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NO, VIRGINIA, THERE ISN'T A SANTA CLAUS (FOR MOST COUNTRIES' GROWTH CYCLES)

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Abstract

We consider the seasonal distribution of turning points in the post-war growth cycles of sixteen economies. Using nonparametric tests for distributions on the circle, we cannot reject the hypothesis of a uniform distribution for the turning points for most of the countries. In the case of troughs in the cycle, uniformity is supported for eleven countries, notwithstanding the unusually large number of December or January troughs. This provides evidence against a possible 'Santa Claus effect' in the growth cycle.

Keywords: Business cycle; growth cycle; seasonality; Kuiper test; Watson test

JEL Classifications: C12; C14; C16; E32

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1. Introduction

Turning points in the business cycle are of fundamental interest to policy-makers. Understandably, quantitative techniques for identifying and dating the peaks and troughs of the cycle have a long history, with those developed by Mitchell, Burns and Moore at the National Bureau of Economic Research (NBER) and at the Center for International Business Cycle Research at Columbia University standing out as being of crucial historical interest.[1] The importance of the past business cycle research at the NBER prevails today, with 32 peaks and 33 troughs in the U.S. business cycle having been identified from 1854 to date.

The methods used to determine and date these "reference cycles" (and the associated "leading indicators" and "lagging indicators") are extensively documented, and they will not be discussed or critiqued here. What is of interest, however, is the empirical fact that the peaks and troughs of the NBER's measure of the U.S. business cycle are *not* spread out evenly across the months of the year. For example, based on the latest data (NBER, 2004), six of the 33 troughs occurred in the month of December, and five of the 32 peaks occurred in the month of January. The data in question have other well-known features, of course, such as the asymmetry in the contractions and expansion time-horizons. These are not our concern.

The apparent seasonal clustering of the troughs in the cycle has attracted the attention of other writers. Notably, Ghysels (1994) appears to have been the first to subject these data to formal testing. Applying a Markov-switching model to the NBER data, he found evidence of unequal probabilities of switching from a recession to an expansion across the months of the year. In particular, he found that there is a tendency for the cycle to "bottom out" in December and in the Spring months.[2] Ghysels' results have been questioned by Blough and Zaman (1995). Using an empirical Bayes approach, they were unable to reject the hypothesis that troughs in the NBER reference cycle are uniformly distributed across the months of the year. They attribute their finding to their use of finite-sample, rather than asymptotic, testing procedures.

In this paper we re-consider the NBER data, and we also analyze similar data for several other countries. There have been numerous attempts to construct reference cycles for various economies, using essentially the same methodology as is employed by the NBER. Rather than work with different time-series from disparate sources, with the risk that variations in the details of the data construction may mask important results, we have chosen to use data from a single, readily accessible, source – the Economic Cycle Research Institute (ECRI). The ECRI was founded by Geoffrey Moore and closely follows the NBER methodology of which he was one of the pioneers. One consequence of this choice is that our analysis of the ECRI (2004) data is limited to the post-World War II period. In addition, in order to maintain reasonable sample sizes, we focus primarily on the (reference) “growth cycle” rather than the pure “business cycle”, and we consider only sixteen of the twenty countries analyzed by the ECRI.[3, 4]

Our objective is to test the hypothesis that growth cycle turning points are uniformly distributed across the months of the year. If this is so, then there is no ‘Santa Claus effect’. To this end we use standard nonparametric tests based on the empirical distribution function, and designed specifically for testing on the circle. In section 2 we outline the motivation for using this approach, and some of the technical details. Section 3 presents our results, and some concluding comments appear in the final section.

2. Testing Issues

For each of the cycles under study we have the empirical distribution of the months in which peaks (or troughs) occurred historically. Superficially, one might consider using a Chi-Square goodness-of-fit test of the hypothesis that the underlying population distribution of dates is uniformly distributed on [1 , 12]. However, this would be inappropriate. First, even our largest sample (troughs in the U.S. business cycle) contains only 33 observations. So, the requirement that the expected frequency for each month should be greater than five cannot be satisfied.

Other nonparametric tests, such as “supremum tests” of the Kolmogorov-Smirnov type, or “integrated deviations” tests of the Cramér-von Mises type might be used.[5] These tests involve a comparison of the empirical distribution function of the data with the hypothesized distribution, relying on the Glivenko-Cantelli Theorem for their justification.[6] However, our data have a special characteristic that must be taken into account – they have a circular distribution. To see this, consider values that are distributed on a straight line, with a scale from one to twelve. Values such as one and twelve are relatively far apart, whereas values such as three and five are relatively close in value. In our case, though, a value of unity corresponds to January, and twelve corresponds to December. Clearly, these months are not ‘far apart’, but as close together as is possible.

This phenomenon is common in many areas of application, and there is a rich literature on testing for the underlying distribution in such cases. One well-known example is Kuiper’s (1959) V_N test, which is a modified Kolmogorov-Smirnov test. Another classic example is Watson's (1961) U_N^2 test, which is a modified Cramér-von Mises test. The crucial point is that these modified tests are invariant to the location of the origin for the scale on the circle, whereas conventional such tests are not.[7] Suppose that the empirical distribution function for a sample of size N is $F_N(x)$, and that the null population distribution function is $F_0(x)$. Then Kuiper's basic test statistic is given by:

$$V_N = D_N^+ + D_N^- \quad ,$$

where the two components are the one-sided Kolmogorov-Smirnov statistics:

$$D_N^+ = \sup_{-\infty<x<\infty}. [F_N(x) - F_0(x)]$$
$$D_N^- = \sup_{-\infty<x<\infty}. [F_0(x) - F_N(x)] \quad .$$

Watson's basic test statistic is:

$$U_N^2 = N\int_{-\infty}^{\infty} [(F_N(x) - F_0(x)) - (\overline{F_N(x) - F_0(x)})]^2 \, dF_0(x) \quad ,$$

where

$$\overline{F_N(x) - F_0(x)} = \int_{-\infty}^{\infty} [F_N(x) - F_0(x)] \, dF_0(x) \quad .$$

For computational purposes, this can be written more conveniently as[8]

$$U_N^2 = \sum_{j=1}^{N} (t_j - \frac{j-0.5}{N})^2 - N(\bar{t} - 0.5)^2 + (1/12N) \quad ,$$

where

$$\bar{t} = N^{-1} \sum_{j=1}^{N} t_j \quad ,$$

and the t_j's are the ordered distances from an arbitrary starting point on the circle to the observed sample points, travelling in a fixed direction (say, clockwise). Exact distributional results for these two tests are provided by Stephens (1965) and Durbin (1973, pp.34-35), and by Stephens (1963, 1964), respectively.[9]

3. Results

Our concern is with the hypothesis that the troughs (or peaks) of the cycle are uniformly distributed across the calendar months. The alternative hypothesis is quite open. However, given

Ghysels' (1994) results relating to a preponderance of December troughs, we will pay special attention to the December-January period and the possibility of a 'Santa Claus effect'.

As noted already, the NBER business cycle data include 32 peaks and 33 troughs since 1845. Six of the troughs occurred in the month of December (j = 12), and one in January (j = 1). Five of the peaks occurred in January, and one in December. Data that are uniform on the interval [1 , 12] have a mean of 6.5 and a variance of 10.083. The sample means for the peak and trough dates are 6.063 and 7.152 respectively, and testing the hypothesis that the true mean is 6.5 yields p-values of 0.481 and 0.303. The sample variances for the peak and trough dates are 12.060 and 12.758 respectively, and the p-values when we test the hypothesis that the true variance is 10.083 are 0.209 and 0.144. Of course, these results are dependent on the convention of numbering January as the first month of the year, and December as the twelfth. More appropriately, if we apply the Kuiper and Watson tests we obtain V_N = 1.282 (p = 0.419) and U_N^2 = 0.056 (p = 0.623) for the peaks, and V_N = 1.630 (p = 0.100) and U_N^2 = 0.141 (p = 0.124) for the troughs. These results suggest that the hypothesis that troughs are uniformly distributed across the months cannot be rejected. However, the outcome is marginal (at the 10% significance level) for the peaks when Watson's test is used. Certainly, these results run contrary to Ghysels' (1994) conclusions.

Turning to the ECRI international growth cycle data, Table 1 presents the summary statistics for each country, together with the results of testing that the mean turning point date is 6.5, and the variance is 10.083. Overall, the results in this table provide evidence of non-uniformity in the both the peaks and the troughs in the cases of Austria, Germany, Korea, Taiwan and the U.S.A.. There is also evidence of non-uniformity (only) in the peaks in the case of Italy, and (only) in the troughs in the case of New Zealand. With respect to peaks, there is equal evidence that any departure from uniformity comes from the value of the mean, as opposed to the variance. However, the evidence for the troughs suggests that any departure from uniformity comes from the value of the variance, rather than from the mean. This last result reinforces the value of using tests that recognize the circularity of the data, as they are well-known to be powerful against shifts in the variance.[10]

Table 2 provides the corresponding results for Kuiper's test and Watson's test. There is evidence of a departure from uniformity in both the peaks and the troughs in the cases of Austria, Germany and New Zealand. Further, there is significant departure from uniformity in the distribution of (only) the peaks for Italy, Japan and the U.S.A., and in the distribution of (only) the troughs for

Australia and Taiwan. Despite the fact that Table 1 assumes a particular numbering scheme for the months (or, a particular assumed origin for the data), there is a close accordance between the results provided in the two tables. Of course, those in Table 2 have more secure statistical underpinnings, and on the basis of these results the uniform distribution of turning point dates (for either peaks or troughs) can be rejected for half of the countries considered.

As far as a possible ‘Santa Claus effect’ is concerned, the results in Table 2 that relate to troughs *favour* a uniform distribution for 11 of the 16 countries studied. This is not good news for the man in red, or his helpers! As the alternative hypothesis is simply “not uniform”, one cannot infer anything from this result regarding a ‘Santa Claus effect’ for the remaining five countries. However, it can be observed in Table 1 that the percentage of troughs occurring in December or January ranged from 30% to 50% for these five countries (with an average of 40%). It is clear from this, and from an inspection of the empirical frequency distributions, that in these cases the non-uniformity is associated closely with December/January clustering of the troughs.

4. Conclusions

The turning points of the U.S. business cycle and growth cycle, and those in the growth cycles of many other countries, exhibit a tendency to cluster in certain months of the year. In particular, the troughs tend to cluster in December and January. Does this clustering reflect a statistically significant ‘Santa Claus effect’ in the cycle? Do the Christmas and the New Year herald the arrival of economic good cheer? In this paper we have examined this phenomenon, making use of nonparametric methods based on the empirical distribution function for testing ‘circular’ data.

In contrast to the conclusions drawn by Ghysels (1994), our results suggest that there is no such ‘Santa Claus effect’ in the case of the NBER’s dating of the business cycle since 1854. As far as the growth cycles for sixteen countries are concerned, we again find limited support for this effect. However, we do find some evidence that both the peaks and the troughs in the growth cycles for such countries as Austria, Germany and New Zealand are not uniformly distributed across the months of the year.

Church (1897) was an editorial writer for a newspaper whose present-day namesake has the by-line: ‘Illuminate your world with a different point of view’. Hopefully, the results presented here will shed new light on the issue of seasonal effects in the business cycle and the growth cycle.

Table 1: Descriptive Statistics for Growth Cycle Turning Points

Country		**Peaks**			**Troughs**	
	N	**Mean**	**Variance**	**N**	**Mean**	**Variance**
	(D, J)#	**(p-value)+**	**(p-value)++**	**(D, J)**	**(p-value)+**	**(p-value)++**
Australia	14	6.571	13.341	15	5.400	14.543
	(1,1)	(0.943)	(0.190)	(0,5)	(0.283)	(0.124)
Austria	10	7.600	20.489	10	4.100	13.211
	(3,1)	(0.462)	(0.032)*	(1,2)	(0.066)**	(0.225)
Canada	19	5.158	14.251	18	6.278	24.556
	(0,5)	(0.139)	(0.113)	(1,2)	(0.808)	(0.105)
France	11	6.455	14.473	10	5.600	9.600
	(0,1)	(0.969)	(0.158)	(0,0)	(0.382)	(0.478)
Germany	10	3.700	11.344	11	4.455	17.673
	(1,4)	(0.028)*	(0.340)	(1,4)	(0.138)	(0.064)**
India	15	5.733	12.924	14	6.714	14.527
	(1,1)	(0.423)	(0.209)	(1,0)	(0.837)	(0.132)
Italy	9	6.222	20.444	8	6.625	11.696
	(1,1)	(0.858)	(0.039)*	(0,0)	(0.921)	(0.322)
Japan	14	5.429	15.187	15	6.933	13.067
	(2,1)	(0.322)	(0.106)	(3,1)	(0.650)	(0.200)
Korea	11	6.000	18.800	11	6.636	17.655
	(1,4)	(0.694)	(0.082)**	(3,1)	(0.916)	(0.064)**
New Zealand	10	6.600	16.267	10	4.200	15.067
	(0,3)	(0.939)	(0.105)	(0,5)	(0.094)**	(0.143)
South Africa	10	5.800	11.733	9	8.222	10.194
	(0,1)	(0.534)	(0.314)	(0,0)	(0.144)	(0.425)
Spain	9	5.778	12.694	8	4.500	13.143
	(1,1)	(0.560)	(0.260)	(0,1)	(0.163)	(0.244)
Sweden	9	5.889	10.611	9	6.667	7.000
	(0,0)	(0.589)	(0.394)	(0,0)	(0.855)	(0.303)
Taiwan	12	8.250	6.386	12	5.917	17.356
	(1,0)	(0.035)*	(0.198)	(1,4)	(0.637)	(0.062)**
U.K.	13	5.154	10.641	12	5.500	9.545
	(0,3)	(0.163)	(0.394)	(1,0)	(0.286)	(0.494)
U.S.A.	16	4.625	12.917	16	6.250	15.800
	(1,5)	(0.054)**	(0.204)	(2,3)	(0.805)	(0.074)**

#	D = number of December turning points; J = number of January turning points.
+	Null hypothesis is that the population mean = 6.5.
++	Null hypothesis is that the population variance = 10.083.
*	Significant at the 5% level, or less.
**	Significant at the 10% level, or less.

Table 2: Nonparametric Tests of Uniformly Distributed Growth Cycle Turning Points

Country	Peaks			Troughs		
	N	Kuiper (V_N) (p-value)	Watson (U_N^2) (p-value)	N	Kuiper (V_N) (p-value)	Watson (U_N^2) (p-value)
Australia	14	0.123 (0.484)	0.078 (0.409)	15	1.710 (0.062)**	0.108 (0.235)
Austria	10	1.789 (0.039)*	0.219 (0.027)*	10	2.098 (0.005)*	0.253 (0.013)*
Canada	19	1.574 (0.126)	0.134 (0.141)	18	1.417 (0.253)	0.085 (0.361)
France	11	1.289 (0.408)	0.059 (0.571)	10	1.141 (0.623)	0.071 (0.460)
Germany	10	2.159 (0.003)*	0.260 (0.011)*	11	1.933 (0.016)*	0.272 (0.009)*
India	15	1.512 (0.168)	0.115 (0.206)	14	1.389 (0.284)	0.089 (0.332)
Italy	9	1.928 (0.016*	0.188 (0.049)*	8	1.395 (0.277)	0.078 (0.401)
Japan	14	1.826 (0.031)*	0.164 (0.079)**	15	1.314 (0.374)	0.068 (0.491)
Korea	11	1.289 (0.408)	0.088 (0.339)	11	1.611 (0.105)	0.146 (0.113)
New Zealand	10	1.851 (0.027)*	0.233 (0.020)*	10	1.727 (0.056)**	0.176 (0.063)**
South Africa	10	0.925 (0.902)	0.026 (0.910)	9	1.438 (0.233)	0.110 (0.224)
Spain	9	0.980 (0.845)	0.026 (0.908)	8	1.464 (0.208)	0.133 (0.146)
Sweden	9	1.176 (0.570)	0.074 (0.433)	9	1.340 (0.341)	0.078 (0.403)
Taiwan	12	1.369 (0.306)	0.086 (0.353)	12	1.732 (0.054)**	0.148 (0.109)
U.K.	13	1.178 (0.569)	0.065 (0.513)	12	1.453 (0.218)	0.109 (0.227)
U.S.A.	16	1.629 (0.095)**	0.152 (0.100)**	16	1.317 (0.37)	0.086 (0.36)

* Significant at the 5% level, or less.

** Significant at the 10% level, or less.

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Footnotes

1. For example, see Moore (1936), Burns and Mitchell (1946), and Mitchell (1961a, 1961b). A definitive and extensive discussion of the early history of the NBER and the roles of Mitchell, Moore, and especially Burns, is provided by Rutherford (2003).
2. Ghysels also found that the length of downswings and upswings in the business cycle depend on the month of the preceding turning point.
3. To quote the Economic Cycle Research Institute's web-site: "Business cycles are pronounced, pervasive and persistent advances and declines in aggregate economic activity, which cannot be defined not by any single variable, but by the consensus of key measures of output, income, employment and sales", whereas "Growth rate cycle downturns are pronounced, pervasive and persistent declines in the growth rate of aggregate economic activity."
4. We have considered only those countries for which a minimum of nine peaks (or troughs) has been dated. Accordingly we have not analyzed the ECRI's growth cycle data for China, Mexico, Jordan or Switzerland. The starting dates vary by country, as follows: Australia (1952), Austria (1966), Canada (1950), France (1956), Germany (1963), India (1960), Italy (1963), Japan (1958), Korea (1968), New Zealand (1968), South Africa(1968), Spain (1973), Sweden (1974), Taiwan (1965), U.K. (1957), U.S.A.(1949).
5. For a detailed technical discussion of such tests, see Durbin (1973), for example.
6. The Glivenko-Cantelli Theorem assures us that, under quite mild conditions, the empirical distribution function converges uniformly (with probability one), to the population distribution function.
7. If the data are circular, as is the case with calendar months, the distribution of the test statistic should not depend on whether we count the months from January to December (say), or from July to June (say).
8. For complete details, see Durbin (1973, pp.33-39).
9. Finite-sample adjustments are often made to the test statistics, as is the case in the EViews (2003) package that we have used to apply these tests. Exact finite-sample *p*-values are also provided by EViews.
10. In fact, this is true even when applied to data on the line, rather than on the circle if the underlying distribution is symmetric. See Durbin (1973, p.36).