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The business cycle in historical perspective: Reconstructing quarterly data on Swedish GDP 1913-2014.*

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Abstract

Although historical national accounts for Sweden belong to the most detailed in the world, hitherto no quarterly series of Sweden GDP has been published for the period before the 1960s. In this paper we present such a series back to 1913, using higher frequency series on manufacturing and private consumption as indicators, and standard methods for temporal disaggregation from annual GDP data. By applying the JDemetra+ software, we also estimate a deseasonalized volume time series. Based on this new quarterly data and the Bry-Boschan algorithm to identify peaks and troughs we present different chronologies of the classical business cycle in Sweden, indicating a somewhat new and more precise picture of the economic development for the last 100 years. We find that the new series provides new information on the business cycle, confirming its very irregular nature and detecting recessions that are not clearly indicated by annual data.

Keywords: Quarterly GDP; Temporal disaggregation; Business cycles

1 Introduction

This paper presents new data on quarterly GDP for Sweden dating back to 1913, which so far only been available from the late 1960s onwards. Quarterly GDP is estimated through temporal disaggregation from annual data, with help from a monthly index of industrial production (manufacturing) and quarterly series of private consumption from 1960. The new series is subsequently used to

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provide a chronology of the Swedish business cycle during 100 years, by identifying recessions and expansions taking place during the period. The business chronology is contrasted with earlier research, which also serves as a reliability check of the new series. In this way this study exemplifies to what extent a quarterly GDP series can enhance our knowledge of past economic fluctuations.

As pointed out by Reinhart and Rogoff (2009), many books written about both historical and international economic fluctuations etc. have a rather narrative approach, and are not data driven. Experience of the Great Recession in 2008-2009, and the subsequent years of slow growth in many countries, reminds us that the lessons learned from historical studies of the business cycle are still highly relevant. It is not that the past accounts of great significance repeat mechanically in the present. However, without understanding the past properly we may fall into the trap of confusing the present reality.

Barro and Ursua (2008) argues that since the macroeconomic disasters are rare, general conclusions can only be drawn based on analysis of longer periods, and compare economic fluctuations during different time periods. However, our knowledge of business cycles through history still has many gaps. Historical national accounts have mainly focused on gathering annual data (Maddison (2010)). Today, USA is one of the few countries with quarterly data on GDP that stretches back to the 19th century. Much of the analysis for other countries, such as Sweden, is based on annual data.

Historical national accounts for Sweden are among the most detailed in the world. Annual GDP for Sweden stretching back to the early modern periods has been reconstructed in, among others, Edvinsson (2011, 2012, 2005) (cf. also Krantz (2004) and Schön and Krantz (2015)). Long time series of GDP and other measures of economic activity, including real wage growth, is also presented as annual data in Edvinsson and Söderberg (2011) and Söderberg (1987).

More high frequency data on national accounts are however more sparse. Statistics Sweden (Statistiska centralbyrån, SCB) presents series of GDP in accordance with the latest recommendations by the international guidelines of System of National Accounts back to 1993. Although much previous research has been done on economic crises in Sweden (e.g. Dahmén (1950); Edvinsson (2010); Jonung (2009, 1994); Jörberg (1961); Larsson and Lönnborg (2014); Lundberg (1983); Lönnborg *et al.* (2003); Schön (2000); Edvinsson (2005)), there is much left to analysis in this area, not least because different historical macroeconomic series that have been used were not always suited for the analysis of short-term fluctuations.

For the US the National Bureau of Economic Research (NBER), has made an update of the modern US business cycle dating back to the 1850s (Hall *et al.* (2003)). In Edvinsson (2005) a preliminary historical division of Swedish economic history into booms and recessions are presented, illustrating that during 1850-2000, Sweden experienced 26 recessions and 26 expansions. Alternation between recessions and expansions were sharper in earlier periods than later. The identification of the deepest recessions conforms quite well with other previous research, such as Hagberg and Jonung (2006). Christoffersen (2000), Holm

(2007) and Bergman (2011), who uses a similar method as this study, identifies several recessions from 1971 onwards.

The following two sections describes our data, methods and results, including our estimates on quarterly GDP. This is followed by a discussion of how to define a recession, which is related to various theoretical models of the business cycle, and a chronologisation of the Swedish business cycle based on using different definitions of a recession. The conclusions section sums up the main results.

2 Data

The data for the reconstruction of quarterly GDP is first based on the annual series, gathered from Statistics Sweden and Edvinsson *et al.* (2014), which has previously been reconstructed as part of Swedish historical national accounts. This series is used as a benchmark for the quarterly series. Within Swedish historical national accounts there exists several different alternative series. An example of an alternative series of historical GDP is Schön and Krantz (2015). However, this series is not compatible with the most recent series presented by Statistics Sweden, since it uses a methodology and classification that was applied in the pre-1950 period. Over time the various revisions applied by Statistics Sweden has increased the difference between earlier series to a quite large extent. In Edvinsson *et al.* (2014) there also exist two alternative time series, of which we here use the "SNA 2008"-series, since it is closest to the most recent official statistics.

Aggregated quarterly GDP are collected from Statistics Sweden, where nominal data covers 1980-2014, and GDP in fixed prices covers 1969-2014 (Statistiska centralbyrån (2001, 1965, 1973, 1985)). The quarterly series contains several breaks. Furthermore, these quarterly levels also deviate from the annual series we use as a benchmark. The annual series is often the most reliable one, since it can make various adjustments that are not known when estimates are first presented for the different quarters. Statistical offices sometimes extrapolate revisions backwards, but often only for the annual data. The older quarterly data therefore tend to deviate from the revised annual data.

For the period before 1960 the reconstructed series of quarterly GDP is based on industrial production. For the period 1960-68 some quarterly data exists on some components of GDP, but not GDP at an aggregate level. Most importantly a series of government final consumption is missing for that period. Only series of private consumption and gross investment can be reconstructed directly from the data. For some years, the data on private consumption has to be deflated by the Consumer Price Index.

Monthly industrial production indices (IPI) covers the period 1913 and forward. IPI, calendar adjusted, is taken from Sjölund and Wiklander (2003) and Statistics Sweden, which traces the production in mining, mineral, quarrying and manufacturing, consisting of four separate indices, describing the same kind of industries, with minor differences.[1] GDP and IPI follow each other closely,

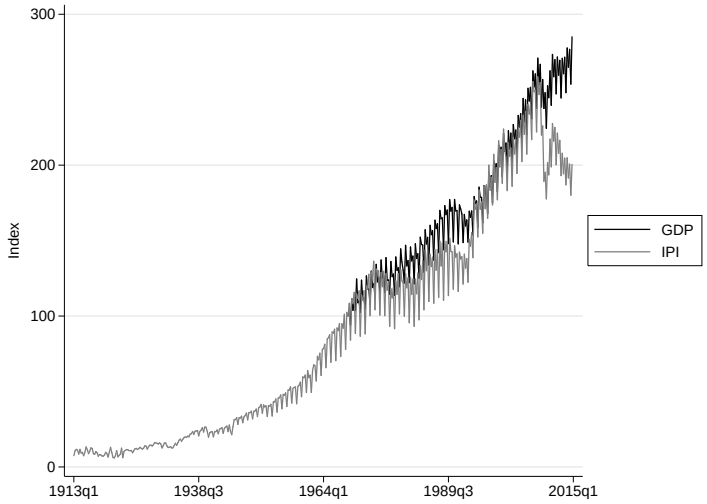
[1] See Sjölund and Wiklander (2003) for details on IPI before 1990. IPI 1991-2014 is compiled

with some important differences. IPI increased exponentially between 1913 and the early 1970s. Thereafter, IPI have been more sluggish, with particular slow growth between 1970 and the mid 1990s; and between 2008 and 2014, as shown in figure 1.

In general, changes in IPI and GDP follow the same direction every quarter, indicated by the overall positive and linear covariation in figure 2. For later decades, most quarters and years there is a similar pattern in both series, with a decrease of GDP and IPI during quarter one and three; and an increase of both during quarter two and four, which is illustrated by all points for each quarter tends to gather in the same area of the graph. During 6 quarters of 183, IPI and GDP moves in different directions, shown by the points in the upper left and lower right quadrant. The long fitted line through origo depicts the linear relation between percent change in IPI and GDP.

The serie is therefor tested for structural breaks in the period 1969-2014.

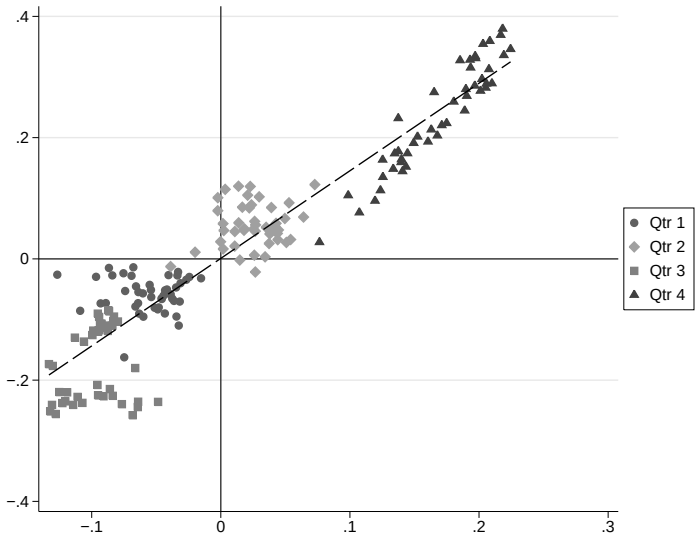
Figure 1: GDP and Industrial Production Index (IPI). Index 100 = 1969q1.



Source: Statistics Sweden; own calculations. GDP index constructed from quarterly data, originally in 1968, 1980, 1991, and 2013 prices.

from Statistics Sweden, available at http://www.scb.se/sv_/Hitta-statistik/Statistik-efter-amne/Naringsverksamhet/Industriproduktionens-utveckling/Industriproduktionsindex-IPI/

Figure 2: Correlation between IPI and GDP, change per quarter.



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3 Method

3.1 Structural break

Our use of IPI does not demand that the actual industrial production in Sweden during this time period must constitute a major part of GDP. Most important is that the two series show an adequate level of correlation. Nevertheless, it could be problematic to use the coefficients derived from regressing GDP on IPI for the whole period 1969:2-2014:4 to estimate quarterly GDP before 1969.

We test 1994 as a possible breaking point, since Statistics Sweden then switched to a new classification system for national accounts, which might have long run effects on the time series. Also, the recession in the early 1990s has been characterized as a structural crisis in Sweden, which also might be a reason for break in the time serie (Edvinsson (2005)). The test is done through regular OLS using a time dummy variable, *TD,* with value 0 for the period 1969:2-1993:4, and value 1 for the period 1994:1-2014:4:

$$\Delta LN(y_t) = \alpha + \beta_1 * \Delta LN(IPI_t) + \beta_2 * TD + \beta_3 * TD * \Delta LN(IPI_t) + \epsilon_t \quad (1)$$

where y_t is volume GDP in quarter t, and Δ describes relative logarithmic change. IPI_t is the industrial production index.

3.2 Temporal disaggregation

We wish to find the unknown quarterly GDP, y (the high frequency series), whose annual sums are equal to the known annual GDP, y_l (the low frequency series). In order to estimate quarterly GDP, one or more indicator variables of higher frequency (quarterly/monthly) may be used depending on method. The simplest way to estimate quarterly estimates is to assume that both series have the same growth rate, therefor making the indicator series a good approximation of the data we wish to estimate. A problem is that the growth rate of the indicator variable is often different from the growth rate of the annual series.

Methods of temporal disaggregation often consists of two steps. First a preliminary quarterly series p has to be determined. In the next step a new series, $\hat{y}$, is constructed with help from a preliminary quarterly series, p, and standard methods for temporal disaggregation to adjust the quarterly estimates to the annual data, y_l. The different series are here treated as vectors containing the values for all quarters or years. If n and n_l are the number of quarterly and annual observations, respectively, y, p and $\hat{y}$ are 1 x n vectors, while y_l is a 1 x n_l vector. p is derived from the various high frequency indicators used, which are collected in a matrix X, with n rows. If there is only one indicator X is a 1 x n vector. As described by Sax and Steiner (2013) in their article on the R-package tempdisagg there is several methods for adjusting for this. The differences between annual values of the preliminary series we wish to estimate and observed annual values is distributed among the preliminary quarterly estimates. The sum of the estimated quarterly series and the distributed annual residuals gives the final quarterly estimates, $\hat{y}$.

$$\hat{y} = p + Du_l \tag{2}$$

where u_l is a vector of length n_l and contains the differences between the annualized values of p and the actual annual values, and D is a $n \times n_l$ distribution matrix that distribute the annual differences to the various quarters. u_l can also be written as:

$$u_l \equiv y_l - Cp. \tag{3}$$

where C is a conversion matrix, which performs annualization (i.e. the quarterly values of p are summed up for each year). Equation 2 is the basic framework for all disaggregation methods, even if different methods determine the preliminary series, p, and the distribution matrix, D, in different ways.

We here focus on two common methods for temporal disaggregation: Denton and Denton-Cholette, based on (Denton (1971) and Dagum and Cholette (2006)).Both use a single indicator, i.e. p is the same as X above. If preferred, this allows for the use of a constant as an indicator without any indicator series. In the Denton method, p or X, can in turn be reconstructed using other series, as we do in this study. The Denton method minimizes the absolute/relative

deviations from a differenced indicator. Denton-Cholette modifies the original Denton method by removing the spurious movement at the beginning of the estimated series.

Other common temporal disaggregation methods include e.g. Chow-Lin (based on Chow and Lin (1971)), Fernandez (1981), and Quilis, Enrique M. (2009), all of which perform a Generalized Least Square Regression (GLS) of the annual value on the annualized quarterly indicator series. The problem is that all of these are based on the assumption that the linear relationships between the annual series and the annualized quarterly indicator series also must hold between the quarterly series of y and X. Even if y and X may have similar growth in the long run, they may not correlated well in the short run.

In the present study, the preliminary quarterly series, p, is spliced from three series. From 1969Q1 p follows the reconstructed quarterly GDP series, which is termed p_{GDP}. The series p_{GDP} deviates from the actual annual GDP series, y_l, because of a discrepancy between earlier methods to gather GDP and the annual series reconstructed for historical national account. Therefore, methods of temporal disaggregation must be used to adjust p_{GDP} to y_l as well.

3.3 Seasonal adjustment

Most series fluctuate during the year due to seasonal effects, which could arise for a number of reasons: such as weather conditions, holidays and timing decisions. GDP may also vary due to different number of work days during a year and a quarter. This so-called calendar effect can be divided between a seasonal and a non-seasonal component (Eurostat (2013, p. 212)). A problem is that seasonality is an unobserved entity, which is problematic to determine. It is not even possible to determine all the causes of seasonal fluctuations. For a historical series seasonality may change due to structural shifts in the economy, the timing of holidays and leisure time but also due to unknown factors.

A special problem for this study is that while industrial production is used to reconstruct quarterly GDP before 1968, it is possible that the relation between the seasonal pattern of industrial production and the the aggregate economy was different earlier in time, not least because the share of agriculture was larger. Furthermore, although grains were mostly harvested in the third quarter, work within agriculture was spread during the whole year. Seasonalisation of agricultural production is also problematic today, even if the problem is minimized by the small relative size of the activity. In this study we do not take this into account in detail, but instead rely on technical adjustment.

There are a numerous techniques to implement seasonal adjustment, which can be divided into two groups: moving average-based methods and model-based methods. Moving average-based methods use filters, and do not rely on any explicit underlying model (Eurostat (2013, p. 215)).

This study uses the Demetra+ software to accomplish the decomposition of the actual series, and compares three different variants. The moving average-based method in Demetra+ is X-13ARIMA-SEATS (Grudkowska (2015)), while the model-based method is TRAMO/SEATS. The first step in both methods

removes deterministic effects applying a regression model with ARIMA noise. The second step is different in the two models: X-13ARIMA-SEATS is based on the Henderson moving average of the seasonal components. The advantage with Henderson average is its sensitive to sudden changes in the seasonal component. The default version has a 13-term moving average, which we compare to a version that has a 39-term moving average.

4 Results: Estimated quarterly GDP

Structural break test OLS regression on structural break dummy variable D indicates there is a structural break in 1994. The estimated regression is:

$$\Delta LN(y_t) = 0.002 + 0.549 * \Delta LN(IPI_t) + 0.001 * TD + 0.256 * TD * \Delta LN(IPI_t) + \epsilon_t \quad (4)$$

The t-value for the coefficient of $TD * \Delta LN(IPI_t)$ is 6.62, indicating that the null hypothesis of no structural break in 1994 can be rejected at the 0.1 per cent significance level. An F-test shows that the coefficients of TD and $TD * \Delta LN(IPI_t)$ are jointly significant at a 0.1 percent level. For the period 1994-2014, the coefficient of ΔIPI_t increased from 0.55 to 0.8, indicating a long term increase in the positive correlation between GDP growth and IPI. It is possible that a structural break occurred in 1969 as well, but this is not supported by corresponding test for that time period on annual data (not shown here but available on request).

Temporal disaggregation For the period 1960Q1-1969:Q1 p follows p_{IPI+C}, which is derived from regressing quarterly logarithmic changes in GDP on quarterly logarithmic changes in IPI and private consumption for the period 1969:Q1-1993:Q4

$$\Delta LN(y_t) = 0.001 + 0.344 * \Delta LN(IPI_t) + 0.621 * \Delta LN(PC_t) + \epsilon_t \quad (5)$$

where PC is private consumption volume in quarter t. R^2 is 0.94. Gross investment does not add any additional information, and is therefore deleted from the regression. Before 1960 p follows p_{IPI}, which is derived from regressing quarterly logarithmic changes in GDP on quarterly logarithmic changes in the industrial production index for the period 1969:2-1993:4

$$\Delta LN(y_t) = 0.002 + 0.549 * \Delta LN(IPI_t) + \epsilon_t \quad (6)$$

R^2 is 0.87. The equivalent regression for annual data (labeled l) for the period 1969-1993 is

$$\Delta LN(y_{l,T}) = 0.011 + 0.377 * \Delta LN(IPI_{l,T}) + \epsilon_T \quad (7)$$

, where T is year. R^2 is in this case substantial lower, at 0.59. The coefficient for the independent variable is somewhat larger, when regressing for the whole period 1913-2014, at 0.43. The large difference between the linear relationships between the annual series and the same series at the quarterly level is the main reason why we here focus on the Denton and Denton-Cholette methods for temporal disaggregation.

Deseasonalization Figure 3 and 4 show examples of estimated GDP per quarter plus the deseasonalized version of the same series. A worrying sign for our estimated series is that the volatility seems to be very high during the early phases of our time period. However, this volatility is also displayed in the annual series of GDP, and the series of industrial production, and should therefor not cause any concerns for this study.

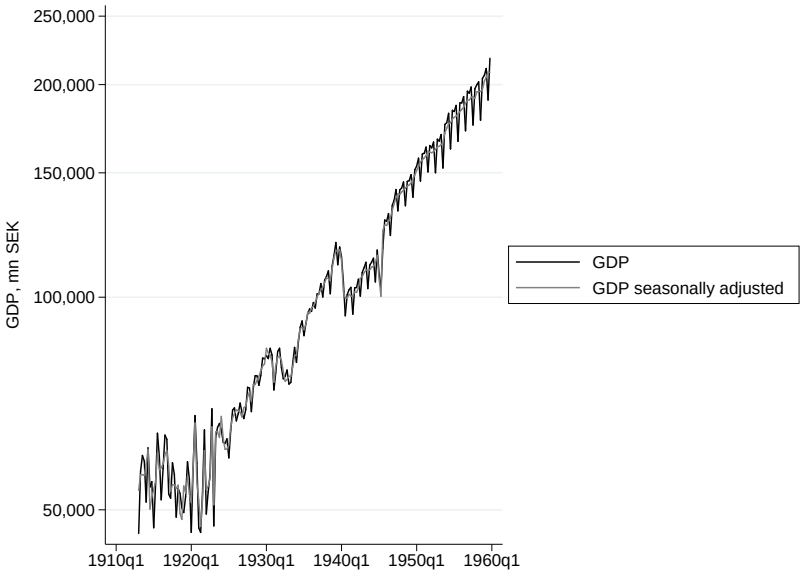
Figure 5 presents the derived seasonal components, and how they have developed over time. The seasonal component is not constant for all years, which may have several explanations. The most dramatic change was for the seasonal component of the third quarter: from being highly positive in the 1910s, it turned highly negative by the end of the 20th century. The seasonal component for the first quarter had the opposite development, from highly negative in the 1920s to slightly positive in the 1940, 1950s, and 1960s, and thereafter around zero. In Sweden the late summer holiday is more of a recent phenomenon. The vacation period has been prolonged in several steps. Earlier during the time periods, summers were the period with highest economic activity, in manufacturing not least to take advantage of the longer times of daylight.

The difference between various methods of seasonalisation is, in practice, quite small. The movements in the seasonal components move in about the same direction during the time period. The root mean square difference of the logarithmic change in quarterly GDP between the 13-term X-13ARIMA-SEATS and the TRAMO/SEATS series is 0.012, and between the 13-term and the 39-term X-13ARIMA-SEATS series 0.008. The volatility is somewhat higher for the two X-13ARIMA-SEATS seasonalized series than for the TRAMO/SEATS seasonalized series.

5 Recession and expansions using our estimated data

One of the main purposes to reconstruct a quarterly GDP series is to be able to reconstruct a chronology of the business cycle. Economic historians in Sweden

Figure 3: Estimated quarterly GDP and seasonally adjusted serie 1913 - 1959. Mn SEK, year 2000 reference prices (see appendix).



Source: See text

Figure 4: Estimated quarterly GDP and seasonally adjusted serie 1960-2014. Mn SEK, year 2000 reference prices (see appendix).

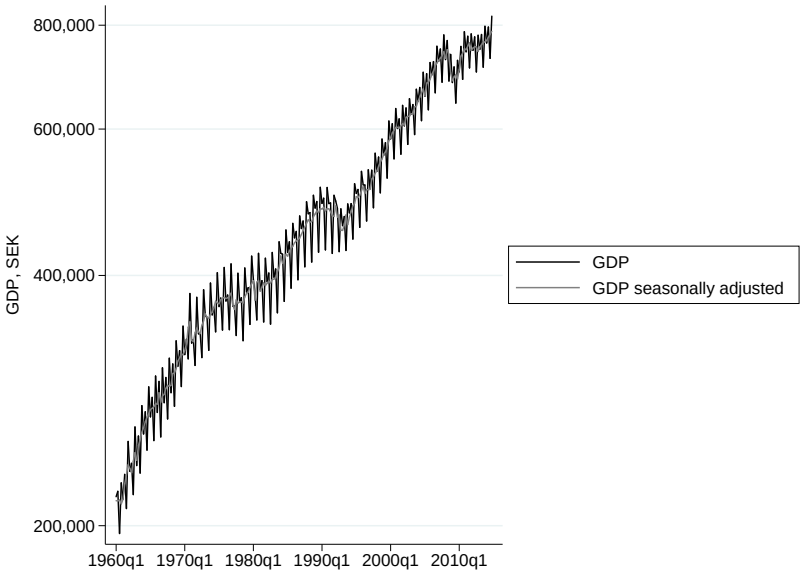


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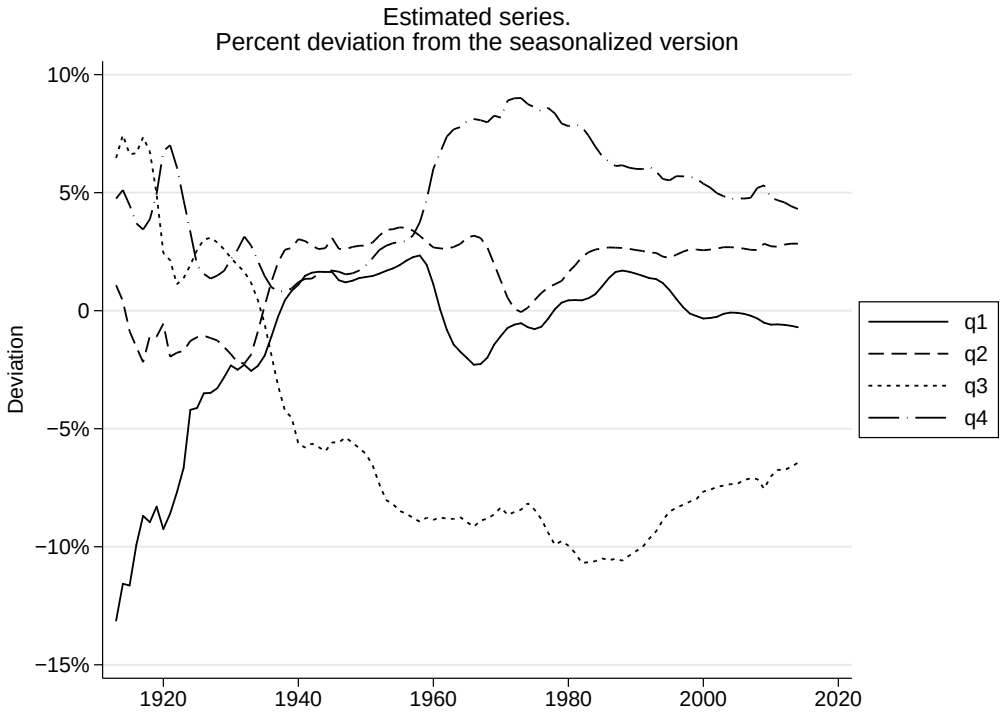
Figure 5: Estimated quarterly GDP, not deseasonalized. Percent deviation from the seasonalized version



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has hitherto relied on annual GDP data to identify various economic crises. However, annual data may miss fluctuations in economic data, that still is of interest to research. A problem is that there are no common definitions of terms such as recession, crisis, depression. Partly this is reflecting the complexity of these phenomenon, and partly that it is a question of how we theoretically understand fluctuations in production in the short, medium and long term. There are a number of possible definitions of these things, none of which seems to escape being at least partly arbitrary, or based on specific theories. Here we use different definitions to illustrate the development and possibilities with our estimated data.

There are two main approaches to establish the business cycle. While the classical business cycle entails that a recession is defined as an actual decline in economic activity, growth cycles fluctuate around a trend, which may be determined applying various filters, such as the Hodrick Prescott filter. However, defining a trend depends on the technique and parameters used, which might produce different estimates of GDP gap etc. Since the main purpose here only is to illustrate the sensitivity to methods to reconstruct the quarterly data and to present a seasonalized series, we focus solely on absolute decline or increase, not in growth rates. Assessing the sensitivity of a chronology of the growth cycle to different filters is outside the scope of the present study, although our data enables a future study in this area for Sweden.

5.1 What is a recession?

Burns and Mitchell (1946) formulates what is probably the most authoritative definition of the classical business cycle, as "a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve year; they are not divisible into shorter cycles of similar character with amplitudes approximating their own" (Burns and Mitchell (1946, p. 3)). This definition implies that not all historical periods and not all countries display a business cycle. It attempts to differentiate between the kind of fluctuations experienced by the economy prior to the emergence of a "business economy" from the modern business cycle. It also presupposes that there is no fixed length of the business cycle and that it can vary considerably, although a lower and upper limit is suggested. A recession as defined by Burns and Mitchell is measured in absolute terms, and what is investigated is whether there is an outright contraction in economic activity.

Following Burns and Mitchell (1946), NBER maintains a famous chronology of the American business cycle from the 1850s onward defining a recession as "a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales" (Hall *et al.* (2003)). A recession

begins after the economy has reached a peak, and it continues up to the trough. The time span between the trough and the peak is labeled an expansion. The Centre for Economic Policy Research (CEPR) , which establishes the business cycle dating for the euro area, defines a recession as "a significant decline in the level of economic activity, spread across the economy of the euro area, usually visible in two or more consecutive quarters of negative growth in GDP, employment and other measures of aggregate economic activity for the euro area as a whole" (Euro Area Business Cycle Dating Committee (2012)).

The problem with the definitions of both Burns and Mitchells and NBER is that they are quite vague. Perhaps the most common definition outside academia describes a recession as a decline of GDP for two consecutive quarters, originally one of several recommendations from Shiskin (1974)). This is straightforward but also the most arbitrary approach: Why not 3 or 4 quarters?[2] Although the NBER and CEPR definitions often coincide with two consecutive quarters of falling real GDP, there are some recessions that do not fulfill this criteria.

The Bry-Boschan (BB) algorithm (Bry and Boschan (1971)) attempts to mimic the NBER approach, and involves different stages of determining peaks and troughs, and to enforce a minimum cycle of 15-months duration (cf. Romer (1994); Watson (1994)).We here apply the BB approach using the R-package BC-dating, setting the minimum length of the cycle to 5 quarters, and the minimum length of a phase to 2 quarters. A recession occurs between a peak and the subsequent trough, while an expansion occurs between a trough and the subsequent peak.

5.2 Recessions and expansions in Sweden 1913-2014

Based on our estimated quarterly GDP we here map out the Swedish business cycle since 1913 until today. We use a combined series of earlier data on GDP combined with our estimates, using Denton-Cholette method. Different variables might be used to indicate a recession. Here we only use quarterly GDP. Our estimated data for quarterly GDP for Sweden is found in table 1 and 2. The declines in GDP were often much sharper than suggested by the annual data. After the description of our data and chronologies of the Swedish Business cycle follows some comparison of earlier research on the subject and economic fluctuations during the time period.

Table 3 compares various chronologies of the business cycle, according to different series and definitions. The first chronology is here used as a benchmark. The first five chronologies are based on the seasonalized series, where the irregular component is not deleted, and the applications of the BB-method. The first four chronologies assume a cycle length of 5 quarters and a phase length of 2 quarters. The first three series are all based on the main Denton-Cholette method of temporal disaggregation applied in the present study, but

[2] UK Treasury confirms per e-mail that among other definitions they also use this one (May 2016).

they all apply different methods of seasonalisation: X-13ARIMA-SEATS using a 13 term Henderson filter, X-13ARIMA-SEATS using a 39-term filter and TRAMO/SEATS. The fourth chronology is derived by applying Chow-Lin as the temporal disaggregation method, and X-13ARIMA-SEATS with a 13-term Henderson filter for seasonalisation. The Chow-Lin series uses only IPI as indicator for temporal disaggregation for the whole period under inestigation, which is not the case for the other series. It is clearly inferior, since it underestimates quarterly fluctuations, but is presented here as a comparison. The fifth chronology uses the same series as the first chronology, but sets the maximum length of the cycle to 8 quarters. The sixth chronology is also based on X-13ARIMA-SEATS (applying a 13-term Henderson filter for seasonalisation), but uses the trend that deletes the irregular component as well as the seasonal component. The last chronology implements the more straightforward definition of a recession as two consecutive quarters of falling GDP.

Although there are some differences, seven of the recessions are identified by all chronologies, highlighted in table 3: the First World War downturn, the early 1920s deflation crisis, the Great Depression during the 1930s, the Second World War outbreak, the early 1990s financial crisis, and the Great recession in 2008/09. Interestingly, none of the fluctuations during the 1970s are identified as recession by all chronologies, but all chronologies identify at least one recession during the 1970s. Each chronology identifies between 14 and 22 recessions since 1913.

Most of the recessions identified by our benchmark chronology also fulfill the definition of two consecutive quarters of GDP. However, in late 1919 and early 1972, respectively, GDP fell two consecutive quarters, while in 1991 GDP fell four consecutive quarters, even if none of the three are defined as a recession using the BB-procedure in the first chronology. Especially the case of 1991 is problematic. Using the TRAMO/SEATS or the Chow-Lin seasonalized series, or the trend (which smooths out the peak in the first quarter of 1992), entails that the early 1990s crisis is depicted as a double dip, i.e. consisting of two recessions, similarly to the early 1930s crisis. During the Euro crisis of 2012 GDP did not fall two consecutive quarters, but is defined as a recession by all the first six chronologies.

While the Chow-Lin series entails that no recession occurred during the 25 years between 1945 and 1971, the Denton-Cholette series identify several recession in that period. Interestingly six of the seven chronologies exclude recessions between 1993 and 2007, which would entail a longer cycle than the maximum of 10-12 years according to Burns and Mitchell. The dot com crisis is defined as a recession only in one of the chronologies, when applying the 39-term Henderson filter; its identification seems to be highly sensitive to the method of seasonalization.

It should also be considered that the business cycle chronologies are also sensitive to the annual series used. Here we only use one annual series, which is based on the latest data of Statistics Sweden and Sveriges Riksbank, but further revisions or alternative annual series would produce different business cycle chronologies than the one presented here. Further considerations of the

calendar effect could also change the business cycle chronology.

1910s While annual data displays positive growth in GDP in 1914 and 1915, the quarterly data displays a sharp contraction at the time of the outbreak of the First World War, in the third quarter of 1914. The longest recession according to our chronology occurred during the First World War, lasting four and a half years, with a peak in the second quarter of 1914, and a trough in the fourth quarter of 1918. It was the second deepest decline in GDP, by 20 percent. Imports fell and a food crisis deepened during 1916-1917 because of bad harvests in Northern Europe, which consequently led to social unrest towards the end of the War (Montgomery (1954, pp. 121-128), Schön (2000, pp. 278-280) Heckscher (1970, p. 291))

1920s The deepest recession occurred during the so called "deflation crisis" of the early 1920s, when GDP decreased by 29 percent. This was a deeper decrease than in most other industrialized countries and was followed by sharp deflation. (Örtengren (1979, pp. 65-70)). This downturn was in a sense the first clear-cut case of a modern general recession, since all major economic activity declined except agriculture and ancillaries (Edvinsson (2005)).

1930s Our estimated data indicates that the deep recession in Sweden during the 1930s, the Great depression, was actually a double dip, with one recession in 1930/31, when GDP declined by 10 percent, and another one in 1931/32, when GDP declined by 8 percent, with an expansion in between from the first to the fourth quarter of 1931. The recession in 1930/31 was only the fifth sharpest since 1913. The fall in GDP was not much larger than during 2008/09. Previous research has pointed out that the Great Depression was milder in Sweden than in several other similar countries (Edvinsson (2005)).

1940s During the Second World War two major recessions occurred. Both displayed larger declines in GDP than during the Great Depression. Johansson (1985, pp. 182-196) points to the dramatic effects on the Swedish economy produced by the outbreak of the Second World War, which was preceded by several years of relatively high growth during the 1930s. The development towards the home market that began during the 1930s was accentuated, as exports declined. Import also fell rather drastically, affecting branches dependent on imported supplies. Lundberg (1983) describes the time span of 1945-49 as a systemic recession characterized by post-War readjustments and a legitimacy crisis for the economic system, although production growth was positive during the same period. In contrast, Jonung (1994) purports instead that there was no real economic crisis in Sweden in 1945-49. In relation our estimates indicate that the economy decreased quite sharply in the first half of 1945, by 13 percent, even if GDP during the whole year declined by only 0.4 percent.

1950s - 1980s According to Edvinsson (2005) the usual business cycle was suspended after the downturn in 1952-53 up to the mid-1970s. The early 1950s recession was characterized by a readjustment after the boom accompanying the Korean War with falling exports. However, our new estimates identify recessions in the early 1960s and the early 1970s. The four deepest recessions after 1945 occurred in 1971, 1977, 1992 and 2008/2009. The 1970s experienced four recessions, more than in any other decade. The recession in 1971 coincided with the fall of Bretton Woods, and was the deepest one during the 1970s, even if annual GDP displayed positive growth. Örtengren (1979, pp. 74-77) points out that in contrast to the 1920s or the 1930s, there was no quick readjustment during the course of the crises in the 1970s. For instance, did not unemployment rise much, and at the same time there was an increase in social policies..

1990s In previous research, the recession in the early 1990s has been considered to be the most drawn-out economic crisis during the modern history of Sweden (Edvinsson (2005)), with three consecutive years of falling GDP, from 1990 to 1993. Our chronology only identifies a recession lasting just four quarters. Jonung (1994, pp. 243-250) argue that the main driving forces behind this recession were domestic, especially of a financial nature. The deregulations of financial markets during the latter half of the 1980s followed by first an increasing growth, and then rather sharp decrease, in the amount of private credit, which contributed to spikes in consumption and real estate prices (cf. Jaffee (1994) and Söderström (1995)). The expansionary policies at the end of the 1980s were followed by contractionary policies starting in 1990, which aggravated the downturn in the economy. The Swedish krona was also pegged to the ECU, exports were falling in 1991, and only after the devaluation of the Swedish krona at the end of 1992, did the economy start to recover. Our chronology displays a peak in the first quarter of 1992 and a trough in the first quarter of 1993.

The 21st century According to our first chronology no recessions occurred between 1994 and 2007; the expansion then lasted for 61 quarters. The cycle 1993-2009 lasted for 16 years, above the upper limit of 10-12 years suggest by Burns and Mitchell. At the end of the 20th century, a discussion ensued around whether a so-called "new economy" had made its historical entry entailing accelerated economic growth. Some scholars went so far as to argue that the business cycle was over for good. The dot com crisis, "the Great Recession", and the euro crisis have all punctuated that view. However, in Sweden, in contrast to the early 1990s crisis, but similar to the Great Recession, the economic crises in the 21st century were largely caused by international factors. As mentioned above, for Sweden, the dot com crisis is only classified as a recession using an alternative method of seasonalization. After 1945, "the Great Recessions" was the most severe one. Although Sweden escaped some of the worst repercussions of "the Great Recession", with no substantial increase in unemployment, GDP fell by 8 per cent from peak to trough, almost as much as during the Great Depression. The euro crisis caused the Swedish economy to experience a new recession, only

two-and-a-half years of "the Great Recession".

5.3 Comparison similar earlier studies

The identification of various recessions in this study corresponds well to earlier studies. However, there are large differences in earlier research concerning the identification of the deepest economic crises. Christoffersen (2000), who also uses the the Bry-Boschan procedure on industrial production to date the Swedish business cycle, identifying recessions in 1971-1972, 1974-1978, 1979-1982, 1985-1986, and 1989-1993.

Bergman (2011) uses the Bry-Boschan Procedure as well, but on GDP, and identifies recessions in 1970-1971, 1976-1977, 1980-1981, 1990-1993, and 2007-2009.

Holm (2007) identifies recessions in 1971, 1976/1977, 1979-1982 and 1991-1993 using four different series, and also recessions for GDP in 1976/1977 and 1990/1992. All of these recessions are also identified in this study, except for the early 1980s and 1985-1986.

Jonung (1994) defines an economic crisis as a shorter time span under peaceful conditions when production falls "markedly". Jonung identifies four crises periods or depressions in Sweden after the First World War: 1919-24, 1929-34, 1973-78, 1979-84 and 1989-93. Schön (1994) identifies three types of crises that have different temporal locations in the course of a structural cycle, after 1913: 1920/22, 1930/34, 1951/55, 1961/63, 1975/80, and 1991/94. Neither Jonung nor Schön, however, include the World War contractions. All of these crises fulfill the requirements of a recession according to the present study, although some of the crisis periods rather consisted of several recessions, most notably during the 1970s.

Edvinsson (2005) presents the only chronology of the business cycle covering more than a century. The following recessions are identified based on the definition that the annual increase in GDP is less than one percent: 1916-1918, 1920-1921, 1924-1925, 1930-1932, 1939-1941, 1952-1953, 1976-1978, 1979-1981, 1990-1993, and 2000-2001. All are classified as recessions in the present study, with the exception of the 1981 recession and 2000-2001, the so called "dot com crisis". Later revisions of Statistics Sweden has upgraded GDP for 2001 to above one percent growth.

6 Concluding remarks

While historical national accounts provide annual data of GDP for most rich countries back to the 19th century, and for some countries even back to the Middle Ages, studies on the business cycle may gain much from, or even necessitate, quarterly data. In this paper we attempt to estimate quarterly GDP for Sweden back to 1913. We show that it is possible to reconstruct such series by using temporal disaggregation methods and an index of industrial production and private consumption back to 1961 as indicators. We also present a series

that is deseasonalized, which shows that there were substantial long-term shifts in the seasonal components. While the seasonal component for the third quarter was positive in the 1910, it turned highly negative by the late 20th century.

We use our estimated seasonalized GDP to create a benchmark chronology of the Swedish business cycle, applying the Bry-Boschan procedure, and six alternative chronologies using slightly different methods. The chronologies does not only depend on the indicators used, but also on the methods of seasonalization and temporal disaggregation, and also how we identify and interpret recessions. This is partly a technical issue and partly a question of theory. No definition of recessions seems to escape the risk of being at least partly arbitrary, not the least regarding the technical aspects of the definition and how inclusive this should be.

Regardless of theory and method, the quarterly data indicate recessions that would have been difficult to identify using only annual data. In our benchmark chronology we find that the longest recession occurred during the First World War, while the deflation crisis in the early 1920s was the deepest. The Great Depression was in our chronology actually a double dip, but was milder than four other recessions. While previous research has indicated that Sweden escaped the usual business cycle during the golden years of capitalism, at least after 1952 until the 1970s, our new estimated data indicate that this period contained several recessions.

We show how the business cycle chronology is highly sensitive to different series and the methods applied. Although the Bry-Boschan procedure generates a chronology that partly corresponds to the non-academic definition of a recession as two consecutive quarters of declining GDP, the correspondence is not one-to-one. For example, in 1991 GDP declined during four consecutive quarters, while according to the Bry-Boschan procedure no recession occurred in that year. The dot com crisis in the early 2000s, is only identified as a recession according to one of our alternative chronologies, using a different method for seasonalization.

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Appendix

Table 1: Estimated GDP Sweden. Volumes, 2000 year's prices, Mn SEK. Unseasonalized.

1913q1	46287	1924q1	64945	1935q1	88217	1946q1	128038	1957q1	194453	1968q1	289109	1979q1	381882	1990q1	488376	2001q1	600988	2012q1	746367
1913q2	56655	1924q2	62320	1935q2	91710	1946q2	131354	1957q2	198431	1968q2	313033	1979q2	386708	1990q2	495418	2001q2	617135	2012q2	774577
1913q3	59700	1924q3	62068	1935q3	94751	1946q3	122309	1957q3	175314	1968q3	278387	1979q3	349301	1990q3	429351	2001q3	559671	2012q3	702823
1913q4	58597	1924q4	63021	1935q4	96262	1946q4	134891	1957q4	197373	1968q4	333725	1979q4	421985	1990q4	510331	2001q4	640649	2012q4	777970
1914q1	51282	1925q1	59218	1936q1	95471	1947q1	137180	1958q1	199833	1969q1	311126	1980q1	395770	1991q1	488196	2002q1	605368	2013q1	748368
1914q2	61185	1925q2	64811	1936q2	98268	1947q2	142063	1958q2	201793	1969q2	324766	1980q2	379608	1991q2	488949	2002q2	636142	2013q2	779609
1914q3	53849	1925q3	69205	1936q3	96529	1947q3	132505	1958q3	178084	1969q3	294088	1980q3	353658	1991q3	425189	2002q3	575107	2013q3	712202
1914q4	54814	1925q4	69720	1936q4	101068	1947q4	141892	1958q4	204078	1969q4	347593	1980q4	425239	1991q4	499404	2002q4	652615	2013q4	797578
1915q1	47161	1926q1	66813	1937q1	101094	1948q1	142735	1959q1	206088	1970q1	321297	1981q1	384684	1992q1	491598	2003q1	625444	2014q1	761528
1915q2	54383	1926q2	68380	1937q2	104563	1948q2	145601	1959q2	210783	1970q2	335273	1981q2	394307	1992q2	481744	2003q2	642164	2014q2	795929
1915q3	64182	1926q3	70808	1937q3	100064	1948q3	134742	1959q3	190200	1970q3	317528	1981q3	351671	1992q3	427334	2003q3	590983	2014q3	729878
1915q4	59472	1926q4	68708	1937q4	105729	1948q4	145893	1959q4	217901	1970q4	380481	1981q4	419555	1992q4	481012	2003q4	669902	2014q4	820291
1916q1	51667	1927q1	67320	1938q1	107004	1949q1	146184	1960q1	216738	1971q1	331676	1982q1	393209	1993q1	459207	2004q1	647695		
1916q2	57189	1927q2	69317	1938q2	108963	1949q2	149124	1960q2	219974	1971q2	334850	1982q2	402681	1993q2	470923	2004q2	673209		
1916q3	63793	1927q3	74557	1938q3	101134	1949q3	138531	1960q3	195742	1971q3	311772	1982q3	349553	1993q3	428693	2004q3	614124		
1916q4	62921	1927q4	74366	1938q4	110712	1949q4	151472	1960q4	225188	1971q4	376478	1982q4	426259	1993q4	487608	2004q4	702191		
1917q1	52604	1928q1	68868	1939q1	114628	1950q1	153380	1961q1	215254	1972q1	340295	1983q1	398104	1994q1	475653	2005q1	657346		
1917q2	51933	1928q2	74312	1939q2	119538	1950q2	157362	1961q2	230522	1972q2	340819	1983q2	407233	1994q2	488086	2005q2	699442		
1917q3	58287	1928q3	77410	1939q3	111168	1950q3	146010	1961q3	209763	1972q3	318655	1983q3	360725	1994q3	442460	2005q3	632925		
1917q4	56080	1928q4	77389	1939q4	117795	1950q4	159495	1961q4	252558	1972q4	384485	1983q4	439030	1994q4	515668	2005q4	721347		
1918q1	48819	1929q1	75026	1940q1	113981	1951q1	159843	1962q1	232542	1973q1	357642	1984q1	425188	1995q1	502056	2006q1	697152		
1918q2	53595	1929q2	77464	1940q2	104897	1951q2	163128	1962q2	237726	1973q2	356154	1984q2	424297	1995q2	507540	2006q2	723247		
1918q3	52762	1929q3	82015	1940q3	94124	1951q3	150446	1962q3	218014	1973q3	325132	1984q3	372289	1995q3	457059	2006q3	663427		
1918q4	50327	1929q4	81767	1940q4	100817	1951q4	163967	1962q4	262902	1973q4	391677	1984q4	453614	1995q4	533624	2006q4	754653		
1919q1	49559	1930q1	82679	1941q1	102462	1952q1	162690	1963q1	236283	1974q1	358634	1985q1	426441	1996q1	514095	2007q1	724112		
1919q2	52226	1930q2	81868	1941q2	103265	1952q2	165841	1963q2	256386	1974q2	366183	1985q2	439105	1996q2	513857	2007q2	748944		
1919q3	58486	1930q3	84661	1941q3	94624	1952q3	150032	1963q3	231411	1974q3	342169	1985q3	386161	1996q3	465108	2007q3	683199		
1919q4	55231	1930q4	82803	1941q4	103111	1952q4	167399	1963q4	278888	1974q4	403008	1985q4	462038	1996q4	535946	2007q4	778734		
1920q1	46458	1931q1	73905	1942q1	103210	1953q1	166335	1964q1	257882	1975q1	366999	1986q1	443956	1997q1	508498	2008q1	727483		
1920q2	57418	1931q2	78254	1942q2	106062	1953q2	169983	1964q2	274189	1975q2	375737	1986q2	451860	1997q2	535363	2008q2	766733		
1920q3	67987	1931q3	83794	1942q3	100359	1953q3	152380	1964q3	246585	1975q3	343845	1986q3	395287	1997q3	482494	2008q3	685408		
1920q4	58252	1931q4	84665	1942q4	108384	1953q4	175638	1964q4	293785	1975q4	408922	1986q4	471637	1997q4	561131	2008q4	737754		
1921q1	47132	1932q1	79489	1943q1	110117	1954q1	176583	1965q1	270379	1976q1	372679	1987q1	455547	1998q1	533720	2009q1	682560		
1921q2	46452	1932q2	76625	1943q2	112069	1954q2	182120	1965q2	285370	1976q2	378875	1987q2	465066	1998q2	555265	2009q2	712644		
1921q3	52888	1932q3	77276	1943q3	102859	1954q3	162138	1965q3	253206	1976q3	344236	1987q3	409722	1998q3	502903	2009q3	644762		
1921q4	64889	1932q4	78866	1943q4	111001	1954q4	183906	1965q4	302760	1976q4	413017	1987q4	490571	1998q4	583578	2009q4	725709		
1922q1	49315	1933q1	75333	1944q1	112089	1955q1	183195	1966q1	273717	1977q1	367406	1988q1	474529	1999q1	558254	2010q1	703082		
1922q2	53018	1933q2	75746	1944q2	113556	1955q2	186886	1966q2	298255	1977q2	367581	1988q2	476082	1999q2	577818	2010q2	754283		
1922q3	56019	1933q3	80585	1944q3	105100	1955q3	166250	1966q3	255777	1977q3	338737	1988q3	415159	1999q3	523842	2010q3	688623		
1922q4	69512	1933q4	84911	1944q4	116607	1955q4	188453	1966q4	309719	1977q4	402407	1988q4	499450	1999q4	613440	2010q4	785627		
1923q1	47445	1934q1	80851	1945q1	107819	1956q1	188385	1967q1	281222	1978q1	371729	1989q1	482126	2000q1	583895	2011q1	743216		
1923q2	63387	1934q2	86301	1945q2	103369	1956q2	192335	1967q2	301522	1978q2	376142	1989q2	490902	2000q2	608846	2011q2	775849		
1923q3	65431	1934q3	90679	1945q3	117402	1956q3	172026	1967q3	268826	1978q3	333892	1989q3	426635	2000q3	552514	2011q3	710758		
1923q4	66270	1934q4	92549	1945q4	128606	1956q4	195765	1967q4	318054	1978q4	408338	1989q4	510568	2000q4	635103	2011q4	780946		

Table 2: Estimated GDP Sweden. Volume values. 2000 year's prices, Mn SEK. Seasonalized.

1913q1	53280	1923q4	63306	1934q3	90277	1945q2	100284	1956q1	184478	1966q4	286468	1977q3	373874	1988q2	463736	1999q1	559528	2009q4	689090
1913q2	56049	1924q1	67795	1934q4	90635	1945q3	124338	1956q2	185814	1967q1	287728	1977q4	370574	1988q3	464350	1999q2	563230	2010q1	707229
1913q3	56070	1924q2	63125	1935q1	89932	1945q4	126462	1956q3	188214	1967q2	292500	1978q1	371506	1988q4	470485	1999q3	569216	2010q2	734211
1913q4	55938	1924q3	60885	1935q2	91523	1946q1	126404	1956q4	190156	1967q3	295041	1978q2	371974	1989q1	474299	1999q4	580973	2010q3	740654
1914q1	57990	1924q4	60990	1935q3	95282	1946q2	128001	1957q1	190141	1967q4	294292	1978q3	370643	1989q2	478350	2000q1	585821	2010q4	749695
1914q2	60935	1925q1	61764	1935q4	94866	1946q3	129540	1957q2	191921	1968q1	294980	1978q4	376826	1989q3	476036	2000q2	593668	2011q1	747586
1914q3	50122	1925q2	65542	1936q1	96529	1946q4	132698	1957q3	192198	1968q2	304875	1979q1	380583	1989q4	481415	2000q3	598352	2011q2	755351
1914q4	52148	1925q3	67466	1936q2	97087	1947q1	135549	1957q4	191271	1968q3	305290	1979q2	381896	1990q1	480817	2000q4	602674	2011q3	762138
1915q1	53372	1925q4	68406	1936q3	98377	1947q2	138447	1958q1	195261	1968q4	309053	1979q3	387094	1990q2	483017	2001q1	602840	2011q4	746019
1915q2	54863	1926q1	69235	1936q4	100068	1947q3	140025	1958q2	195588	1969q1	315668	1979q4	390967	1990q3	478059	2001q2	601581	2012q1	750865
1915q3	60192	1926q2	69109	1937q1	101344	1947q4	139745	1958q3	195574	1969q2	318476	1980q1	394028	1990q4	481397	2001q3	605618	2012q2	753509
1915q4	56928	1926q3	68736	1937q2	102465	1948q1	140948	1958q4	196696	1969q3	321859	1980q2	373537	1991q1	481089	2001q4	608853	2012q3	753726
1916q1	57354	1926q4	67650	1937q3	103354	1948q2	141768	1959q1	202146	1969q4	321087	1980q3	392720	1991q2	476885	2002q1	606956	2012q4	743800
1916q2	58081	1927q1	69746	1937q4	104871	1948q3	142724	1959q2	204792	1970q1	324774	1980q4	394385	1991q3	472494	2002q2	619860	2013q1	753168
1916q3	59806	1927q2	70129	1938q1	106538	1948q4	143626	1959q3	208473	1970q2	331093	1981q1	382952	1991q4	471115	2002q3	621460	2013q2	758085
1916q4	60676	1927q3	72320	1938q2	106223	1949q1	144201	1959q4	208148	1970q3	346387	1981q2	386878	1992q1	484930	2002q4	621633	2013q3	762663
1917q1	57613	1927q4	73365	1938q3	105602	1949q2	145139	1960q1	214345	1970q4	351723	1981q3	391891	1992q2	470189	2003q1	626253	2013q4	763723
1917q2	53089	1928q1	71205	1938q4	109816	1949q3	147086	1960q2	214229	1971q1	334108	1981q4	388864	1992q3	472962	2003q2	625347	2014q1	766886
1917q3	54298	1928q2	75259	1939q1	113679	1949q4	148945	1960q3	214774	1971q2	333017	1982q1	391473	1992q4	453367	2003q3	638277	2014q2	773979
1917q4	54215	1928q3	75234	1939q2	116442	1950q1	151213	1960q4	212428	1971q3	341301	1982q2	393756	1993q1	453148	2003q4	638931	2014q3	780155
1918q1	53621	1928q4	76254	1939q3	116447	1950q2	153138	1961q1	215116	1971q4	345713	1982q3	391413	1993q2	459672	2004q1	648236	2014q4	786419
1918q2	54173	1929q1	77205	1939q4	116697	1950q3	155424	1961q2	224601	1972q1	342307	1982q4	395459	1993q3	472894	2004q2	655584		
1918q3	49429	1929q2	78678	1940q1	112740	1950q4	156493	1961q3	229912	1972q2	340551	1983q1	396019	1993q4	460453	2004q3	662856		
1918q4	48453	1929q3	79940	1940q2	101808	1951q1	157520	1961q4	236697	1972q3	348372	1983q2	397385	1994q1	470159	2004q4	670477		
1919q1	54043	1929q4	80409	1940q3	99741	1951q2	158541	1962q1	234440	1972q4	352740	1983q3	403726	1994q2	477180	2005q1	657943		
1919q2	52804	1930q1	84644	1940q4	99611	1951q3	160982	1962q2	231662	1973q1	359530	1983q4	408725	1994q3	485513	2005q2	681236		
1919q3	55731	1930q2	83400	1941q1	100966	1951q4	160395	1962q3	239068	1973q2	356382	1984q1	422213	1994q4	488436	2005q3	683071		
1919q4	52627	1930q3	82805	1941q2	100310	1952q1	160182	1962q4	244822	1973q3	355083	1984q2	413582	1995q1	497706	2005q4	688483		
1920q1	51196	1930q4	81033	1941q3	100452	1952q2	160734	1963q1	239702	1973q4	359295	1984q3	416497	1995q2	496420	2006q1	698052		
1920q2	57737	1931q1	75800	1941q4	101733	1952q3	161943	1963q2	249653	1974q1	361177	1984q4	424155	1995q3	499569	2006q2	704723		
1920q3	66366	1931q2	80004	1942q1	101578	1952q4	163208	1963q3	253794	1974q2	365721	1985q1	422074	1995q4	505686	2006q3	714716		
1920q4	54566	1931q3	82203	1942q2	103217	1953q1	163565	1963q4	258997	1974q3	372565	1985q2	427822	1996q1	511519	2006q4	720423		
1921q1	51566	1931q4	82525	1942q3	106345	1953q2	164350	1964q1	262449	1974q4	370584	1985q3	431397	1996q2	501974	2007q1	725670		
1921q2	47376	1932q1	81349	1942q4	106925	1953q3	165661	1964q2	266634	1975q1	369869	1985q4	433652	1996q3	507506	2007q2	730076		
1921q3	51782	1932q2	78382	1943q1	108324	1953q4	170930	1964q3	270224	1975q2	374040	1986q1	437915	1996q4	507064	2007q3	735427		
1921q4	60641	1932q3	76022	1943q2	109223	1954q1	173471	1964q4	272567	1975q3	375504	1986q2	440071	1997q1	507752	2007q4	743177		
1922q1	53426	1932q4	76465	1943q3	109166	1954q2	176051	1965q1	275928	1975q4	376464	1986q3	441993	1997q2	522284	2008q1	729913		
1922q2	53979	1933q1	77301	1943q4	109295	1954q3	176608	1965q2	276826	1976q1	375214	1986q4	443596	1997q3	525698	2008q2	747551		
1922q3	55401	1933q2	77179	1944q1	110283	1954q4	178790	1965q3	278133	1976q2	376051	1987q1	448197	1997q4	530915	2008q3	738049		
1922q4	65526	1933q3	79649	1944q2	110629	1955q1	179729	1965q4	280267	1976q3	377562	1987q2	452990	1998q1	534387	2008q4	701262		
1923q1	50828	1933q4	82631	1944q3	111746	1955q2	180517	1966q1	280134	1976q4	380844	1987q3	457828	1998q2	541187	2009q1	686053		
1923q2	64480	1934q1	82791	1944q4	114646	1955q3	181650	1966q2	289058	1977q1	368657	1987q4	462229	1998q3	547198	2009q2	692967		
1923q3	64540	1934q2	87078	1945q1	106075	1955q4	183103	1966q3	281553	1977q2	364021	1988q1	466576	1998q4	552206	2009q3	697334		

Table 3: Seven chronologies of the Swedish business cycle

	Denton-Cholette, X13, 13-term filter, seasonalized series, BB-procedure, minimum 5q-cycle	Denton-Cholette, Tramo Seats, seasonalized series, BB-procedure, minimum 5q-cycle	Denton-Cholette, X13, 39-term filter, seasonalized series, BB-procedure, minimum 5q-cycle	Chow-Lin, X13, 13-term filter, Tramo Seats, seasonalized, BB-procedure, minimum 5q-cycle	Denton-Cholette, X13, 13-term filter, seasonalized series, BB-procedure, minimum 8q-cycle	Denton-Cholette, X13, 13-term filter, trend, BB-procedure, minimum 5q-cycle	Denton-Cholette, X13, 13-term filter, 2q falling GDP
	Peak-trough	Peak-trough	Peak-trough	Peak-trough	Peak-trough	Peak-trough	Peak-trough
WWI	**14Q2-18Q4**	**15Q3-16Q1**	**14Q2:17Q2**	**16Q3-18Q3**	**14Q2-18Q4**	**14Q2-17Q3**	**16Q4-17Q2**
		16Q4-18Q4					17Q3-18Q1
			18Q2:18Q4			18Q1-18Q4	18Q2-18Q4
							19Q3-20Q1
Deflation crisis	**20Q3-21Q2**	**20Q3-21Q2**	**20Q3:21Q2**	**20Q3-21Q2**	**20Q3-21Q2**	**20Q3-21Q2**	**20Q3-21Q2**
			21Q4:23Q1				
Harvest failure	**24Q1-24Q3**	**24Q1-24Q3**	**24Q1:24Q4**	**24Q1-24Q3**	**24Q1-24Q3**	**24Q1-24Q4**	**24Q1-24Q3**
	26Q1-26Q4	26Q1-26Q4	26Q1:26Q4		26Q1-26Q4	26Q2-26Q4	26Q1-26Q4
Great depression	**30Q1-31Q1**	**30Q1-31Q1**	**30Q1:31Q1**	**30Q2-31Q1**	**30Q1-31Q1**	**30Q2-31Q1**	**30Q1-31Q1**
Second dip	31Q4-32Q3	31Q4-32Q3	32Q1:32Q3	31Q3-32Q3		31Q4-32Q3	31Q4-32Q3
US recession	38Q1-38Q3						38Q1-38Q3
WWII, outbreak	**39Q4-40Q4**	**39Q2-40Q4**	**39Q2:40Q3**	**39Q3-40Q4**	**39Q4-40Q4**	**39Q3-40Q3**	**39Q4-40Q4**
		43Q2-43Q4					
WWII ends	44Q4-45Q2	44Q4-45Q2	44Q4:45Q2	44Q4-45Q2	44Q4-45Q2		44Q4-45Q2
Korea boom ends	51Q3-52Q1	51Q3-52Q1			51Q3-52Q1		51Q3-52Q1
		57Q2-57Q4					
		60Q1-60Q4				60Q2-60Q4	
	61Q4-62Q2	61Q4-62Q2	61Q4:62Q2		61Q4-62Q2	61Q4-62Q2	61Q4-62Q2
			67Q3:68Q1				
Bretton Woods	70Q4-71Q2	70Q4-71Q2	70Q4:71Q2	70Q3-71Q3	70Q4-71Q2		70Q4-71Q2
							71Q4-72Q2
	73Q1-73Q3	73Q1-73Q3				73Q1-73Q3	73Q1-73Q3
1st oil crisis	74Q3-75Q1	74Q3-75Q1	74Q3:75Q1	74Q2-74Q4			74Q3-75Q1
Structural crisis	76Q4-77Q2	76Q4-77Q2	76Q4:77Q2	76Q3-77Q4	76Q4-77Q2		76Q4-77Q2
Kuwait War		90Q4-91Q3		90Q1-91Q4			90Q4-91Q4
Financial crisis	**92Q1-93Q1**	**92Q1-93Q1**	**92Q1:92Q4**	**92Q3-93Q1**	**92Q1-93Q1**	**90Q2-92Q4**	**92Q3-93Q1**
Dot-com crisis			00Q4:01Q2				
Great recession	**08Q2-09Q1**	**08Q2-09Q2**	**08Q2:09Q1**	**08Q1-09Q1**	**08Q2-09Q1**	**07Q4-09Q1**	**08Q2-09Q1**
				11Q1-11Q3			
Euro crisis	11Q3-12Q4	11Q3-12Q4	11Q3:12Q4	12Q1-12Q4	11Q3-12Q4	11Q3-12Q4	
Number of recessions	18	22	19	15	14	14	22
Average length of recession	3.6	3.1	3.4	3.7	4	4.3	2.5

Highlighted = recession according to all seven chronologies.