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The Orgins of the Seasonal Cycle in 19th Century US Money Markets and the Evolution of Futures Contracts

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1. Introduction

Early scholars of aggregate fluctuations, including Jevons (1884) and Kemmerer (1910), introduced the notion that seasonal cycles were relevant to the study of other, seemingly more important, fluctuations in macroeconomic time series. Kuznets (1933) continued this approach, recognizing the tendency for seasonal variations to exacerbate the variability of employment and capital accumulation. But, as economic contractions intensified in the 1930's, economists began to discount the relative importance of the seasonal cycle. Work by Mitchell (1927), Pigou (1929) and later, Burns and Mitchell (1947), promulgated the view that fluctuations in commercial activity were relevant to the study of business cycles, while seasonal fluctuations were not.

Currently, economists are calling for the reinterpretation of seasonal fluctuations as a means to understanding business cycles.[2] As Miron (1996) explains, seasonal fluctuations account for a large portion of the overall movement in macroeconomic time series, and may be related to the behavior of non-seasonal (business) cycles. Moreover, to the extent that seasonal cycles are not Pareto Optimal, understanding how monetary and fiscal policy decisions can eliminate them may prove useful.

While promising, the efficacy of such an approach is limited ultimately by economists' understanding of the seasonal cycle. Hence, in order to add to our knowledge of business cycles, the complexities of US seasonal cycles must be unraveled. One such example, for which numerous studies have been written, is the cessation of seasonal pressures on US money markets in 1914.[3] While the disappearance of seasonal variations in US interest rates is compelling simply because it challenges our intuition that seasonal cycles are endemic fixtures of US money markets, the implications of this episode are all the more pressing in light of the recent literature linking seasonal and business cycles.

In this paper we examine the origins of the seasonal cycle in US interest rates, beginning in the antebellum period, in order to gain a better understanding of when and why seasonal pressures emerged (and perhaps, disappeared) in early US financial markets. Seasonal tests indicate that variations in short-

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[2] See Beaulieu and Miron (1997), Beaulieu, et. al. (1992), Miron and Beaulieu (1996), and Wells (1997).
[3] See Angelini (1992), Barsky, et. al. (1988), Clark (1986), Fishe (1991), Fishe and Wohar (1990), Friedman and

term interest rates are relatively unexplained by the seasonal cycle prior to the mid-1870s, and hence, are similar to their post-1914 counterparts.

We propose that the absence of a seasonal cycle prior to the 1870's was most likely due to money market volatility. Prior to 1874, movements in interest rates were erratic and financial instabilities imparted relatively large shocks to money markets, particularly in the autumn months. After 1874, the effects of financial instabilities on interest rates diminished and the regularization of seasonal movements was attained. We attribute this change in behavior of short-term rates in the nineteenth century to the following institutional innovation: the introduction of futures markets and the resulting substitution away from consignment contracts in the agricultural trade shortly after 1874.

The US experience with interest rate seasonals questions the view that seasonal cycles are a well-defined and predictable phenomenon in macroeconomic time series. Like business cycles, seasonal cycles can exhibit irregularities, as exemplified by their absence prior to 1874, as well as after 1914, and hence should not be dismissed as uninteresting fluctuations. Moreover, that a financial innovation contributed to the regularization of seasonal cycles in 1874 is particularly compelling, given the recent connection drawn between seasonal and business cycles, insofar as it suggests that business cycles may also be regularized by economic innovations.

2. Seasonality in US Short-term Interest Rates

Since the inception of US money markets in the late eighteenth century, annual seasonal fluctuations have occurred in the demand and supply for credit, causing interest rates to drop in the late spring and summer and rise in the fall and early winter of most years.[4] According to Kemmerer (1910), in a monograph prepared for the National Monetary Commission, this periodic tightening of credit was fueled by interregional cash transfers that financed the planting, harvesting and moving of the nation's crops.[5] Friedman and Schwartz (1963) explain that these cash transfers lead to fluctuations in the public's currency to deposit ratio, causing bank reserves and credit conditions to expand and contract throughout

Schwartz, (1963), Holland and Toma (1991), Kool (1995), Mankiw and Miron (1986), Mankiw, Miron, and Weil (1987), Miron (1986), Miron (1988), and Toma (1993).

the year.[6] This explanation is supported by Mankiw, et. al. (1987), who show that seasonal variations in US short-term interest rates were common throughout the latter nineteenth and early twentieth centuries.[7]

However, seasonal pressures in US money markets disappeared abruptly in 1914.[8] Table 1 illustrates this change in behavior for the New York commercial paper rate between 1875 and 1936. While the mean level of the series remains relatively unchanged over the period, the adjusted R^2's from regressions of the paper rate on monthly (seasonal) dummies shows that the seasonal cycle explains 19% of the variation in the (differenced) paper rate before 1914, compared to 2% afterwards.[9] Indeed, Miron (1986) identifies a similar cessation of seasonal fluctuations using the New York 3-month time money rate.[10]

Table 1: Summary statistics, monthly data in first differences.

Sample Period	Sample Mean	Standard Deviation	Adj. R-Squared
New York (a), 1875:01 – 1910:12	4.88	1.12	0.19
New York (b), 1920:01 – 1936:12	3.71	1.97	0.02

Adjusted R^2 is based on the following regression specification:
$\Delta x_t = c + \delta 2(d2) + \delta 3(d3) + ... + \delta 12(d12) + \varepsilon_t$

Most of the literature surrounding this conundrum is centered on the establishment of the Federal Reserve System.[11] In particular, Friedman and Schwartz (1963) remark that the Fed eliminated seasonal movements in US interest rates through its manipulation of high powered money; Holland and Toma (1991) contend that the Fed provided emergency credit to banks during (seasonal) panics, thus quelling (seasonal) spikes in interest rates; Barsky, et. al. (1988) offer an international perspective by proposing that the establishment of the Fed allowed the US (and other countries) to smooth interest rates without

[4] See Friedman and Schwartz (1963), Mankiw, Miron and Weil (1987), and Miron (1986).
[5] Kemmerer, E.W., Seasonal Variations in the Relative Demand For Money and Capital in the United States, p. 292.
[6] Friedman, M. and A. J. Schwartz, A Monetary History of the United States, 1867-1960, p. 292.
[7] Mankiw, N. Gregory, Jeffrey A. Miron and David N. Weil, "The Adjustment of Expectations to a Change in Regime: A Study of the Founding of the Federal Reserve," p. 358.
[8] Ibid., p. 358.
[9] The adjusted R^2 is used in Miron (1996) to illustrate the existence of a seasonal cycle in various economic time series.
[10] See Miron (1986).
[11] See Barsky, et. al. (1988), Friedman and Schwartz (1963), Holland and Toma (1991), Mankiw and Miron (1986), Mankiw, Miron, and Weil (1987), Miron (1986), Miron (1988), and Toma (1993).

destabilizing their respective gold flows.[12] By far, the most popular explanation is that of Miron (1988), who argues that the Fed began to smooth short-term interest rates shortly after 1913, thus quelling the seasonal cycle present in US money markets.

Alternative hypotheses have also surfaced in the literature. Of these, Clark (1986) conjectures that seasonal strains diminished (worldwide) because of the rise in gold imports from 1915 to 1916; Fishe (1991) associates the disappearance of seasonal pressures to heavy US gold inflows (resulting from increased exports to allied belligerents) during the inter-war period; and Kool (1995) concludes that the change in interest rate behavior occurred in 1917, not 1913, because of interest rate targeting by the US and Britain for the purpose of war finance.[13]

In this paper, we examine the origins of the seasonal cycle in US interest rates, beginning in the antebellum period, to explore the notion that a well-defined seasonal cycle is endemic to US money markets. Indeed, if seasonal pressures are absent from money markets at other times prior to 1914, economic historians may be able to draw from the past in order to better understand the nature of seasonal cycles in later periods.

3. The Seasonal Cycle in Antebellum Money Markets

This section examines the behavior of antebellum interest rates in Boston, New York, Philadelphia and New Orleans for the period 1836 to 1860.[14] All four series, shown in figure 1, represent short-term discount rates on commercial paper and bills of exchange. Table 2 presents summary statistics and adjusted R^2s from regressions of each series (differenced) on monthly seasonal dummies. The New York commercial paper rate (used in table 1) is included for the purpose of comparison.

Table 2 illustrates that antebellum money markets are the highest and most volatile compared to either of the post-1875 series. In particular, Boston, the northernmost money market, and New Orleans,

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[12] Friedman, M. and A. J. Schwartz, A Monetary History of the United States, 1867-1960, p. 293, Holland, A. Steven and Mark Toma, "The Role of the Federal Reserve as 'Lender of Last Resort' and the Seasonal Fluctuation of Interest Rates." p. 659, Barsky, Robert B., N. Gregory Mankiw, Jeffrey A. Miron, and David N. Weil, "The Worldwide Change in the Behavior of Interest Rates and Prices in 1914," p. 1124.

[13] Clark, Truman A., "Interest Rate Seasonals and the Federal Reserve," p.78, Fishe, Raymond P. H., "The Federal Reserve Amendments of 1917: The Beginning of a Seasonal Note Issue Policy," p. 311, Kool, Clemens, J. M. "War Finance and Interest Rate Targeting: Regime Changes in 1914-1918," p. 365.

[14] The data are from, Bodenhorn, Howard, "Capital Mobility and Financial Integration in Antebellum America," pp. 603-608. See data appendix for details.

the southernmost marketplace and cotton trade 'hub,' report the highest average rates of any series, with mean values of 9.3% and 9.1%, respectively; the standard deviations for both series exceed 400 basis points.

Once again, the adjusted R^2 reported in table 2 indicates the extent to which a seasonal cycle is present in each series. The greater the adjusted R^2, the larger the share of interest rate variation that can be explained by seasonal fluctuations. It is apparent from this measure that seasonal variations are responsible for relatively little of the movement in antebellum interest rates. The seasonal cycle explains between 1% and 7% of the total variation in (differenced) antebellum rates, and this explanatory power falls to between 1% and 4% when the northeast markets are considered in isolation. By comparison, seasonal pressures account for 19% and 2% of the variation in rates between 1875-1910 and 1920-1933, respectively. Hence, antebellum interest rates are similar to their post-Fed counterparts in that they exhibit little, if any, seasonal variation.[15]

Table 2: Summary statistics, antebellum and postbellum series, monthly data in first differences.

Sample Period	Mean	Standard Deviation	Adjusted R^2
New York (a), 1875:01 – 1910:12	4.88	1.12	0.19
New York (b), 1920:01 – 1936:12	3.71	1.97	0.02
Boston, 1836:02 – 1859:12	9.28	4.72	0.04
New York, 1843:08 – 1859:12	6.82	2.69	0.01
Philadelphia, 1839:03 – 1857:06	8.74	3.29	0.04
New Orleans, 1839:12 – 1859:12	9.12	4.04	0.07

Adjusted R^2 is based on the following regression specification:
$\Delta x_t = c + \delta 2(d2) + \delta 3(d3) + \ldots + \delta 12(d12) + \varepsilon_t$

A second test for the presence of a seasonal component consists of calculating the autocorrelation functions of the first difference of each data series. A seasonal component is present (and specified as an AR(1)) if the correlogram of first differences exhibits positive and significant autocorrelations at

[15] The non-seasonal nature of this series is well-documented in the literature. For example, see Friedman and Schwartz (1963) or Mankiw, Miron, and Weil (1987).

multiples of the seasonal span (12), and zero otherwise.[16] Table 3 presents only those autocorrelations at multiples of the seasonal span since all others are in fact zero. Again, only the New York commercial paper rate, between 1875-1910, exhibits a significant seasonal cycle, and hence, like the post-Fed period, a seasonal component is not identifiable in antebellum money markets.

Table 3: Test for seasonality: Sample Autocorrelations for the First Difference of the Short Rate, monthly data.

Series	Sample Autocorrelations at Annual Lags				
	r(12)	r(24)	r(36)	r(48)	r(60)
New York, 1920:02 – 1936:12	-.06	-.00	.03	-.07	.02
New York, 1875:02 – 1910:12	.20*	.19*	.18*	.20*	.15*
Boston, 1836:02 – 1859:12	.05	-.06	.05	.02	.02
New York, 1843:08 – 1859:12	.09	.04	.05	.09	.03
Philadelphia, 1839:03 – 1857:06	.11	.11	.10	-.03	.01
New Orleans, 1839:12 – 1859:12	.08	-.02	.09	.05	.01

'*' denotes statistical significance at the 5% level.

That the seasonal characteristics of the antebellum and post-Fed periods are similar supports the notion that a seasonal cycle was not always present in US interest rates prior to the founding of the Federal Reserve. However, compared to the post-1914 period, the antebellum economy was more agrarian and less industrialized, financial intermediaries were presumably less developed, and monetary authorities capable of smoothing away interest rate seasonality were absent. Hence, many of the explanations used to describe the absence of seasonal pressures in 1914 will not apply to the antebellum markets due to the institutional differences between the two periods.

4. A Regime Switch in the 19th Century

Tables 2 and 3 point out that a seasonal cycle in US interest rates is discernable at some time after, but not before, the Civil War, questioning the conventional notion that a well-defined seasonal cycle is present in short-term interest rates at all times prior to 1914. In this section, we explore the dynamic

[16] Vandaele, Walter, Applied Time Series and Box-Jenkins Models, p. 56. Applications of this method can be found in Clark (1986). The correlograms for each data set in levels were inspected for the presence of a seasonal moving average and mixed seasonal models as well; no such

nature of seasonality in short-term interest rates between the nineteenth and early twentieth centuries. In particular, we examine the change in behavior of interest rates around the Civil War and test for the most likely date at which this break occurred. To obtain a continuous data set, we restrict our analysis in this section to Macaulay's commercial paper rate (1836-1933).[17]

As the degree of seasonality in short-term interest rates changes, so too should the R^2 obtained from the regression specification employed in tables 1 and 2. In particular, if one were to estimate a series of fifteen-year rolling regressions, beginning with 1836.01 and incrementing by one month, the R^2 should rise or fall as the seasonal cycle becomes more or less pronounced, respectively. Figure 2 plots the R^2 statistics from a set of fifteen-year rolling regressions beginning with the sample 1836.01-1850.12.[18] In general, the intensity of the seasonal cycle varies over time, and it is distinctly absent before 1860 and after 1914. Moreover, the explanatory power of the seasonal cycle increases as data from the 1870s are included in the rolling regressions. For example, beginning with the sample 1857.11-1872.10, the R^2s rises from a neighborhood of 10% to that of 17%, meanwhile the highest R^2s are produced for data regressed over the period 1873 to 1893, suggesting a break in the series occurs in the early 1870s. In summary, a well-defined seasonal cycle in US money markets is not the rule throughout the pre-1914 period. On the contrary, the degree to which the seasonal cycle explains variations in short-term interest rates varies, with a relatively distinct change in behavior occurring in the early 1870s.

To estimate the time at which a break occurred in short-term rates, we use the maximum likelihood technique found in Goldfeld and Quandt (1973) and employed in Mankiw, et. al. (1987) to detect the break in 1914. In particular, the short-term interest rate is modeled as the following:

$$r_{t+1} = a_o + b_o r_t + \beta_{o\,s} X_s + n_{t+1}, \qquad t=1,2,\ldots,T_s\text{-}2,T_s\text{-}1$$

$$r_{t+1} = a_n + b_n r_t + \beta_{n\,s} X_s + n_{t+1}, \qquad t=T_s,T_{s+1},\ldots,T \qquad (4)$$

where o and n denote *old* and *new* regimes, respectively; T_s is the first period of the new regime. The error terms on the two regression equations, namely n_{t+1} old and new, are assumed to be distributed

processes could be identified.

[17] These data consist of antebellum Boston from 1836-1859 and the New York commercial Paper rate from 1860-1933.

$N(0,s_o^2)$ and $N(0,s_n^2)$ respectively, while $(a_o,b_o\,,\beta_{ns})$ and $(a_n,b_n\,,\beta_{os})$ are the regression coefficients calculated using OLS; specifically, a, b and β are the constant term, autoregressive term and seasonal dummy coefficients, respectively. Given these assumptions, the break date can be estimated by maximizing the likelihood function conditional on T_s.[19]

In this model a break in short-term interest rates implies a change in the parameter values (or entire specification) of (4). Technically, a shift is possible in both the autoregressive and seasonal parameters of the specification. But, given that the autoregressive term included in (4) is both mean reverting and significant throughout the full sample used here, we identify a break as a shift in only the seasonal parameters.

The results of the break test indicate that a shift occurred in the series near November, 1873. That is, the seasonal specification in (4) underwent a structural change at this time. Hence, it is in the neighborhood of this date that the US short rate began to exhibit a statistically significant seasonal component.

5. Explanations for the Absence of Seasonal Pressures in Antebellum Money Markets

There are three possible explanations for the absence of a seasonal cycle in US interest rates prior to 1873: (1) seasonal strains on US credit markets, fueled by agriculture and popularized by Kemmerer (1910), did not exist prior to the 1870's; (2) seasonal strains were present, but sterilized by some sort of monetary intervention (centrally planned or otherwise); (3) seasonal strains were present, but had no discernable effect on money markets due to (unexplained) noise.

The first explanation is not plausible. The existence of seasonal strains, imparted on US credit markets by the agricultural cycle, is well documented in the literature.[20] Hence, it is not reasonable to

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[18] Similar results are obtained for ten-, twenty- and thirty-year rolling regressions as well.

[19] The break date can be estimated by maximizing the following likelihood function conditional on T_s:

$$L(r/T_s^*)=\left(\frac{1}{2\Pi}\right)^{\frac{n}{2}}\sigma_o^{T_s}\sigma_n^{(T-T_s)}\exp\left\{-\frac{1}{2\sigma_o^2}\sum_{t=1}^{T_s}(r_t-x_t\beta_o)^2-\frac{1}{2\sigma_n^2}\sum_{t=T_s+1}^{T}(r_t-x_t\beta_n)^2\right\}$$

This is done by first calculating the maximum likelihood estimates for the parameters in the model and then choosing the T_s which has the greatest likelihood. While this methodology allows for heteroscedasticity across the two subsamples, it assumes that the innovation variance is constant within each subsample. That is, the model specifies *constant heteroscedasticity*. In addition, the error term is assumed pure white noise and hence autocorrelated errors are not considered. Based on an examination of residuals of the differenced data, these assumptions seem appropriate.

[20] See Chandler (1977), Friedman and Schwartz (1963), Jevons (1884), and Kemmerer (1910).

argue that seasonal pressures simply did not exist prior to the 1870's. The second explanation requires that monthly changes in the nation's money supply quelled seasonal pressures on money markets, making it impossible for observers to detect a seasonal cycle in antebellum rates. This explanation is unconvincing in two respects. First, the smoothing of interest rates over a period of three decades seems highly unlikely in the absence of a central monetary authority. Second, if a time series is smoothed, it is removed of all transitory fluctuations, and hence it should exhibit non-stationary behavior.[21] Judging from the autocorrelation functions (acf's) of each series, presented in table 4, all of the antebellum series are stationary, as are their postbellum counterparts prior to 1914.[22] Hence, antebellum rates do not appear to be 'smoothed.'[23] The only series that exhibits non-stationary behavior, and hence the only series for which the smoothing-hypothesis is plausible, is the New York (b), a post-Fed series.[24]

Table 4: Autocorrelation functions of US short-term rates, antebellum and postbellum periods, monthly data in levels.

Sample Period	First 12 Sample Autocorrelations									
	1	2	3	4	5	6	7	8	9	10
New York (a), 1875:01 – 1910:12	.86*	.65*	.46*	.32*	.23*	.19	.15	.11	.09	.08
New York (b), 1920:01 – 1936:12	.98*	.96*	.93*	.90*	.87*	.84*	.80*	.77*	.73*	.70*
Boston, 1836:01 – 1859:12	.86*	.66*	.52*	.44*	.39*	.33*	.28*	.21	.17	.14
New York, 1843:07 – 1859:12	.76*	.50	.36	.27	.20	.16	.14	.12	.08	.06
Philadelphia, 1839:02 – 1857:06	.81*	.62*	.45*	.32*	.22	.15	.10	.09	.07	.09
New Orleans, 1839:11 – 1859:12	.66*	.58*	.44*	.31*	.23	.25	.11	.10	.08	.01

'*' denotes statistical significance at the 5% level.

We propose that the third explanation is most appropriate. That is, the absence of a seasonal cycle prior to the 1870's is most likely due to money market volatility. Although the annual process of planting, harvesting and moving crops occurred at similar times throughout each year, market volatility

[21] Mankiw, N. Gregory, Jeffrey A. Miron and David N. Weil, "The Adjustment of Expectations to a Change in Regime: A Study of the Founding of the Federal Reserve," p. 358.

[22] Acf's represent the autoregressive relationship between a time series and its 1st, 2nd, ..., kth month lag. A series for which acf's begin near unity and decline quickly is identified as stationary (and AR(1)), while one for which acf's remain near unity as lag length is increased is identified as nonstationary.

[23] Vandaele, Walter, Applied Time Series and Box-Jenkins Models, p. 56.

[24] See Clark (1986), Friedman and Schwartz (1963), Mankiw, et. al. (1987), Miron (1988).

created large standard deviations from the seasonal path of interest rates, thus hampering the detection of a seasonal cycle. After the mid-1870's, market volatility is quelled sufficiently so that seasonal strains affect short-term interest rates in a consistent manner year after year. Indeed, the standard error of the estimate from (4) is 2.08 between 1836 and 1873, but only .57 between 1874 and 1910. Hence, the variance of innovations to interest rates decreases in the early part of the 1870's, allowing for the advent of a seasonal cycle in US money markets.

5. Market Volatility and the Absence of a Seasonal Cycle in Antebellum Money Markets

Despite the absence of a significant seasonal cycle in short-term interest rates for both the pre-1874 and post-1914 periods, there exists one crucial difference between the two series. To illustrate this difference, figure 3 (a-f) depicts the seasonal patterns of each series, along with their respective 95% confidence bands. As expected, only the postbellum rates, prior to 1910 (figure 3.e.), exhibit significant declines in February, May and June, and significant increases in September, October, November, and December. Nonetheless, antebellum rates display occasional, albeit insignificant, seasonal movements and hence their seasonal patterns are not like those of the post-Fed rates, which display no seasonal fluctuations of any kind (figure 3.f.). In particular, the patterns for antebellum New York and Boston (panels a and b, respectively) indicate that many of the same seasonal forces associated with the behavior of rates from 1875 to 1910 are also present in antebellum rates. Indeed, some of the monthly movements in antebellum Boston and New York can be explained by the planting and harvesting cycles endemic to US agriculture.[25] This is consistent with our earlier finding that, while antebellum rates are not seasonal, they do not appear smoothed.

Clearly, the seasonal patterns for antebellum rates, depicted in figures 3 a-d, result from relatively infrequent and large seasonal movements in the data; the patterns are not statistically significant because the monthly seasonal fluctuations do not occur with sufficient regularity. By comparison, the absence of a seasonal pattern after 1914 occurs because seasonal movements are extremely infrequent and small. To illustrate this difference between the two periods, we construct a measure termed the *autumn differential*, defined as the annual October-June interest rate differential. For example, the 1836 autumn differential is calculated as $\frac{\{October_{1836} - June_{1836}\}}{June_{1836}}$. Such a metric will hover *above* zero in years for which the underlying series is seasonal, while nonseasonal years will produce a plot that hovers *about* zero.

Figure 4 plots the autumn differential for Macaulay's commercial paper rate (1836-1936). A 'violation' of a seasonal cycle for a given year occurs when the autumn differential is either zero or negative. Frequent violations occur in both the antebellum and the post-1914 periods, whereby autumn rates fall below their summer counterparts in 32% and 45% of the years in these samples, respectively. By comparison, between 1874 and 1910, violations occur three times in 37 years (8%). However, despite the high number of violations in pre-1874 and post-1914 samples, a seasonal pattern is discernable in the latter but not in the former. Put differently, seasonal movements occur infrequently in both of these samples, but only in the pre-1874 case does a seasonal pattern emerge.

One explanation for this difference is that large and occasional seasonal movements, driven by financial instabilities in a few of the years between 1836 and 1874 (1839, 1857, and 1873), produce a seasonal pattern in interest rates. By comparison, although seasonal movements also occur in the years between 1914 and 1933, these movements are relatively small. Large spikes in interest rates during autumn panics, common prior to 1874, were nonexistent after 1914 (1931 excepted).

Hence, prior to 1874, movements in interest rates were erratic and financial instabilities imparted relatively large shocks to money markets, particularly in the autumn months. After 1874, the effects of financial instabilities on interest rates diminished and the regularization of seasonal movements was attained. We attribute this change in behavior of short-term rates in the nineteenth century to the following institutional innovation: the introduction of futures markets and the resulting substitution away from consignment contracts in the agricultural trade shortly after 1874.

6. The Financing and Marketing of Grain and Cotton Before the 1870's

[25] See Miron (1988), Barsky, et. al. (1988) and Friedman and Schwartz (1963).

6.a. Grain

Prior to the 1870's, the US grain trade was financed through a network of producers, local merchants, purchasing agents, commission houses, and produce dealers. Producers, including farmers, millers and local merchants, were situated in the western-most portion of the network while the produce dealers, who purchased grain in its consumption stage, were situated primarily in the East. Purchasing agents and commission houses, located in Buffalo, New York and Liverpool, bridged western production and eastern consumption with the financial resources necessary to facilitate trade.[26]

The eastward movement of grain began with farmers, who offered their production to purchasing agents, who in turn sold the grain to commission houses in the East. From there, the grain was sold to either a final purchaser or another commission house. Agents and commission houses ameliorated their exposure to price risk during crop movements by operating on a consignment basis, rather than purchasing the commodities outright. Moreover, each agent requested a commission or fee, hence adding costs at each stage of the financing process.[27] According to Rothstein (1966), this approach linked farmers, agents and commission houses such that the "entire procedure was attended by considerable risk and speculation, which was assumed by both the consignee and consignor."[28]

6.b. Cotton

While credit systems played a role in Southern agriculture since Colonial times, the network of intermediaries differed from that of the grain trade. In particular, factors were the principle lenders of funds for the purchase of agricultural inputs, and served as both purchasing agents and intermediaries for large Southern planters and Northern and European money lenders.[29] The method of credit extension from year to year was such that current credit was provided on the basis of future crop production. Liens were often placed on future harvests when current production proved insufficient to pay outstanding credit

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[26] Rothstein, M., "The International Market for Agricultural Commodities, 1850-1873," p. 65.
[27] Ibid., p.120.
[28] Ibid., p.120.
[29] Small farms in the hills of the Carolinas, Georgia and Tennessee were self-sufficient. They bought and sold little and thus had no need for a system of credit.

balances.[30]

However, after the Civil War, factors frequently lacked the funds to make advances to farmers and hence were forced to seek advances from commission houses in the North and in Europe.[31] A system similar to that in the West evolved such that large commission houses dealt with correspondents in Liverpool, and factors became the local agents (receivers) within the hinterland.[32]

7. Changes in the Financing and Marketing of Grain and Cotton in the 1870's

Storage and shipment technologies such as grain elevators and railroads became available in the 1850's. Because these implements required that staples be stored and transported in bulk, shipments could no longer be tagged according to farmer or region. Moreover, due to the high volume of transports, purchasers were unable to inspect and choose their bundles upon delivery. This presented a problem in the East because produce agents often gauged the quality (and hence price) of a staple on the basis of such information and inspections.[33] Hence, a nationally accepted system of grading and standardizing staples was required.

In the 1850's, grain exchanges emerged, and their roles included weighing, inspecting and classifying each commodity shipment.[34] The Chicago Board of Trade began this practice in the late 1850's. St. Louis and Buffalo exchanges adopted similar methods in 1854. Like the grain industry, cotton exchanges defined, standardized and inspected cotton. The first US cotton exchange formed in New York one year after the Liverpool Cotton Brokers Association in 1869, while a 'complete' network of grading and standardizing was not in place until 1874.[35] The East, and the New York Produce Exchange in particular, accepted the methods of grading used in the West and South as a national

[30] By 1855, the risks of factoring appeared so excessive that the Southern Commercial Convention recommended that the chambers of commerce and commission merchants to the southern and southwestern cities, "adopt such a system of laws and regulations as will put a stop to the dangerous practice heretofore existing of making advances to planters in anticipation of their crops -- a practice entirely at variance with everything like safety in business transactions and tending directly to establish the relations of master and slave between the merchant and planter by bringing the latter into the most abject and servile bondage." Cf. Hammond (1897), p. 110.
[31] Rothstein, M., "The International Market for Agricultural Commodities, 1850-1873," p.111.
[32] Ibid., p. 65.
[33] Ibid., p. 121.
[34] Chandler, A.D., The Visible Hand, p. 211.
[35] Ibid., p. 213.

standard at this time.[36] This complete network made business communication easier and less subject to expensive arbitration.[37]

In addition, a national system of grading standards allowed for the use of 'to arrive' or futures contracts. A futures contract stipulated the quality, amount, price and (a future) delivery date of a staple; the staple was purchased in cash upon delivery. High volume futures contracting required the standardization of staples because contracts were made before the deliverable was harvested. Hence, both parties to the contract had to agree on the quality of the deliverable before it was exchanged. It was not until the 1870's that the language used to define such 'quality' was generally accepted by all parties involved, including the conservative business community in the East.[38]

Futures trading also required a technological infrastructure capable of communicating prices across markets, nationally and internationally, in a timely fashion.[39] Telegraphic communication provided this service.[40] Perfected in 1837, the telegraph impacted the commodity exchanges some thirty to forty years later by allowing prices in the East to be communicated to the South and West so that grain and cotton could be purchased while the goods were still in transit.[41] In fact, the staples could be purchased before they were harvested. Slow and unreliable communication streams before 1874 motivated agents to engage in (riskier) consignment contracts. Agents and commission houses in the East refused to take ownership of the commodities at a fixed price because of the information lags coming from the West. In summary, some form of futures trading existed prior to the Civil War, however, innovations in staple standardization, transportation and communications developed such that futures trading became fully operational in 1874.[42]

8. The Effect of Futures Markets on US Money Market Volatility

[36] Chandler, A.D., The Visible Hand, p. 211.
[37] Rothstein, M., "The International Market for Agricultural Commodities, 1850-1873," p. 67.
[38] Chandler, A. D., The Visible Hand, p. 214.
[39] Nonetheless, futures trading took place before such technological infrastructures became available. Rothstein (1965) explains that regular mail service by "fast boats" enabled British grain importers in the 1840's to send ahead samples of a staple which was still in transit. Merchants on the floor of London's Baltic Exchange entered into buy and sell contracts on the "to arrive"' staple based on inspection of these samples.
[40] Rothstein, M., "The International Market for Agricultural Commodities, 1850-1873," p. 67.
[41] Chandler, A.D., The Visible Hand, p. 214.

The effect of futures markets in the post-1874 US agricultural trade centered on a risk-transferring scheme referred to as hedging. Chandler writes that traders used this technique "immediately" following the introduction of the modern (post 1874) futures contract.[43] In general, hedging transfers price risk, or the volatility of an asset's price, from hedgers to speculators. In terms of the 1870's, hedgers were able to immunize their portfolios from the volatility of staple prices. In general, futures contracts allowed grain traders to move crops with relatively less risk.[44] The reason for this was twofold.

First, futures contracts insulated traders from the annual fluctuations in staple prices, caused by such real factors as variations in planting and harvesting conditions. As a result, when traders borrowed from the money market to purchase these staples, the amount of cash that they required (demanded) was also relatively insulated from staple price volatility. Hence, while real shocks continued to hit agricultural markets after 1874, the demand and supply for loanable funds remained relatively unaffected. Therefore, money markets were less inclined to react to real shocks and hence the volatility in the annual cost of borrowing decreased. As a result, interest rate volatility diminished such that statistically significant seasonality, in addition to seasonal patterns, was discernible after 1874.

In effect, futures contracts, used in conjunction with hedging techniques, contributed to a decrease in interest rate volatility because they insulated traders from price risk, as uncertainties regarding the amount required to purchase a bundle of staples were mitigated. This led to borrowing patterns that were less erratic from year to year. For example, suppose a purchasing agent planned to borrow money to pay for a staple shipment coming in from the West. The quantity of money demanded by this agent equaled the product of the price of the staple times the quantity purchased. By engaging in a futures contract, the agent effectively insulated himself from any variations in the market price of the deliverable that might occur between the time the order was placed and the staple was shipped. Since the agent 'locked in' at a specific purchase price, the amount of money he needed to borrow was also insulated

[42] Rothstein, M., "The International Market for Agricultural Commodities, 1850-1873," p. 72.
[43] Chandler, A.D., The Visible Hand, p. 212.

from price fluctuations. Therefore, money markets, and interest rates in particular, were less volatile in the advent of futures contracts.

However, the futures contract did not eradicate seasonal patterns in interest rates. Borrowing increased during the harvest and crop moving seasons regardless of whether or not a futures contract was employed. For example, in the presence of futures contracts: wheat was purchased *in* September, wheat prices fluctuated *in* September, transactions were *still* settled in cash, and if the long position required a loan to purchase wheat, that loan was acquired *in* September. The only difference was that traders were certain about the price they would effectively pay in the market for the staple. In the context of this example, the demand for money increased every September just as it did prior to the existence of futures markets. Likewise, if the September harvest was poor, staple prices rose accordingly. Hence, the annual movements in the marketing of wheat remained seasonal and the volatility of staple prices did not necessarily diminish. Nonetheless, the transfer of price risk from traders to speculators quelled money market volatility. This led to a decrease in the variance of interest rates and hence statistically significant seasonality was introduced into US money markets. This notion is consistent with our findings that seasonal patterns in interest rates were present before and after 1874 while the variance of interest rates and money market shocks in general declined shortly after this date. We suggest that these changes led to the introduction of a statistically significant seasonal cycle shortly after 1874.

Note, while the speculator took the opposite (risky) position, to that of the trader, the former was presumably better diversified in the presence of futures contracts than the latter would have been in the absence of futures contracts. Hence, a speculator's losses on a particular futures contract did not shock the demand for money in the manner that the trader's loss would have done prior to futures contracts.

A second explanation for the decrease in money market volatility with the advent of futures trading is the substitution of futures for consignment contracts around 1874.[45] Regarding the abandonment of consignment contracts, Chandler writes, "No longer did the financing of the movement

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[44] Clark, J.G., The Grain Trade in the Old Northwest, p. 120.
[45] Chandler, A.D., The Visible Hand, p. 211.

of the crops require long and often risky negotiations between one commission merchant and another."[46] Once futures markets were fully operational, the crowding out of the consignment contract was immediate.[47]

Negotiations based on consignment were inherently risky because none of the parties involved purchased the produce from the farmers, millers and merchants at the point of production. Rather, the owners of the produce were compensated upon the execution of a final sale in the East. Prior to this sale, traders at every level of the marketing process were unaware of the price that they would pay or receive for the produce. Regardless of the motive, contracts made on consignment and financed with short-term credit tied money markets to the volatility of staple prices. This occurred because a sudden change in price would unexpectedly affect the financial positions of borrowers and lenders. This would lead to relatively large fluctuations in interest rates.

The design of a futures contract was obviously quite opposite that of a consignment contract. By generally adopting the former in 1874, players in the agricultural trade could choose between business transactions of varying risk. For the conservative business-person wishing to purchase staples from the West, a futures contract and a hedging scheme was the ideal combination for guarding oneself against price risk. Likewise, for the speculator, schemes such as selling staples short in anticipation of a price decrease or taking a long position in anticipation of a price increase enabled quick gains (and losses) to be made.

The emergence of futures markets, in conjunction with hedging techniques and the eradication of consignment contracts, could explain the decrease in interest rate volatility observed after 1874 and the subsequent emergence of statistically significant seasonality. In addition, this explanation is consistent with the observed seasonal patterns in US short-term interest rates throughout the 19th and early 20th centuries.

[46] Chandler, A.D., The Visible Hand, p. 212.
[47] See Chandler (1977), Clark (1966), and Hammond (1897).

9. Conclusion

The notion that seasonal cycles are relevant to the study of business cycles is regaining popularity among economists. Nonetheless, if seasonal cycles are to assist economists in their understanding of business cycles, seasonal cycles must be explored more closely. Indeed, the change in behavior of seasonal cycles in US money markets, around 1914, is one case that continues to puzzle economists.

This paper examined the origins of the seasonal cycle in US interest rates, beginning in the antebellum period. Tests indicated that variations in short-term interest rates are relatively unexplained by the seasonal cycle prior to the mid-1870s, and hence, are similar to their post-1914 counterparts. However, despite the absence of a significant seasonal cycle in short-term interest rates for both the pre-1874 and post-1914 periods, the two series differ in one crucial respect. Namely, antebellum rates display occasional, albeit insignificant, seasonal movements and hence their seasonal patterns are not like those of the post-Fed rates, which display no seasonal fluctuations of any kind.

A break test, performed on the commercial paper rate between 1836 and 1910, indicated that a shift occurs in the series in the final months of 1873 and hence the US short rate began to exhibit a statistically significant seasonal cycle at this time.

The change in the behavior of interest rates can be explained by the introduction of futures markets and the resulting substitution away from consignment contracts in the agricultural trade. By hedging in the futures markets, staple traders were able to protect themselves from erratic price movements. Price risk declined and money market volatility subsequently decreased, allowing for the introduction of a seasonal cycle to short-term interest rates.

In conclusion, the notion that seasonal cycles are a well-defined and predictable phenomenon in macroeconomic time series appears inappropriate in the context of US money markets. On the contrary, seasonal cycles can exhibit irregularities, as exemplified by their absence in US money markets prior to 1874 and after 1914, and hence should not be dismissed as uninteresting fluctuations. Moreover, that a financial innovation (futures contracts) contributed to the regularization of seasonal cycles in 1874 is instructive to the extent that similar innovations may have comparable effects on business cycles.

Data Appendix

United States Short-term interest rates:

Macaulay's *call money rates* at the New York Stock Exchange, 1861:01 - 1936:12,
Source:

Macaulay, Frederick R. 1938. *The Movement of Interest Rates, Bond Yields and Stock Prices In The United States Since 1856.* National Bureau of Economic Research, New York. PP. A142-161. Col (1).

Macaulay's *commercial paper rate,* 1836:01 - 1936:12,
Source:

Macaulay, Frederick R. 1938. *The Movement of Interest Rates, Bond Yields and Stock Prices In The United States Since 1856.* National Bureau of Economic Research, New York.

1836:01 - 1860:12:
PP. A248-250. Boston. Rates are averages of Bigelow's reported "beginning," "middle," and "end" of month. Bigelow describes these rates as "street rates on first class-paper in Boston...at the beginning, middle, and end of the month."[48]

1861:01 - 1936:12:
PP. A142-161. Col (3). New York. From 1860 to 1923:12 `choice 60-90 day two name paper'; from 1924:01 to 1936:12 `4 to 6 month prime double and single name paper.'

Macaulay's 3-month *time money rate* in New York City, 1890:01 - 1936:12,
Source:

Macaulay, Frederick R. 1938. *The Movement of Interest Rates, Bond Yields and Stock Prices In The United States Since 1856.* National Bureau of Economic Research, New York. PP. A150-161. Col (2).

MM&W's 3-month *time money rate* in New York City, 1890:01 - 1936:12,
Source:

Mankiw, N. Gregory and Jeffrey A. Miron. 1985. "The Changing Behavior of the Term Structure of Interest Rates," *NBER Working Paper #1669.* "Three Month Rate." Mankiw and Mankiw and Miron (1985) state that:
"These data are time rates available at New York banks from 1890 to 1958; they are interest rates banks charged for loans of fixed maturity. In 1910, the National Monetary Commission compiled these data from 1890 to 1909 by tabulating them from the *Financial Review*, a periodical that analyzed current financial market developments. We updated this series to 1958 using the *Review* and the *Commercial and Financial Chronicle*, which took over the *Review* in 1921."
Data are from the first week of each month.[49]

MM&W's 3-month *time money rate* in New York City, 1890:01 - 1968:05
Source:

Mankiw, N. Gregory and Jeffrey A. Miron. 1985. "The Changing Behavior of the Term Structure of Interest Rates," *NBER Working Paper #1669.* "Three Month Rate." These data are the 3-month Treasury bill yields during the first week of each month.

[48] For the period 1836:01-1859:12 these data are also found in Bodenhorn (1992)
[49] See footnote 9 of Miron (1988).

Regional antebellum interest rates on short-term bills of exchange,

Boston, 1836:01-1859:12,

Charleston, 1838:01-1859:12,

New Orleans, 1839:11-1859:12,

Philadelphia, 1839:02-1857:06.

Source:

Bodenhorn, Howard. 1992. "Capital Mobility and Financial Integration in Antebellum America," *Journal of Economic History*, 52(3), Sep., pp. 603-608; Boston, col(1); Charleston, col(5); New Orleans, col(6); Philadelphia, col(4).

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Figure 1: Short-term Antebellum Interest Rates, 1836-1860

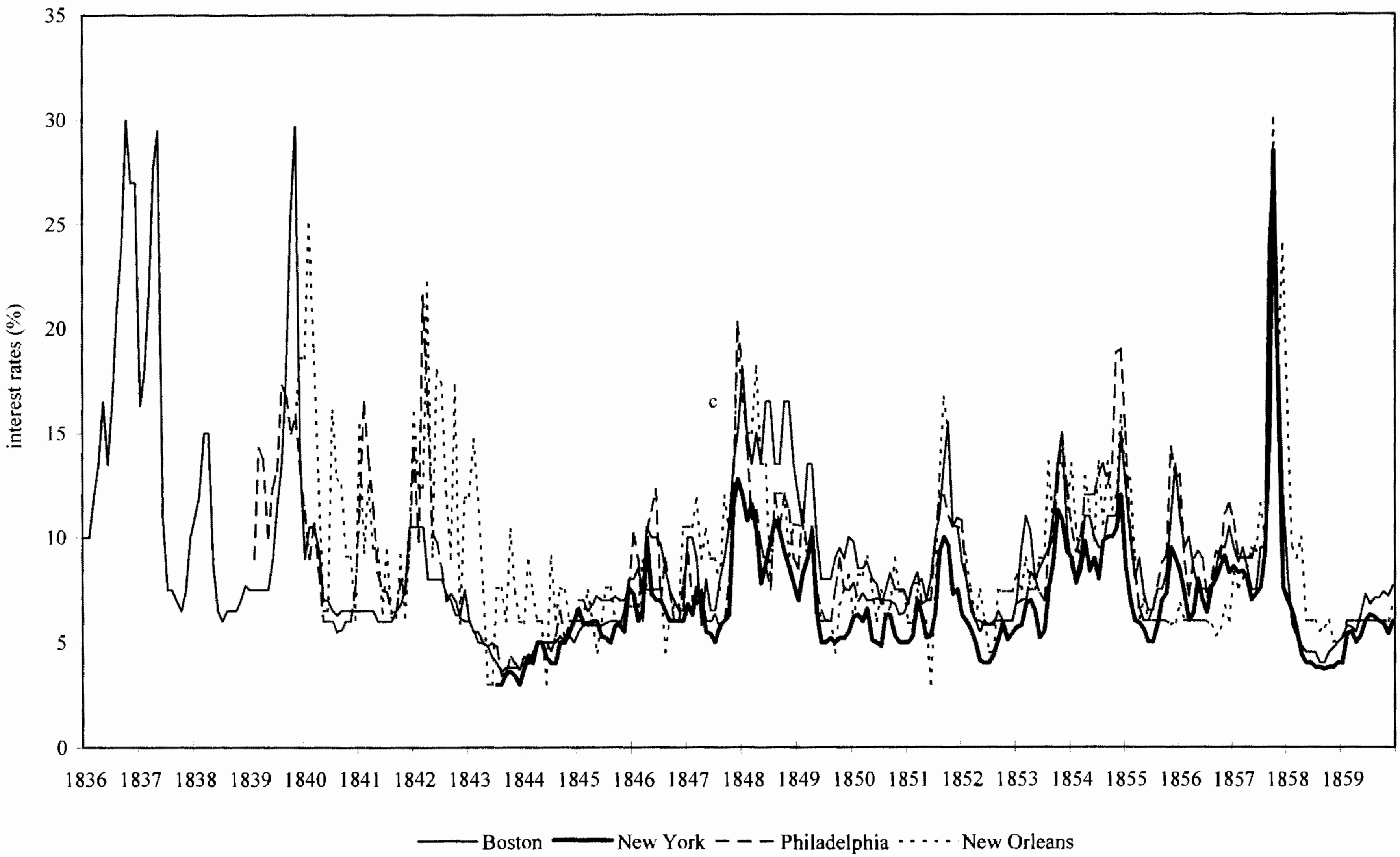

Figure 2: R Squares, 15 Year Rolling Regressions, 1836.01 - 1933.12

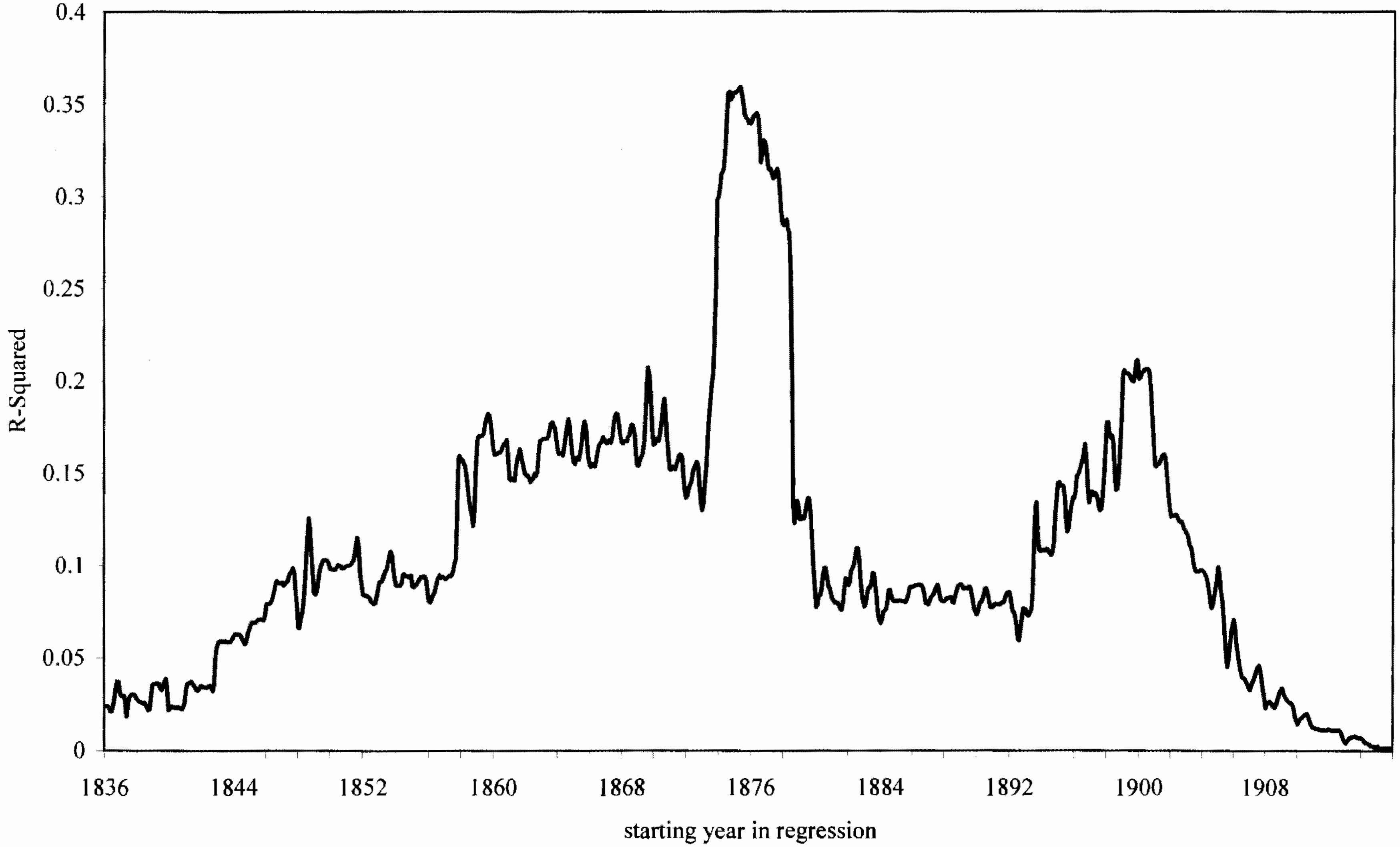

Figure 3.a. Seasonal Patterns and Standard Errors, Boston, 1836-1859

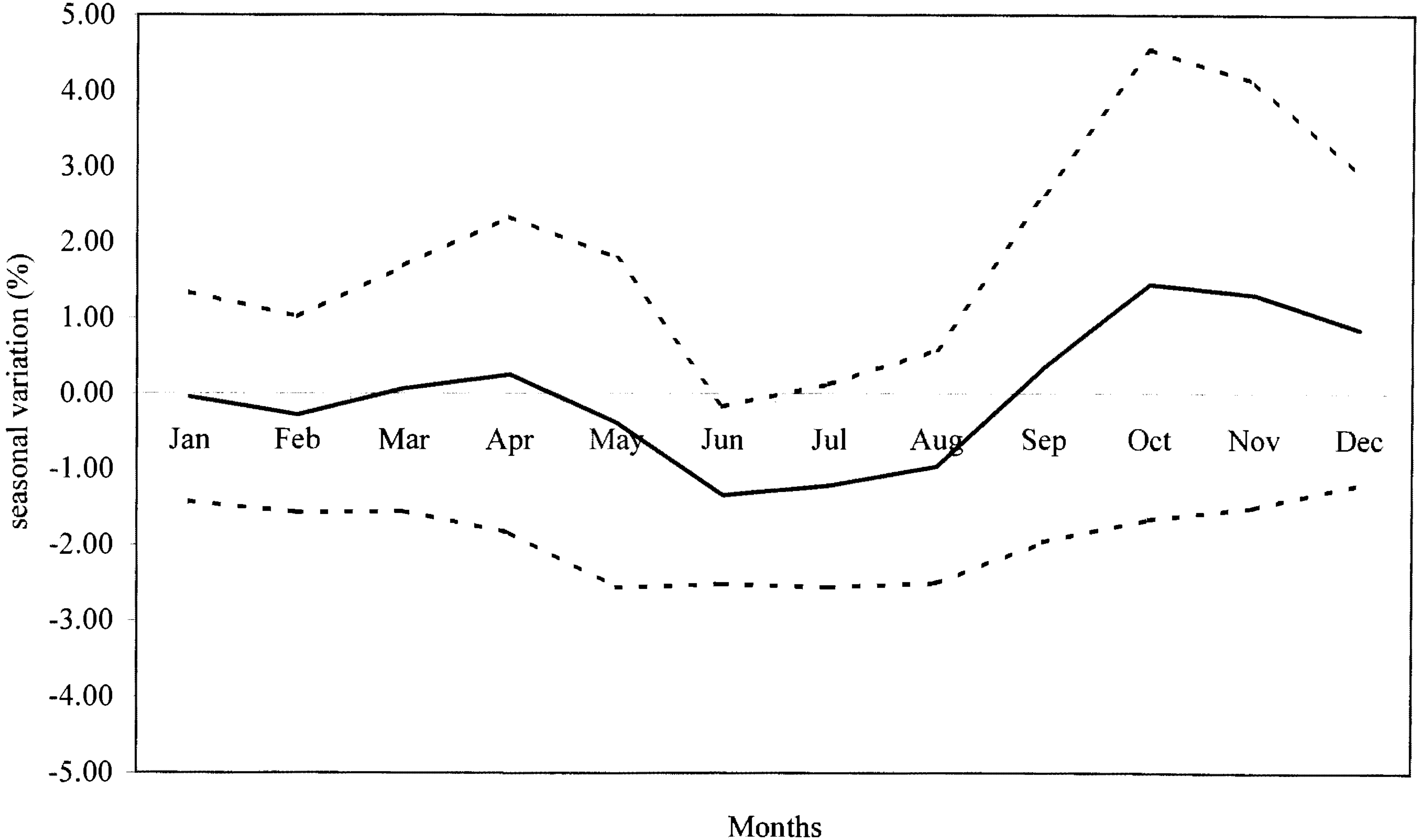

Figure 3.b. Seasonal Patterns and Standard Errors, New York, 1843-1859

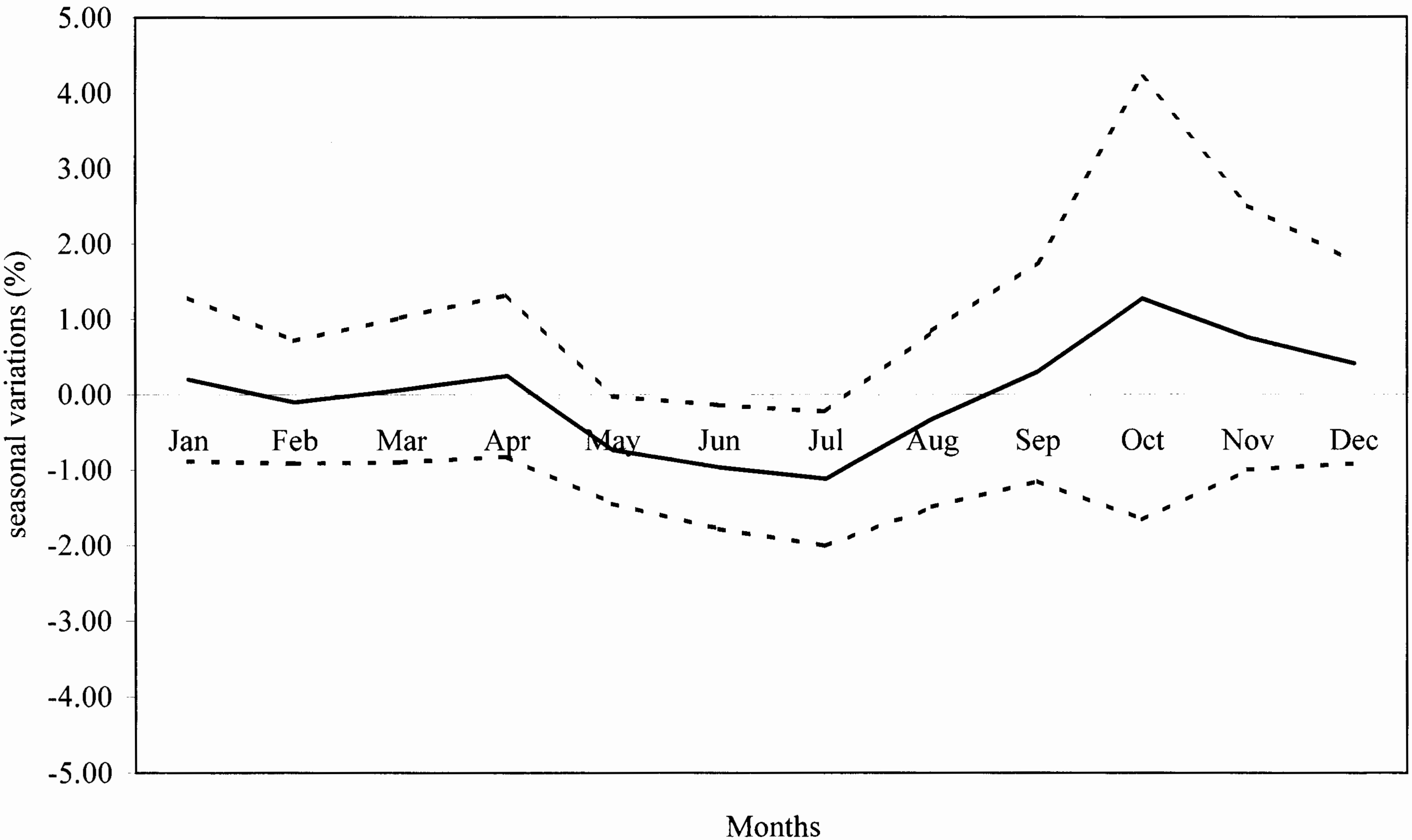

Figure 3.c. Seasonal Patterns and Standard Errors, Philadelphia, 1839-1857

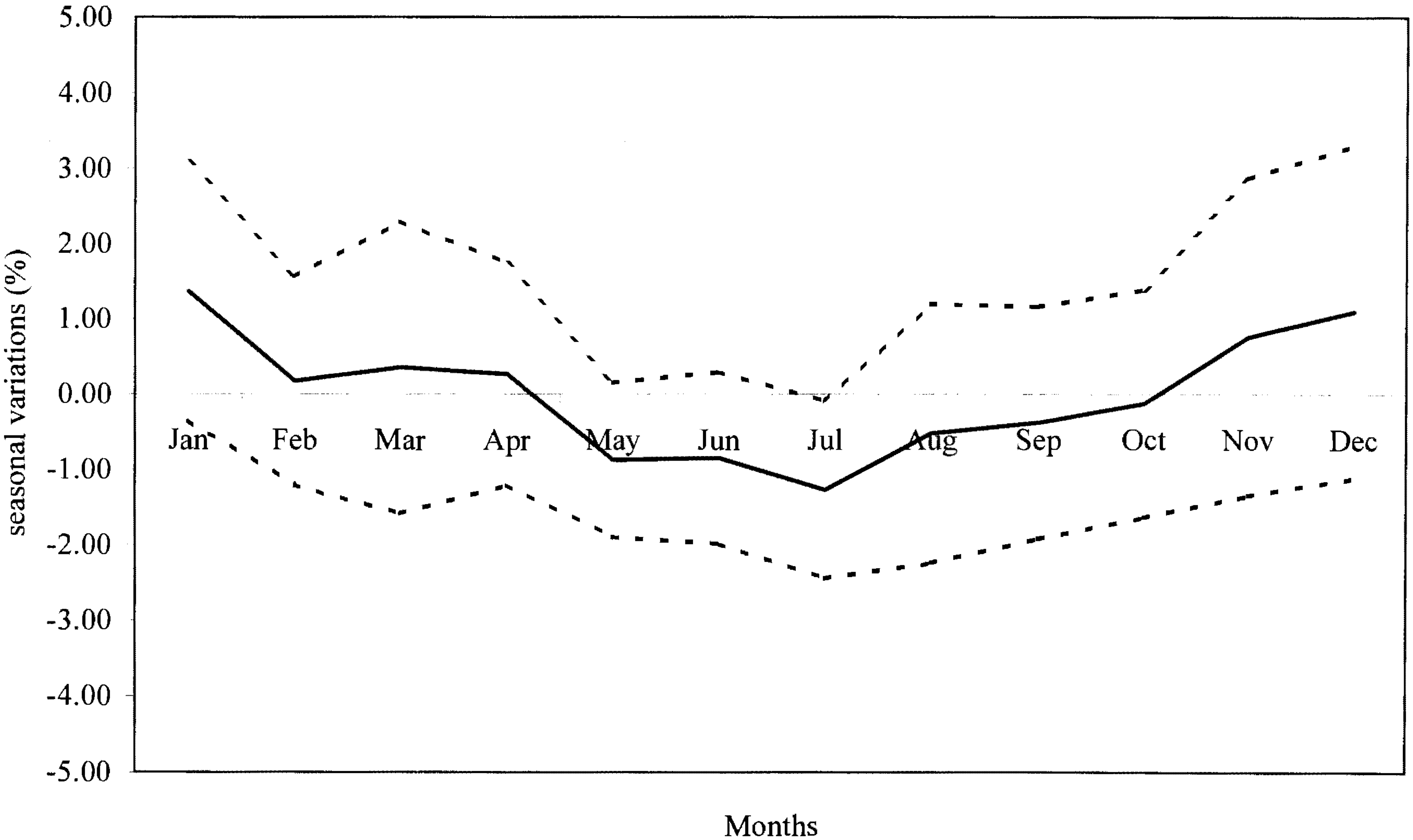

Figure 3.d. Seasonal Patterns and Standard Errors, New Orleans, 1836-1859

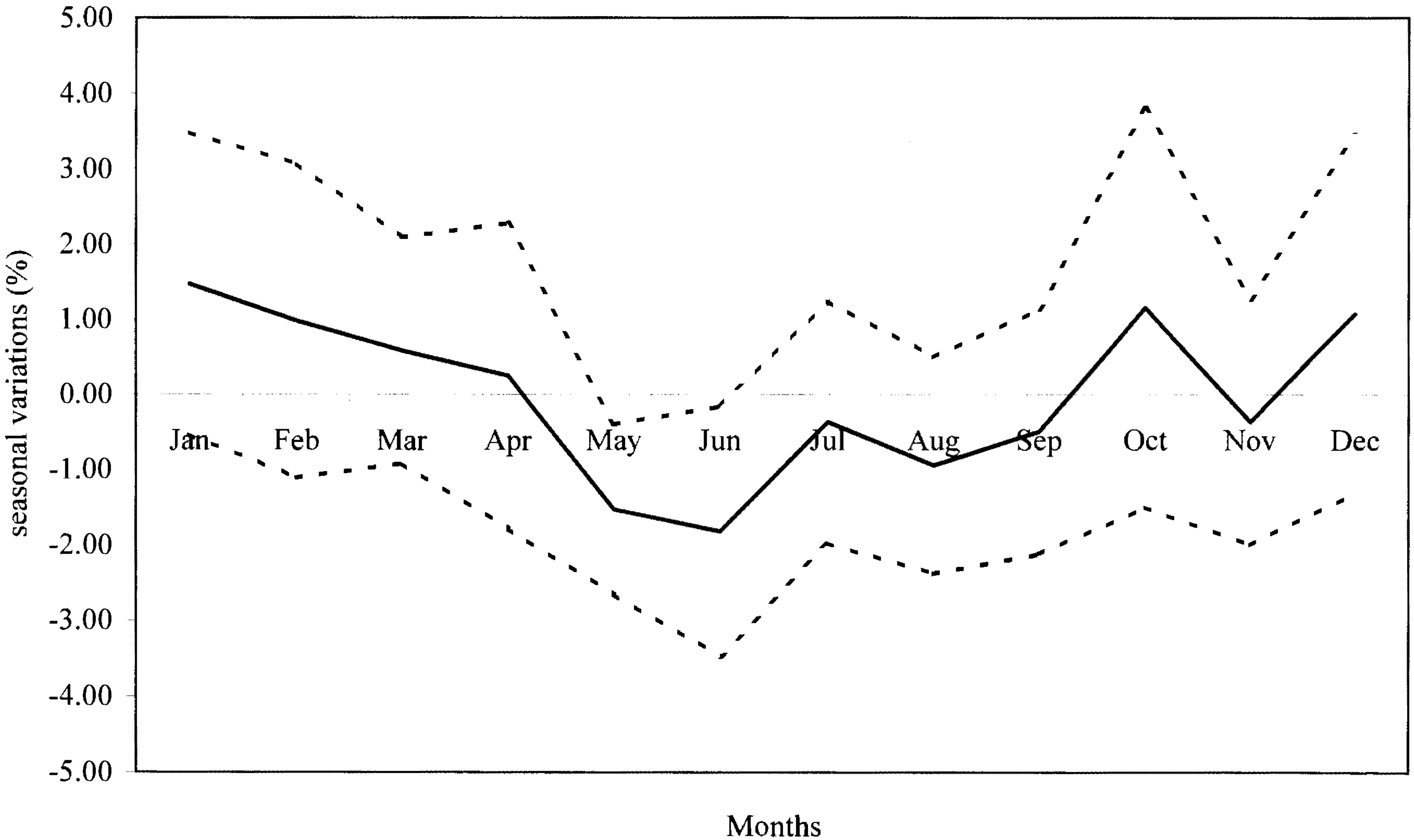

Figure 3.e. Seasonal Patterns and Standard Errors, New York, 1875-1910

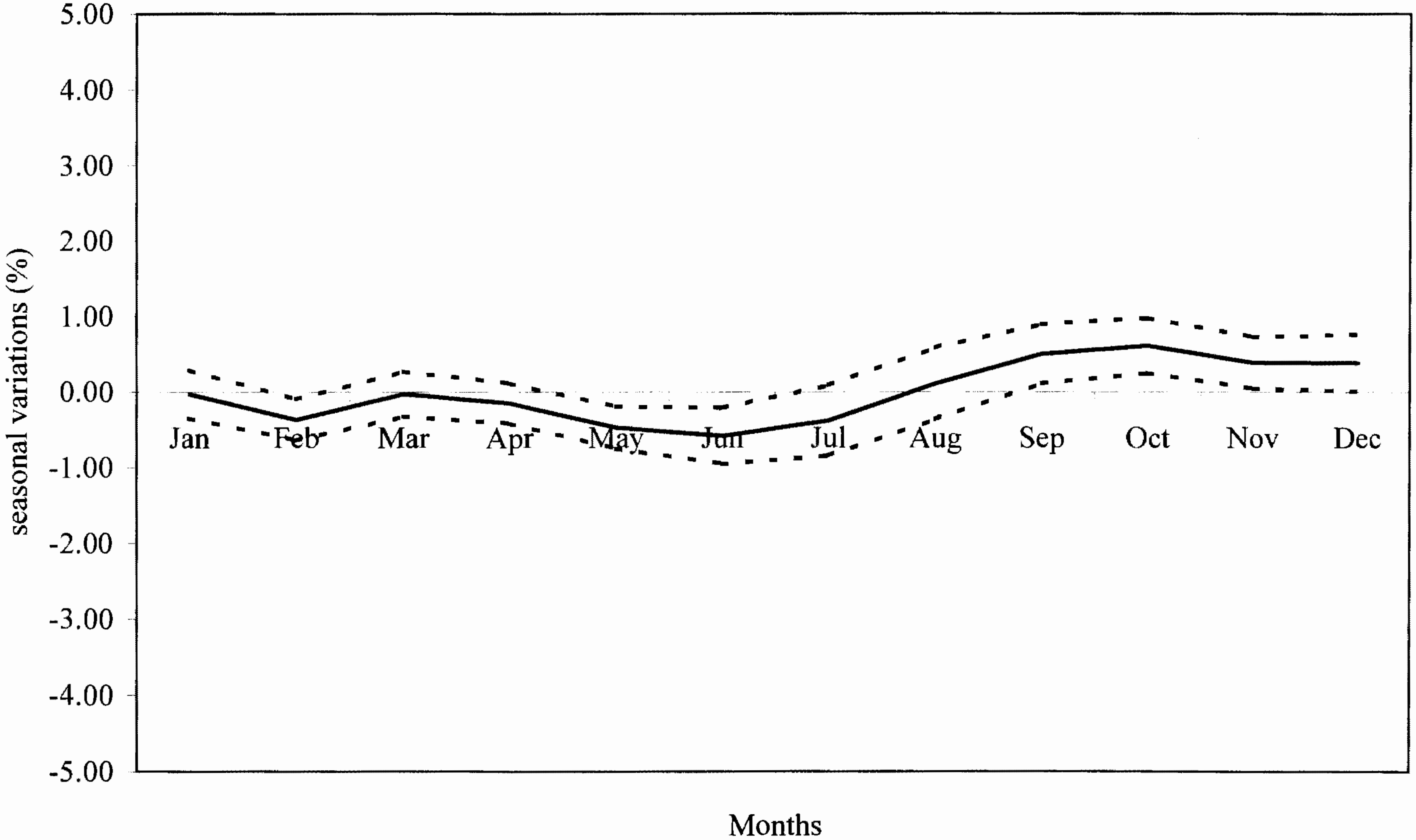

Figure 3.f. Seasonal Patterns and Standard Errors, New York, 1920-1933

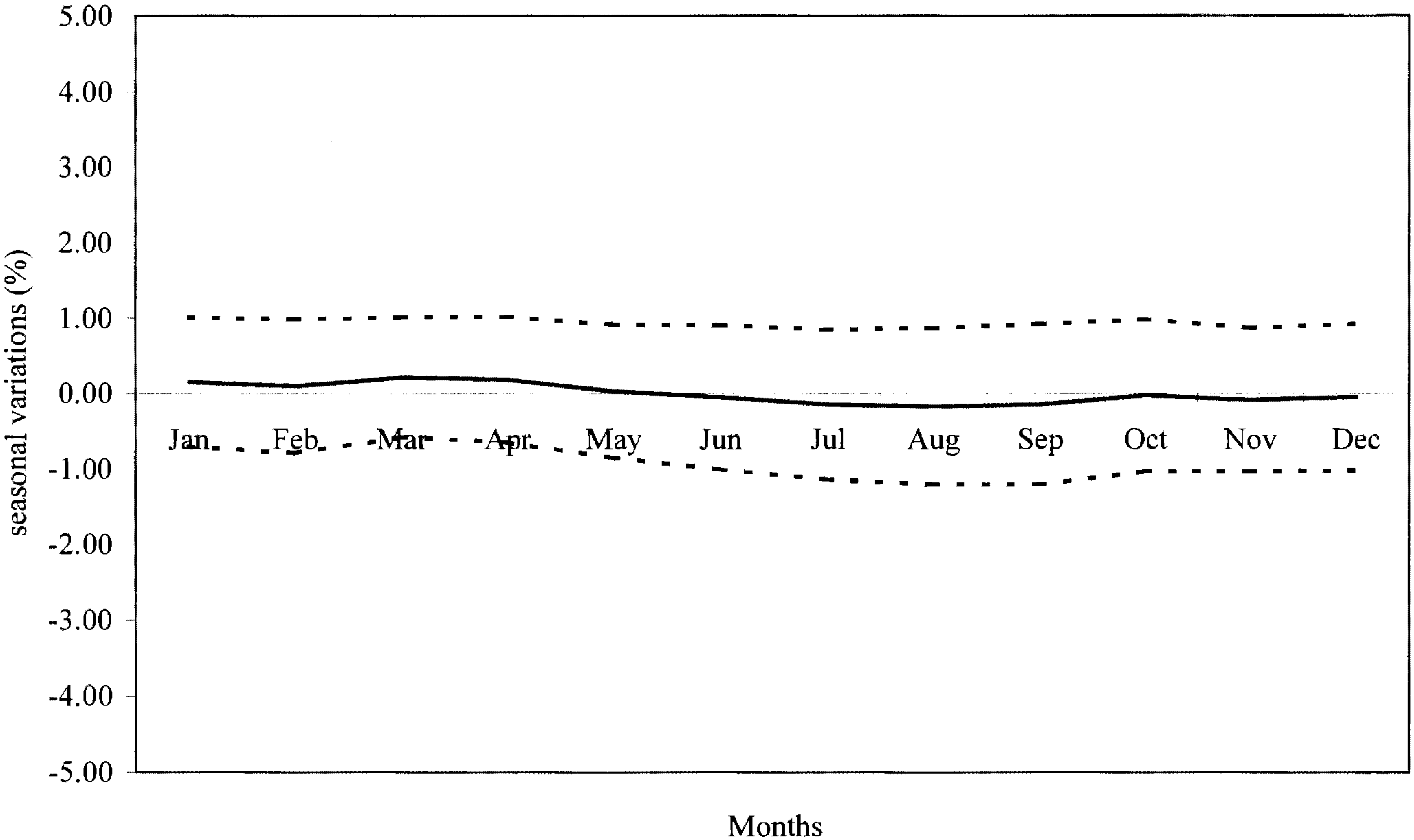

Figure 4: Autumn Differential, Macaulay's Commercial Paper Rate, 1836-1933