

# Dating the Turning Points of Nordic Business Cycles

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Abstract: When were the significant turning points in business activity in the Nordic countries during the last forty years? How frequent, long, and sharp were the contractions? This paper provides answers to these questions by applying the Bry and Boschan (1971) algorithms, which have been used to analyze business cycle turns in several countries, in particular the United States. Applying the same methods for Nordic countries it is found that contractions were unusually long and frequent in Sweden, while expansions were unusually long in Finland and Norway. However, contractions were not necessarily sharper in Sweden when compared with the other Nordic countries. Surprisingly, not much evidence of a common Nordic cycle is found. It appears instead that Sweden and Denmark tend to mimic the downturns in the G-7 countries more closely than Finland and Norway.

## Acknowledgments:

I would like to thank Mark Watson for providing the Bry-Boschan routines in GAUSS, and Thomas Worm Andersen and Hyunchul Chung for research assistance. Torsten Sløk, Peter Birch Sørensen and seminar participants at EPRU provided very useful comments, but any remaining errors are of course mine alone. Finally, I would like to acknowledge financial support from FCAR and SSHRC, and thank EPRU for its hospitality.

*“Everyone recognizes we're in a recession except for the economists”*  
John Sculley, then CEO of Apple Computers, October 22, 1990, Newsweek

## **1. Introduction**

Business cycle turning point dates are publicly announced and recorded for the U.S. economy by the NBER, and they make for fruitful discussions among analysts in business, academia and government. When John Sculley made the remark above to the economics profession in 1990, the economy was in fact in a recession as later judged by the NBER, who subsequently dated a business cycle peak in July of 1990, and the following trough in March of 1991. But naturally, the turning points were announced with a lag of several months.

Reference dates of business cycle turning points enables policy makers and academics to ask and answer questions such as: Has economic policy been successful in achieving stabilization? What events trigger contractions? Are financial market variables affected by the state of the business cycle? How synchronized are recessions across countries? Can turning points be forecasted using financial, commodity price or other indicator variables?

The NBER dates have formed the base for an important strand of academic literature, starting with the seminal work by Burns and Mitchell (1946) creating the first set of dates. More recent work includes Hamilton (1989) (regime switching modeling); Diebold and Rudebusch (1992) and Watson (1994) (duration and postwar stabilization measurement); Stock and Watson (1993) (forecasting); Romer (1994) (consistency of dates pre and post WWII); King and Plosser (1994) (Real Business Cycle (RBC) model evaluation); and Perez-Quiroz and Timmerman (2000) (riskiness of firms by size over the cycle).

Outside the United States, there has only been a limited number of studies dating business cycles. Notable exceptions are Artis, Kontolemis and Osborn (1995), who analyze monthly data on industrial production for the G-7 countries as well as Benelux, Ireland, and Spain; and Pedersen (1998), who studies quarterly GDP data on G-7 excluding Germany, but including Australia, Austria, Denmark, Spain, and the Netherlands. This paper extends this literature by conducting a study of four Nordic countries (Denmark, Finland, Norway and Sweden) using

monthly data on industrial production. Nordic business cycles have previously been analyzed in Berman, Gerlach and Jonung (1992), and Thygesen, Velupillai and Zambelli (1991), but no unified dating of turning points has been done for the Nordic countries thus far.

Romer (1994) and Watson (1994) strongly argue in favor of a systematic, programmed approach to dating turning points. They find evidence that the NBER dating procedures are not consistent pre- and post-WWII, perhaps due to the ad hoc procedures applied by a host of different researchers over time. This paper therefore adopts a programmed approach and apply the procedures by Bry and Boschan (1971), keeping in mind their guarded optimism (page 17): *“...turning point determination...cannot be regarded as objective in the sense that all reasonable and conscientious investigators would agree on the answers. Only agreement on the application of a specific set of detailed, and sometimes arbitrary, procedural conventions could bring about agreement on the choice of turns.”*

Using Bry and Boschan's programmed approach, the paper proceeds to provide answers to the following research questions for the four Nordic countries: 1) When are the cycle peaks and troughs during the post-war era? 2) How frequent, long, and deep are the recessions? 3) Is the timing of recessions independent across the Nordic countries, or is a common Nordic business cycle apparent? 4) How affected are the Nordic cycles by cycles in other countries, such as Germany, the US and the UK?

The remainder of the paper is organized as follows. In Section 2, an overview of the NBER and programmed dating procedures is given, in Section 3, turning point dates are constructed for the Nordic countries, and Section 4 concludes and points to directions for future research.

## 2. NBER and Programmed Turning Point Dates

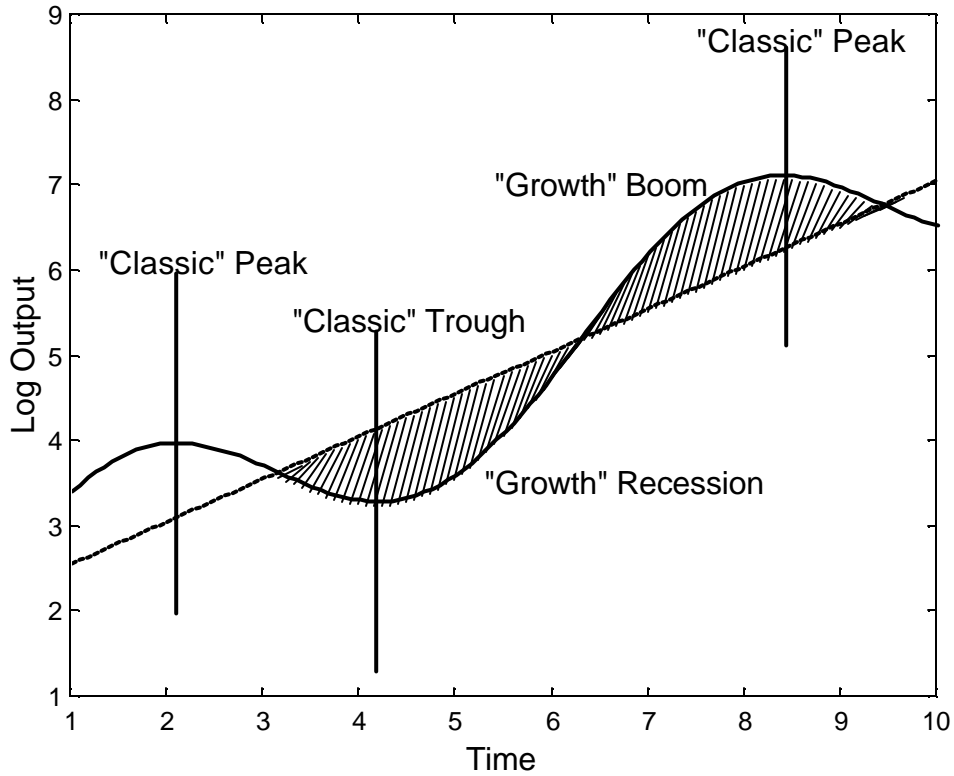
### 2.1 Growth Cycles versus Classical Cycles

In business cycle measurement, two very different but complementary approaches exist. One approach refers to “growth cycles,” and relies on detrending procedures to identify the residual cyclical component of output. For example, when researchers calibrate real business cycle models, the business cycle is typically found by detrending the data applying a Hodrick-Prescott filter or a similar method. Thus, the cycle is defined *relative* to a trend, which must first be somehow estimated. The cycle is subsequently defined to be booming when actual output is above the estimated trend, and to be in recession when the actual output is below the estimated trend. As indicated in the stylized example in Figure 1, the boom will therefore typically start well after the economy has turned and last beyond the point of downturn.

In contrast, “classic cycles” attempts to identify significant turning points—peaks and troughs—and define a contraction to simply be the time from peak to trough, and an expansion to be the time from trough to peak. The classical cycles approach has the advantage that no trend modeling is needed, and that the output loss from a contraction is well defined and easily measured. It should be noted that the absence of trend modeling does not imply a free lunch: As suggested in the Bry and Boschan quote above, when picking the exact turning points, one must make a number of methodological choices, each of which obviously has impact on the results.

Figure 1 illustrates the difference between a growth cycle and a classical cycle in a stylized example assuming a log linear trend. Notice the potential for large difference in the dating of the cycles and the measurement of output loss in the two approaches. In the analysis below, the classical cycle's approach is taken.

**Figure 1: Classic Versus Growth Cycle**  
**A Stylized Example**



Notes to figure: The dotted line represents a linear trend and is defined as:  $trend = 2 + 0.5 * time$ , the solid line represents log output and is defined as:  $log\ output = trend + \sin(time)$ . The vertical lines show the "Classic Cycle" turning point dates. The period from the peak to the trough is the "Classic Cycle" contraction, and the period between the trough and peak is the "Classic Cycle" expansion. The shaded area below the linear trend is the "Growth Cycle" recession and the shaded area above the linear trend is the "Growth Cycle" boom. Notice the phase shift of the cycle between the two definitions.

## 2.2 The NBER Dates

The standard point of reference in the business cycle literature is of course the NBER dates for the United States ([www.nber.org/cycles.html](http://www.nber.org/cycles.html)). These dates are constructed and updated by researchers who consider many different data series, use a number of different statistical methods, and finally apply much individual judgement. The general analytical approach of the NBER dates is to 1) identify major cyclical swings; 2) find neighborhoods of maxima and minima; and 3) narrow search for turning points to specific dates.

The advantages of such a comprehensive analysis are obvious: The inherent risks of relying on the idiosyncrasies of a single time series, a single statistical tool, or a single researcher, are reduced. The disadvantage of a nonprogrammed approach is that consistency over time might be lost. As an example, consider that when relying on the NBER dates, average post-WWII expansions are twice as long as pre-WWII expansions and contractions are half as long. Watson (1994) investigates if this difference is due to 1) smaller post-WWII shocks, 2) a change in the composition of output, or 3) changes in dating procedure at the NBER. Using the Bry and Boschan (1971) procedure, Watson finds the balance of the evidence to be in favor of changing dating procedures. Romer (1994) similarly finds that, using her own systematic dating procedure, recessions have *not* become shorter, less severe, or less persistent after WWII, but she does find that expansions have become longer since WWII. Needless to say, these inconsistencies motivate a serious look at the programmed approaches.

## 2.3 Programmed Approaches

The objective of the programmed approaches is to mimic the NBER dates in an automated procedure on an individual series, typically industrial production. The analytical recursion of the Bry and Boschan (1971) procedure is described in Table 1 which is taken directly from their book. The general idea is to perform different degrees of smoothing on the data in order to locate neighbourhoods of potential turning points which are then finalized using the raw data. The cycles implied by the turning points are required to have certain minimum and maximum durations.

### **Table 1: Bry-Boschan Procedure for Programmed Determination of Turning Points**

- I. Determination of extremes and substitution of values.
- II. Determination of cycles in 12-month moving average (extremes replaced).
  - A. Identification of points higher (or lower) than 5 months on either side.
  - B. Enforcement of alternation of turns by selecting highest of multiple peaks (or lowest of multiple troughs).
- III. Determination of corresponding turns in Spencer curve (extremes replaced).
  - A. Identification of highest (or lowest) value within  $\pm 5$  months of selected turn in 12-month moving average.
  - B. Enforcement of minimum cycle duration of 15 months by eliminating lower peaks and higher troughs of shorter cycles.
- IV. Determination of corresponding turns in short-term moving average of 3 to 6 months, depending on MCD (months of cyclical dominance).
  - A. Identification of highest (or lowest) value within  $\pm 5$  months of selected turn in Spencer curve.
- V. Determination of turning points in unsmoothed series.
  - A. Identification of highest (or lowest) value within  $\pm 4$  months, or MCD term, whichever is larger, of selected turn in short-term moving average.
  - B. Elimination of turns within 6 months of beginning and end of series.
  - C. Elimination of peaks (or troughs) at both ends of series which are lower (or higher) than values closer to end.
  - D. Elimination of cycles whose duration is less than 15 months.
  - E. Elimination of phases whose duration is less than 5 months.
- VI. Statement of final turning points.

While Artis, Kontolemis and Osborn (1995) find that the Bry and Boschan procedure performs reasonably well when applying it to the monthly industrial production series, they attempt to simplify it, and simultaneously try to avoid its apparent tendency to find too many small recessions, when compared with the NBER dates. The Artis et al procedure is similar to Bry-Boschan. Turning points are determined on smoothed and unsmoothed series, and points on the unsmoothed series which are not approximately matched by points on the smoothed series are excluded. Finally, the amplitude of a phase is required to be at least as large as one standard error of the monthly growth rate, and as in Bry and Boschan, the duration of a cycle must be at least 15 months.

Table 2 from Artis et al compares the business cycles turning point dates for the United States for the period from 1961 to 1993 using three different methods. Notice the strong similarities between the methods and in particular that a programmed approach on a single series is able to match the NBER dates closely.

**Table 2: United States Turning Point Dates from Three Methods**

	<u>NBER</u>	<u>Bry-Boschan</u>	<u>Artis et al</u>
Peak	69m12	69m8	69m10
Trough	70m11	70m11	70m11
Peak	73m11	73m10	73m11
Trough	75m3	75m3	75m3
Peak	80m1	80m2	80m3
Trough	80m7	80m7	80m7
Peak	81m7	81m7	81m7
Trough	82m11	82m12	82m12
Peak	90m7	89m3	89m4
Trough		89m10	
Peak		90m9	
Trough	91m3	91m3	91m3

Artis et al proceed to apply their own procedure to all the G-7 countries as well as Benelux, Ireland, and Spain. As is evident in the NBER dates for the United States, they find that expansions are generally larger and longer than contractions, but that cycle durations vary considerably across countries. The timing of cycles across countries is quite uniform with three turning point peak periods being common across countries: 1973-75, 1979-1980, and 1989-1991. While the first two episodes are generally associated with oil price shocks, the last is less synchronous across countries and has no obvious trigger event.

### 3. The Nordic Cycles

In the following, the Bry-Boschan procedures will be applied to four Nordic countries, Denmark, Finland, Norway, and Sweden. The classic turning point analysis has not before been performed at the monthly frequency for any of these countries, and not at any frequency for the latter three.



Following Artis et al., this paper will apply monthly seasonally adjusted (*s/a*) data on industrial production (IP). The monthly IP data is taken from IMF's IFS databank and runs from 1960m1 to 1998m12, except for Denmark where the IP data is only available from 1974m1.

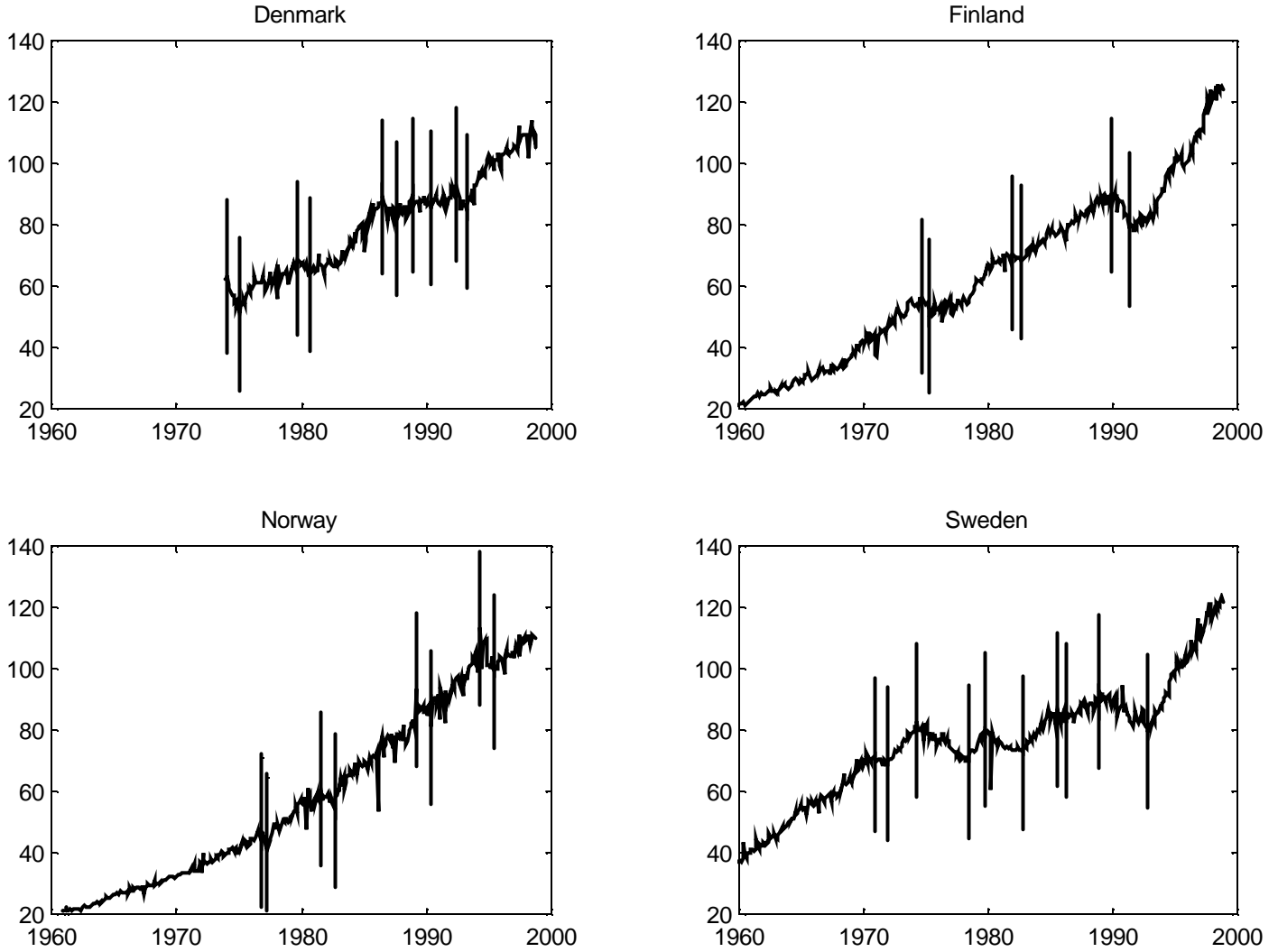
Artis et al were able to match the NBER dates for the US very closely looking only at IP and applying a variant of the Bry-Boschan routine judiciously. Motivated by their finding, attention is restricted to IP data in the analysis below.

Rather than working with a simplified version of it, the original Bry-Boschan algorithm is applied directly on the logarithm of the *s/a* IP series, and then afterwards the raw cycle dates are checked for the amplitude restriction imposed by Artis et al. It turns out that for the four Nordic countries under study, all the contractions found meet the amplitude requirement imposed by Artis et al. Hence there appears to be no reason to adjust the turning point dates found by the Bry-Boschan routine.

A peak is however imposed in Denmark in March of 1974, which is not captured by the Bry-Boschan algorithm. Recall that the data only starts in Denmark in January of 1974, and that the algorithm excludes turning points within six months from each end of the sample, such that no peaks can be found in the first half of 1974 in Denmark. However, in analysis not reported here, experiments were done splicing the monthly Danish IP data with quarterly data available further back in time. Regardless of the method applied for converting quarterly data to monthly, the Bry-Boschan algorithm consistently dated a peak in March 1974. This peak is therefore imposed and will indeed appear to be justified in the output loss calculations below.

The four series for IP along with the peak and trough dates (vertical lines) are plotted in Figure 2. Notice the substantially different growth paths for IP in the four countries. In particular, developments in the 1970s and 1980s vary dramatically between Sweden, who experienced long and deep contractions, and Norway and Finland who enjoyed long stretches of uninterrupted expansions. The period from the mid 1980s to the early 1990s in Denmark is also notable by containing no less than three contractionary periods. Note that the four plots in Figure 2 are drawn on the same scale to facilitate comparison across countries.

**Figure 2: Business Cycle Peaks and Troughs for Four Nordic Countries**



Notes to Figure: The peaks and troughs (marked by high and low vertical lines) are found by applying Bry and Boschan's (1971) algorithm to the seasonally adjusted series for log industrial production for each country.

In order to give a brief summary of the turning point results, Table 3 reports the average business cycle durations for the four Nordic countries as well as three major reference countries (the U.S., Germany, and the U.K.) taken from Artis et al. The Full Cycle column shows the average duration measured from peak to peak. Notice in particular how long the expansions are in Finland and how long the contractions are in Sweden as compared with the other Nordic countries and the three reference countries. Sweden spent a total of 152 months in a contractionary state, as compared with 35 months in Finland and 46 months in Norway (see Table 5 below).

**Table 3: Average Business Cycle Duration in Months**

	<u>Full Cycles</u>	<u>Expansions</u>	<u>Contractions</u>	<u>No of Cycles</u>	<u>Sample</u>
Denmark	55	41	13	4	1974-98
Norway	70	59	12	3	1960-98
Sweden	54	28	30	4	1960-98
Finland	93	85	12	2	1960-98
<b>Artis et al:</b>					
US	59	46	15	5	1961-94
Germany	101	77	24	3	1961-94
UK	57	45	14	6	1961-94

Consider next the actual peak and trough dates for the four Nordic countries and again compare with the three reference countries taken from Artis et al. The turning point dates are reported in Table 4. In order to facilitate the detection of lead-lag relationships, the contractions in Table 4 are aligned across countries if any part the contractions are overlapping. The vertical lines in the table indicate that a contraction in a country spans two contractions in the other countries. Notice that this is the case on three occasions for Sweden and once for Germany. Finally, an area in Table 4 is shaded if data was not available for that particular period.

Notice how, analogously to the finding by Artis et al, it is possible from Table 4 to identify three periods of relatively synchronous peaks: 1973-1974, 1979-1980, and 1989-1990. The notable exception of course is Norway, which peaks well after the other countries have hit the trough in the two oil price triggered downturns.

**Table 4 Classic Business Cycles in the Nordic Countries**

	<u>Denmark</u>	<u>Norway</u>	<u>Sweden</u>	<u>Finland</u>	<u>US</u>	<u>Germany</u>	<u>UK</u>
Peak						66m3	66m7
Trough						67m5	66m11
Peak					69m10		
Trough					70m11		
Peak			71m1				71m1
Trough			72m1				72m2
Peak	74m3		74m6	74m11	73m11	73m8	74m6
Trough	75m3			75m6	75m3	75m7	75m8
Peak		76m12					
Trough		77m5	78m7				
Peak	79m10		79m12		80m3	79m12	79m6
Trough	80m11				80m7		81m5
Peak		81m9		82m1	81m7		
Trough		82m10	82m11	82m10	82m12	82m11	
Peak							84m1
Trough							84m8
Peak			85m8				
Trough			86m5				
Peak	86m8						
Trough	87m10						
Peak	89m1	89m4	89m1	90m4	89m4		90m6
Trough	90m7	90m7		91m11	91m3		92m5
Peak	92m7					91m6	
Trough	93m5		93m1				
Peak		94m6					
Trough		95m7					

Besides the three episodes where most countries in the industrialized world hit downturns simultaneously, not much of a common Nordic classic cycle is apparent. The closest correspondences appear to be between Denmark and Sweden who often hit downturns almost simultaneously, but with Sweden taking a much longer time to recover.

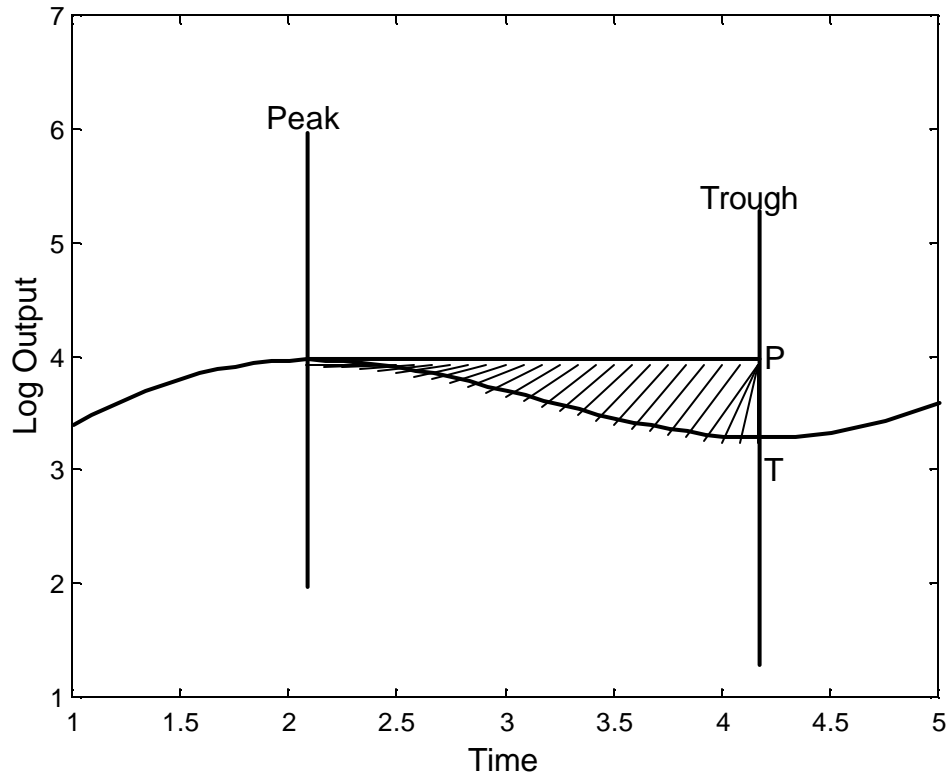
Focus is now turned to the measurement of output loss during the contractions found above. Two methodologies for loss measurement are applied. First, following Artis et al, one can simply take (100 times) the difference in logs between IP at the cycle peak and IP at the preceding trough. This number is reported in the Total Loss column in Table 5. The Loss per Month column divides the total by the duration (in months) of the contraction. The total loss is also reported in terms of the number of standard deviations of the monthly log differences that the loss constitutes. Notice that nowhere is this number less than one, thus none of the contractions here would be excluded on the amplitude criteria in Artis et al.

Romer's (1994) cumulated loss calculations and attempts to capture the shape of the downturn motivate the second loss measure. This measure computes the area between a horizontal line from the IP value at the peak at the beginning of the contraction, and the actual IP, starting at the time of the peak and ending at the subsequent trough. See Figure 3 for a stylized example. Table 5 reports both the total cumulated loss calculation (last column) and the cumulated loss per month (penultimate column).

In terms of total peak-to-trough loss, the worst contractions occurred in Denmark and Sweden in the episode after the first oil price shock. But adding the losses across contractions, the Swedish total comes to 52 percent—which is less than Norway's 54 percent.

In terms of peak-to-trough loss per month the short but sharp Norwegian contraction during 1976-1977 appeared the most severe. While as noted above, Sweden spent much more time in a contractionary state, the contractions in the other countries tend to be sharper: The average loss per month across contractions was only 0.37 percent in Sweden as compared with 0.86 in Denmark, 0.99 in Finland, and 1.44 in Norway.

**Figure 3: Cumulated Versus Peak-to-Trough Loss Calculations  
A Stylized Example**



Notes to Figure: Log output is defined as in Figure 1. The vertical lines show the classic cycle turning point dates. The distance from point P to point T indicates the peak-to-trough loss calculation, and the shaded area represents the cumulated loss calculation.

**Table 5.a: Contractions in Denmark** (Sample: 1974-1998)

Start		End		Duration (Months)	<u>Peak-to-Trough Loss</u>			<u>Cumulated Loss</u>	
<u>Year</u>	<u>Month</u>	<u>Year</u>	<u>Month</u>		<u>Loss per Month</u>	<u>Total Loss</u>	<u>No of Std.Dev.</u>	<u>Loss per Month</u>	<u>Total Loss</u>
1974	3	1975	3	12	1.84	22.05	7.48	12.28	147.34
1979	10	1980	11	13	0.61	7.93	2.69	4.00	51.99
1986	8	1987	10	14	0.60	8.45	2.87	5.37	75.15
1989	1	1990	7	18	0.29	5.16	1.75	3.32	59.68
1992	7	1993	5	10	0.98	9.81	3.33	6.69	66.93

**Table 5.b: Contractions in Finland** (Sample: 1960-1998)

Start		End		Duration (Months)	<u>Peak-to-Trough Loss</u>			<u>Cumulated Loss</u>	
<u>Year</u>	<u>Month</u>	<u>Year</u>	<u>Month</u>		<u>Loss per Month</u>	<u>Total Loss</u>	<u>No of Std.Dev.</u>	<u>Loss per Month</u>	<u>Total Loss</u>
1974	11	1975	6	7	1.82	12.75	4.60	5.70	39.93
1982	1	1982	10	9	0.40	3.56	1.29	1.92	17.31
1990	4	1991	11	19	0.77	14.54	5.25	7.76	147.42

**Table 5.c: Contractions in Norway** (Sample: 1960-1998)

Start		End		Duration (Months)	<u>Peak-to-Trough Loss</u>			<u>Cumulated Loss</u>	
<u>Year</u>	<u>Month</u>	<u>Year</u>	<u>Month</u>		<u>Loss per Month</u>	<u>Total Loss</u>	<u>No of Std.Dev.</u>	<u>Loss per Month</u>	<u>Total Loss</u>
1976	12	1977	5	5	2.90	14.50	3.46	6.79	33.96
1981	9	1982	10	13	0.89	11.57	2.76	5.34	69.40
1989	4	1990	7	15	0.95	14.22	3.40	7.48	112.13
1994	6	1995	7	13	1.02	13.29	3.17	8.81	114.49

**Table 5.d: Contractions in Sweden** (Sample: 1960-1998)

Start		End		Duration (Months)	<u>Peak-to-Trough Loss</u>			<u>Cumulated Loss</u>	
<u>Year</u>	<u>Month</u>	<u>Year</u>	<u>Month</u>		<u>Loss per Month</u>	<u>Total Loss</u>	<u>No of Std.Dev.</u>	<u>Loss per Month</u>	<u>Total Loss</u>
1971	1	1972	1	12	0.36	4.30	1.45	3.03	36.41
1974	6	1978	7	49	0.36	17.87	6.04	9.48	464.67
1979	12	1982	11	35	0.28	9.91	3.35	6.87	240.36
1985	8	1986	5	9	0.49	4.45	1.51	2.86	25.78
1989	1	1992	12	47	0.34	15.76	5.33	6.86	322.48

In terms of total cumulated loss over the contraction, the long 1974-1978 recession in Sweden stands out again, this time along with the enduring contraction in 1989-1992, which also took place in Sweden. Adding up the cumulated losses across contractions, Sweden is three times higher than number two, which is Norway. But, in terms of average cumulated loss per month, the countries do not differ much, ranging from 5.13 percent in Finland to 7.10 percent in Norway. This confirms the overall picture that Sweden's contractions are unusually long but not unusually sharp.

#### **4. Summary and Directions for Future Research**

This paper represents a first attempt to create a unified set of classic business cycle turning point dates for the Nordic countries. When relying on monthly data for industrial production as the indicator of business activity, substantial differences are found among the Nordic countries, particularly in terms of the duration and frequency of contractions. Since its first peak in early 1971 and until its last trough in early 1993, the industrial production in Sweden spent remarkably more time in a contractionary state than in expansion. Contractions in the other Nordic countries were on the other hand often sharper than the ones incurred by Sweden.

Due to the modest number of turning points in the relatively short sample for which high-frequency business activity indicators are available in any of the Nordic countries, formal statistical inference is not conducted in this paper. However, pooling a larger number of countries, and conducting a panel data study of the determinants of business cycle turning points could be interesting and is left for future research.

Remaining research questions include the following: Has economic policy been successful in achieving stabilization? What events trigger contractions? Are financial market variables affected by the state of the business cycle? How synchronized are recessions across countries? Can turning points be forecasted using financial, commodity price or other indicator variables?



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