

PRICE TRANSMISSION AND PASS-THROUGH EFFECT IN U.S. ALCOHOLIC BEVERAGE INDUSTRIES

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Abstract

This paper examines the time-series properties of price changes among sectors of the U.S. alcoholic beverage industries. Utilizing vector autoregression and impulse response analysis, the pass-through effect between the producer price index and consumer price index is examined for breweries, distilleries, and wineries. The findings suggest that industry-level price changes are stationary with significant pass-through effects in breweries and wineries. The implications are that price shocks are temporary and may transmit onto consumers in the form of higher (or lower) prices. Understanding industry-level price dynamics are important to managers in formulating long-term cost estimates, budget formation, and forecasting price changes in alcoholic beverage industries.

Keywords: Inflation, Stationarity, Vector Autoregression, Pass-Through Effect, Alcoholic Beverage Industries

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1. Introduction

Industry analysts and managers need accurate cost estimates for budgeting and planning purposes. For example, managers often design long-term strategies based on an inflation rate forecast. Therefore,

knowledge and understanding of the time-series properties of their respective industry inflation rate may lead to better cost estimates, better forecasts and, subsequently, better planning and decision-making. While it is important to know the industry-level pricing dynamics, it is also important to understand how producer price shocks affect consumer prices (i.e., pass-through effect). Since allocating resources among these industries requires knowledge about how prices respond to unexpected (price) changes, this paper examines industry-level inflation rates and how producer price index (PPI) shocks affect the respective consumer price. In particular, the producer prices for breweries, distilleries, and wineries are examined, along with the consumer price index for beer, ale, and other malt beverages at home (CPI-beer), distilled spirits at home (CPI-spirit), and wine at home (CPI-wine).

Several papers have examined the pass-through effect or how the price mechanism works through the supply chain (e.g., Bills, 1987; Clark, 1995). While the price transmission process depends on several factors, there are reasons to specifically examine the alcoholic beverage industries of breweries, distilleries, and wineries. The US alcoholic beverage industry contributes over \$300 billion in total economic activity (*Beverage World*, 2007). The industry also contributes substantially to state and local governments through the various taxes imposed on alcohol. This is especially true with respect to distilled spirits, where there is a higher tax burden compared to wine and beer. Even though there are many similarities across these industries, differences in consumer tastes and market concentration may lend itself to difference in the pass-through effect (Tremblay, 1987; Heien and Pompelli, 1989; Elzinga, 1990, Xia and Buccola, 2003). Therefore, we are interested in examining the price transmission and pass-through effect in these alcoholic beverage industries. Industry analysts and forecasters should understand how shocks transmit to consumer prices, because they value accurate pricing and wish to pursue competitive market strategies. For example, when prices are lower than anticipated, can firms expect this condition to continue indefinitely or will prices return to some “normal” level? Thus, key questions arise with respect to the time-series behavior of industry-level price changes. Following an industry-specific price shock, can managers expect this new price level to remain permanent or revert to some “long-run” or “normal” level? In addition, if the shock dissipates, then how long does this adjustment take? Finally, do producer price shocks pass through to the respective consumer price?

This paper examines the time-series properties of industry-level inflation by conducting standard stationarity tests and employing the

innovation accounting technique known as impulse response analysis to examine the pass-through effect. The results have implications for forecasting and budgeting, and also highlight the pass-through effect in each industry that may arise following unexpected changes in demand conditions, supplier availability, economic and political environment, production capabilities, and technology, among others.¹ Generally speaking, innovation accounting allows for the simulation of how the consumer price (e.g., CPI-beer, CPI-spirit, and CPI-wine) responds to *unexpected* changes in the producer price of the respective industry (e.g., PPI-breweries, PPI-distilleries, and PPI-wineries) over time.²

2. Data, Methodology, and Results

This study uses monthly Producer Price Index (PPI) from the U.S. Bureau of Labor Statistics for three major alcoholic beverage industries (i.e., breweries, distilleries, and wineries) over the period January 1992 to June 2006. A representative Consumer Price Index (CPI) measure is used for each industry.³ The industry-level PPIs are plotted in Figure 1 and the respective CPIs are in Figure 2. While there is an upward trend in each of the price series, there are some differences across the different industries. The consumer prices are higher than the producer prices for each industry as expected if there is a significant pass-through effect from producer to consumer prices. In addition, there are movements in producer prices reflected in consumer prices for each of the industries. However, movements between the two price series (i.e., PPI and CPI) are not one-to-one. There are periods when changes in the PPI for a particular industry do not seem to be reflected in CPI changes. Visual inspection may indicate a pass-through effect, but empirical

¹ As Clark (1995) pointed out, however, the pass-through effect may be weakened for conceptual and definitional differences. One such difference worth mentioning is sales and excise taxes (in alcoholic beverage industries). PPI represents the revenue received by the producer and such taxes are not included (as they do not represent revenue to the producer). However, the CPI is the price collected for the item by a consumer and sales and excise taxes are included.

² Unexpected changes in a variable are referred to as shocks in the statistical time-series literature (Harvey, 1994).

³ In particular, CPI-beer, ale, and other malt beverages at home (for breweries), CPI-distilled spirits at home (for distilleries), and CPI-wine at home (for wineries).

testing is needed to further examine the pass through between producer and consumer prices.

If the industry-level price series is nonstationary, then a sudden, unexpected increase will lead to a permanent increase in the price level. On the other hand, unexpected changes to a stationary series are only temporary as the shock will dissipate over time. In order to estimate vector autoregression (VAR) models, the data series need to be stationary. If the price series is not stationary, then the data may require first-differencing or some comparable transformation (Enders, 2004). Therefore, pre-testing the data series for stationarity is important prior to modeling the VAR.

The augmented Dickey-Fuller (ADF) (1981), the Phillips-Perron (PP) (1988), and the Kwiatkowski et al. (KPSS) (1992) unit root testing procedures were employed to examine the stationarity of the price series for each industry.⁴ Overall, the results of the stationarity tests are presented in Table 1 and indicate that each price series is nonstationary.⁵ Since nonstationary series are problematic for VAR modeling, annualized inflation rates are employed in the VAR. Stationarity test results for annualized inflation rates, calculated as the change in the logged price series times 1200, are report in the lower half of Table 1. A finding of stationarity means that shocks to these series are temporary as the inflation rate will revert back to its long-run historical mean. Thus, using historical values may be useful for forecasting future industry-level inflation, especially understanding how long shocks take to fully dissipate. As such, the descriptive statistics on the industry-level annualized inflation rates are reported in Table 2. Over the sample period, there is a lot of similarity across the different industries. For example, the annualized inflation rates are similar ranging for 1.4 to 1.9 percent. While the descriptive statistics may indicate that the growth rates in producer and consumer prices are similar on average across the three alcoholic beverage industries, there may be evidence of producer prices passing through to consumers. In order to examine the adjustment process and pass-through effect, VAR models and impulse response functions are estimated for each industry.

VAR and impulse response analysis is required to examine the (potential) pass-through effect between producer and consumer prices in

⁴ For further discussion of unit root testing, see Enders (2004).

⁵ The KPSS unit root test statistic for PPI-Distilleries is rejected at the 10 percent level.

the alcoholic beverage industries. The VAR(m) model for each industry can be written using matrix notation as follows:

$$(4) \quad \mathbf{INF}_t = \mathbf{a}_0 + \beta(L)\mathbf{INF}_{t-1} + \mathbf{v}_t$$

Here, \mathbf{INF}_t is the 2x1 vector of PPI and CPI inflation rates (i.e., breweries and beer, distilleries and distilled spirits, and wineries and wines), \mathbf{a}_0 the constant term vector, and \mathbf{v}_t be the corresponding disturbance vector (i.e., shocks to the inflation rates). L denotes a polynomial in the lag operator, thus, the right-hand-side of equation (4) contains only past values of the industry-level PPI and CPI inflation rates, as well as, the constant and error terms.

The main interest of this paper is to examine the industry-level PPI and CPI inflation rates to price (inflation) shocks. As such, own inflationary shocks are examined and measured, as well as, the pass-through effect. Consistent with the time-series literature, a shock is defined as an unexpected change in some variable, i.e., the inflation rate. Consider the following moving average representation of the two-equation VAR(m) model:⁶

$$(5) \quad \mathbf{INF}_t = \Psi(L)\mathbf{v}_t$$

Let $E(\mathbf{v}_t\mathbf{v}'_t) = \Sigma_v$ such that the PPI and CPI inflation shocks are contemporaneously correlated. The generalized impulse response function of INF_i to a unit (one standard deviation) shock in INF_j is given by:

$$(6) \quad GIRF_{ij,h} = (\sigma_{ii})^{-1/2} (\mathbf{e}'_j \Sigma_v \mathbf{e}_i)$$

where σ_{ii} is the i^{th} diagonal element of Σ_v , \mathbf{e}_i is a selection vector with the i^{th} element equal to one and all other elements equal to zero, and h is the horizon measured in months.⁷

⁶ The constant term has been removed for simplicity in writing the notation.

⁷ One such criticism to the conventional impulse response method is the assumption of orthogonality. This assumption is a problem when the error terms in the VAR system are contemporaneously correlated. According to Lutkenpohl (1991), the impulse responses from the VAR model may display noticeably different time paths depending on the ordering of the variables in the VAR. The *generalized* methodology of Pesaran and Shin (1998) and Koop, Pesaran, and Potter (1996) provided more robust results, since this methodology does not impose the orthogonality restriction. Thus, the resulting impulse responses are not sensitive to the ordering of the variables in the VAR.

The order of the VAR models is two for Breweries/Beer VAR and Wineries/Wine VAR based on AIC criteria. Distilleries/Spirit VAR is estimated as a VAR(1). After each industry's VAR model is estimated (and the estimation results are available upon request), a one-standard deviation shock is imposed to each industry's PPI and CPI inflation series and the impact traced out to 6 months for breweries and beer in Figure 3, distilleries and distilled spirits in Figure 4, and wineries and wine in Figure 5. The use of confidence intervals representing plus/minus two standard deviations indicates significance of the impulse responses (Runkle, 1987). When the confidence bands do not straddle the line at zero, the impulse response is considered to be statistically different from zero at the 5 percent level or less ($p\text{-value} \leq 0.05$).

The simulated responses to (own) producer and consumer price inflation shocks are similar by industry. For example, the producer or consumer price inflation shock takes 1 month before it fully dissipates (or reverts back to its long-run mean). The differences among the different industries exist in the pass-through effects. Figure 3 shows no significant response in PPI-Breweries price inflation to a shock in the CPI-Beer inflation rate. However, there is a significant pass-through effect from PPI-Breweries to CPI-Beer. While there is no (significant) initial response, a PPI-Breweries inflation shock is passed unto consumers in the form of higher CPI-Beer inflation rate in the second and third month before the shock fully dissipates. This finding may support the notion of breweries being competitive in their respective regional markets before the pass through takes place and dissipates shortly thereafter. Interestingly, no significant pass through exist in the distilleries and spirit industry as evident in Figure 4. This finding may support the idea that the declining demand for spirits does not allow distilleries to pass on price shocks to consumers. In addition, distilleries may be capable of absorbing price shocks across the different international and product markets. In Figure 5, there is a significant pass-through effect. Unlike the PPI-Breweries and PPI-Distilleries, PPI-Wineries inflation rate responds to unexpected consumer price changes (to wine), although short lived as the response reverts back to its long-run mean inflation rate the next month. While the pass-through effect is significant in the initial month, it reverts back in the following month before fully dissipating two months later. This result is similar to the brewing industry in terms of significant pass-through effect, but differs in timing.

These results provide information about how long industry-level inflationary shocks last and the pass-through effect on producer and consumer prices, which would be beneficial to managers for budgeting,

planning, and forecasting purposes. The results also illustrate the importance of modeling each industry separately as the pass-through effect and timing of shocks differ depending on the industry.

3. Concluding Remarks

Research on industry-level cost analysis related to the beverage industry is lacking. Previous work focused on the pricing dynamics and its transmission process in many other industries or agricultural markets. However, studies of the time-series properties of industry-level inflation rates in the alcoholic beverage industries are noticeably missing from the literature. The issue of industry-level inflationary dynamics is important as managers utilize forecasting techniques, develop long-term cost estimates, and make budgeting decisions.

Therefore, this research examines the times-series properties of industry-level inflation utilizing multiple-equation time series analysis and innovation accounting to improve the understanding of the U.S. alcoholic beverage industry. In particular, this paper examines the adjustment paths of inflationary shocks on breweries, distilleries, and wineries, as well as, the pass-through effect onto consumer prices. The findings suggest that industry-level inflation is a stationary process and shocks to the series are temporary. Hence, analysts could use historical inflation rates to develop pricing models and forecasts. The results also indicate differences in these industries in terms of both own inflationary responses and in the transmission process.

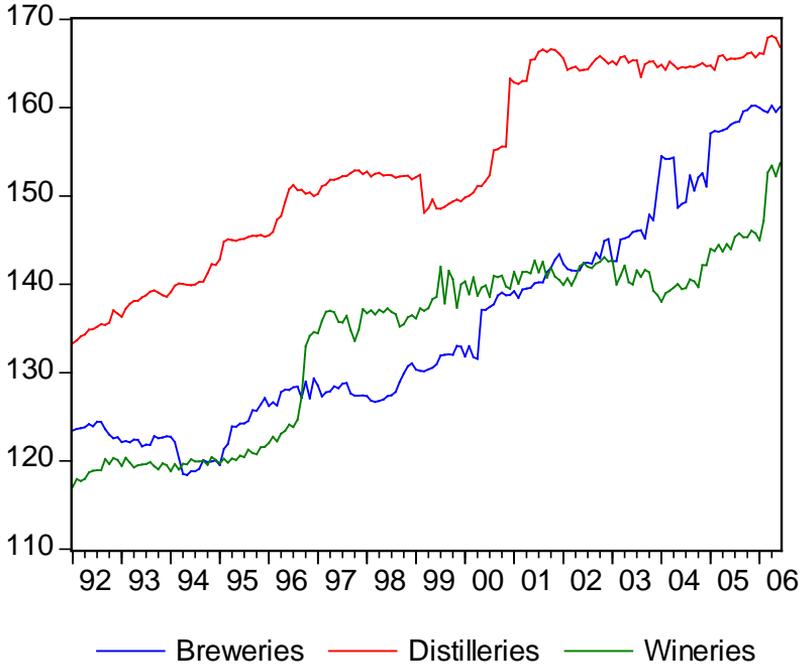
Financial analysts will benefit from understanding industry pricing and how price shocks get passed through to consumers. Since the results indicate differences across the three alcoholic beverage industries, analysts may not want to group them into one broad category. Local and state governments may also be interested in these results to have a better understanding of how producer price shocks get transmitted to consumers and ultimately in the form of higher tax revenue collections. Understanding the pass-through effect may yield better tax policies in terms of the impact on these different alcoholic beverage industries.

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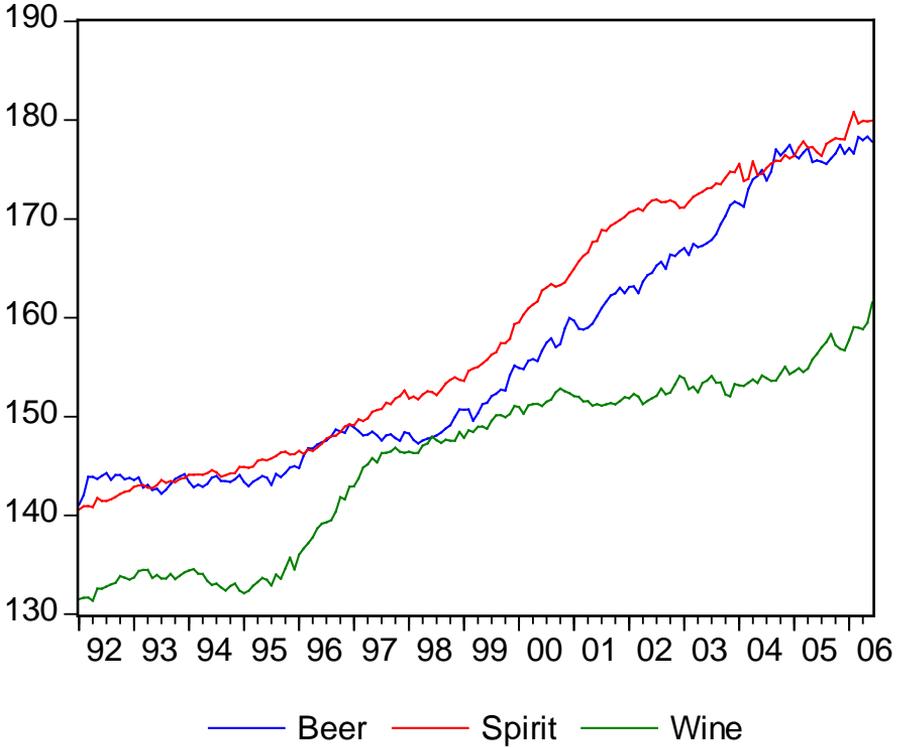
Xia, Y. and Buccola, S., Factor use and productivity change in the alcoholic beverage industries, *Southern Economic Journal*, 2003, **70**, 93-109

Figure 1. Producer Price Indexes



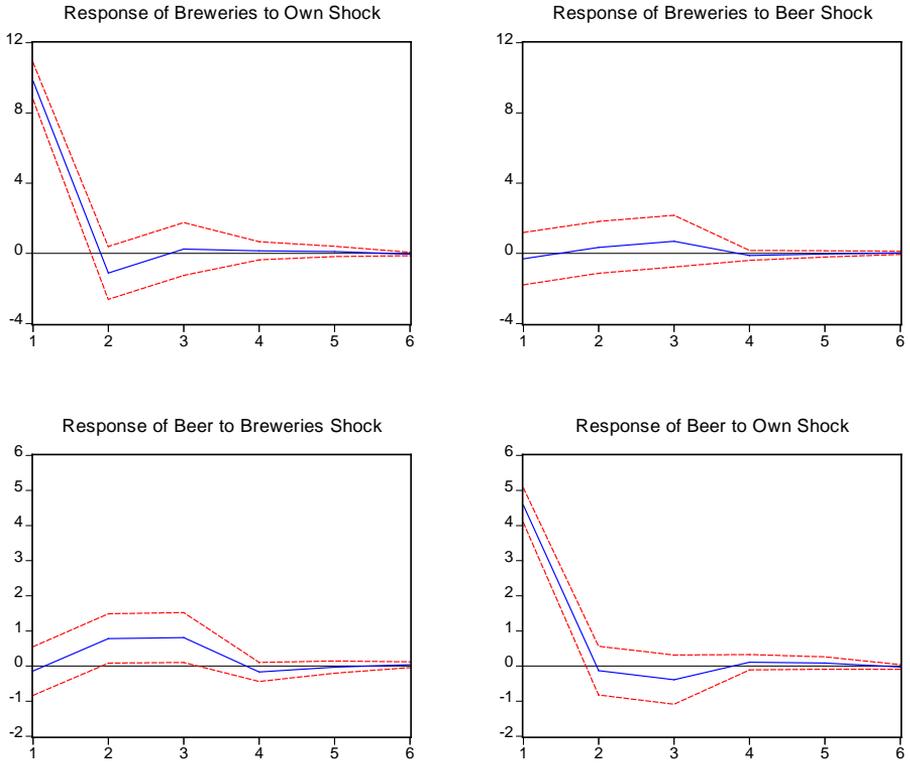
Notes: The sample period is January 1992 to June 2006 for 174 (seasonally adjusted) monthly observations. Breweries, Distilleries, and Wineries represent the respective PPI for those industries. Data are from the U.S. Bureau of Labor Statistics.

Figure 2. Consumer Price Indexes



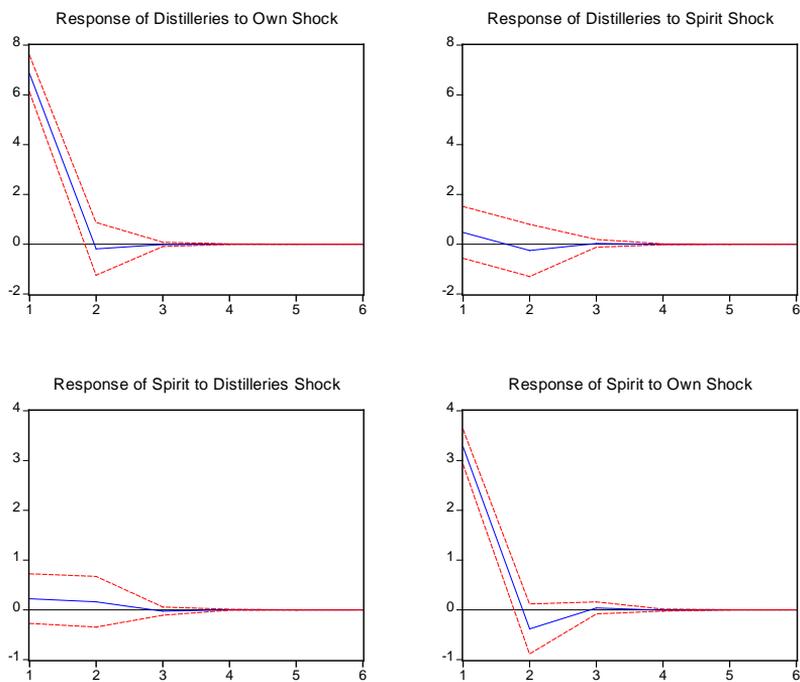
Notes: The sample period is January 1992 to June 2006 for 174 (seasonally adjusted) monthly observations. Beer represents the CPI-beer, ale, and other malt beverages at home. Spirit represents the CPI-distilled spirits at home. Wine represents the CPI-wine at home. Data are from the U.S. Bureau of Labor Statistics.

Figure 3. GIRFs for U.S. Breweries/Beer Industry



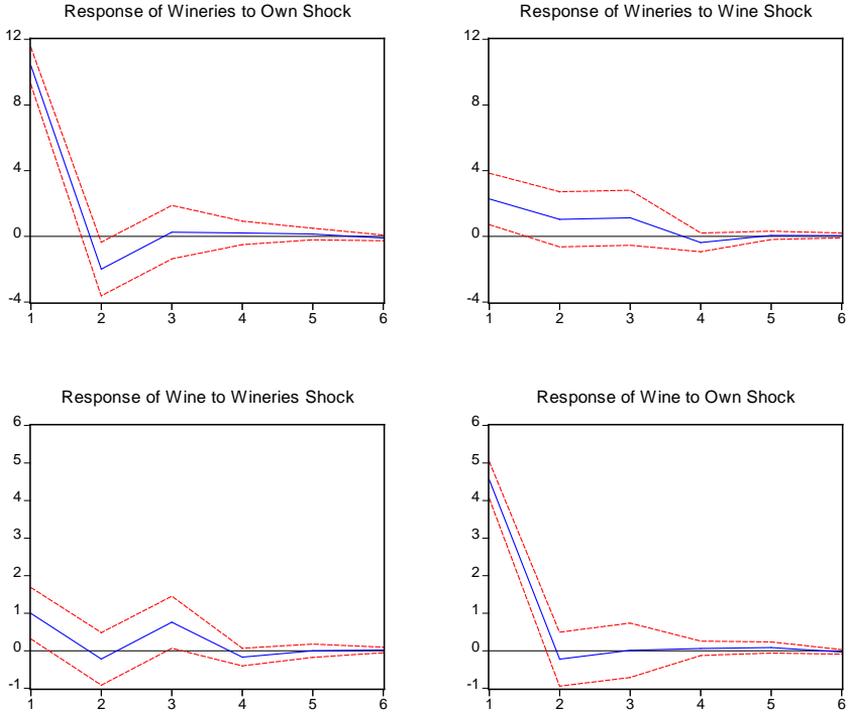
Notes. The horizontal axis is the number of month. The bands represent plus or minus two standard deviations.

Figure 4. GIRFs for U.S. Distilleries/Spirit Industry



Notes. The horizontal axis is the number of month. The bands represent plus or minus two standard deviations.

Figure 5. GIRFs for U.S. Wineries/Wine Industry



Notes. The horizontal axis is the number of month. The bands represent plus or minus two standard deviations.

Table 1. Stationarity Tests

	ADF	PP	KPSS
<i>Prices</i>			
PPI-Breweries	-2.664	-2.481	0.322**
PPI-Distilleries	-1.680	-1.965	0.129
PPI-Wineries	-1.912	-1.729	0.261**
CPI-Beer	-1.683	-1.632	0.371**
CPI-Spirit	-1.735	-1.646	0.237**
CPI-Wine	-1.323	-1.316	0.254**
<i>Inflation Rates</i>			
PPI-Breweries	-14.718**	-14.844**	0.246
PPI-Distilleries	-14.663**	-14.694**	0.313
PPI-Wineries	-15.573**	-15.502**	0.095
CPI-Beer	-13.117**	-13.117**	0.237
CPI-Spirit	-13.330**	-13.438**	0.165
CPI-Wine	-13.427**	-13.437**	0.148

Notes: The critical values for ADF and PP tests (null hypothesis of unit root) were obtained from MacKinnon (1996) and the asymptotic critical values for the KPSS test (null hypothesis of stationarity) were obtained from Kwiatkowski et al. (1992). * (**) denotes significance at the 5 (1) percent level. Lag length is determined by Akaike information criterion (AIC).

Table 2. Descriptive Statistics on Industry-Level Inflation

	Mean	Maximum	Minimum	Standard Deviation
PPI-Breweries	1.803	49.561	-44.953	9.796
PPI-Distilleries	1.557	57.785	-34.455	6.793
PPI-Wineries	1.890	52.446	-35.536	10.573
CPI-Beer	1.606	15.556	-9.783	4.680
CPI-Spirit	1.712	12.149	-12.017	3.271
CPI-Wine	1.426	15.384	-10.530	4.541

Note: Annualized inflation rates are calculated on the adjusted sample period of February 1992 to June 2006 for 173 monthly observations.