

**THE BEHAVIOR OF THE
CONSUMER PRICE INDEX:
1913 TO 2003**
**A study of seasonality in the monthly
consumer price index (CPI)**

Shaikh A. Hamid, Ph.D.

*Associate Professor of Finance
Southern New Hampshire University*

Tej S. Dhakar, Ph.D.

*Professor of Quantitative Studies
Southern New Hampshire University*

Working Paper No. 2005-03

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ABSTRACT

This paper analyzes the seasonality in the monthly consumer price index (CPI) over the period January 1913 to December 2003. We examine three types of month effects: if the mean of monthly CPI changes of the entire data set, and of a given month were significantly different from zero; if the mean of monthly CPI changes of a given month was different from the mean of the other months; and if the variance of the monthly CPI changes for a given month was different from the variance of the other months. The mean of monthly CPI changes for the entire data set (0.27%) was found to be significantly greater than zero. The means of monthly changes show a downward trend from September to December. When the data are sliced into three sub-periods, we find an increasing trend in the means and medians of monthly changes but a decreasing trend in the standard deviations of the monthly changes. The mean of monthly CPI changes during the Republican presidencies (0.15%) was significantly lower than during the Democratic presidencies (0.38%).

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INTRODUCTION

Though inflation has been the scourge of savers and investors everywhere, for the last two decades it has been tamed in the U.S. Over this period, the Federal Reserve System has been largely successful in steering the economy towards price stability. In an intensely competitive global economy, with American businesses under relentless pressure to operate ever more efficiently, it is possible that prices will stay flat or even decline over the next decade.

The most widely used barometer of inflation is the Consumer Price Index (CPI), which is reported monthly by the Bureau of Labor Statistics, U.S. Department of Labor. It is a measure of the average change in prices over time in a basket of representative goods and services consumed by a typical American family. User fees (such as water and sewer service) and sales and excise taxes paid by the consumers are also included. Income taxes and investment items (like stocks, bonds, and life insurance) are not included. It is a gauge of inflation in consumer goods and services. It would be interesting to explore the existence of seasonality in the CPI. Various forms of seasonalities have been explored in the case of different financial assets, but to our knowledge, similar effects have not been explored in the case of inflation. This paper seeks to fill that gap.

Insight into the behavior of CPI has implications for consumers, investors and policy makers. It has been pointed out that during Democratic governments unemployment went down at the cost of higher inflation, while during Republican governments inflation was controlled at the cost of higher unemployment. This seems to suggest that there is indeed a very real economic difference in the policies of the two parties, and that Americans' choice at the ballot box makes a real difference, perhaps even more than they realize (Leonhaedt, 2003). For this reason, we also look at the difference in inflation and seasonality between Republican and Democratic presidencies.

The next section explains the research methodology, followed by analysis of results, and summary and conclusion.

RESEARCH METHODOLOGY

The goal of this research is to find out, for the length of period of study, if there is a month effect in CPI, and if so, is it more pronounced during Democratic presidency or Republican presidency. Many studies have used the dummy variable methodology to detect market seasonality. Chien, Lee and Wang (2002) provide statistical analysis and empirical evidence that the methodology may lead to misleading results. We avoid this problem by following the methodology used in Hamid and Dhakar (2003) through which they analyze seasonality in the Dow Jones Industrial Average.

We study the month effect in three different ways. Unless otherwise stated, significance in all cases is tested at the 5% level.

1. Is the mean of monthly changes in CPI different from zero? We do this by subjecting the mean percentage change for a given month i to the following

hypothesis test: $H_0: \mu_i = 0$ vs. $H_a: \mu_i \neq 0$. We used the standard t-test for testing this hypothesis.

2. Is the mean of monthly CPI changes of a given month different from the mean of the other months? We do this by conducting the following hypothesis test for a given month i : $H_0: \mu_i = \mu_j$ vs. $H_a: \mu_i \neq \mu_j$, where j represents the remaining 11 months other than i . Since the variances for many (i, j) periods and the sample sizes were unequal, we used the more conservative t-test assuming unequal variances.
3. Is the variance of the monthly CPI changes for a given month different from the variance for the other months? We do this by conducting the following hypothesis test for a given month i : $H_0: \sigma_i^2 = \sigma_j^2$ vs. $H_a: \sigma_i^2 \neq \sigma_j^2$, where j represents the remaining 11 months other than i . We used the standard F-test for testing this hypothesis.

In addition to the t-tests and F-tests, we use Kruskal-Wallis nonparametric tests for differences in population medians. In important cases, we use the Mood's Median test, which is more robust against outliers.

To gain deeper insight into the month effect, we divide the entire period (January 1913 to December 2003) into three sub-periods:

- 1913 to 1945 (which includes the First World War, the Great Depression years, and the Second World War);
- 1946 to 1972 (which includes the Breton Woods fixed exchange rate era, and the break down of that era in 1972);

- 1973 to 2003 (which includes the volatile world we live in since the first oil crisis of 1973).

We analyze the behavior of monthly percentage changes in CPI for (a) the entire data, (b) the three sub-periods, (c) the Democratic presidencies, and (d) the Republican presidencies.

DATA AND DESCRIPTIVE STATISTICS

Our data consists of monthly percentage changes of the CPI in the U.S. from January 1913 to December 2003. The data is obtained from the Bureau of Labor Statistics (BLS) website (www.bls.gov/). The data contains 517 months during which Republicans were presidents, and 575 months during which Democrats were presidents. That gives us 1,092 months of observations. Monthly percentage change in the consumer price index (CPI) is computed as:

$$\% \Delta CPI = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} \times 100$$

The descriptive statistics for the monthly CPI changes are shown in Table 1. The mean monthly change for the entire period is 0.27% and the median is 0.25%. The distribution of monthly means is positively skewed. The maximum monthly change was 5.88% (July 1946) and the minimum was -3.16% (February 1921).

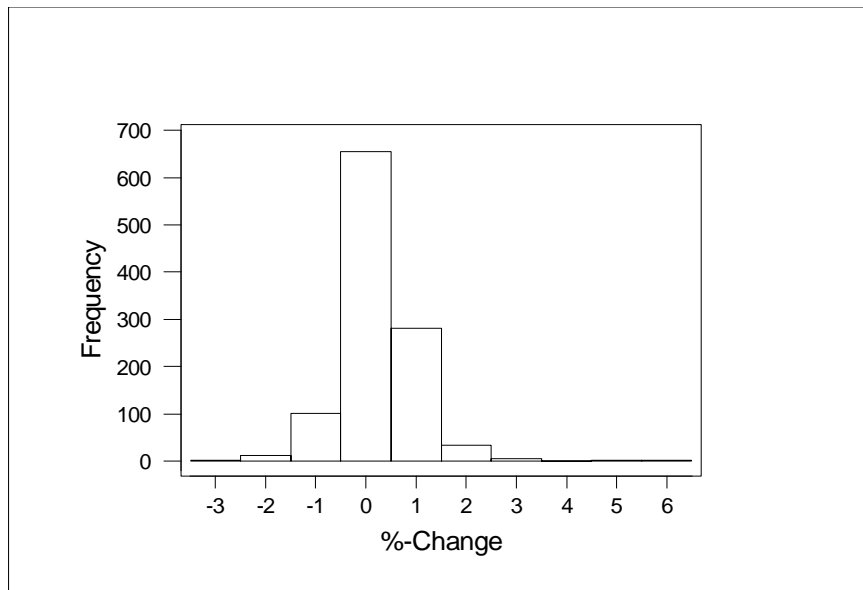
Table 1: Descriptive statistics for January 1913 to December 2003

Monthly % Change in CPI	
Mean	0.271366
Standard Error	0.020626
Median	0.247222
Mode	0
Std Deviation	0.681608

Sample Variance	0.46459
Kurtosis	8.510082
Skewness	0.813719
Range	9.040248
Minimum	-3.15789
Maximum	5.882353
Sum	296.3316
Count	1092

The histogram in Figure 1 shows that monthly percentage changes in CPI are not normally-distributed.

Figure 1: Frequency distribution of monthly CPI changes



In 650 cases CPI changes were greater than 0%; in 159 cases they were less than 0%; and in 283 cases they equaled 0%. There were only 18 instances of monthly inflation rates of more than 2% over the ninety-one years; half of them were between 1913 and 1920. We find only 4 cases of changes greater than 3%; one case greater than 5%; and none between 4% and 5%. 109 months have seen monthly inflation rates of between 1% and 2%; 333 months were between 0% and 1%; 2 cases equaled 1%; and 283 cases

equaled 0%. So between 0% and 1% - both inclusive - we have 618 cases or 57% of the total cases.

Of the 159 cases where the CPI changes were negative; 105 of them were before 1940. In 127 cases, CPI changes were between 0% and -1%. In 26 cases, CPI changes were between -1% and -2%; 6 cases were between -2% and -3%; and 1 case of change between -3% and -4%; all were before 1938. The four-year period, 1929-1932 – the years of the Great Depression – saw 40 instances of negative monthly changes; that is 25% of the total cases of deflation in the entire period. The 15-year period, 1966-1980, saw no negative monthly change in CPI.

MONTH EFFECT IN THE CONSUMER PRICE INDEX

Entire Period (1913 – 2003)

Firstly, we explore month effect for the entire CPI data set (1913-2003). We test for the three types of month effects. Table 2 summarizes the statistical outputs and results of the tests.

Table 2: Month effects in consumer price index: January 1913 to December 2003

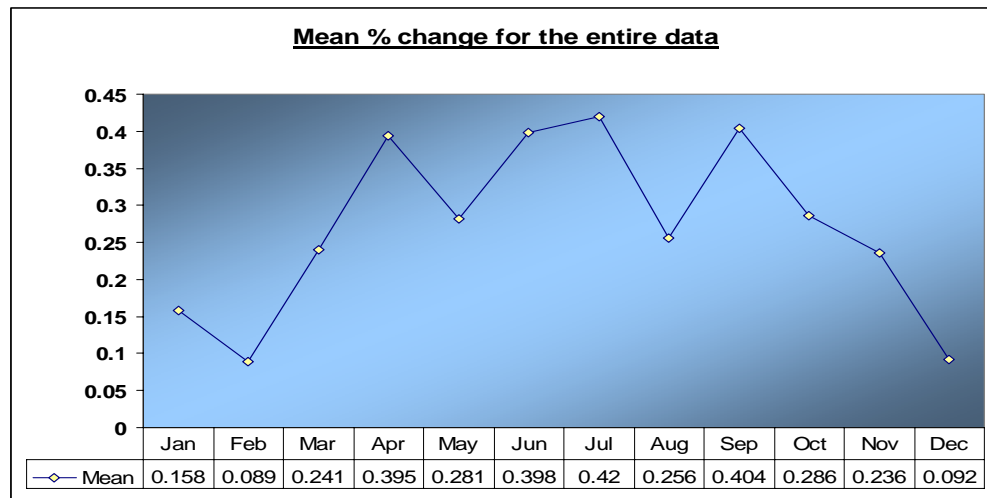
TEST OF MONTH EFFECTS OF CPI FROM APRIL 1913 TO DECEMBER 2003													
Period 1913-2003	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	1092.00	91.00	91.00	91.00	91.00	91.00	91.00	91.00	91.00	91.00	91.00	91.00	91.00
Mean	0.27	0.16	0.09	0.24	0.39	0.28	0.40	0.42	0.26	0.40	0.29	0.24	0.09
Median	0.25	0.00	0.12	0.25	0.35	0.28	0.35	0.31	0.19	0.33	0.29	0.07	0.00
Minimum	-3.16	-2.31	-3.16	-1.18	-1.09	-2.21	-1.31	-1.70	-2.40	-1.48	-0.98	-1.34	-2.02
Maximum	5.88	2.19	2.56	1.86	5.00	2.11	2.08	5.88	2.02	2.31	1.96	2.40	2.16
Range	9.04	4.50	5.72	3.04	6.09	4.32	3.39	7.59	4.42	3.79	2.94	3.75	4.18
Standard Deviation	0.68	0.75	0.76	0.58	0.76	0.61	0.54	0.93	0.66	0.61	0.58	0.59	0.62
Sample Variance	0.46	0.56	0.58	0.34	0.58	0.37	0.29	0.87	0.44	0.37	0.33	0.35	0.39
p-value (m=0)	0.00	0.05	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
p-value (t test)		0.13	0.02	0.60	0.11	0.87	0.02	0.11	0.82	0.03	0.80	0.56	0.01
p-value (F test)		0.10	0.07	0.02	0.07	0.08	0.00	0.00	0.38	0.08	0.02	0.03	0.12
Mean % Change	Positive	Positive		Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	
Month Effect (Mean)			Lower				Higher			Higher			Lower
Month Effect (Var)				Lower			Lower	Higher			Lower	Lower	

Note 1. “Positive” implies that the mean percentage change was significantly greater than zero. “Negative” implies that the mean percentage change was significantly less than zero.

Note 2. “Higher” implies that the mean percentage change was significantly greater than the rest of the months. “Lower” implies that the mean percentage change was significant smaller than the rest of the months.

The mean of monthly percentage changes for the entire data set of 0.27% is significantly greater than zero ($p = 0.00$). Except for February and December, the means of monthly percentage changes of the remaining ten months are significantly greater than zero. July experienced the highest mean monthly change (0.42%) followed by June and September (0.40%). February and December had the lowest means (0.09%). Figure 2 graphs the mean monthly percentage changes for the entire data. There is a slight rise in January, fall in February, a rising trend in March and April, then fall in May, a rising trend in June and July, fall in August, before peaking in September. We then see a falling trend in inflation rates from September all the way to December.

The falling prices from September onwards may indicate the desire of retailers to boost sales prior to the Christmas season. The lower margins because of falling prices seek to get offset via higher volumes. As sales decrease after the Christmas season, prices increase to compensate for lower volumes.

Figure 2: Mean % change in CPI: January 1913 – December 2003

In terms of the month-effect, June and September experienced mean monthly CPI changes which were significantly greater than the mean CPI changes for the other months. February and December experienced mean CPI changes significantly lower than the other months. Kruskal-Wallis nonparametric test for difference in medians of monthly CPI changes for the entire data set is significant at the 0.00 level (the Kruskal-Wallis H-statistic = 35.84, p-value = 0.00). June, September, April and July had higher average ranks (in descending order) based on medians. December had the lowest average rank, followed by February and November.

In regard to volatility, only July exhibited higher variance compared to the other months, and four months (March, June, October and November) exhibited lower variances compared to the other months.

First Sub-Period (1913-1945)

Table 3 shows that for this period, in spite of the Great Depression and deflation, the mean of monthly percentage changes in consumer prices (0.16 %) was significantly greater than zero. The deflation effect was possibly lost because of two world wars that

this period saw since prices tend to increase in times of wars. Only the mean CPI changes for the months of April, June and September were significantly greater than zero.

Table 3: Month effects in consumer price index: 1913-1945

TEST OF MONTH EFFECTS OF CPI FROM APRIL 1913 TO DECEMBER 1945													
Period 1913-1945	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	395.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	32.00
Mean	0.16	-0.12	-0.27	-0.03	0.43	0.23	0.35	0.34	0.12	0.43	0.22	0.26	-0.05
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Minimum	-3.16	-2.31	-3.16	-1.18	-1.09	-2.21	-1.31	-1.70	-2.40	-1.48	-0.98	-1.34	-2.02
Maximum	5.00	2.19	2.56	1.78	5.00	2.11	2.08	3.15	2.00	2.31	1.91	2.21	2.16
Range	8.16	4.50	5.72	2.96	6.09	4.32	3.39	4.85	4.40	3.79	2.89	3.55	4.18
Standard Deviation	0.95	1.08	1.01	0.72	1.19	0.92	0.79	1.12	0.92	0.88	0.81	0.81	0.88
Sample Variance	0.90	1.16	1.02	0.52	1.41	0.85	0.62	1.25	0.84	0.78	0.65	0.66	0.78
p-value (m=0)	0.00	0.53	0.14	0.82	0.04	0.16	0.02	0.09	0.47	0.01	0.13	0.07	0.76
p-value (t test)		0.12	0.01	0.14	0.17	0.64	0.16	0.32	0.78	0.08	0.69	0.46	0.18
p-value (F test)		0.17	0.31	0.02	0.04	0.42	0.09	0.11	0.41	0.31	0.11	0.13	0.30
Mean % Change	Positive				Positive		Positive			Positive			
Month Effect (Mean)			Lower										
Month Effect (Var)				Lower	Higher								

An examination of the month effect in terms of means reveals that the mean of February was lower compared to the other months. That was the only effect in this respect. Kruskal-Wallis test shows significant difference at 8% level of significance in the medians of monthly CPI changes (Kruskal-Wallis H-statistic = 18.18, $p = 0.08$). There was also some month effect in terms of variance as can be seen from the last row of Table 3 (March with lower mean variance and April with higher mean variance compared to the other months).

Second Sub-Period (1946-1972)

This was an era of fixed-exchange rates and relative domestic progress and prosperity. It was an era in which America helped Europe to rise up from the ashes of the Second World War under the Marshall Plan and also helped Japan to get back on its feet. (The Marshall Plan itself was worth \$120 billion in today's dollars.) Compared to the previous

sub-period, the mean of monthly changes in CPI nearly doubled (0.26% vs. 0.15%) and this was significantly greater than zero. Table 4 shows that nine months (March to November) exhibited mean monthly changes significantly greater than zero. Only January, February and December exhibited mean monthly changes not significantly different from zero.

In terms of month effect, June exhibited mean monthly change significantly greater than other months and February exhibited mean monthly change significantly lower than the other months. Kruskal-Wallis test for the difference in medians of the monthly CPI changes shows significant difference (Kruskal-Wallis $H = 27.65$, $p = 0.004$). July has the highest average rank based on median, followed by June as we found in case of the means. January has the lowest average rank followed by December.

April, May and June experienced significantly less volatility (variance of monthly CPI changes) than the other months; July experienced significantly higher volatility. So, this sub-period underwent some significant month effects compared to the previous sub-period.

In terms of the month effect, the means of November and December were significantly lower than the other months. Kruskal-Wallis test for difference in the medians of the monthly CPI changes is significant at 0.00 level (Kruskal-Wallis H-statistic = 45.12, $p = 0.00$). February, September and January have the highest average ranks (in descending order). December has the lowest average rank followed by November. This roughly follows what we found in respect of the means.

The incidence of month effect in terms of variance is less pronounced in this sub-period compared to the second sub-period. With greater volatility in oil prices during this sub-period, we would have expected prices to be more volatile. The conventional wisdom too is that consumer prices have become more volatile in the last three decades. But that is not reflected in the variances of the monthly CPI changes.

Comparison of Three Sub Periods

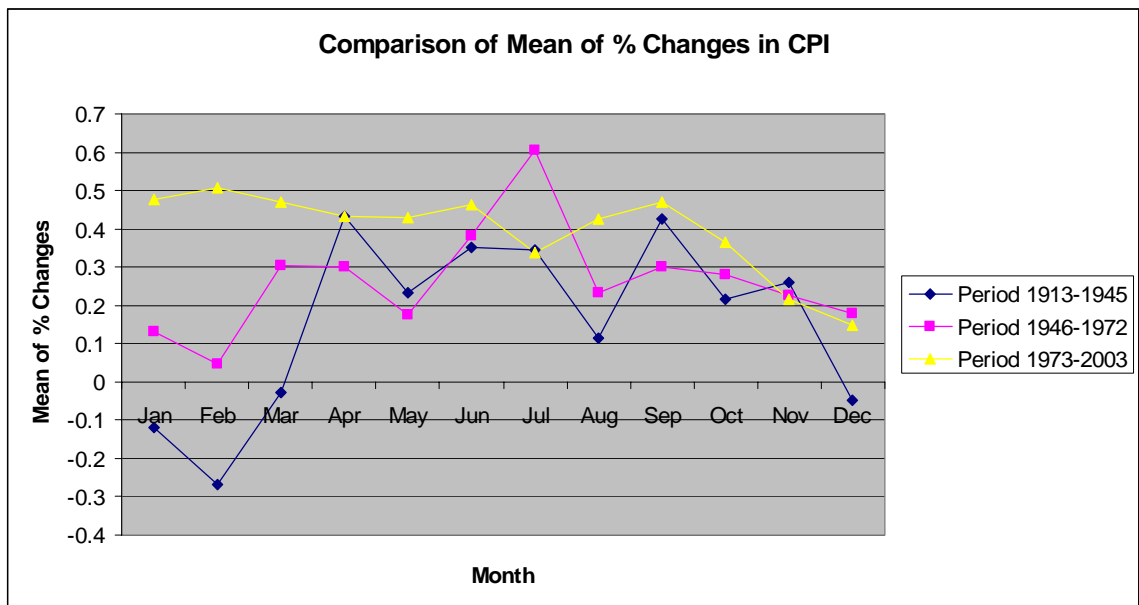
Figure 3 shows the means of the various months for the three sub-periods. As we saw for the entire data, we see a similar pattern for each of the three sub-periods with a clearly discernible falling trend from September to December.

An interesting trend is the increase in the mean of monthly changes for each of the three successive sub-periods (0.16%, 0.26%, 0.40%) and corresponding increase in the medians (0.00%, 0.26%, 0.33%) but a decrease in the standard deviations of the monthly changes (0.95%, 0.54%, 0.35%).

The mean for the second sub-period (0.26%) is significantly higher than the first sub-period (0.16%) with a p -value = 0.07. The mean for the third sub-period (0.40%) is significantly higher than the first sub-period (0.16%) and the second sub-period (0.26%) with a p -values = 0.00. The medians of the three sub-periods (0.00%, 0.26%, 0.33%) are

significantly different from each other (Kruskal-Wallis H statistic = 57.64 and p value = 0.00). Mood's Median test yields a Chi-square of 54.39 and p value = 0.00. The lower mean of the first sub-period is attributable to the depression years which did offset the higher prices during the First World War and the Second World War. The higher means for the subsequent sub-periods reflect higher cost of inputs as more goods were produced and consumed, leading to higher interest rates, and higher energy costs.

Figure 3: Comparison of the mean CPI changes during three sub-periods



While the means and medians increased, the standard deviations actually decreased from 0.95% (1913-1945) to 0.54% (1946-1972) to 0.35% (1973-2003). The standard deviations are different from each other in two-sample F-tests with p values of 0.00. The higher standard deviation of monthly changes during the first sub-period (0.95%) is attributable to the upheavals that this sub-period saw: two tumultuous World Wars and the Great Depression. The lower standard deviation of monthly changes during the second sub-period (0.54%) is partly attributable to the Breton Woods fixed exchange rate system, and relative calm (in spite of Korean War and Vietnam War). The even

lower standard deviation of monthly changes during the third sub-period (0.35%) is attributable to better monetary policy, and innovation and use by companies of derivative instruments to reduce risk (price risk, interest rate risk, foreign exchange risk, etc.).

MONTH EFFECT: REPUBLICAN AND DEMOCRATIC PRESIDENTIAL PERIODS

Given the important impact the presidencies have on the economy, we explored the three types of month-effects in CPI changes during the Republican and Democratic presidencies. Table 6 shows the names of 16 presidents from March 1913 until present, and their political affiliations. Table 7 shows the frequencies of Republican and Democratic presidencies for each of the twelve calendar months.

Table 6: US presidents, political parties and periods

PRESIDENT NAMES	POLITICAL PARTY	BEGIN PERIOD		END PERIOD	
		Month	Year	Month	Year
<i>William Howard Taft</i>	Republican	April	1909	March 3	1913
<i>Woodrow Wilson</i>	Democratic	March 4	1913	March 3	1921
<i>Warren Gamaliel Harding</i>	Republican	March 4	1921	August 2	1923
<i>Calvin Coolidge</i>	Republican	August 3	1923	March 3	1929
<i>Herbert Clark Hoover</i>	Republican	March 4	1929	March 3	1933
<i>Franklin Delano Roosevelt</i>	Democratic	March 4	1933	April 12	1945
<i>Harry S. Truman</i>	Democratic	April 12	1945	January 20	1953
<i>Dwight David Eisenhower</i>	Republican	January 20	1953	January 20	1961
<i>John Fitzgerald Kennedy</i>	Democratic	January 20	1961	November 22	1963
<i>Lyndon Baines Johnson</i>	Democratic	November 22	1963	January 20	1969
<i>Richard Milhous Nixon (2)</i>	Republican	January 20	1969	August 9	1974
<i>Gerald Rudolph Ford</i>	Republican	August 9	1974	January 20	1977
<i>Jimmy Earl Carter, Jr.</i>	Democratic	January 20	1977	January 20	1981
<i>Ronald Wilson Reagan</i>	Republican	January 20	1981	January 20	1989
<i>George H. W. Bush</i>	Republican	January 20	1989	January 20	1993
<i>William Jefferson Clinton</i>	Democratic	January 20	1993	January 20	2001
<i>George Walker Bush</i>	Republican	January 20	2001	Now	

Source: Potus Presidents of the United States, www.ipl.org/div/potus/

**Table 7: Monthly data distributions: Republican
Versus Democratic presidencies**

MONTH	REPUBLICAN	DEMOCRATIC	TOTAL
<i>January</i>	43	48	91
<i>February</i>	44	47	91
<i>March</i>	43	48	91
<i>April</i>	43	48	91
<i>May</i>	43	48	91
<i>June</i>	43	48	91
<i>July</i>	43	48	91
<i>August</i>	43	48	91
<i>September</i>	43	48	91
<i>October</i>	43	48	91
<i>November</i>	43	48	91
<i>December</i>	43	48	91
TOTAL	517	575	1,092

Republican Presidencies

Table 8 shows the statistical output for monthly CPI changes during Republican presidencies over the period 1913-2003. The mean of monthly CPI changes (0.15%) over the 517 Republican months is significantly greater than zero. The overall median of monthly CPI changes during Republican periods was 0.24%. The means of monthly CPI changes for April, June, July, September and October were significantly greater than zero.

Table 8: Month effects in consumer price index: Republican presidencies

TEST OF MONTH EFFECTS OF CPI FROM APRIL 1913 TO DECEMBER 2003													
Period 1913-2003	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	517.00	43.00	44.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00
Mean	0.15	-0.01	0.07	0.13	0.19	0.18	0.29	0.29	0.11	0.29	0.24	0.10	-0.03
Median	0.24	0.15	0.20	0.20	0.35	0.30	0.34	0.35	0.16	0.34	0.31	0.08	0.00
Minimum	-2.31	-2.31	-1.55	-1.18	-1.09	-2.21	-1.31	-1.70	-1.19	-1.13	-0.75	-1.34	-1.83
Maximum	1.81	1.03	1.29	1.27	0.79	1.25	1.25	1.18	1.81	1.20	0.99	1.69	0.78
Range	4.12	3.34	2.84	2.45	1.88	3.46	2.56	2.88	3.00	2.33	1.73	3.04	2.61
Standard Deviation	0.54	0.70	0.61	0.52	0.45	0.62	0.52	0.58	0.53	0.45	0.39	0.48	0.48
Sample Variance	0.29	0.49	0.37	0.27	0.20	0.39	0.27	0.34	0.28	0.20	0.15	0.23	0.23
p-value (m=0)	0.00	0.94	0.47	0.12	0.01	0.06	0.00	0.00	0.16	0.00	0.00	0.18	0.70
p-value (t test)		0.11	0.33	0.72	0.60	0.77	0.09	0.11	0.62	0.04	0.16	0.45	0.01
p-value (F test)		0.01	0.13	0.38	0.06	0.11	0.41	0.27	0.43	0.06	0.00	0.16	0.16
Mean % Change	Positive				Positive		Positive	Positive		Positive	Positive		
Month Effect (Mean)										Higher			Lower
Month Effect (Var)		Higher									Lower		

In terms of month effect, the mean CPI change for September was higher than the other months and December was lower based on t-tests. Kruskal-Wallis test also found significant differences in the medians of various months (Kruskal-Wallis H-statistic = 28.52, $p = 0.00$). July had the highest average rank based on median followed by June and September. December had the lowest average rank followed by November. In regard to the month effect in variance of CPI changes, January's standard deviation was higher than the other months, whereas October's was lower than the other months.

Overall, month effects under Republican presidents were less significant. Inflation, measured by consumer price index, appears to have been rather low. The Great Depression years presumably partly contributed to these outcomes during Republican presidencies.

Democratic Presidencies

Table 9 shows the statistical output for monthly CPI changes during Democratic presidencies over 1913-2003. The mean of monthly CPI changes (0.38%) over the 575

Democratic months is significantly greater than zero. The overall median of monthly CPI changes during Democratic periods was 0.28% compared to 0.24% during the Republican periods. Ten of the 12 months during democratic presidencies experienced monthly CPI changes significantly greater than zero.

Though the means of seven months were significantly greater than zero, no month experienced mean change significantly greater than the mean of the other months; only the mean monthly CPI changes of February was lower than the mean for the other months. We get similar finding from Kruskal-Wallis test for difference in the medians of the monthly CPI changes; there is no significant difference in the medians of various months (Kruskal-Wallis H-statistic = 16.05, $p = 0.14$). Though the result is not significant, June had the highest average rank based on median followed by April.

Table 9: Month effects in consumer price index: Democratic presidencies

TEST OF MONTH EFFECTS OF CPI FROM APRIL 1913 TO DECEMBER 2003													
Period 1913-2003	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	575.00	48.00	47.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00
Mean	0.38	0.31	0.11	0.34	0.58	0.37	0.50	0.54	0.38	0.50	0.33	0.36	0.20
Median	0.28	0.00	0.00	0.30	0.36	0.19	0.40	0.30	0.25	0.32	0.21	0.06	0.00
Minimum	-3.16	-2.06	-3.16	-1.00	-1.01	-1.02	-0.72	-1.54	-2.40	-1.48	-0.98	-0.82	-2.02
Maximum	5.88	2.19	2.56	1.86	5.00	2.11	2.08	5.88	2.02	2.31	1.96	2.40	2.16
Range	9.04	4.25	5.72	2.86	6.01	3.13	2.81	7.42	4.42	3.79	2.94	3.22	4.18
Standard Deviation	0.77	0.77	0.88	0.62	0.93	0.59	0.53	1.16	0.75	0.72	0.70	0.66	0.71
Sample Variance	0.60	0.59	0.78	0.38	0.86	0.35	0.29	1.34	0.56	0.51	0.50	0.43	0.51
p-value (m=0)	0.00	0.01	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
p-value (t test)		0.51	0.03	0.70	0.12	0.95	0.12	0.31	0.95	0.21	0.62	0.84	0.08
p-value (F test)		0.50	0.10	0.02	0.04	0.01	0.00	0.00	0.41	0.25	0.20	0.07	0.24
Mean % Change	Positive	Positive		Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	
Month Effect (Mean)			Lower										
Month Effect (Var)				Lower	Higher	Lower	Lower	Higher					

There was quite a bit of month-effect in terms of variance. Three of the months exhibited lower standard deviations (March, May and June) and two months exhibited higher standard deviations (April and July) compared to the other months. The standard

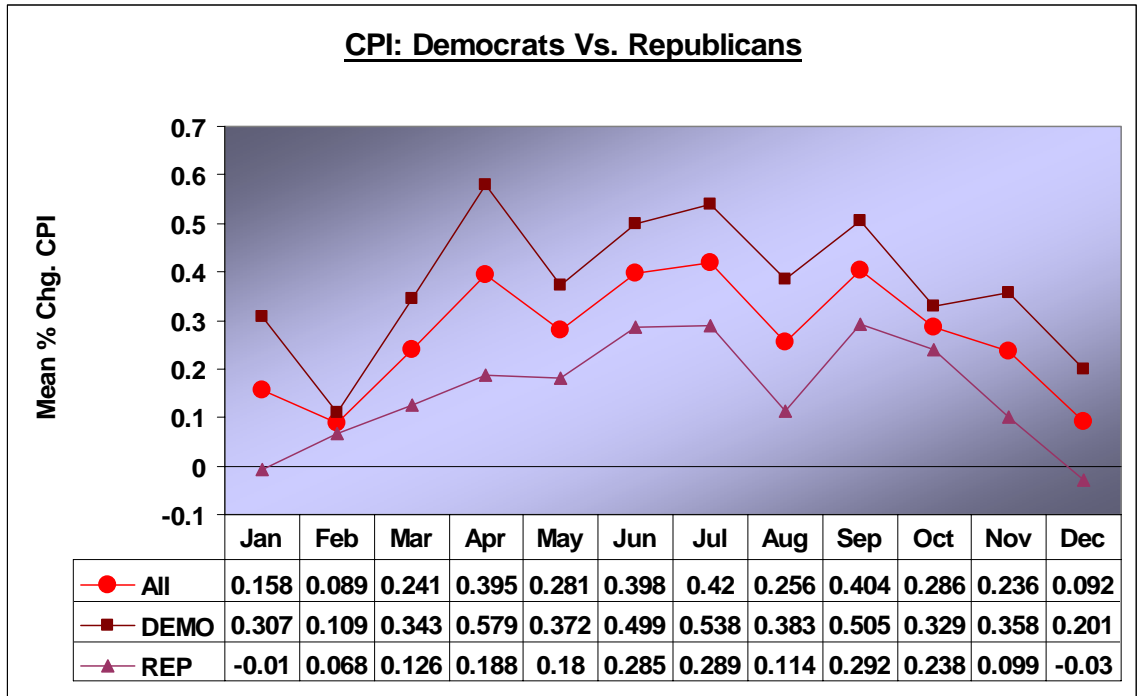
deviations were higher under Democrats (ranging from 0.53% to 1.16%) than under Republican presidents (ranging from 0.39% to 70%).

Comparison between Republican and Democratic Presidencies for the entire period 1913-2003

Figure 4 shows the mean monthly CPI changes as well as the mean monthly changes under Republican and Democratic presidencies. If we observe the pattern, there is a sharp rise in consumer prices from February to April. The peak is reached in April under Democratic presidencies and in September under Republican presidencies. We can see a falling trend after that for the rest of the year. Though the monthly rising and falling trends are similar, the mean monthly CPI changes have been higher under Democratic presidencies than under Republican presidencies in each of the months. The smallest difference occurs in February but is still higher under Democrats than Republicans (0.11% vs. 0.07%).

Two-sample t-test assuming unequal variances shows a significant difference (p value = 0.00) between the mean for the Republican periods of 0.15% and for Democratic periods of 0.38%. Kruskal-Wallis test for difference of medians of monthly CPI changes during Republican and Democratic periods (0.24% vs. 0.28%) is significant with H statistic = 10.09 and p-value of 0.00. However, nonparametric Mood's Median test, which is more robust against outliers, shows no significant difference (Chi-square statistic = 0.83 and p-value = 0.36). The variances of the monthly CPI changes for Republican versus Democratic periods (0.54% vs. 0.77%) are significantly different with a p value = 0.00.

Figure 4: Mean monthly CPI changes during Democratic and Republican presidencies and the entire period



Thus inflation, as measured by consumer price index, was rather under control with Republican presidents in the White House than Democratic presidents. As any economist knows, this state of affairs is caused by a number of factors, among which are presidential actions, as well as fiscal and monetary policies, and the actions of the Congress.

If war periods cause higher prices, Democrats have had more than their share of war presidents: Woodrow Wilson was the war president during First World War, Franklin Delano Roosevelt during Second World War, Harry Truman during Korean War, and Kennedy and Johnson presided over the major part of the Vietnam War. The Depression Years, which depressed prices greatly, were presided over by Republican President Herbert Hoover. These factors could well have accounted for the higher consumer prices during Democratic presidencies.

The mean monthly CPI changes during the various war years during Democratic presidencies are as follows:

World War I (July 1, 1914 to July 31, 1918):	0.8719%
World War II (January 1, 1939 to August 15, 1945):	0.3234%
World War II (December 7 to August 15, 1945) ¹ :	0.3609%
Korean War (June 27, 1950 to July 27, 1953):	0.3239%
Vietnam War (August 1964 to January 1973) ² :	0.3092%
Vietnam War (August 1964 to April 30, 1975) ³ :	0.4132%

Part of the Vietnam War period was Republican President Nixon's presidency (January 1969 to August 1974) and then it was Republican President Ford (August 1974 to January 1977). The Vietnam War cost \$118 billion, and started the inflationary cycle that engulfed the Carter presidency (February 1977 to January 1981). The mean of monthly changes during this period was 0.83%.

The foregoing numbers are higher than the mean monthly CPI changes for the entire period (0.27%) but some of those are lower than the mean monthly changes during Democratic presidencies (0.38%). The very high means during World War I and Carter presidency have contributed significantly to the higher mean for the Democratic presidencies.

In contrast, the monthly mean change during Republican President Herbert Hoover (March 1929 to March 1933) who presided over the worst part of the Great Depression years (September 1929 to December 1939) was -0.6191%. This greatly depressed the mean under the Republicans.

Comparison of Republican and Democratic Presidencies over the three sub-periods

We also compared the Republican and Democratic presidencies for the three types of month effects during the three sub-periods, which produced six tables. For the sake of brevity, we do not report the tables (available upon request), but Table 10 summarizes the findings from the six tables. As can be gleaned from the Table, inflation measured by CPI changes was lower in each of the three sub-periods under Republican presidencies compared to Democratic presidencies. On the whole, under Democratic presidencies, not only were consumer price changes higher, the incidence of the second and third types of month effects were also higher.

If we compare the medians of the three sub-periods under Republican presidencies and Democratic presidencies, we find that only in the 1913-1945 sub-period there is significant difference in the medians of the monthly changes (Kruskal-Wallis H statistic = 47.0, p value = 0.00). There is no significant difference in the median CPI changes in the two later sub-periods. So, the difference for the entire data sample is mainly attributable to the first sub-period.

Table 10: Comparison of monthly CPI changes during Republican and Democratic presidencies over three sub-periods

Sub-Periods	Republican			Democrats		
	$\mu = 0$	Month Effect	Month Effect	$\mu = 0$	Month Effect	Month Effect
	$\mu \neq 0$	(Mean)	(Var.)	$\mu \neq 0$	(Mean)	(Var.)
1913-1945	-0.25*			0.40*		Apr (Higher)
	(146.00)	Feb (Lower)	Mar & Aug (Lower)	(250.00)	None	Jun (Lower)
1946-1972	0.20*			0.31*		Apr, May & Jun (Lower)
	(143.00)	None	May (Lower)	(180.00)	Feb & May (Lower)	July (Higher)
1973-2004	0.38*			0.42*		
	(228.00)	Nov & Dec (Lower)	Jan (Lower)	(144.00)	None	None

* Significant at 0% level

CPI AND OIL PRICE: GRANGER CAUSALITY

The Granger causality test is used to determine if there is a “Granger” causal relationship between oil prices (represented by West-Texas Instrument Intermediate Crude price which is available on the internet from 1982) and CPI, and vice versa. The Augmented Dickey Fuller test for unit roots showed that the oil price series was stationary after first order differencing I(1), and the CPI data was stationary after second order differencing I(2). The Granger causality test was performed to check if there was a bidirectional causal relationship between oil prices and CPI. The tests were done for various lags, and a sinusoidal causal relationship was found. The test results are not reported for the sake of brevity. The tests reveal that for lags 2 through 6, CPI does Granger cause oil price changes (p value = 0.05) while oil price does not. For lag 8, CPI does not Granger cause oil price (p value = 0.09), and oil price does not Granger cause CPI. With lag 10, CPI does Granger cause oil price (p value = 0.04) and oil price does not. For lags 12 through 24, there is a bidirectional effect between the two (p value < 0.02). CPI Granger-causing oil price with shorter lags is surprising. Oil price Granger-causing CPI is not surprising. What is revealing is that it occurs only after 12 lags.

SUMMARY AND CONCLUSION

This paper sought to explore seasonality in the CPI over the period January 1913 to December 2003 using CPI monthly series which gave us 1,092 monthly CPI changes. We looked at the seasonality of the CPI via the month effect. We looked at three types of month effects: if the means of monthly CPI changes of the entire data set and of a given month were significantly different from zero; if the mean of monthly CPI changes for

each month was different from the means of the other months; if the variance of the CPI changes for each month was different from the variance of the other months.

The mean of monthly percentage CPI changes for the entire data set (0.27%) is significantly greater than zero ($p = 0.00$). We find that there is some periodicity to the consumer price index with a high point reached in July for the entire data set and a falling trend after that. (The high point is September during Republican presidencies and April during Democratic presidencies.)

We sliced the data into three sub-periods. An interesting finding is the increase in the means and medians of monthly changes for each of the three successive sub-periods and the corresponding decrease in the standard deviations of the monthly changes for the successive sub-periods. The mean of monthly CPI changes in the 517 months of Republican presidencies (0.15%) was significantly lower than mean of the 575 months of Democratic presidencies (0.38%) and so were the medians. Nonparametric Kruskal-Wallis test supports the findings from standard t-tests.

Further nonparametric analysis reveals that the lower CPI changes under Republican presidencies are attributable to the negative monthly changes in the sub-period (1913-1945). In part of this period (1929-1933), Republican President Herbert Hoover occupied the White House. Deflation that occurred during this period must have caused the monthly CPI changes under Republican presidents to be significantly lower than Democratic presidents for the entire data sample. Based on nonparametric tests, there is no significant difference in the medians of the other two sub-periods (1946-1972 and 1973-2003) based on the party in the White House. Granger causality tests reveal that

while CPI Granger-caused oil prices at lower lags, we find a bidirectional effect only at higher lags (12 to 24).

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¹ This period takes into account the formal declaration of war against Japan after the bombing of Pearl Harbor by the Japanese on December 7, 1941.

² The start of the Vietnam War is assumed as August 1964 when President Johnson got Congressional authorization for use of force for going into combat operations. Prior to that, the U.S. had mainly training and support role with the South Vietnamese Armed Forces. The war formally ended on April 30, 1975, but in this scenario, the end of U.S. active involvement is taken as the Paris accord of January 1973.

³ This scenario takes into account the final fall of the South Vietnamese regime.