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by

Niclas A Krüger
niclas.kruger@esi.oru.se
Swedish Business School
Örebro University
Sweden

Mikael Svensson
mikael.svensson@esi.oru.se
Swedish Business School
Örebro University
Sweden

http://www.oru.se/esi/wps

SE-701 82 Örebro
Sweden

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Good Times Are Drinking Times:
Empirical Evidence on Business Cycles and Alcohol Sales in Sweden 1861-2000

Niclas Krüger[a] and Mikael Svensson[a, b, 1]
[a] Department of Economics, Örebro University
[b] Adolescent Health Research, Karlstad University

Abstract: This paper studies the relationship between the business cycle and alcohol sales in Sweden using a data set for the years 1861-2000. Using wavelet based band-pass filtering it is found that there is a pro-cyclical relationship, i.e. alcohol sales increases in short-term economic upturns. Using moving window techniques we see that the pro-cyclical relationship holds over the entire time period. We also find that alcohol sales are a long-memory process with non-stationary behavior, i.e. a shock in alcohol sales has persistent effects.

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[1] Corresponding author:
mikael.svensson@esi.oru.se
Adolescent Health Research, Karlstad University
Universitetsgatan 2, 651 88, Karlstad, Sweden
+46-54-700-16-61

I. Introduction

Recently there have been a number of papers exploring the relationship between macroeconomic conditions and health. Even though long-term GDP growth is beneficial and a necessity for improved health status, short-term fluctuations may have other consequences. In a series of papers based on US data it has been shown that the short-term impact of increases in the growth rate of GDP is bad for your health (Ruhm, 2000; Ruhm, 2003; Ruhm, 2005). These results have also been confirmed on studies based on German and Spanish data (Neumayer, 2004; Granados, 2005). There have been some exceptions to these results, using data from Nordic countries a counter-cyclical relationship has been found for some cause-specific mortality rates (Gerdtham and Johannesson, 2005; Johansson *et al.*, 2006; Svensson, 2007).

Considering these results, there is a general interest in exploring how different health behaviors changes with the business cycle in order to understand what explains the relationship between mortality rates and business cycles. An important health behavior that may change with economic conditions is alcohol consumption. In economic upturns alcohol-consumption may increase due to increases in income, if alcohol is a normal good. However, alcohol consumption may also increase in economic downturns due to increases in leisure time, decreasing the opportunity cost of drinking. Drinking may also increase if individuals use alcohol as self-medication to cope with economic-related stress. Direct evidence is available from self-reported data, where individuals report that alcohol is a way to deal with job-related and economic-related stress. Further, the evidence for stress-related drinking is reinforced from experimental animal studies, which has shown that stress induces alcohol abuse (Poherecky, 1991; NIAAA, 1996; Dee, 2001).

Some findings based on aggregate state-level US data, as well as individual level data, indicates that drinking, and binge drinking, varies pro-cyclically; i.e. increases in economic upturns (Ruhm, 1995; Ruhm and Black, 2002). Other studies have found that average drinking is pro-cyclical, but binge-drinking is counter-cyclical (Dee, 2001). Considering non-US data, a recent study using Finnish data finds that aggregate alcohol-related mortality decreases in economic upturns (counter-cyclical), while micro-level data indicates that alcohol consumption increases in economic upturns (pro-cyclical).

Taking into account the literature discussed above, the contributions of this paper are the following: (i) we examine the relationship between business cycles and alcohol sales over a much longer time period (between 1861 and 2000), (ii) we explore if the relationship has changed over time, which may be particularly interesting since it has been shown that the relationship between business cycles and mortality has changed significantly over time (Tapia Granados, 2007), and (iii) performing the analysis on Swedish data, since it is not necessarily so that the results based mostly on US data are globally valid.

The methodological approach in the paper is (i) using long-memory tests for persistence in alcohol sales over time, and (ii) using business cycle dynamics based on wavelet band-pass filtering estimating the relationship between the cyclicality of GDP and alcohol sales. Our results indicate that there is a pro-cyclical relationship, i.e. alcohol sales increases in economic upturns. The results on the long-memory test suggest that a shock in alcohol sales has a persistent effect. Both conclusions have a major impact on public health policy, necessitating measures taken with consideration of economic conditions.

II. Results

Figure 1 gives an illustration of the development of alcohol sales in Sweden between 1861-2000 as liters of pure alcohol per capita and year, data coming from CAN (CAN, 2007). In the end of WWI we see a sharp decline in alcohol sales. In 1917 a rationing system was implemented, such that an individual were allowed to purchase a maximum of 2 liters (not pure alcohol) per quarter.[2] Until the 1960s alcohol sales mostly consisted of hard liquor, which has decreased since. After the 1960s sales of beer and wine (expressed in pure liters of alcohol) have, on the other hand, increased.

[Insert Figure 1 here]

We do not see any precise deterministic trend; the observed trend in the series may well be stochastic in nature. Since alcohol sales cannot grow without boundaries we reject, on theoretical grounds, a pure random-walk process. Examining the autocorrelation function, however, reveals a long-range dependency in the stochastic process followed by alcohol sales (see Figure 2). We see that alcohol sales one year depend significantly on sales in the preceding 10 years. The autocorrelation function looks similar if we remove a deterministic linear time trend from the series.

[Insert Figure 2 here]

In order to formally test for long-memory in alcohol sales, we employ a battery of tests for the estimate of the long memory (fractional integration) parameter *d* of a time series, based on the log-periodogram regression (Phillips, 1999; Phillips, 2007) and the local Whittle estimation

[2] Low income-earners, married women or the unemployed were not allowed to purchase alcohol at all.

(Kuensch, 1987; Robinson, 1995; Shimotsu and Phillips, 2005; Shimotsu, 2006). If a series exhibits long memory it is a fractionally integrated process I(*d*) with *d* being a real number. Table 1 shows the results.

[Insert Table 1 here]

We conclude that alcohol sales are a long-memory process with non-stationary behavior since *d* lies between 0.5 and 1 (Percival and Walden, 2000). This has interesting implications since it implies that a shock in alcohol sales has persistent effects on sales (for a unit root process this would be a permanent effect) and thus creating non-periodic cycles which can be misinterpreted as local trends. The evidence for persistence in the time series of alcohol sales is clearly in accordance with the hypotheses that alcohol establishes modified consumption patterns and addiction.

The next question is whether deviations from trend growth, i.e. business cycles, increase or decrease alcohol consumption. We use alcohol sales as a proxy for consumption, considering that the correlation between the two is close to one. We use the Haar-wavelet as a filter in order to separate business cycle dynamics from noise and underlying trend behavior. It can be shown that the Haar-wavelet is approximating an ideal band-pass filter, capturing dynamics with a frequency in the interval [1/8, 1/4].[3] This implies that it captures the typical business cycle variations with a period of 4 to 8 years. Moreover, it removes non-stationarity and long-term dependence from the time series.

[3] We use the second scale in a maximum overlap discrete wavelet transform (MODWT), see e.g. Percival and Walden (2000).

The results from the contemporaneous correlation coefficient between alcohol sales (natural log differences) and GDP is highly significant (p-value<.01) and positive (rho=.48). Hence, alcohol sales clearly increase during economic upturns and decreases during downturns. In Figure 3 we use a moving window approach in order to estimate the correlation for sub-samples of 20 year-periods so that changes in the relationship during time are revealed. The pattern is consistent over time, with exception of a temporary breakdown of the relationship for time-windows around the end of the 19th century.

[Insert Figure 3 here]

Using time series analysis allows us to test for causality in the Granger (Granger, 1969) sense between growth (GDP) and alcohol sales (SALES). That is, we test whether past values of one variable can contribute in predicting actual values of another variable. We estimate the following vector autoregressive model (VAR) for the wavelet-filtered data:

$$SALES_t = a_0 + \sum_{i=1}^{k} a_i SALES_{t-i} + \sum_{i=1}^{k} b_i GDP_{t-i} + e_{1t} \quad (1)$$

$$GDP_t = c_0 + \sum_{i=1}^{k} c_i SALES_{t-i} + \sum_{i=1}^{k} d_i GDP_{t-i} + e_{2t} \quad (2)$$

The number of lags to include is decided using the Schwartz information criteria (SIC). We test for granger causality by constructing a joint F-test for the inclusion of lagged values of SALES and GDP (Granger, 1986). The null hypotheses is that the coefficients for GDP in equation 1 and the coefficients for SALES in equation 2 are zero, that is, they do not contribute in reducing the variance in forecasts of SALES and GDP, respectively. If both null hypotheses are accepted we have a feedback mechanism between SALES and GDP. If both null hypotheses are rejected we have inconclusive results regarding the causal relationship. In

order to conclude that causality is unidirectional we must have that one null hypothesis is rejected and that one null hypothesis is accepted at conventional significance levels. The results are shown in Table 2.

[Insert Table 2 here]

We find that the granger causality tests for business cycle dynamics are inconclusive, probably because the contemporaneous effect dominates. However, if we filter the data to capture 8 to 16 year period dynamics we are better able to distinguish dynamic effects and find that GDP granger causes sales.

III. Conclusions

Using a data set on alcohol sales and GDP in Sweden for the years 1861 to 2000, we find that alcohol sales, which is naturally closely connected to alcohol consumption, increases in economic upturns. In good economic times, drinking increases. This has potential policy implications for the timing of public health policy interventions to reduce consumption. Further, we also found that alcohol sales are a long memory process with non-stationary behavior. The implication is that that a shock in alcohol sales has persistent effect on sales, e.g. consistent with the fact that alcohol creates an addiction.

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Tables

Table 1. Estimate of fractional differencing parameter *d* for alcohol

Method	**Estimate of *d***
Modified Log-Periodogram Regression estimator	0.82
Local Whittle (LW) estimator	0.72
Exact LW (ELW) estimator	0.82
Feasible ELW estimator	0.73
Feasible ELW estimator (detrended)	0.73
2-step feasible ELW estimator	0.70
2-step feasible ELW estimator (detrended)	0.72

Table 2. Granger causality SALES and GDP 1861-2000

Filter	**Direction of causality**
D2 (4-8 years)	Inconclusive
D3 (8-16 years)	GDP=>SALES***

***p<0.01, **:05, *0.10

Figures

Figure 1. Alcohol sales (liters of pure alcohol per person) in Sweden 1861-2006

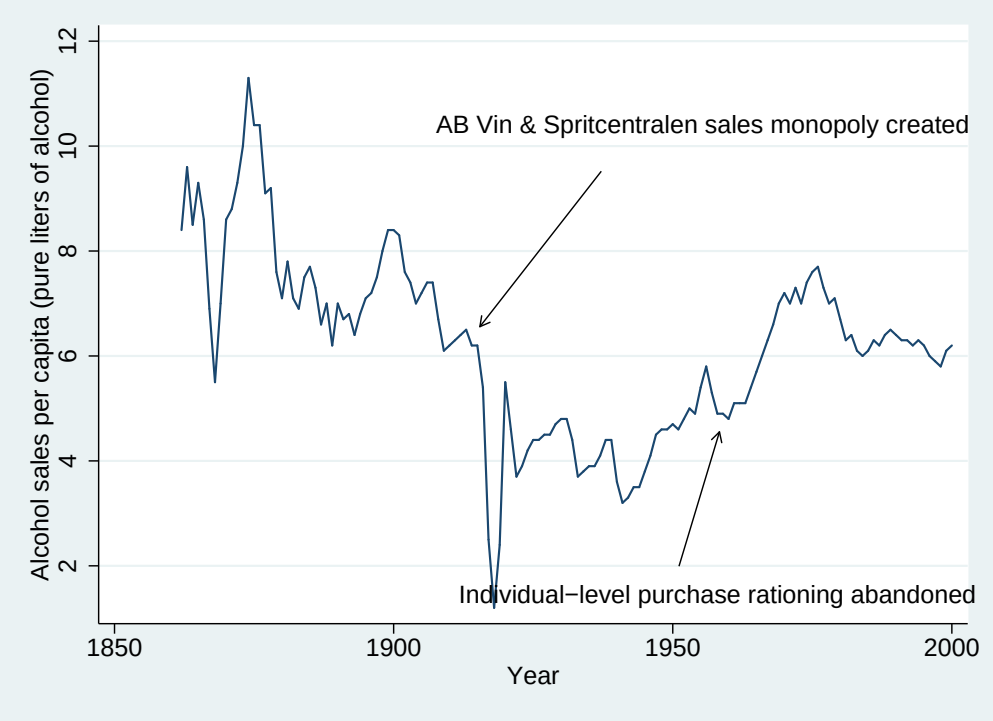

Figure 2. Autocorrelation function for alcohol sales

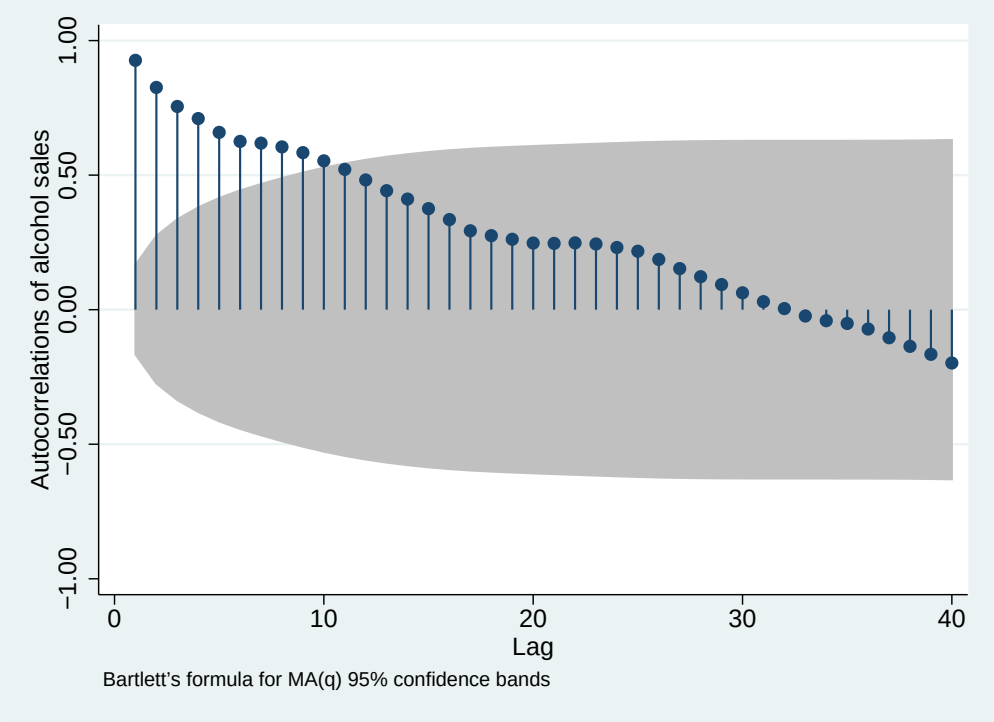

Figure 3. Correlation for moving windows (width 20 years, step 5 years)