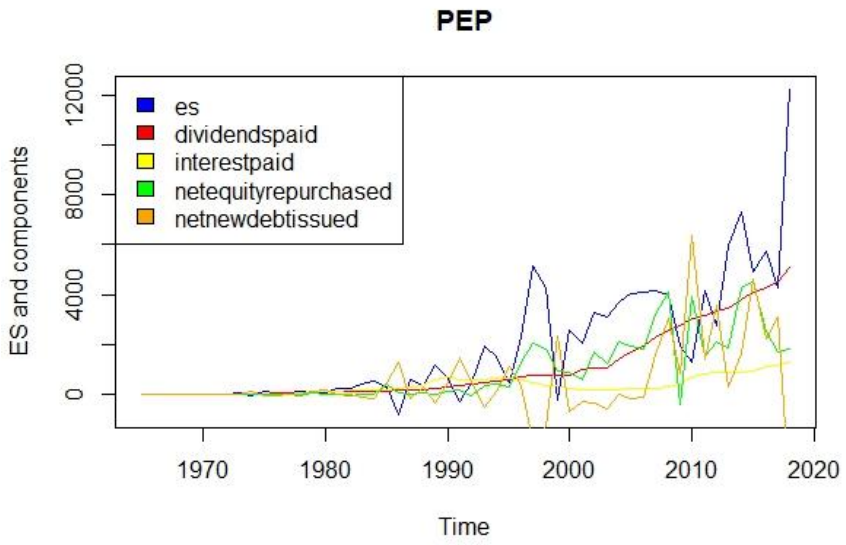

Figure 9: ES and ES components for PEP between 1965-2018

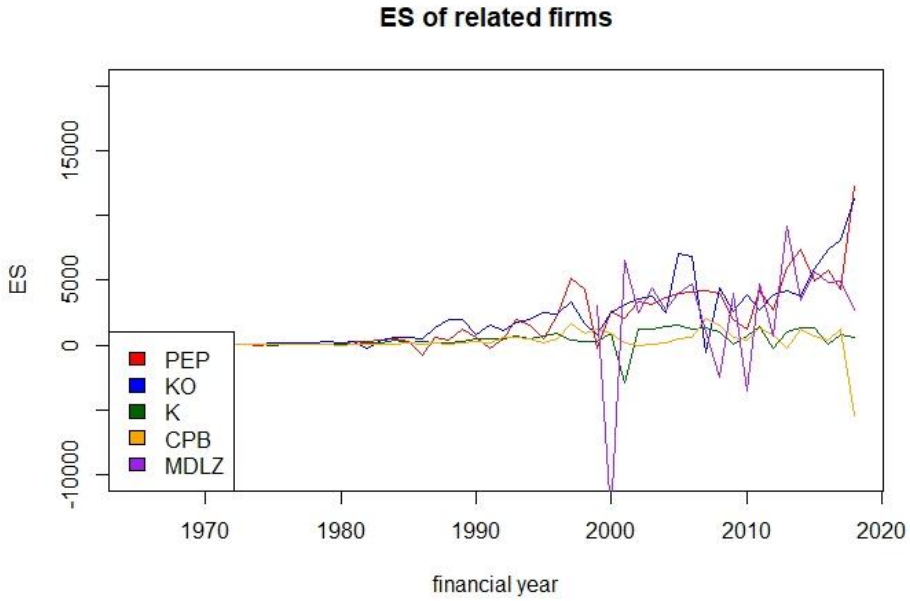

Figure 10: ES of related firms.

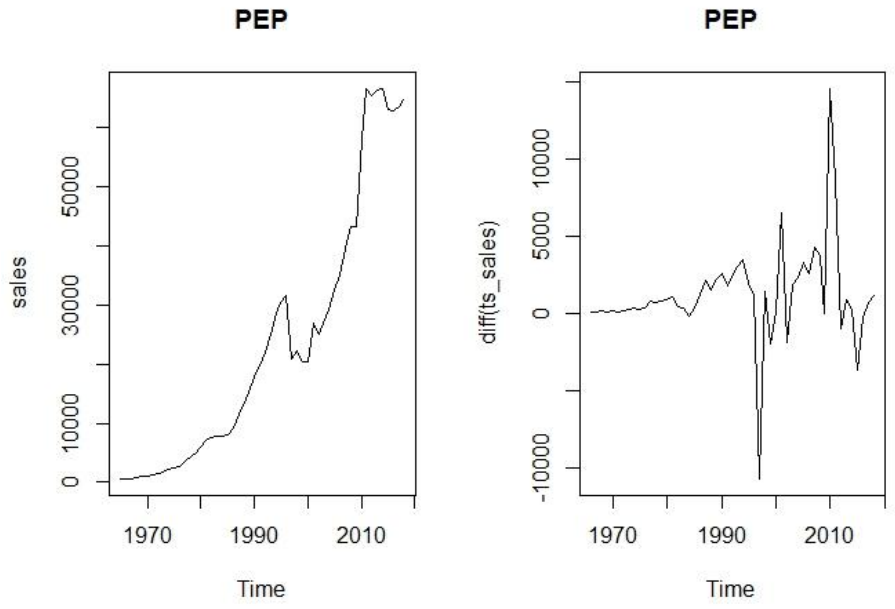

Figure 11: `ts_sale`

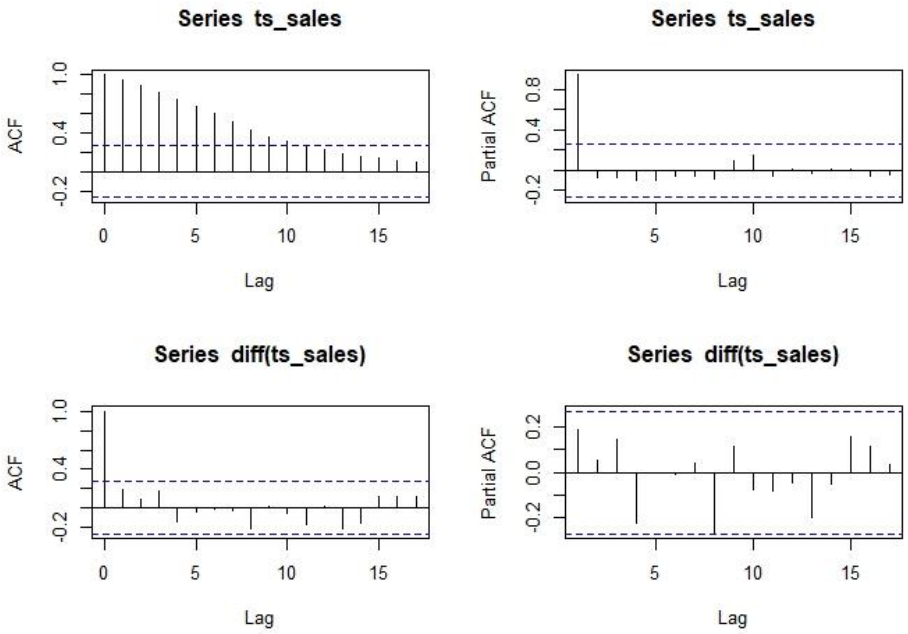

Figure 12: ACF and PACF of `ts_sale` and `diff(ts_sale)`

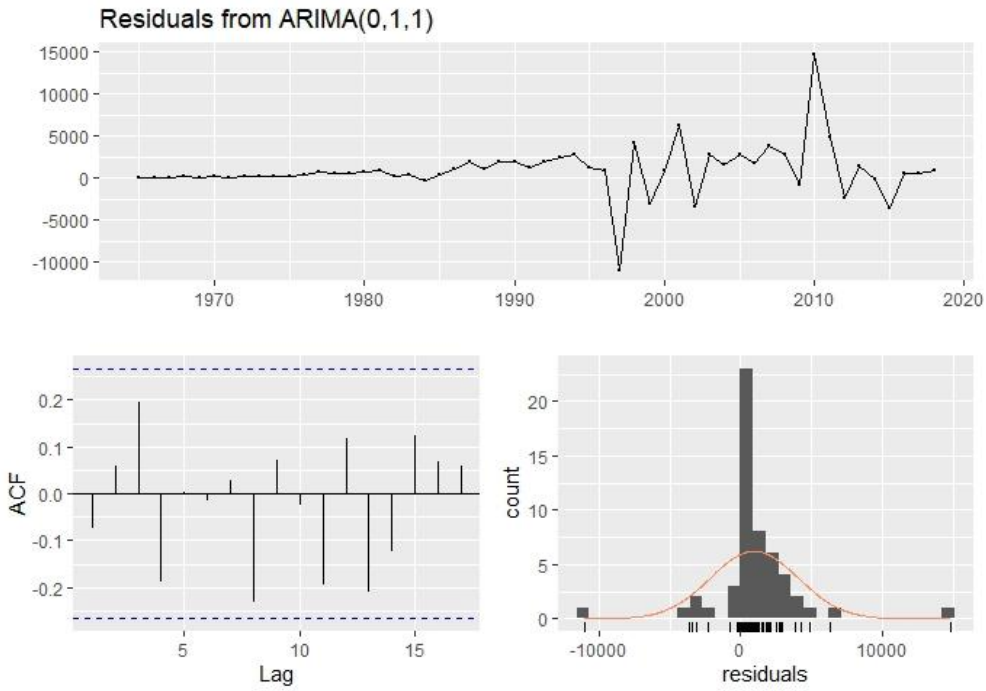

Figure 13: Residuals for ARIMA(0,1,1)

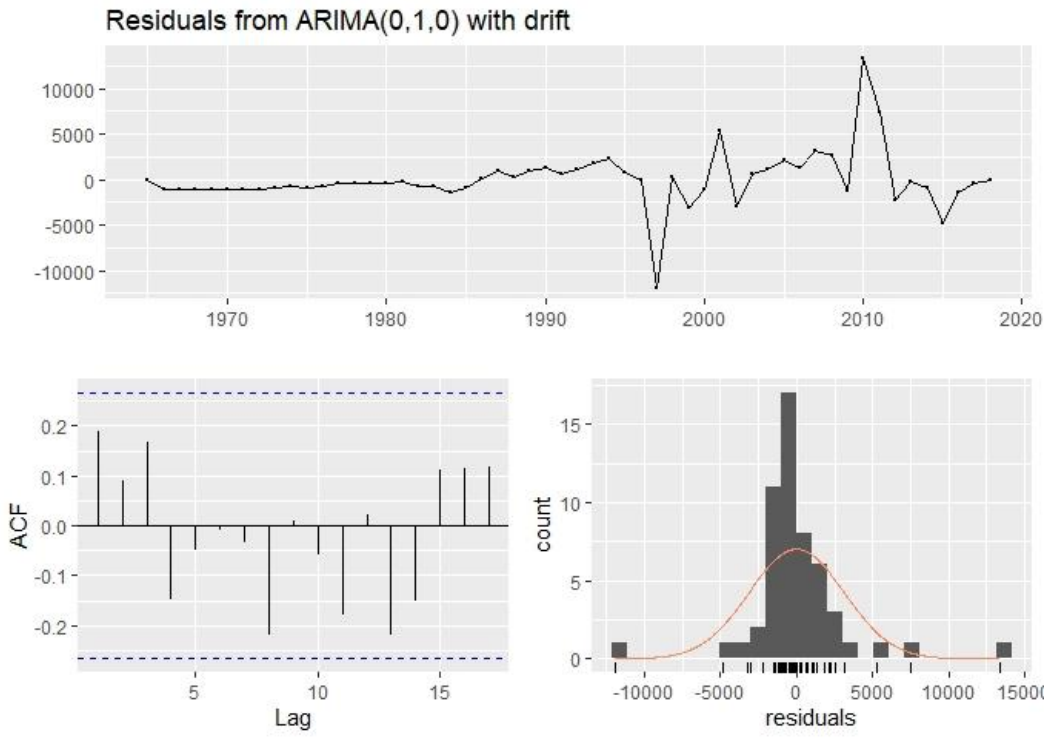

Figure 14: Residuals for ARIMA (0,1,0)

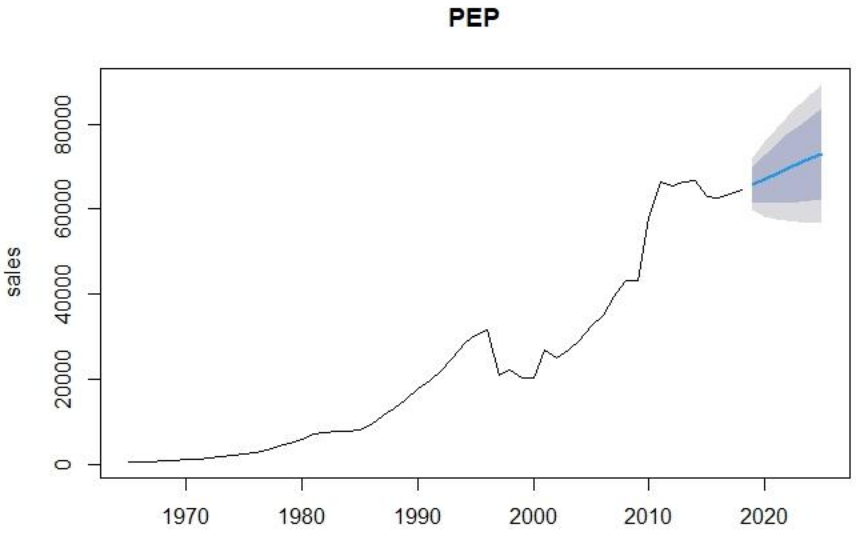

Figure 15: Sales forecast.

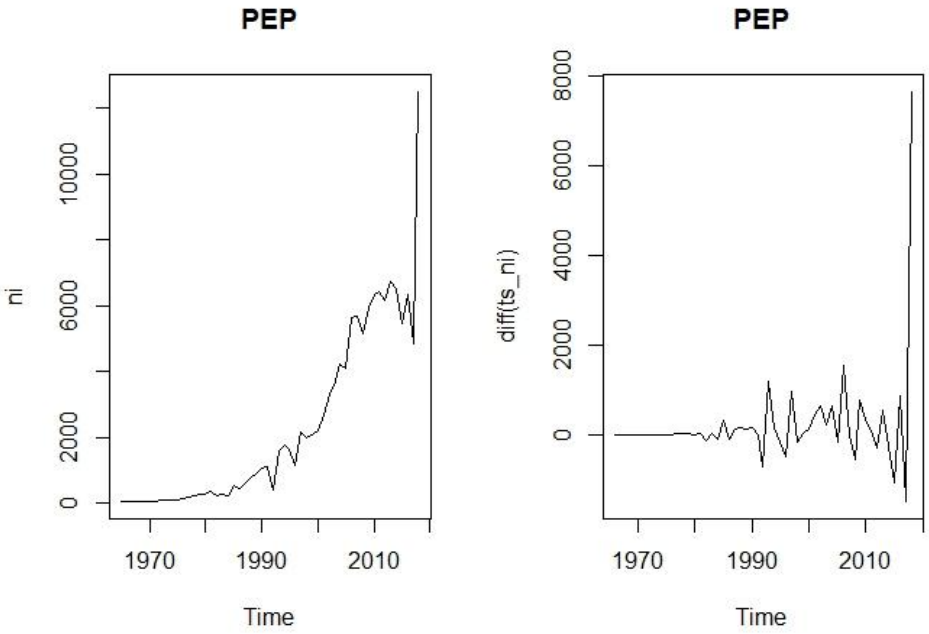

Figure 16: `ts_ni`

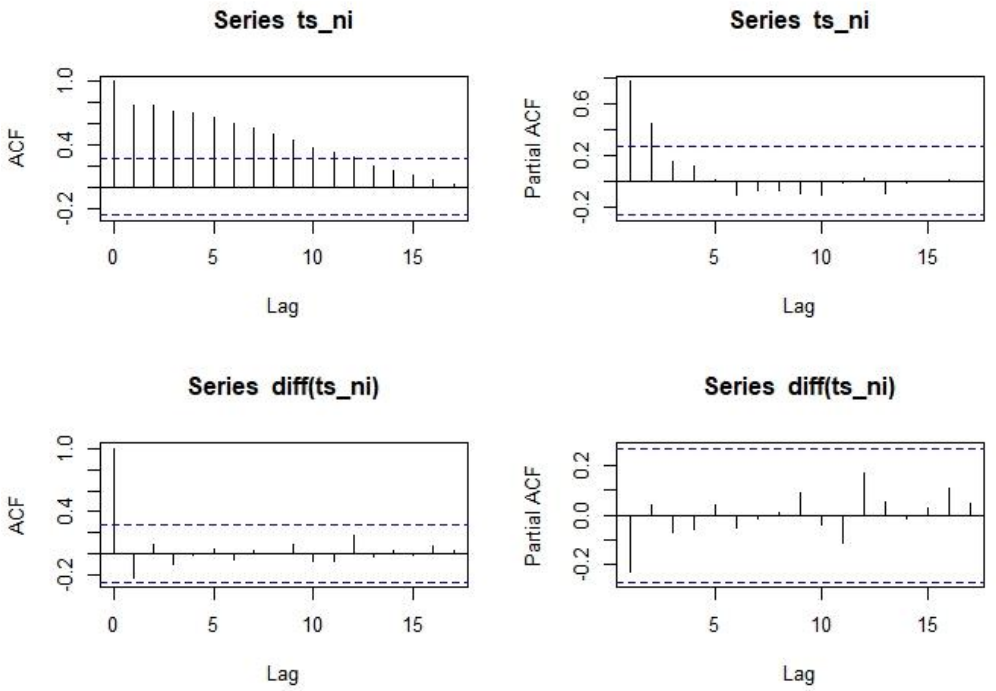

Figure 17: ACF and PACF `diff(ts_ni, differences=1)`

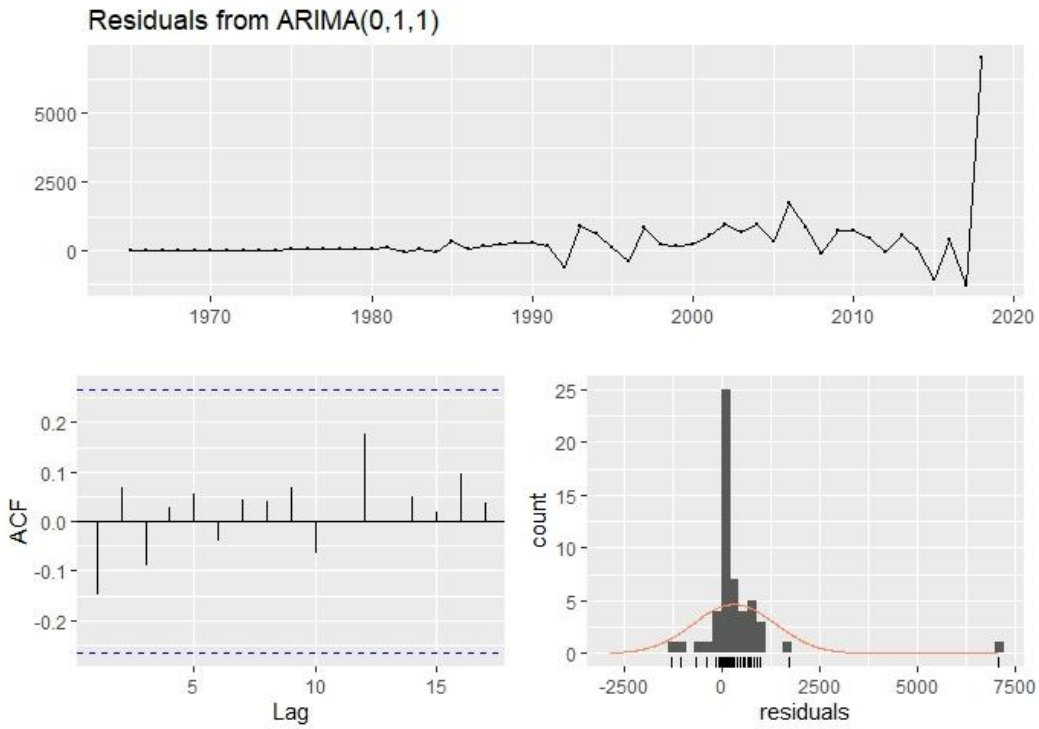

Figure 18: Residuals for ARIMA(0,1,1)

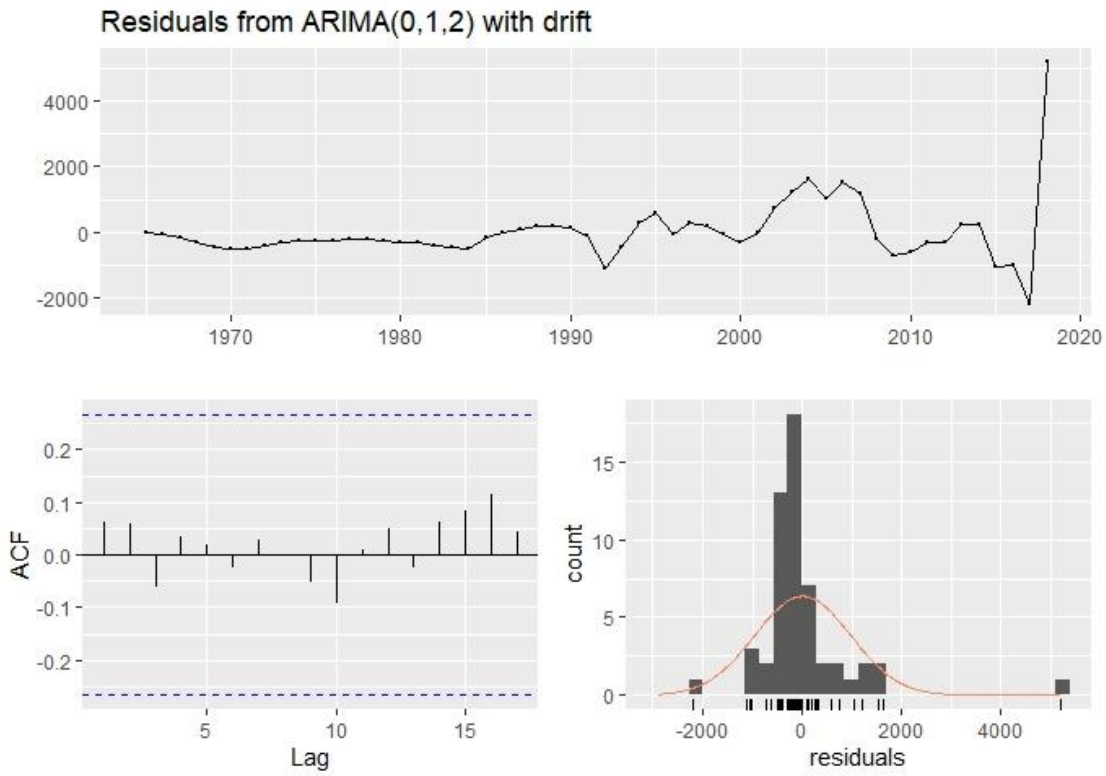

Figure 19: Residuals for ARIMA (0,1,2)

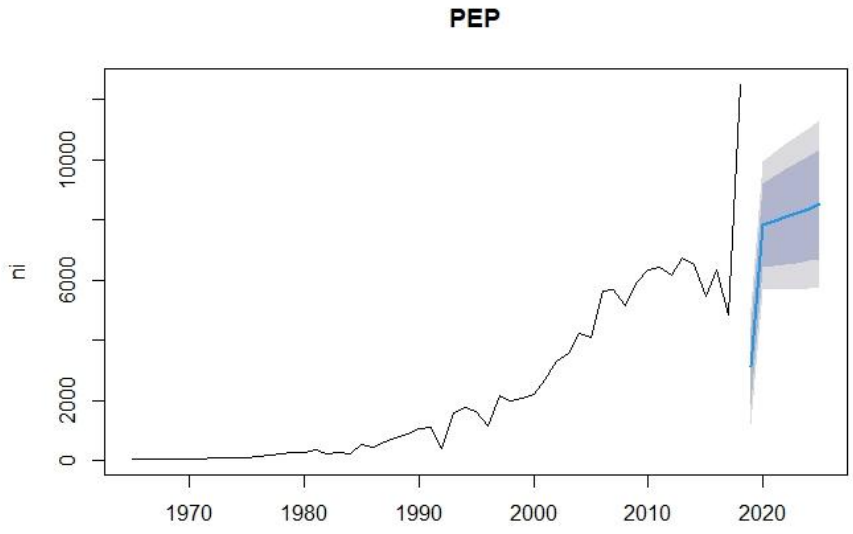

Figure 20: NI forecast

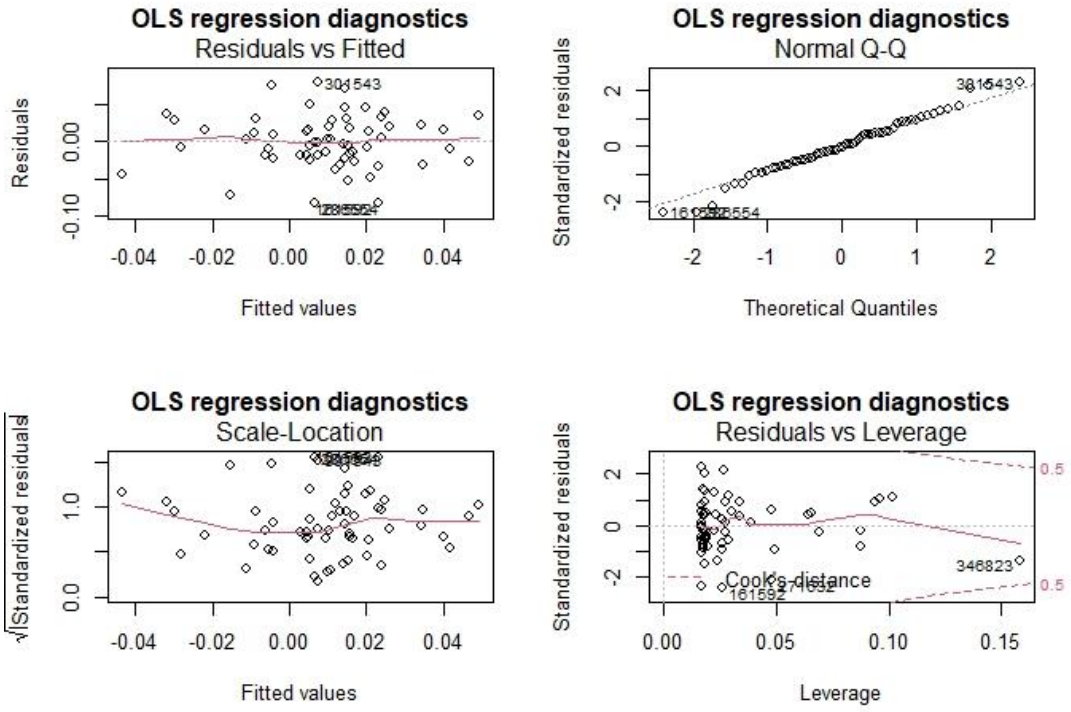

Figure 21: Regression diagnostics for OLS

References

1. Edward I. Altman, 2013. "Predicting financial distress of companies: revisiting the Z-Score and ZETA® models."
2. SEC Form 10-K filing for 1998. PepsiCo. Available at "https://pepsico.gcs-web.com/static-files/7b1f8223-f047-4eff-b710-d91ecd78cd2c". Obtained from "https://www.pepsico.com/investors/financial-information/sec-filings".
3. PepsiCo stock split history. Nasdaq. https://www.nasdaq.com/articles/pepsico-incs-stock-split-history-2016-09-28.
4. Guerard, Saxena and Guletkin. Quantitative Corporate Finance. Second Edition.Springer. 2021.