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Dynamic analysis of source-based preferences: the case of imported beer in China

Andrew Muhammad
The University of Tennessee Institute of Agriculture, Knoxville, Tennessee, USA
Anthony R. Delmond
The University of Tennessee at Martin, Martin, Tennessee, USA, and
Frank K. Nti
US Department of Agriculture, Foreign Agricultural Service, Washington, District of Columbia, USA

Abstract

Purpose – Chinese beer consumption has undergone major changes within the last decade. The combination of a growing middle class and greater exposure to foreign products has resulted in a significant increase in beer imports. The authors examined transformations in this market and how beer preferences have changed over time. This study focuses on changes is origin-specific preferences (e.g. German beer and Mexican beer) as reflected by habit formation (i.e. dynamic consumption patterns) and changes in demand sensitivity to expenditure and prices.

Design/methodology/approach – The authors estimated Chinese beer demand – differentiated by source – using a generalized dynamic demand model that accounted for habit formation and trends, as well as the immediate and long-run effects of expenditures and prices on demand. The authors employed a rolling regression procedure that allowed for model estimates to vary with time. Preference changes were inferred from the changing demand estimates, with a particular focus on changes in habit formation, expenditure allocating behaviour, and own-price responsiveness.

Findings – Results suggest that Chinese beer preferences have changed significantly over the last decade, increasing for Mexican beer, Dutch beer and Belgian beer. German beer once dominated the Chinese market. However, all indicators suggest that German beer preferences are declining.

Originality/value – Although China is the world's third largest beer importing country behind the United States and France. Few studies have focused on this market. While dynamic analyses of alcoholic beverage demand are not new, this is the first study to examine the dynamics of imported beer preferences in China and implications for exporting countries.

Keywords Beer, China, Demand, Europe, Imports, Mexico, Preferences, Rolling regression, Source-differentiation

Paper type Research paper

1. Introduction

Chinese beer consumption has undergone major changes within the last decade. The combination of a growing middle class with rising disposable income and greater exposure to foreign products has resulted in a significant increase in the demand for imported beer. While this has primarily been in large urban and coastal areas, this trend has also spread to less

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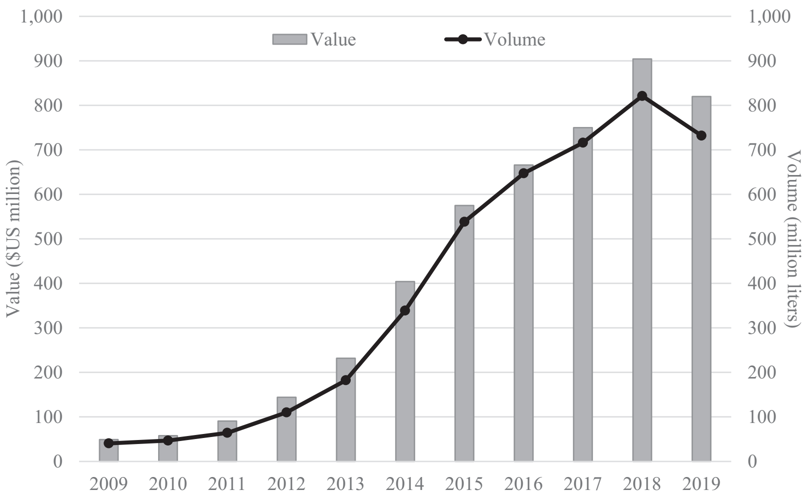
developed cities (Mersol and Luo, 2018). With annual consumption at 46 billion litres, China is the largest beer market in the world – twice the size of the American market and more than five times that of Germany (Nogueira and Jazcii, 2018). China ranks 43rd globally on a per capita basis (29 litres/person/year), about one-third and one-fourth the per-person intake in the United States and Germany (Kirin Beer University, 2019).

Although domestic beer accounts for over 90% of total consumption (Mersol and Luo, 2018), domestic production has been declining and beer imports have increased significantly (Nogueira and Jazcii, 2018). During 2000–2010, Chinese beer imports averaged about $48.0 million annually. Since 2010, imports have steadily increased to over $900 million by 2018, which is an increase of about 1,800% (Figure 1). China ranked 27th among beer importing countries in 2009. In 2018, however, China was the world's third largest beer importer behind the United States and France (United Nations, 2019). This increase is indicative of overall patterns in global demand, with declines in traditional beer-drinking nations like Germany, Belgium, and the United States, and consumption growth in emerging economies like China, Russia, and Brazil (Swinnen, 2017).

The rising importance of China as a major market for agricultural and food exports from Western countries cannot be overstated. Of the many sectors experiencing rapid growth, Chinese demand for imported beer, wine, and spirits stands out. While Chinese wine consumption and imports have been studied at length (Anderson and Wittwer, 2015; Camillo, 2012; Masset *et al.*, 2016; Muhammad and Countryman, 2019; Muhammad *et al.*, 2014; Thorpe, 2009), less attention has been given to the recent rise in beer imports (Gao *et al.*, 2018; Wang *et al.*, 2017). When considering the significant growth in Chinese beer imports, the following questions arise. Has China experienced a universal shift in imported beer preferences or have preference changes been source-specific (e.g. a greater or lesser preference for German beer relative to Belgian beer)? Have preference changes affected consumption or importing behaviour? That is, are preference changes reflected by demand becoming more or less sensitive to income or prices, or by past consumption having a greater or lesser effect on present consumption?



Note(s): HS 220300, *Beermade from malt*

Source(s): Global Trade Atlas®

Figure 1. Chinese beer imports: 2009–2019

To address these questions, we examine imported beer demand in China assuming a source-differentiated framework (i.e. product heterogeneity due to country of origin). We use the generalized dynamic Rotterdam model developed by Bushehri (2003) for estimation, which can account for habit formation and trending behaviour, as well as the immediate and long-run effects of expenditures and prices on demand. Given the considerable changes in the Chinese market over the last decade, it is likely that imported beer preferences have changed accordingly. Preference changes could simply be represented by a time trend in an empirical model, but if changes are not smooth, a more sophisticated approach is needed (Brækkan *et al.*, 2018). Preference changes could also be reflected by discrete shifts in fundamental behavioural relationships such as consumer responsiveness to income or prices (Eales and Unnevehr, 1988; Moschini and Meilke, 1989; Rickertsen, 1996). However, the continual growth in Chinese beer imports suggests that a discrete approach may not fully capture how preferences might have changed over time. Instead of a discrete approach, we use a dynamic estimation procedure (rolling regression) that can account for continual and varying adjustments in the estimated parameters (Brown *et al.*, 1975; Zanin and Marra, 2012; Zivot and Wang, 2007).

Using monthly import data, we estimate China's demand for imported beer by source (Belgium, Germany, the Netherlands, Mexico, etc.), and derive import demand elasticities for each source. We estimate the model using a five-year window (60 months), rolling forward in time by adding and dropping an observation with each estimation run. We sequentially plotted the demand estimates and elasticities and corresponding standard errors from each estimation run and examined changes over time. Preference changes are inferred from how the estimates varied, with a particular focus on changes in habit formation, expenditure allocating behaviour, and own-price responsiveness.

Beer demand is driven by a complex network of factors including income, price, exposure, status, image perception, novelty, and sensory elements (Betancur *et al.*, 2020). Many studies of beer demand focus on these factors. For instance, numerous econometric analyses have focused on willingness to pay for sensory elements or individual quality perceptions (Donadini and Porretta, 2017; Gabrielyan *et al.*, 2014). Malone and Lusk (2018) identified consumer perceptions as a major driver of choice in the beer market. Exposure generally affects consumer preferences and food choice (Zellner, 1991). Foreign influences have also been shown to affect consumption patterns. For instance, McCluskey and Shreay (2011) find that international students studying in the United States developed a stronger preference for American beer due to increased exposure. Deconinck and Swinnen (2015) examined rising beer demand in Russia and found that peer effects play an important role in product adoption and spread. Although our study will not evaluate the key causes of shifting or changing preferences, we can infer preference changes by observing changes in consumption patterns and demand behaviour.

Demand elasticity estimation is the most abundant area of research on alcoholic beverage consumption, with some studies considering beer, wine, and spirits simultaneously (Fogarty, 2010; Gallet, 2007), and others focusing on beer specifically (Hogarty and Elzinga, 1972; Nelson, 2014; Speece Mark *et al.*, 1994; Toro-González *et al.*, 2014). Tian and Liu (2011) use data from 1993 to 2006 on Chinese alcohol demand and reported a price elasticity for beer near zero. However, their analysis focused primarily on individual respondents rather than large-scale trends, and did not account for shifting or changing preferences or other dynamic effects. In fact, many studies of alcohol demand provide only static analysis. However, a dynamic framework allows for observing trends, short- and long-run expenditure and price responsiveness, as well as how past choices affect current demand. Although this type of framework is more common in the wine literature, there have been some dynamic beer demand applications (Grosová *et al.*, 2017; Tomlinson and Branston, 2014), but this type of framework has yet to be applied to the Chinese beer market.

Only recently have beer demand studies considered preferences due to production source or country of origin (Calvo Porral and Levy-Mangin, 2015; Gao *et al.*, 2018), though we know this to be a significant driving factor for other alcoholic beverages, particularly wine. Capitello *et al.* (2015) specifically address how country of origin affects consumers demand for imported wine in China. They find that the price elasticity of demand for wine in China differs by country of origin and type (sparkling, still bottled, and bulk wine). Muhammad *et al.* (2014) also examined source-differentiated wine demand in China and found similar results. To the best of our knowledge, the present study provides the first systematic examination of dynamic changes in Chinese beer demand due to source-based preferences.

2. The Chinese beer market

China's relationship with beer dates back as early as 7,000 BCE (Bai *et al.*, 2011). Production waxed and waned over the ensuing centuries, and the first modern breweries in China were opened around the turn of the 20th century. Similar to other Asian countries, the evolution of the beer industry in China was closely linked to historical and cultural developments, and the Chinese were slow to adopt beer as a preferred alcoholic beverage (Pilcher, 2016). This changed throughout the century as shifting demand and sweeping economic reforms caused the industry to expand significantly leading into the 1980s. As the number of domestic producers increased, China went from being in the bottom half of nations in total beer consumption by volume in 1979 to being second behind Germany by 1995 (Bai *et al.*, 2011). In 2006, China became the largest beer consuming country in the world (Colen and Swinnen, 2016).

Historically, the domestic beer industry in China has competed on the basis of price rather than quality. This has kept the number of domestic producers relatively low as only economies of scale allowed them to maintain the revenue necessary to stay in business. Low prices, in turn, have hampered foreign imports and led to foreign firms seeking joint ventures, mergers, and acquisitions to access the Chinese market in the 1990s with limited success. Foreign marketing strategies and advertising campaigns failed to gain traction. However, trends began to shift after China officially joined the WTO (Bai *et al.*, 2011).

Since Chinese beer products have been fairly homogeneous, foreign companies have a competitive edge in providing differentiated and high-quality beer products. As incomes in China have risen, exporters are increasingly able to exploit this dynamic (Mersol and Luo, 2018). With increased exposure, Chinese preferences for imported beer have been expanding relative to domestic beer (Nogueira and Jazcii, 2018). Despite recent developments in domestic production, such as the expansion of independent craft brewing in China and foreign-domestic mergers (Li *et al.*, 2018), imports increased nearly 1,800% between 2009 and 2018 as shown in Figure 1, and prior to the trade war in 2019 and COVID-19 pandemic in 2020, forecasts indicated continued growth (Euromonitor, 2020).

Chinese beer imports and exporter market share from 2009 to 2019 are reported in Table 1. Belgium, Germany, the Netherlands, and Mexico are China's main suppliers. While the market share for these countries have shifted over time, the value for each exporting country increased significantly through 2018 due to overall import growth. The total volume of imports rose every year between 2009 and 2018, reaching a nearly twentyfold increase (40.5 million litres to 821.1 million litres). Similarly, imports in terms of value rose from $49.1 million to $904.4 million over the same period. However, the total volume and value declined in 2019.

European beer dominates the Chinese import market. Germany has traditionally been the leading supplier averaging 40% since 2009. However, the market share for German beer has steadily declined, decreasing from 60% in 2012 to less than 20% in 2019. Belgian beer has actually increased in market share, increasing from about 5% in 2009 to nearly 13% in 2019.

Year	Volume (mill. liters)	Value ($US mill.)	Belgium	Germany	Netherlands	Other EU	Mexico	ROW
					Import share (%)			
2009	40.5	$49.1	5.2	35.9	2.8	12.1	21.6	22.3
2010	46.7	57.9	7.5	42.4	4.5	10.3	11.7	23.7
2011	64.1	90.6	7.2	54.2	7.9	6.2	5.0	19.4
2012	110.0	144.2	6.1	59.6	8.1	6.8	4.5	14.8
2013	182.3	231.7	7.2	59.1	4.7	10.0	4.4	14.6
2014	338.9	404.1	7.4	48.2	18.8	12.9	2.7	10.0
2015	538.4	575.1	6.5	34.9	24.1	21.0	4.9	8.6
2016	647.3	666.2	8.0	36.5	15.3	22.9	6.8	10.4
2017	716.1	750.0	9.3	27.9	8.8	24.1	14.8	15.2
2018	821.1	904.4	8.2	21.1	5.1	18.0	27.8	19.7
2019	732.1	820.0	12.9	19.5	4.6	18.1	19.5	25.4
Average	385.2	426.7	7.8	39.9	9.5	14.8	11.2	16.7

Note(s): HS 220.300, *Beer made from malt*. Other EU is an aggregation of EU countries not specified. ROW is *rest of world*, an aggregation of non-EU countries not specified
Source(s): Global Trade Atlas®

Table 1.
Chinese beer imports and import share by source: 2009–2019

The market share for beer from the Netherlands peak in 2015 (24%), but has since declined to about 5%. Mexican beer has re-emerged as a strong competitor in recent years, accounting for 28% of total imports in 2018.

Import prices by source are reported in Table 2. On average, the price of imported beer in China has fallen over the last decade – a trend that is particularly evident for German beer. Overall, Belgian beer is higher priced relative to other sources, ranging from $1.73 (per litre) in 2009 to $2.02 in 2019. The price of German beer, however, has declined substantially ($1.42 in 2009 to $0.76 in 2019). Since peaking in 2011 and 2012, the price of beer from the Netherlands has been relatively stable ($1.52). The price of Mexican beer has also been relatively stable throughout most of the data period, averaging $1.18, but increasing from $1.03 in 2009 to $1.46 in 2019.

Year	World	Belgium	Germany	Netherlands	Other EU	Mexico	ROW
				Price ($US/Liter)			
2009	1.21	1.73	1.42	1.55	2.26	1.03	0.85
2010	1.24	1.83	1.42	1.64	1.72	1.02	0.89
2011	1.41	1.91	1.56	2.03	1.81	1.11	0.96
2012	1.31	2.14	1.29	2.01	1.72	1.16	0.96
2013	1.27	2.24	1.24	1.60	1.63	1.16	0.97
2014	1.19	1.96	1.12	1.10	1.75	1.22	0.95
2015	1.07	1.76	0.86	1.27	1.26	1.18	0.92
2016	1.03	1.69	0.79	1.46	1.27	1.12	0.88
2017	1.05	1.55	0.82	1.31	1.21	1.19	0.93
2018	1.10	1.88	0.79	1.40	1.25	1.29	0.98
2019	1.12	2.02	0.76	1.38	1.33	1.46	0.94
Average	1.18	1.88	1.10	1.52	1.56	1.18	0.93

Note(s): HS 220.300, *Beer made from malt*. Other EU is an aggregation of EU countries not specified. ROW is *rest of world*, an aggregation of non-EU countries not specified
Source(s): Global Trade Atlas®

Table 2.
Imported beer prices in China: 2009–2019

3. Model and methods

3.1 Dynamic import demand model

The generalized dynamic Rotterdam model is used in estimating Chinese beer demand by source (Bushehri, 2003). The model is similar to the static Rotterdam model (Theil, 1980; Theil and Clements, 1987), but can also account for dynamic demand behaviour. Let q and p denote the quantity and price of imported beer in China, and i and j denote the exporting country. Given these terms, the demand for beer from the ith exporting country is expressed by the following dynamic demand system (k is the lag order) (Bushehri, 2003):

$$\overline{w}_{it}Dq_{it} = \gamma_i + \sum_j\sum_k \gamma_{ijk}Dq_{jt-k} + \theta_i DQ_t + \sum_j \pi_{ij}Dp_{jt} + \varepsilon_{it} \tag{1}$$

D is the log-difference operator; $Dq_t = \ln q_t - \ln q_{t-12}$ and $Dp_t = \ln p_t - \ln p_{t-12}$. Note that monthly data is used for the analysis and the annual or 12th difference is used to control for seasonality. $w_{it} = \frac{p_{it}q_{it}}{\sum_i p_{it}q_{it}}$ is the average import share for the ith exporter and $\overline{w}_{it}$ is the two-period average of w_{it}: $\overline{w}_{it} = 0.5(w_{it} + w_{it-12})$. DQ_t is the finite version of the Divisia volume index, which is a measure of real aggregate expenditures on imported beer: $DQ_t = \sum_i \overline{w}_{it}Dq_{it}$. The constant term (γ_i) accounts for unexplained import trends, and γ_{ij} is a dynamic adjustment or lag estimate measuring the impact of past imports on currents imports. Positive own-lag estimates $(\gamma_{ii} > 0)$ indicate habit persistence. The cross-lag estimates (γ_{ij}) measure dynamic substitutions or complementarities (Pollak, 1970). $\theta_i = \partial q_i/\partial Q$ is the marginal import share, measuring the impact of real aggregate expenditures on imported beer from the ith exporting source. π_{ij} is the Slutsky price coefficient, measuring the impact of the jth exporter price on beer imports from ith exporting source. ε_{it} is the error term.

$\gamma_i, \gamma_{ij}, \theta_i$, and π_{ij} are treated as fixed parameters for estimation. Demand theory requires the following parameter restrictions for adding-up: $\sum_i \theta_i = 1$; $\sum_i \gamma_i = \sum_i \gamma_{ij} = \sum_i \pi_{ij} = 0$. This condition is satisfied automatically since $DQ_t = \sum_i \overline{w}_{it}Dq_{it}$, but requires that an equation be deleted for estimation. However, estimates are invariant to the chosen deleted equation (Barten, 1969). The homogeneity property is implied by the following restriction on the Slutsky price coefficients: $\sum_j \pi_{ij} = 0$; symmetry is implied by $\pi_{ij} = \pi_{ji}$ (Seale *et al.*, 1992).

A trend term in levels is represented by a constant term in a differenced model. Accordingly, the ceteris paribus growth rate can be derived from Equation (1) as follows: $Dq_{it} = \gamma_i/\overline{w}_{it}$. Since the model is estimated using the 12th difference, $\gamma_i/\overline{w}_{it}$ measures annual growth. The own-lag estimates γ_{ii} can be used to derive a measure of habit formation in percentage terms: $Dq_{it}/Dq_{it-k} = \gamma_{iik}/\overline{w}_{it}$. Equating all lag terms $(Dq_{it-1} = Dq_{it-2} = \ldots = Dq_{it-k})$ results in a habit formation measure based on all own-lag estimates: $Dq_{it}/Dq_{it-k} = \sum_k \gamma_{iik}/\overline{w}_{it}$.

Using the parameters in Equation (1), we can derive the short-run expenditure elasticity $(\theta_i/\overline{w}_i)$ and uncompensated own- and cross-price elasticity $(\pi_{ij}/\overline{w}_i - \overline{w}_j\theta_i/\overline{w}_i)$ (Seale *et al.*, 1992). Setting $Dq_{jt} = Dq_{jt-k}\forall k$, the corresponding long-run measures are derived as follows (Bushehri, 2003):

$$\eta_i^{LR} = \frac{\theta_i}{\overline{w}_i - \sum_k \gamma_{iik}} \tag{2}$$

$$\eta_{ij}^{LRu} = \frac{\pi_{ij}}{\overline{w}_i - \sum_k \gamma_{iik}} - \eta_i^{LR}\overline{w}_j. \tag{3}$$

3.2 Data and estimation

Standard econometric techniques and secondary data are used for the analysis, requiring no direct interactions with Chinese consumers. Monthly import data (January 2009–December 2019) were obtained from the Global Trade Atlas, IHS Markit®. We considered this period because monthly imports were zero prior to 2009 for some sources, which is problematic when estimating a log-differenced model. Chinese beer imports are defined according to the following Harmonized System (HS) subchapter: 2203.00 *beer made from malt*. The countries included in the analysis are China's major suppliers of imported beer: Belgium, Germany, the Netherlands, and Mexico. We also considered *Other EU*, and the *rest of world* (ROW) as sources, which are aggregations of unspecified EU countries and non-EU countries, respectively.

Domestic beer is not included in the analysis. This should not be problematic because there is evidence to suggests that Chinese consumers differentiate between domestic and imported beer (Gao *et al.*, 2018; Nogueira and Jazcii, 2018). This suggests that the marginal rate of substitution between domestic and imported beer could be invariant to country of origin (i.e. domestic and imported beer compete at the product-group level). Theil (1980) shows that if this is the case, the Rotterdam model could be used to estimate import demand without accounting for domestic demand. Regardless of the theoretical arguments, domestic sales are not included in the analysis due to a lack of available data. Additionally, any product category accounting for over 90% of total expenditures such as Chinese domestic beer would clearly dwarf the demand for other products in an expenditure allocation framework. Note that we are simply assuming a multi-stage budgeting process where consumers initially choose between the two product groups: imported and domestic beer. The decision to consume imported beer from a particular source is conditional on the overall decision to consume imported beer.

The demand system represented by Equation (1) was estimated using the generalized Gauss-Newton method in TSP (version 5.0) (Hall and Cummins, 2009). The model was estimated over a rolling subset of the data to assess how the parameter estimates and corresponding standard errors changed over time. Estimates were also used to derive import demand elasticities in the immediate and long-run. For the rolling regression procedure, we started with a segment of successive observations of 60 months (March 2010–February 2015) and then rolled this segment forward in time by adding and dropping an observation for each estimation. Given the entire data period (January 2009–December 2019), rolling segments of 60 months resulted in 59 successive estimation runs [1]. We then graphed the estimated coefficients and confidence bans over time. Likelihood ratio tests were used to determine the appropriate lag order and to test the homogeneity and symmetry properties. Test results for the full sample and select 60-month intervals are reported in the appendix (See Appendix). Results indicated that the model with two-period lags was always preferred to the models with one- or three-period lags. Homogeneity was accepted in all instances. Although the symmetry results were mixed, we maintained both homogeneity and symmetry for all estimation runs.

4. Estimations results

4.1 Final sample estimates

We start with the final sample results (January 2015–December 2019), which are also used when discussing the rolling regression results. The ceteris paribus growth rate, habit formation elasticity, marginal share, expenditure elasticity (short and long run) and uncompensated own-price elasticity (short and long run) for each exporting source are reported in Table 3. Note that the elasticities are derived using the mean imports shares $(\overline{\overline{w}}_{it})$ for the final sample period and the demand system estimates reported in Appendix.

Table 3. Demand estimate and elasticities for Chinese beer imports (final sample): Jan. 2015–Dec. 2019

Country	Growth rate ($\gamma_i/\overline{w}_i$)	Habit formation $\left(\sum_k \gamma_{iik}/\overline{w}_i\right)$	Marginal share (θ_i)	Expenditure		Own-price (uncompensated)	
				Short-run	Long-run	Short-run	Long-run
Belgium	0.23 (0.08)***	0.29 (0.12)**	0.02 (0.02)	0.27 (0.17)	0.38 (0.27)	−0.87 (0.17)***	−1.23 (0.29)***
Germany	−0.09 (0.06)**	0.30 (0.11)***	0.25 (0.04)***	0.85 (0.13)***	1.21 (0.26)***	−1.37 (0.31)***	−2.19 (0.56)***
Netherlands	−0.05 (0.14)	0.80 (0.12)***	0.20 (0.04)***	1.50 (0.33)***	7.59 (4.20)*	−1.61 (0.47)***	−4.08 (2.53)**
Other EU	−0.12 (0.07)*	0.03 (0.13)	0.24 (0.03)***	1.16 (0.16)***	1.20 (0.18)***	−1.59 (0.28)***	−1.55 (0.22)***
Mexico	−0.20 (0.16)	0.52 (0.08)***	0.24 (0.05)***	1.73 (0.38)***	3.58 (0.93)***	−2.34 (0.50)***	−4.06 (1.01)***
ROW	0.36 (0.11)***	−0.02 (0.91)	0.05 (0.04)	0.36 (0.24)	0.37 (0.26)	−0.81 (0.49)	−0.83 (0.52)

Note(s): Asymptotic standard errors are in parentheses. ***Denotes the 0.01 significance level; **Denotes the 0.05 significance level; *Denotes the 0.10 significance level. Other EU is an aggregation of EU countries not specified. ROW is *rest of world*, an aggregation of non-EU countries not specified

The growth rate estimates measure persistent import changes that are unexplained by the variables in the model, which could be very different from observed import changes. The negative estimates for German beer (−0.09) and Other EU beer (−0.12) suggest declining preferences during the final sample period. The growth rates for Belgian (0.23) and ROW beer (0.36) suggest the opposite (increasing preferences), indicating unexplained annual growth of 23 and 36%, respectively. The growth rate estimates for the remaining countries are not statistically significant. The results for the final sample are somewhat atypical. Throughout the entire data period and for almost all other sample periods, the growth rate estimates were by and large insignificant.

The habit formation elasticities are positive and significant for all major sources: Belgium, Germany, the Netherlands, and Mexico. Results indicate that current consumption is partly determined by past consumption (habit persistence), and that Chinese consumers do not fully respond to price or expenditure changes in the short run. Habit persistence is quite large for the Netherlands (0.80), indicating that as much 80% of present consumption changes are explained by past consumption changes. Although smaller by comparison, habit persistence is fairly large for Mexico (0.52). Note that the Netherlands and Mexico are the only sources with significant first and second order own-lag estimates (See Appendix), which explains why the influence of past consumption on present demand is particularly strong for Dutch and Mexican beer in China. The habit formation elasticities for Germany and Belgium are 0.30 and 0.29, respectively.

The marginal share estimates measure how an additional dollar on imported beer is allocated across the supplying countries. Germany has the largest marginal share (0.25), implying that one-fourth of every dollar spent on imported beer is spent on German beer. The estimates for the Netherlands (0.20), Other EU (0.24), and Mexico (0.24) are relatively close. Belgium (0.02) and ROW (0.05) are the only sources with insignificant marginal share estimates. What is interesting is that Belgium and ROW are also the only sources with positive and significant growth rate estimates. This implies that import changes for these sources – at least during the final sample period – was due to unexplained trends as opposed to changes in aggregate import expenditures.

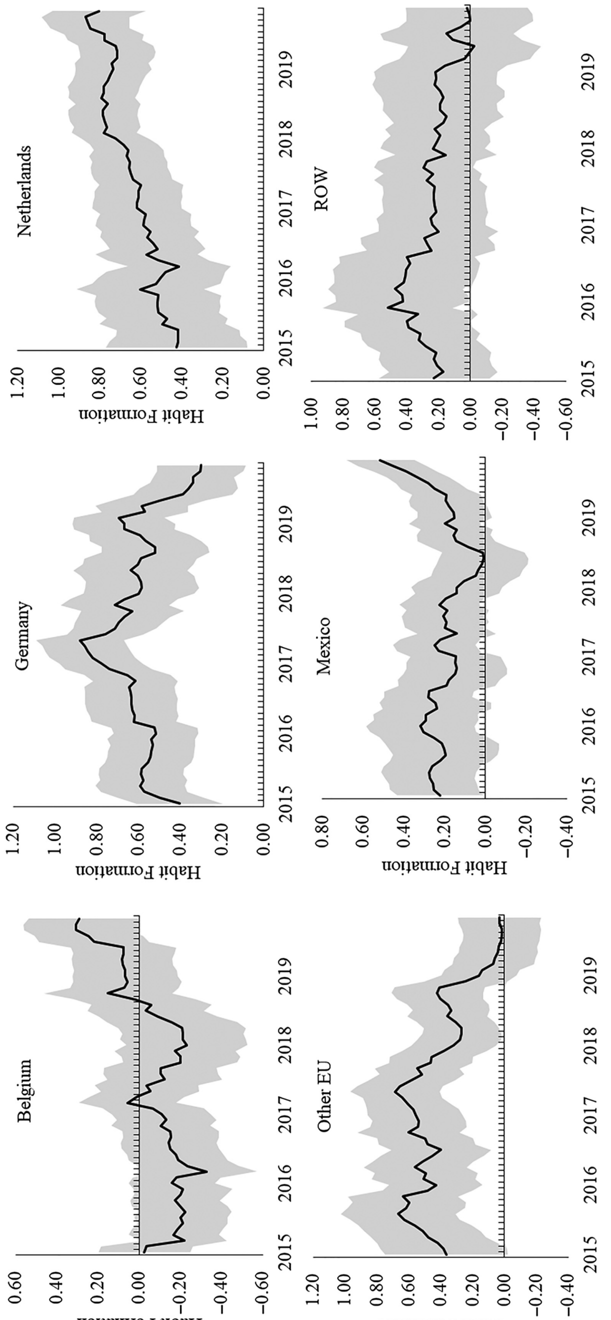
The expenditure elasticities are the marginal share relationships expressed in percentage terms. Mexico and the Netherlands have particularly high short-run expenditure elasticities: 1.73 and 1.50, respectively. Given their relatively large habit formation estimates, the corresponding long-run estimates are 3.58 and 7.59, respectively. German beer is expenditure inelastic in the short run (0.85), but expenditure elastic in the long run (1.21). The expenditure elasticity for Other EU beer was relatively the same in the short (1.16) and long run (1.20) due to insignificant habit formation.

The uncompensated own-price elasticities indicate that Chinese demand is mostly elastic (Table 3). The short-run own-price elasticity for Belgium is the exception (−0.87). The long-run own-price elasticities for the Netherlands (−4.08) and Mexico (−4.06) are particularly large, suggesting that Chinese buyers are highly sensitive to Dutch and Mexican beer prices in the long-run.

4.2 Rolling regression estimates

The rolling regression estimates for each source are reported in Figures 2–6. The estimates are plotted over time from February 2015 (last observation, first sample) to December 2019 (last observation, final sample). The solid lines denote the mean response, and the shaded areas are the 95% confidence intervals. The elasticities are derived using mean import shares that are specific to the sample period used for estimation.

The habit formation elasticity quantifies intertemporal linkages between current and past consumption (see Figure 2). The higher the estimate, the greater the tendency for buyers to maintain purchases, even if prices change in favour of a competing product. Throughout the entire data period, the habit formation elasticity for Belgium was mostly insignificant.



Note(s): Each graph gives the elasticity value for imported beer from a particular source. The solid line is the mean response and the shaded area denotes the 95% confidence bands. Other EU is an aggregation of EU countries not specified. ROW is rest of world, an aggregation of non-EU countries not specified

Figure 2.
Rolling estimates: habit formation (elasticity)

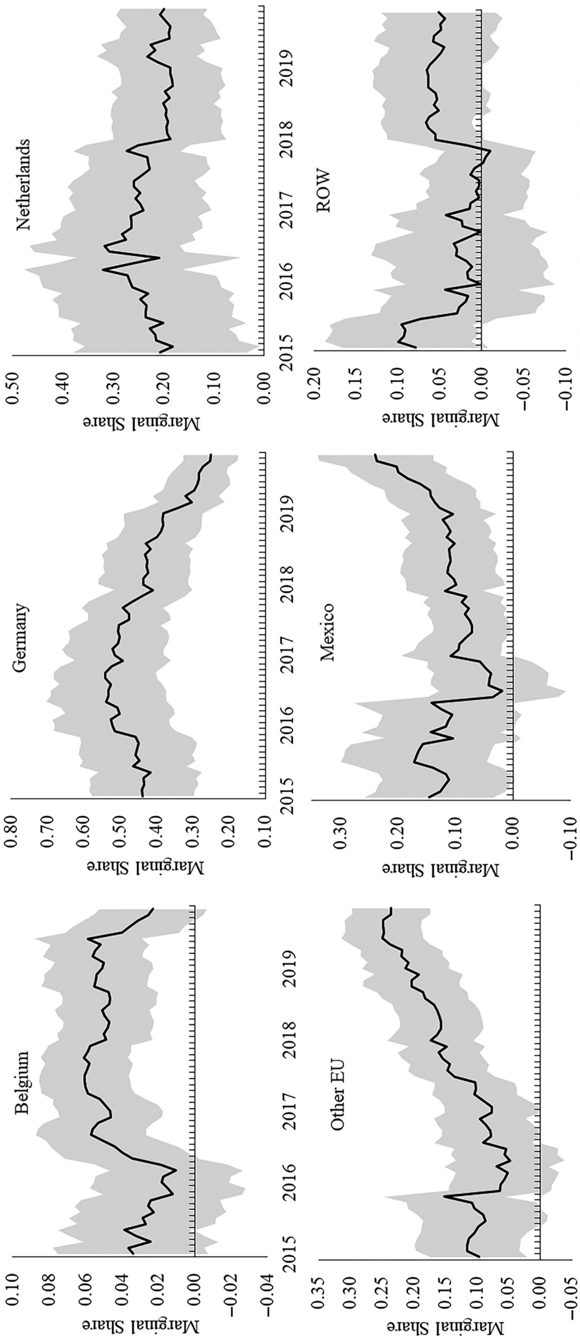
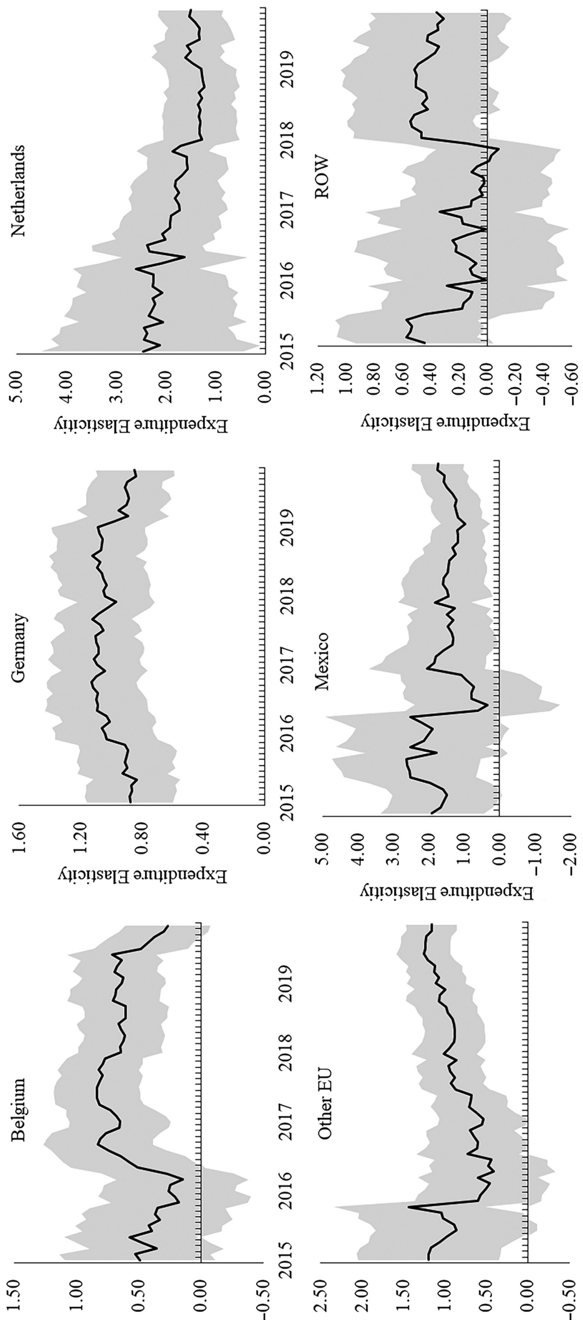


Figure 3.
Rolling estimates: marginal share

Note(s): : Each graph gives the elasticity value for imported beer from a particular source. The solid line is the mean response and the shaded area denotes the 95% confidence bands. Other EU is an aggregation of EU countries not specified. ROW is rest of world, an aggregation of non-EU countries not specified



Note(s): Each graph gives the elasticity value for imported beer from a particular source. The solid line is the mean response and the shaded area denotes the 5% confidence bands. Other EU is an aggregation of EU countries not specified. ROW is rest of world, an aggregation of non-EU countries not specified

Figure 4.
Rolling estimates: expenditure elasticity (short-run)

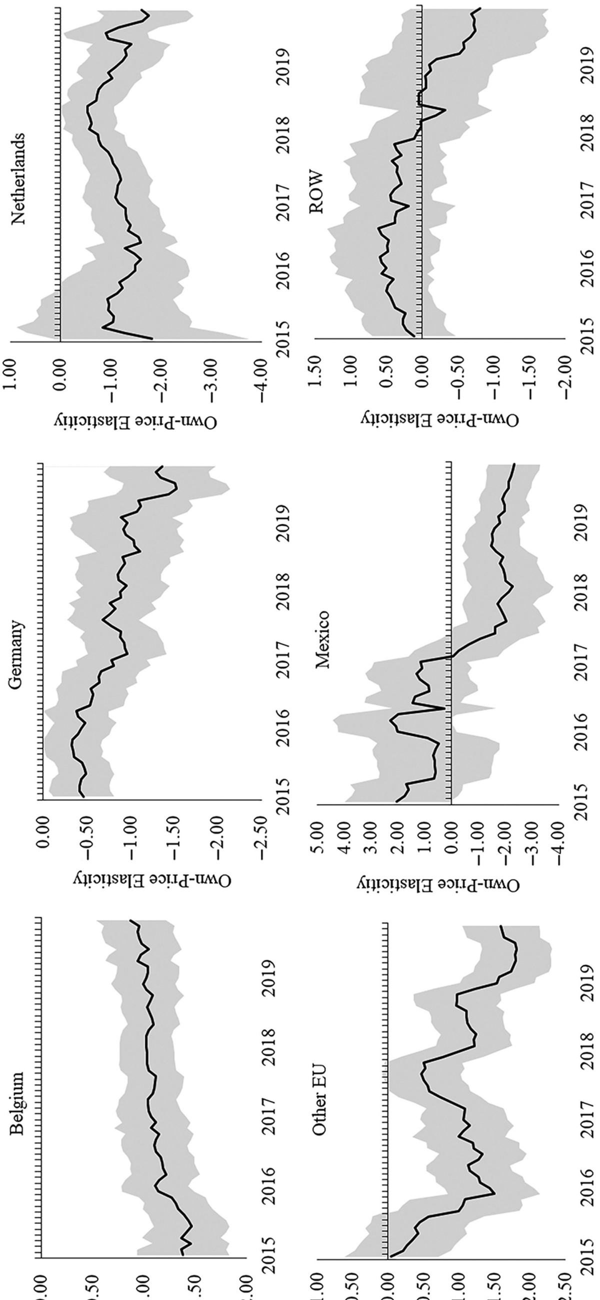
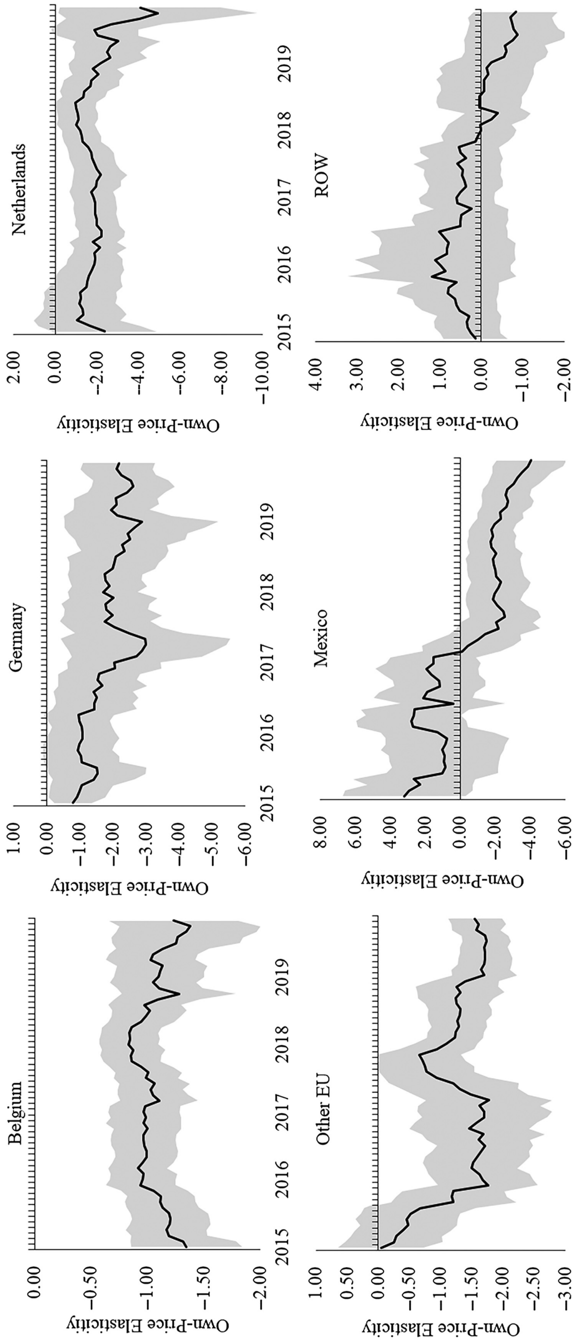


Figure 5.
Rolling estimates: uncompensated own-price elasticity (short-run)

Note(s): Each graph gives the elasticity value for imported beer from a particular source. The solid line is the mean response and the shaded area denotes the 95% confidence bands. Other EU is an aggregation of EU countries not specified. ROW is rest of world, an aggregation of non-EU countries not specified



Note(s): Each graph gives the elasticity value for imported beer from a particular source. The solid line is the mean response and the shaded area denotes the 95% confidence bands. Other EU is an aggregation of EU countries not specified. ROW is rest of world, an aggregation of non-EU countries not specified

Figure 6.
Rolling estimates: uncompensated own-price elasticity (long-run)

The results for Germany are particularly interesting. Since 2015, habit formation continually increased, reaching a high of around 0.8 in 2017, but continually declining to about 0.3 within the last two years. For the Netherlands, habit formation has continually increased, but appears to be levelling off in more recent months (around 0.8). The habit formation elasticity for Mexico was mostly insignificant until early 2019, thereafter increasing to 0.5. Overall, the habit formation estimates suggest that Chinese preferences for Dutch beer have persistently increased throughout the entire data period, and have increased for Mexican beer in more recent months. German beer preferences, however, appear to be in decline.

The rolling marginal share estimates indicate that expenditure allocation has not been constant throughout the data period (see Figure 3). At the beginning of the data period, a relatively small share of total expenditures was allocated to beer from Belgium, Mexico, Other EU, and ROW; Germany and the Netherlands dominated the market. The estimate for Belgium shows a distinct upward shift in 2016 but remained relatively constant at around 0.06 before declining into insignificance in more recent months. The share of total expenditure allocated to German beer was fairly stable but has gradually declined over the last three years. Note that Chinese consumers once allocated over half of every dollar to German beer, but this is now about one-fourth of every dollar. The marginal share estimate for Other EU beer has increased significantly; it was initially negligible and mostly insignificant, then steadily increased to more than 0.2 over the last three years.

The expenditure elasticities (Figure 4) either follow a similar pattern as the marginal share estimates (e.g. Belgium), or are relatively more stable than the marginal shares (e.g. Germany and Mexico). Note that the expenditure elasticities depend on the marginal share estimates and import share values. Thus, when an expenditure elasticity is unchanging even as the import shares change, the marginal share changes accordingly. It is not obvious whether changes in the marginal share or expenditure elasticity is more indicative of a preference change. Since the marginal share is an estimated parameter whereas the expenditure elasticity is essentially derived, it could be argued that preference changes are more likely reflected by changes in the marginal share.

The rolling uncompensated own-price elasticities are reported in Figure 5 (short run) and Figure 6 (long run). Recall that the price of German beer in China has been declining over time. The rolling results indicate that Chinese consumers have become more sensitive to German beer prices. For instance, the own-price elasticity has continually decreased from −0.5 to −1.5, indicating that Chinese consumers are nearly three times more sensitive to German beer prices than in years past. By comparison, the demand for Dutch Beer has been more consistent, becoming inelastic for a brief period in 2018, but averaging around −1.0. What is interesting is that Mexican beer prices did not affect imports during the first half of the data period. However, more recent years show that the demand for Mexican beer is consistently elastic (−2.0). Belgian beer is the only import with declining own-price responsiveness. Thus, consumers are becoming less sensitive to prices, even though Belgian beer is more expensive than other sources. Figure 6 shows similar patterns over the long run. A notable difference is the greater responsiveness of import prices. The long-run uncompensated own-price elasticity for Belgium, which is consistently around −1.0, suggests more stable demand in the long run.

4.3 Discussion and implications

As China has become more integrated into the world economy, exposure to foreign brands has increased, thereby increasing import demand. The Chinese have a history of iconic and conspicuous consumption based on product origin (e.g. French wine or German beer) (Muhammad *et al.*, 2014; Speece Mark *et al.*, 1994). For instance, a study showed that about two-thirds of Chinese consumers associated European beer with Germany (Wang *et al.*, 2017). This type of iconic consumption will likely continue for French wine (Muhammad *et al.*, 2014). For German beer, however, this appears to be waning. Chinese consumers are shifting preferences to sources other than Germany. This is evidenced by lower prices for German beer, declining habit formation and expenditure allocation, and a greater sensitivity to changes in German beer prices.

Results suggest that Chinese beer preferences have changed significantly over the last decade, increasing for Mexican beer, Dutch beer, and Belgian beer. German beer once dominated the Chinese market. However, all indicators suggest that German beer preferences are declining. Changes in habit formation, for instance, suggest that Chinese preferences for Dutch beer have been persistently increasing over the last decade, and more recently for Mexican beer. Increasing own-price sensitivity, which is likely due to falling preferences, was particularly the case for German beer. In contrast, changes in the own-price elasticity for Belgian beer (short-run) suggest that its demand is actually becoming more inelastic over time. Lastly, expenditure allocations have also persistently changed over the last few years, declining for German beer and increasing for Mexican beer. In fact, Mexican and Other EU beer now account for about half of additional expenditures on imported beer in China. Chinese consumers once allocated more half of every dollar to German beer. This is now about one-fourth of every dollar.

What are the implications for beer exporting countries in the Chinese market? We find clear differences in preference changes across exporters, suggesting that foreign marketing and advertising campaigns could be successful in the Chinese market, unlike in years past (Bai *et al.*, 2011). The own-price elasticity results could inform pricing strategies moving forward. For instance, the demand for German beer becoming more elastic or price sensitive over time suggests that German suppliers may be benefiting from higher revenues due to lower prices. In contrast, the price elasticity results for Belgian beer suggest that suppliers should continue to target higher-end consumers. Lastly, the observed differences and changes in habit formation and/or expenditure allocation behaviour for Belgian, Dutch, and Mexican beer suggest that source-specific advertising could influence consumption patterns in favour of these particular sources.

5. Summary and conclusion

Although China is the world's third largest beer importing, few studies have focused on this market. While dynamic analyses of alcoholic beverage demand are not new, this is the first study to examine the dynamics of imported beer preferences in China and implications for exporting countries. In this study, we examined how Chinese beer consumption and preferences have changed over the last decade. We assumed that preference changes were reflected by imports becoming more or less sensitive to prices and expenditures, as well as by changes in habit persistence (i.e. the relationship between past and present consumption).

Although many studies indicate the demand for beer is generally inelastic, Chinese demand for foreign beer is mostly elastic. This is consistent with a previous finding that foreign beer consumption in China is characterized as exhibiting "an elastic and fast-changing character" (Li *et al.*, 2018). What is interesting is that changes in own-price responsiveness based on the rolling estimates suggest that demand could become more elastic in the future regardless of source. This was particularly the case for German beer. Belgian beer was the sole exception, where short-run demand is actually becoming more inelastic over time.

As the Chinese economy continues to develop and imported beer expenditures increase, which exporting countries are likely to benefit from this continued growth? The observed changes in habit formation suggest that Dutch and Mexican beer could benefit from a growing market. For Mexican beer, this was also supported by changes in the marginal share/expenditure allocating behaviour. From the perspective of price and own-price responsiveness, Belgian beer is growing in status in the Chinese market. While it is not obvious which countries will benefit moving forward, it is evident that preferences for German beer have declined.

Our results suggest important changes in the Chinese beer economy regarding country of origin, prices, and preferences that may not have been obvious before this study. That said, there are limitations that must be considered and results should be taken with some caution. First, our analysis is based on international trade data which is more indicative of firm behaviour rather than consumer behaviour. However, it could be argued that behaviour at the firm level is likely based on demand at the consumer level, but it is important to acknowledge that preference changes at the consumer level my not be perfectly reflected by changes at the wholesaler or distributor level. Additionally, while our analysis provides a good assessment of how preferences might have changed over time, additional research is needed to understand why preferences have changed. For instance, the results of this study suggest that preferences have changed in favour of Belgian beer and declined for German beer, but a better understanding of what caused these changes requires a more detailed analysis of Chinese consumers. In spite of these limitation, this study clearly shows how beer demand patterns in China have evolved over the last decade, and it illustrates the importance of considering dynamic behaviour when analysing alcoholic beverage demand in emerging markets.

Note

1. We lose 12 observations when taking the annual difference and two observations for the lag terms.

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Corresponding author
Andrew Muhammad can be contacted at: amuhammad@utk.edu

Appendix

Model (lag order k)	Log-likelihood	LR χ^2	Log-likelihood	LR χ^2	Log-likelihood	LR χ^2
	Full sample March 2010–Dec. 2019		Jan. 2011–Dec. 2015		Jan. 2012–Dec. 2016	
Unrestricted (k = 2)	847.69		477.29		520.94	
Unrestricted (k = 1)	810.21	74.96 [0.000]	439.69	75.21 [0.000]	494.11	53.65 [0.005]
Homogeneity (k = 2)	843.77	7.85 [0.165]	471.99	10.60 [0.060]	516.02	9.85 [0.080]
Symmetry (k = 2)	831.77	23.99 [0.008]	456.54	30.91 [0.001]	509.20	13.64 [0.190]
	Jan. 2013–Dec. 2017		Jan. 2014–Dec. 2018		Jan. 2015–Dec. 2019	
Unrestricted (k = 2)	580.11		564.36		574.03	
Unrestricted (k = 1)	543.46	73.30 [0.000]	531.18	66.35 [0.001]	543.93	60.18 [0.000]
Homogeneity (k = 2)	576.77	6.67 [0.247]	559.39	9.94 [0.077]	572.79	2.46 [0.165]
Symmetry (k = 2)	567.00	19.54 [0.034]	552.58	13.62 [0.191]	555.98	33.62 [0.008]

Note(s): p-values are in [brackets]. Lag order tests are based the unrestricted (k = 2) and unrestricted (k = 1) models; number of restricted parameters = 30. Restricted parameters for homogeneity = 5; symmetry = 10. The symmetry model includes homogeneity

Table A1. Likelihood ratio (LR) tests for lag order, homogeneity, and symmetry: full sample and select 60-month intervals

Table A2.
Lag estimates for Chinese beer imports (final sample): Jan. 2015–Dec. 2019

Country	Belgium	Germany	Netherlands	Other EU	Mexico	ROW
			Lag estimates (γ_{ijk}) $k = 1$			
Belgium	0.014 (0.009)	0.017 (0.012)	−0.008 (0.006)	0.008 (0.011)	−0.009 (0.003)*	−0.005 (0.009)
Germany	0.032 (0.023)	0.099 (0.030)*	−0.027 (0.015)	−0.002 (0.027)	−0.015 (0.008)	−0.076 (0.022)*
Netherlands	0.013 (0.025)	−0.064 (0.034)	0.069 (0.017)*	0.056 (0.029)	−0.007 (0.009)	−0.052 (0.026)*
Other EU	0.063 (0.019)*	−0.010 (0.025)	−0.003 (0.013)	−0.016 (0.024)	−0.010 (0.007)	0.017 (0.019)
Mexico	−0.082 (0.028)*	−0.021 (0.039)	−0.015 (0.020)	−0.069 (0.033)*	0.047 (0.010)*	0.078 (0.030)*
ROW	−0.040 (0.021)	−0.022 (0.027)	−0.016 (0.014)	0.024 (0.025)	−0.006 (0.007)	0.038 (0.020)
			Lag estimates (γ_{ijk}) $k = 2$			
Belgium	0.012 (0.008)	−0.024 (0.011)*	−0.009 (0.006)	0.011 (0.008)	−0.007 (0.003)*	0.001 (0.010)
Germany	0.040 (0.021)	−0.011 (0.029)	−0.034 (0.014)*	−0.003 (0.021)	−0.014 (0.008)	−0.024 (0.025)
Netherlands	−0.036 (0.024)	0.039 (0.033)	0.038 (0.016)*	−0.085 (0.025)*	0.005 (0.009)	0.014 (0.029)
Other EU	0.036 (0.017)*	−0.034 (0.024)	−0.006 (0.012)	0.022 (0.018)	−0.009 (0.006)	−0.026 (0.022)
Mexico	−0.046 (0.027)	0.002 (0.038)	0.008 (0.018)	0.039 (0.028)	0.024 (0.01)*	0.069 (0.033)*
ROW	−0.005 (0.019)	0.028 (0.026)	0.003 (0.013)	0.015 (0.019)	0.001 (0.007)	−0.035 (0.023)

Note(s): Asymptotic standard errors are in parentheses. *Denotes significance level ≤0.05. Other EU is an aggregation of EU countries not specified. ROW is *rest of world*, an aggregation of non-EU countries not specified

Table A3. Demand estimates for Chinese beer imports (final sample): Jan. 2015–Dec. 2019

Country	Constant (γ_i)	Marginal share (θ_i)	Belgium	Germany	Netherlands	Other EU	Mexico	ROW
			Slutsky price coefficients (π_{ij})					
Belgium	0.020 (0.007)*	0.023 (0.015)	−0.073 (0.015)*	0.078 (0.027)*	0.015 (0.019)	−0.011 (0.021)	0.022 (0.020)	−0.031 (0.023)
Germany	−0.028 (0.018)	0.251 (0.038)*		−0.331 (0.09)*	0.081 (0.048)	0.009 (0.052)	0.064 (0.050)	0.100 (0.064)
Netherlands	0.007 (0.018)	0.199 (0.044)*			−0.156 (0.062)*	0.090 (0.042)*	0.057 (0.046)	−0.087 (0.043)*
Other EU	−0.024 (0.014)	0.236 (0.032)*				−0.274 (0.055)*	0.104 (0.040)*	0.083 (0.045)
Mexico	−0.028 (0.022)	0.239 (0.051)*					−0.290 (0.071)*	0.044 (0.045)
ROW	0.053 (0.015)*	0.052 (0.035)						−0.109 (0.071)

Note(s): Asymptotic standard errors are in parentheses. *Denotes significance level ≤0.05. Homogeneity and symmetry are imposed on the model. Equation R^2 (respectively): 0.70, 0.78, 0.80, 0.85, 0.77, and 0.26. Other EU is an aggregation of EU countries not specified. ROW is *rest of world*, an aggregation of non-EU countries not specified