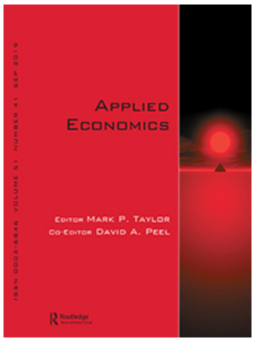

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What drives our Beer Consumption?—In Search of Nutrition Habits and Demographic Patterns

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ABSTRACT
Conventional wisdom in Germany claims pork hocks with sauerkraut and beer. But is it really that simple? In an unbalanced cross-country panel covering 169 nations and time-series records of up to 52 years, we analyse drivers behind beer consumption. Based on data gathered from Worldbank and Faostat, we run multivariate panel regressions and test for the explanatory power of three categories of food and six macroeconomic and demographic variables. Indeed, we confirm most clichés of a typical beer drinker being a middle-aged urbanite with a strong desire for pork and potatoes, however, disliking cheese and wine.

KEYWORDS
Beer consumption; nutrition habits; demographics; cross-country evidence

JEL CLASSIFICATION
J11; J16; Q11; Q21

I. Introduction

It is well understood that white wine pairs well with fish, and red wine with cheese and deer (Harrington 2007). But what goes with beer? A look at the 'Oktoberfest', the world's largest beerfest in Munich, shows that 7.5 million litres of beer are accompanied by approx. 466′000 units of poultry, 80′000 pork hocks and 146 oxen.[1] Thereon, we raise the question whether this is a fair representation of beer drinking habits around the world or a unique case driven by local traditions.

Drivers of alcohol consumption have been subject to numerous research. In this respect, economists try to explain the demand for beer on the basis of economic variables like income or price elasticity (Colen and Swinnen 2016; Freeman 2001). Medicals, like Herbeth et al. (2012), take a different perspective and analyse beer consumption in relation to nutrition habits, whereas psychologists observe addiction parameters. Though starting from different perspectives they all share a common concern: What drives alcohol consumption?

This study contributes to the existing literature in two major ways: (i) we significantly extend the sample size of existing studies on beer consumption in both the cross-section and the time-series dimension, and (ii) we combine the two dominant strands of existing literature on beer consumption, namely the economic and medical perspective, by jointly considering 16 variables from the fields of economics, demographics and nutrition types.

As our first main contribution, we provide a global perspective on beer consumption, based on a large international cross-section and a long observation period. In contrast, most existing studies either concentrate on a specific region – sometimes just one country – or a short observation period.[2] This raises the question of the generalizability of their findings. Time-series records of our dataset range up to 52 years of observations and roughly 170 nations in the cross-section. Thereby, we significantly outsize previous samples considered in this field. In this sense, we deliberately omit local peculiarities which are often in the focus of existing studies, as to derive a better understanding on a global scale. Piron and Poelmans (2016) as well as Colen and Swinnen (2016) provide evidence that beer is by far the most consumed alcoholic drink across the world. Thereon, beer consumption lends itself to analyse homogeneity in global consumption patterns. Furthermore, they also show that demand is not

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*The opinions are strictly those of the authors and do in no way represent the University of Liechtenstein.
[1]Values provided by: https://de.statista.com/themen/2093/oktoberfest/.
[2]We provide an overview in the next section.

constant but changes over time and as such our dependent variable should have sufficient variation. This notion is also supported by Poelmans and Swinnen (2011), who show that in the recent decades beer consumption declined in all major beer-producing countries, which is offset by a stark increase in consumption in emerging countries such as China, Russia, Brazil and India (Arora et al. 2011; Bai et al. 2011; Deconinck and Swinnen 2011).

Our second contribution targets the, so far, separate and disentangled examination of explanatory factors of alcohol consumption.[3] Thereon, we are combining economic and demographic factors, which represent the economic strand, together with alternative food types, representing the medical (health and nutrition) strand. Specifically, we test if statistically significant nutritional dependencies remain after controlling for relevant economic and demographic factors. Consequently, we account for potential moderating effects between economic and nutrition variables, which otherwise could result in false conclusions. To the knowledge of the authors, this is the first study conducted on a large-scale cross-country dataset exploring the dependencies between beer consumption, economic variables, demographic variables and nutrition habits.[4]

As a third minor contribution, we consider processed and unprocessed food types, which have not yet been jointly accounted for in previous studies. The majority of considered factors in this study have been documented to be positively related to an increase in alcohol consumption (Kesse et al. 2001; Herbeth et al. 2012).

We employ a standard linear regression model for panel data and provide estimates for 10 nutrition variables, categorized into 3 groups, as well as a total of 6 economic and demographic variables. Overall, we provide results for 23 combinations of variables according to various categories. In order to account for autocorrelation, all estimated models incorporate one-year lagged beer consumption and we test for stationarity by means of a (panel) unit-root test. Additionally, we apply country- and time-fixed effects to account for time-invariant country- as well as period-specific unobserved determinants of beer consumption.

Our results generally confirm beer drinkers' habits observable on the Oktoberfest on a long-range cross-country panel. We report statistically significant results for all kinds of meat, with pork being the main driver of beer consumption as well as potato and egg consumption explaining beer intake. As expected, cheese and wine yield a negative impact as they serve as complementary goods. Regarding demographic variables, we find a positive relationship between beer consumption and GDP, the percentage of total population between 15 and 64 years as well as the degree of urbanization.

The remainder of the paper is structured as follows: Section II provides a brief literature overview on drinking habits, Section III contains a description of the data set and Section IV introduces the methodology applied in this study. Finally, Section V reports the empirical results for the considered regression models before Section VI concludes.

II. Existing literature on drinking habits

Drivers of beer and alcohol consumption have been subject to a thorough examination from economic, sociological, medical, as well as psychological research. We contribute to the former two areas, as well as the medical subfield of nutritional habits.[5] The existing literature on the consumption of alcoholic beverages can be broadly categorized into three areas of research: dependency on (i) economic variables and price elasticity, (ii) demographic variables and (iii) nutrition habits. This literature review stays within the focus of our study and covers economic, demographic and nutritional factors.

Many researchers have posed the question on whether people tend to drink more during economically strained times as suggested by psychologists (Brenner and Mooney 1983). Statements by

[3]We do not consider the psychological perspective in terms of studies examining addiction to alcohol.

[4]Colen and Swinnen (2011) conduct a closely related study, however, their focus is primarily the macroeconomic, religious and climatic drivers of beer consumption.

[5]Although illnesses of the body and the mind due to alcohol, or alcohol as a source of these problems are a very important research field, we argue that they are not of high importance as general driving factors of beer consumption. Therefore, we will not include this part of the literature.

economists regarding the cyclicality of alcohol and beer consumption tend to support the thesis of beer being a procyclical good, with reduced consumption during bad times (Freeman 2011). However, a generally strong income inelasticity of beer consumption is supported by US-Data (Freeman 2011), as well as several international studies (Fogarty 2010).[6] Colen and Swinnen (2016) emphasize a positive but non-linear dependency of beer consumption on income using a dataset similar to ours.

In contrast to the economic determinants of beer consumption, the demographic variables provide a much clearer picture on the drivers of alcohol intake. Findings of Kerr et al. (2004) and Freeman (2011), show that alcohol and beer consumption reduces significantly with age, leaving the group of 18–44-year-olds which are the heaviest drinkers (cf. Colen and Swinnen 2011). Males generally drink significantly more alcohol than females and, within the alcohol consumption pattern, men have a stronger thirst for beer than women (Kerr et al. 2004). Adding to this, Gao, Wailes, and Cramer (1995) report, that not only being male, but living in an urban environment conferred higher beer consumption. Among others, Kerr et al. (2004) find that an increase in education leads to lower alcohol consumption in general, but in particular to lower consumption of beer within alcoholic drinks.

As for existing studies on nutrition habits with respect to wine and beer drinkers, these have been limited to national datasets including: Denmark (Johansen et al. 2006), France (Kesse et al. 2001), Italy (Chatenoud et al. 2000), Spain (Alcácera et al. 2007) and the U.S. (Siegel et al. 2011). Besides their national focus, sample sizes of previously mentioned studies are rather short ranging between 6 months and 3 years. This highlights the need for an analysis on a broader database to establish generalizability.

More specifically, Kesse et al. (2001) and Herbeth et al. (2012) document that increased alcohol consumption goes hand in hand with a higher consumption of animal products like meat and cheese, as well as potatoes and bread; and on the other hand a reduced consumption of vegetables and fruits. Along these lines, Männistö et al. (1997) observe that alcohol drinkers tend to eat more fat and less carbohydrates than non-drinkers. They also report, that among alcohol consumers, beer and wine drinkers tend to substitute food energy by drinks. Barefoot et al. (2002) report that beer drinkers in the US tend to eat more meat and consume less vegetables and fruits. Furthermore, French beer drinkers not only consume less vegetables, fruits, bread, cheese and eggs but eat more potatoes than other drinkers (Ruidavets et al. 2004). In contrast to these results, Toniolo, Riboli, and Cappa (1991) cannot identify significantly different consumption habits among alcohol drinkers and non-drinkers when related to meat, poultry, eggs, pasta, rice or vegetables. Also, wine drinkers seem to eat significantly healthier than beer drinkers (Johansen et al. 2006; Ruidavets et al. 2004). However, it is not clear whether the conjoint choice of drinks and food is driven by consumers' socioeconomic background (Herbeth et al. 2012).

In summary, most existing literature suggests – and provides empirical evidence – that economic variables, demographics and nutritional habits do effect beer consumption. Interestingly, multiple studies show that higher beer consumption levels are driven by the consumption of more expensive foods like meat (Kesse et al. 2001). Again, this raises the question if variables like meat consumption and GDP are measuring different factors or are a proxy of a potential single moderating factor like wealth of a country. The answer to this question is crucial for economists and policymakers alike and specifically for the healthcare sector. By testing for the statistical significance of nutrition variables, after controlling for economic and demographic variables, we close this gap in the current literature.

III. Dataset

Next, we describe our dataset in detail and explain the methodological approach to answer our research questions. This study combines two datasets from two well-known sources. First, beer consumption and additional data on nutrition habits is gathered from the Statistics Division of the Food

[6]For survey and meta-studies on price elasticity and the impact of price and tax levels see Gallet (2007) and Wagenaar, Salois, and Komro (2009).

Table 1. Variables, classification and units.

Classification	Variable	Unit
–	Beer	g/per capita/day
Economic	GDP, public spending on education	US Dollar/per capita
Demographic	Urban population, tertiary education enrollment, male residents, population between 15–64 years	% of total population
Meat	Bovine, pork, poultry	g/per capita/day
Staple	Potato, rice, wheat	g/per capita/day
Miscellaneous	Cheese, eggs, nuts, wine	g/per capita/day

and Agriculture Organization of the United Nations (FAO).[7] We focus on three food classes: meat (bovine, pork and poultry), staple (potato, rice and wheat) and miscellaneous (cheese, egg and nut). Additionally, we include wine to test its effect as a substitute good (adding it to the class of miscellaneous food). FAO provides data on food supply, which is available for human consumption, on a per capita basis. Based on neoclassical economic principles, we assume an equilibrium market such that supply equals demand and as such proxies for consumption.

Secondly, data on demographics and economic variables are obtained from the statistical database of the World Bank.[8] Apart from classical measures of demography, such as the share of urban citizens or males in the population, we additionally consider economical and educational aspects. Specifically, GDP growth, public spending on education and tertiary school enrolment are taken into account.

Table 1 provides an overview on the classification and units of cross-country data applied in this study. Note that the data used is mainly derived from consensus surveys. Although Clements, Liu, and Tarverdi (2018) have shown that consensus data is not always reliable when it comes to alcohol consumption, for lack of choice and the benefit of a large cross-section and long time-series, we consider all data from FAOSTAT and WorldBank as they are reported.[9]

The entire dataset is structured as an unbalanced panel, with time-series data available between 1961 to 2013. The cross-sectional dimension of the dataset comprises 169 countries.[10] Figure 1 illustrates that the worldwide annual cross-country median of beer consumption per capita increased steadily from the early 1960s up to 2013. Skog (1986) argues that this trend is partially attributable to other factors than economic growth.[11] Alongside beer consumption, a number of further independent variables exhibit a clear trend. Carefully controlling for non-stationarity in our series, we construct level differences for respective variables. Descriptive statistics and correlations are summarized in Table 2 and Appendix A2, respectively.

IV. Methodology

In a linear regression approach, we test the explanatory power of two sets of variables with regard to beer consumption across all countries in our sample. For that purpose, we employ a panel approach in which beer consumption ($beer_{i,t}$) of country i in year t is modelled as a function of several exogenous variables. We estimate two (three) different settings, one that covers macroeconomic and demographic drivers, while the other setting addresses nutrition habits. Additionally, we re-run the latter and control for significant macroeconomic and demographic factors. These models are outlined in the following three equations, where we

[7]http://faostat3.fao.org/home/index.html.
[8]http://data.worldbank.org.
[9]Colen and Swinnen (2016) also state doubts that alcohol consumption for some countries might be misreported because of religious views or prohibitions. Because of the high number of countries in our sample and a conducted robustness test for only European countries we refrain from changing the original dataset.
[10]For a detailed list, we refer to Appendix A1.
[11]Skog (1986) does not specify additional factors exactly; however, concludes that alcohol consumption and general private consumption are negatively related to various subsamples.

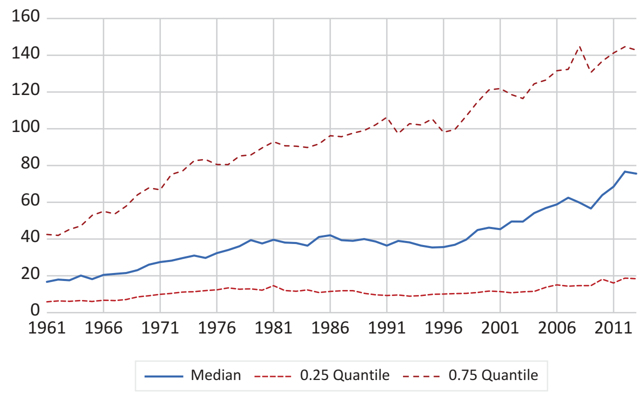

Figure 1. Worldwide beer consumption (g/day) per capita (1961–2013).

Table 2. Pooled descriptive statistics.

		Mean	Median	Std.dev	Skewness	Kurtosis	Nobs
	Beer[a]	70.96	33.52	88.03	1.83	6.18	7433
I	GDP[b]	6,134	1,491	11,731	3.63	20.38	7,046
	spending[c]	4.48	4.37	1.93	1.56	10.16	2,907
	pop_15–64[d]	58.76	58.04	6.78	0.18	1.90	8,557
	tertiary[d]	21.86	16.07	21.53	1.23	4.00	4,302
	urban[d]	0.48	0.47	0.24	0.13	2.05	8,663
	male[d]	0.50	0.50	0.02	5.06	50.37	8,504
II	Bovine[a]	33.82	23.35	32.00	2.27	10.61	8,082
	Pork[a]	31.59	15.16	38.69	1.68	5.59	7,581
	Poultry[a]	30.27	16.69	34.41	1.78	6.45	8,065
	Potato[a]	83.67	39.51	97.89	1.52	5.14	7,912
	Rice[a]	80.87	30.61	103.02	1.77	5.70	8,042
	Wheat[a]	174.39	151.70	135.73	0.82	3.09	8,092
	Cheese[a]	10.17	4.09	14.05	1.92	6.57	7,531
	Eggs[a]	15.16	11.15	13.57	0.89	2.83	7,736
	Nuts[a]	4.63	2.28	6.13	2.57	13.02	6,970
	Wine[a]	21.11	3.14	41.78	3.47	18.01	7,231

This table reports descriptive statistics of beer consumption and its potential drivers: demographics and economics (group I), nutrition habits (group II). Values are calculated based upon an unbalanced panel. Units provided in superscript according to the following notation: a) g/capita/day, b) per capita in current USD, c) % of GDP, d) % of total population. Demographic variables are denoted as follows: GDP *(GDP)*, public spending on education *(spending)*, share of population aged 15–64 *(pop_15 – 64)*, tertiary school enrolment *(tertiary)*, urban *(urban)* and male *(male)*.

account for autocorrelation induced by a dynamic relationship in beer consumption through its one-year lagged value ($beer_{i,t-1}$)[12]

$$beer_{i,t} = b_1 \cdot beer_{i,t-1} + b_2 \cdot macro_{i,t} + b_3 \cdot demogr_{i,t} + c_i + \mu_t + u_{i,t} \quad (1)$$

$$beer_{i,t} = b_1 \cdot beer_{i,t-1} + b_2 \cdot meat_{i,t} + b_3 \cdot staple_{i,t} + b_4 \cdot misc_{i,t} + c_i + \mu_t + u_{i,t} \quad (2)$$

In specification (1) the macroeconomic variable $macro_{i,t}$ represents a country's gross domestic product (*GDP*) and its public spending on education (*spending*). Demographic variables are summarized by $demogr_{i,t}$ and include a country's percentage of urban population (*urban*), its fraction of male residents (*male*), the percentage of total population that is enrolled for tertiary education (*tertiary*) and the share of people aged between 15 and 64 years *(pop_15 – 64)*.

[12]In these equations we only depict the functional relationship between the variables. Which variables we include in levels (differences) can be seen from the result tables.

Model (2) includes the variable $meat_{i,t}$ to represent the consumption of *bovine*, *pork* and *poultry* meat. Within $staple_{i,t}$ we comprise the consumption of *potato*, *rice* and *wheat* while $misc_{i,t}$ summarizes a country's consumption of *cheese, eggs, nuts* and *wine*

$$beer_{i,t} = b_1 \cdot beer_{i,t-1} + b_2 \cdot meat_{i,t} + b_3 \cdot staple_{i,t} + b_4 \cdot misc_{i,t} + + b_5 \cdot macro^*_{i,t} + b_6 \cdot demogr^*_{i,t} + c_i + \mu_t + u_{i,t} \quad (3)$$

In a third specification (3), we re-run model (2) and include statistically significant variables from model (1), which we denote as $macro^*_{i,t}$ and $demogr^*_{i,t}$. Thereby, we account for potential single moderating factors like wealth of a country. Whilst we provide results from model (2) in Table 5 for completeness, we only discuss findings for models (1) and (3) in detail.

In all cases, we account for time-invariant country-specific determinants of beer consumption, by including country-fixed effects, which are represented by c_i. Moreover, time-fixed effects, labelled as μ_t, control for period specific but unobserved determinants of beer consumption.[13] We test for stationarity of each variable by applying the panel unit root test developed by Levin, Lin, and Chu (2002). For variables that pass the test, we employ first differences in order to ensure stationarity, all others are employed as levels.

V. Cross-country empirical evidence

The models are tested as outlined in Section IV. First, we regress beer consumption on its one-year lagged value and on each independent variable individually and, second, we conduct multivariate analyses on each group of variables – i.e. meat, staple, miscellaneous, demographics and macroeconomics – concluding with kitchen-sink models for all three specifications. Former studies show mixed results regarding the explanatory power of nutrition habits for the benefit of explaining beer consumption.[14] We expect all estimated food coefficients to be positive except for wine – which serves as a substitute good – and cheese – which is more commonly served alongside wine rather than beer (Tjønneland et al. 1999).

Table 3. Estimation output – demographics and economics.

		Economic		Demographic				
	Δbeer(t−1)	ΔGDP	Δspending	Δpop_15-64	Δtertiary	urban	male	R^2/R^2_{adj}
(1)	−0.067***	0.000***						0.057
	(0.000)	(0.002)						0.024
(2)	−0.051**		−0.321					0.131
	(0.023)		(0.405)					0.047
(3)	−0.058***			1.764***				0.053
	(0.000)			(0.000)				0.024
(4)	−0.042**				0.030			0.094
	(0.019)				(0.726)			0.038
(5)	−0.060***					0.075***		0.051
	(0.000)					(0.003)		0.022
(6)	−0.056***						−0.300	0.051
	(0.000)						(0.244)	0.021
(7)	−0.056**		−0.326	6.065***	0.019			0.168
	(0.036)		(0.518)	(0.000)	(0.867)			0.063
(8)	−0.057***					0.063**	−0.343	0.051
	(0.000)					(0.014)	(0.183)	0.022
(9)	−0.058**	0.000	−0.286	6.161***	0.022	0.089	−0.665	0.169
	(0.032)	(0.210)	(0.572)	(0.000)	(0.846)	(0.350)	(0.438)	0.062

This table summarizes estimation outputs for nine different unbalanced regression models testing potential demographic drivers of cross-country beer consumption using two-way fixed effects. Each variable is tested individually and also grouped according to categories: economics and demographics. In all models lagged beer consumption (Δbeer(s.a.–1)) is included. Notation as follows: changes in per capita GDP growth (ΔGDP), changes in per capita public spending on education (Δspending), changes in per capita tertiary school enrolment (Δtertiary), changes in share of population aged 15-64 (Δpop_15-64), share of male (male) and urban (urban) population. Statistical significance of coefficients at 10%, 5% and 1% levels are provided in parenthesis according to conventional notation.

[13]We test for redundancy of each/both fixed effects in every model using F- and likelihood-ratio tests, and find that the hypothesis can be rejected every time at the highest significance levels.

[14]See Kesse et al. (2001), Männistö et al. (1997) and Herbeth et al. (2012), who support the influence of meat consumption and Toniolo, Riboli, and Cappa (1991) for counter-evidence.

Table 3 reports the results for the case of macroeconomic and demographic variables and their impact on beer consumption, as laid out in model (1). We find three economic/demographic variables to be essential for explaining beer consumption, namely ΔGDP, Δ*pop_15 – 64* and *urban*. In particular, the thirst for beer is highest among 15–64-year-old individuals. In support of Gao, Wailes, and Cramer (1995), we find that urbanites drink beer more frequently than the rural population. Additionally, we find that women – though not statistically significant – drink more beer than man, which is in contrast to previous studies. However, this could be a potential bias, which might be attributed to the low variation within the male-to-female ratio, supported by non-robust coefficients of *male*.[15] It is worth noting that neither the amount of public spending on education nor the level of tertiary enrolment has a robust impact on beer consumption in our sample. This is surprising as, among others, Kerr et al. (2004) show that education generally reduces alcohol consumption and, in particular, leads to lower beer intake within the group of alcoholic drinks. We cannot confirm previous findings in that respect.

In a second step, we report findings for model (3) and take a closer look at nutrition habits, whilst controlling for economic and demographic variables previously documented to be statistically significant. Thereby, we close a gap in the existing literature by jointly considering economic, demographic and nutrition factors. This is crucial, since factors in both models can potentially be attributable to a single moderating factor, as previously elaborated on.

Results in Table 4 reveal meat consumption to trigger beer consumption, with the strongest drivers

Table 4. Estimation output – food supply controlling for (significant) demographic and economic variables.

		Meat			Staple			Miscellaneous				
	Δbeer(t−1)	Δbovine	Δpork	Δpoultry	potato	rice	wheat	cheese	Δeggs	Δnuts	wine	R^2/R^2_{adj}
(1)	−0.071***	0.068***										0.063
	(0.000)	(0.001)										0.030
(2)	−0.071***		0.174***									0.067
	(0.000)		(0.000)									0.034
(3)	−0.070***			0.130***								0.065
	(0.000)			(0.000)								0.032
(4)	−0.070***				0.017***							0.064
	(0.000)				(0.000)							0.031
(5)	−0.069***					−0.006						0.062
	(0.000)					(0.303)						0.029
(6)	−0.069***						0.002					0.062
	(0.000)						(0.658)					0.029
(7)	−0.070***							−0.147***				0.066
	(0.000)							(0.000)				0.031
(8)	−0.073***								0.228***			0.073
	(0.000)								(0.000)			0.039
(9)	−0.072***									0.091		0.065
	(0.000)									(0.311)		0.030
(10)	−0.070***										−0.022**	0.065
	(0.000)										(0.011)	0.030
(11)	−0.075***	0.065***	0.168***	0.127***								0.072
	(0.000)	(0.001)	(0.000)	(0.000)								0.038
(12)	−0.071***				0.017***	−0.006	0.001					0.064
	(0.000)				(0.000)	(0.312)	(0.754)					0.030
(13)	−0.077***							−0.147***	0.208***	0.130	−0.025***	0.090
	(0.000)							(0.000)	(0.002)	(0.176)	(0.004)	0.051
(14)	−0.086***	0.053**	0.156***	0.154***	0.016***	−0.003	0.005	−0.119***	0.178***	0.115	−0.029***	0.103
	(0.000)	(0.012)	(0.000)	(0.000)	(0.003)	(0.661)	(0.387)	(0.000)	(0.008)	(0.241)	(0.001)	0.063

This table summarizes estimation outputs for 14 different unbalanced panel regression models testing potential nutritional drivers of cross-country beer consumption using two-way fixed effects, controlling for the (significant) demographic and economic drivers identified in Table 5. Each variable is tested individually and according to categories: meat, staple and miscellaneous. In all models lagged beer consumption (Δbeer(t−1)) is included. Statistical significance of coefficients at 10%, 5% and 1% levels are provided in parenthesis according to conventional notation.

[15]See Kerr et al. (2004) demonstrating that men are more thirsty when it comes to beer than women.

Table 5. Estimation output – food supply.

		Meat			Staple			Miscellaneous			
	Δbeer(−1)	Δbovine	Δpork	Δpoultry	potato	rice	wheat	cheese	Δeggs	Δnuts	wine	R^2/R^2_{adj}
(1)	−0.059***	0.079***										0.052
	(0.000)	(0.000)										0.023
(2)	−0.057***		0.180***									0.056
	(0.000)		(0.000)									0.027
(3)	−0.057***			0.162***								0.055
	(0.000)			(0.000)								0.026
(4)	−0.058***				0.019***							0.053
	(0.000)				(0.000)							0.024
(5)	−0.056***					0.001						0.050
	(0.000)					(0.832)						0.021
(6)	−0.057***						0.011***					0.051
	(0.000)						(0.002)					0.022
(7)	−0.060***							−0.163***				0.056
	(0.000)							(0.000)				0.025
(8)	−0.059***								0.243***			0.060
	(0.000)								(0.000)			0.031
(9)	−0.057***									0.046		0.062
	(0.000)									(0.584)		0.029
(10)	−0.057***										−0.016**	0.052
	(0.000)										(0.049)	0.022
(11)	−0.062***	0.077***	0.174***	0.159***								0.064
	(0.000)	(0.000)	(0.000)	(0.000)								0.034
(12)	−0.059***				0.018***	0.000	0.010***					0.054
	(0.000)				(0.000)	(0.997)	(0.004)					0.025
(13)	−0.064***							−0.156***	0.212***	0.166*	−0.018**	0.080
	(0.000)							(0.000)	(0.001)	(0.061)	(0.034)	0.044
(14)	−0.073***	0.049**	0.166***	0.160***	0.014***	0.001	0.011**	−0.127***	0.165***	0.139	−0.024***	0.096
	(0.000)	(0.014)	(0.000)	(0.000)	(0.002)	(0.911)	(0.012)	(0.000)	(0.008)	(0.123)	(0.005)	0.059

This table summarizes estimation outputs for 14 different unbalanced panel regression models testing potential nutritional drivers of cross-country beer consumption using two-way fixed effects. Each variable is tested individually and according to categories: meat, staple and miscellaneous. In all models lagged beer consumption (Δbeer(s.a.-1)) is included. Statistical significance of coefficients at 10%, 5% and 1% levels are provided in parenthesis according to conventional notation.

being pork and poultry. These findings are consistent with Barefoot et al. (2002), who show that beer drinkers eat more meat, however, we find no significant preference for a specific type of meat. Yet, levels of regression coefficients point towards a stronger preference for pork, which is consistent with our initial hypothesis and the habits observable on the Oktoberfest. Furthermore, the stronger magnitude for pork is potentially emphasized by the fact that both alcohol and pork consumption is prohibited in strict Islamic countries, whereas they do consume bovine and poultry. On the other hand, countries with strong alcohol consumption generally do not show restrictions in terms of pork consumption and consequently drive up the coefficient for pork. A check for robustness reveals similar levels of significance and equal signs when regressing beer consumption on all types of meat simultaneously.

Looking at staples, we can confirm findings by Ruidavets et al. (2004) as to potatoes showing a small, but robust positive effect. Contrarily, the consumption of rice and wheat has no influence on overall beer consumption. Loosely speaking, the group robustness check supports the hypothesis of a bowl of (potato) chips accompanying a pint of beer.

Furthermore, we observe a negative coefficient for wine, which corroborates our hypothesis that wine serves as a substitute good for beer. Cheese also has a significant negative coefficient, thereby confirming the findings by Ruidavets et al. (2004). Although Kesse et al. (2001) and Herbeth et al. (2012) demonstrate that alcohol consumption is driven by an increased consumption of cheese, we expect wine to be more likely to trigger the appetite for cheese. Cheese is traditionally popular in countries in which people prefer a bottle of wine over a jug of beer, such as France and Italy.

In contrast to Ruidavets et al. (2004), we find strong evidence for beer consumption to be driven by the consumption of eggs, but only weak evidence for nuts. In fact, checking again for joint robustness of the staples and miscellaneous group we find strong evidence for both potatoes and eggs to be drivers of beer consumption. Whilst the positive relation of beer and eggs is not obvious at first glance, eggs are an alternative source of animal protein and therefore might be a substitute for meat in some regions/countries. In this direction, the World Health Organization has reported a strong link between the level of income and the consumption of animal protein. This trend is also linked to the degree of urbanization and comes at the expense of staple foods. Once more, these dependencies substantiate the need to jointly consider economic, demographic and nutrition factors – as done in this study.

For robustness, we also provide findings for model (2), which does not account for significant economic/demographic variables when testing the food variables. Results are presented in Table 5 and are not materially different, except for *wheat* now showing up as significantly positive. Consequently, we observe no indication of a moderating effect, which is good news with respect to the existing literature, as studies so far have not explicitly accounted for this issue. Finally, we apply an overall kitchen-sink robustness check and reveal all of the above relationships to be consistent in direction and significance.

VI. Conclusion

Our study largely confirms that drinking and eating habits observable at traditional German beerfests, like the Oktoberfest, are transferable to a cross-country level without loss of generality.

We test variables categorized as nutrition habits, economics and demographics in a linear regression panel setting, each individually and according to various groups, as well as a kitchen sink approach for both models. The underlying dataset is an unbalanced panel of 169 countries with annual time-series up to 52 years.

The results are generally in line with what has been reported in previous studies. We find that countries with a strong preference for meat, potatoes and egg tend to grab a jug more often. In contrast, nations with a desire for wine and cheese drink less beer. Additionally, we show beer consumption to be higher for people living in cities and aged between 15 and 64 years. Mentioned coefficients are proven to be statistically significant at 1% levels.

The implications of this study are multifold. First of all, the methodological adjustment of jointly considering economic, demographic and nutrition habits, yields empirically robust insight on the relation of beer consumption towards these factors. Furthermore, regarding the economic and demographic factors, we show that an increase in beer consumption is positively related to the level of urbanization in a country and working age group (from 15 to 64 years). With respect to the degree of urbanization, the UN has projected that 68% of the world population will be living in cities (urban areas) by 2050. As such, we can expect beer consumption to further grow on a global level; accompanied by health implications on a personal level and higher costs for national health services in general. On the other hand, this provides a positive outlook for the beer industry with respect to sales, where markets with a fast increase in urbanization should be targeted.

As an area of further research, we suggest to evaluate our findings on a regional basis. Especially within large countries like the US, Canada or Germany regional patterns might vary and not portrait a homogeneous picture. Furthermore, it would be interesting to look deeper into the causality between urbanization and alcohol consumption and the socializing component associated with it. As this study builds on the change in beer consumption rather than the level – for statistical reasons – we cannot further evaluate whether the baseline value in beer consumption between rural and urban areas has an impact on the findings. However, given the increase in urbanization such causalities of alcohol consumption can be interesting both for the beverage industry and even more so for national health services, as previously touched upon.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Alcácera, M. A., I. Marques-Lopes, M. Fajó-Pascual, J. P. Foncillas, F. Carmona-Torre, and M. Á. Martínez-González. 2007. "Alcoholic Beverage Preference and Dietary Pattern in Spanish University Graduates: The SUN Cohort Study." *European Journal of Clinical Nutrition* 62 (10 Jul.): 1178–1186. doi:10.1038/sj.ejcn.1602833.

Arora, A., A. Bhaskar, B. Minten, and A. Vandeplas. 2011. "Opening the Beer Gates: How Liberalization Caused Growth in India's Beer Market." In *The Economics of Beer*, edited by J. F. M. Swinnen, 308–332. Oxford University Press. October. 10.1093/acprof:oso/9780199693801.003.0017

Bai, J., J. Huang, S. Rozelle, and M. Boswell. 2011. "Beer Battles in China: The Struggle over the World's Largest Beer Market." In *The Economics of Beer*, edited by J. F. M. Swinnen, 267–286. Oxford University Press. doi:10.1093/acprof:oso/9780199693801.003.0017

Barefoot, J. C., M. Grønbæk, J. R. Feaganes, R. S. McPherson, R. B. Williams, and I. C. Siegler. 2002. "Alcoholic Beverage Preference, Diet, and Health Habits in the UNC Alumni Heart Study." *The American Journal of Clinical Nutrition* 76 (2 Jan.)): 466–472.

Brenner, M. H., and A. Mooney. 1983. "Unemployment and Health in the Context of Economic Change." *Social Science & Medicine* 17 (16): 1125–1138. doi:10.1016/0277-9536(83)90005-9.

Chatenoud, L., E. Negri, C. La Vecchia, O. V. Volpato, and S. Franceschi. 2000. "Wine Drinking and Diet in Italy." *European Journal of Clinical Nutrition* 54 (2): 177. doi:10.1038/sj.ejcn.1600913.

Clements, K. W., H. Liu, and Y. Tarverdi. 2018. "Alcohol Consumption, Censorship and Misjudgement." *Applied Economics* 50 (49 Oct.): 5269–5276. doi:10.1080/00036846.2018.1486025.

Colen, L., and J. F. M. Swinnen. 2011. "Beer Drinking Nations-The Determinants of Global Beer Consumption." In *The Economics of Beer*, edited by J. F. M. Swinnen, 123–140. Oxford, NY: Oxford University Press.

Colen, L., and J. F. M. Swinnen. 2016. "Economic Growth, Globalisation and Beer Consumption." *Journal of Agricultural Economics* 67 (no. 1 (February)): 186–207. doi:10.1111/1477-9552.12128.

Deconinck, K., and J. F. M. Swinnen. 2011. "From Vodka to Baltika: A Perfect Storm in the Russian Beer Market." In *The Economics of Beer*, edited by J. F. M. Swinnen, 123–140. Oxford, NY: Oxford University Press.

Fogarty, J. 2010. "The Demand for Beer, Wine and Spirits: A Survey of the Literature." *Journal of Economic Surveys* 24 (3): 428–478.

Freeman, D. G. 2001. "Beer and the Business Cycle." *Applied Economics Letters* 8 (1): 51–54. doi:10.1080/135048501750041295.

Freeman, D. G. 2011. "Beer in Good Times and Bad: A U.S. State-Level Analysis of Economic Conditions and Alcohol Consumption." *Journal of Wine Economics* 6 (2): 231–251. doi:10.1017/S1931436100001620.

Gallet, C. A. 2007. "The Demand for Alcohol: A Meta-Analysis of Elasticities*." *Australian Journal of Agricultural and Resource Economics* 51 (2 Jun.)): 121–135. doi:10.1111/j.1467-8489.2007.00365.x.

Gao, X. M., E. J. Wailes, and G. L. Cramer. 1995. "A Microeconometric Model Analysis of US Consumer Demand for Alcoholic Beverages." *Applied Economics* 27 (1): 59–69. doi:10.1080/00036849500000008.

Harrington, R. J. 2007. *Food and Wine Pairing: A Sensory Experience*. Hoboken, N.J: Wiley.

Herbeth, B., A. Samara, M. Stathopoulou, G. Siest, and S. V. Siest. 2012. "Alcohol Consumption, Beverage Preference, and Diet in Middle-Aged Men from the STANISLAS Study." *Journal of Nutrition and Metabolism* 2012.

Johansen, D., K. Friis, E. Skovenborg, and M. Grønbæk. 2006. "Food Buying Habits of People Who Buy Wine or Beer: Cross Sectional Study." *British Medical Journal* 332 (7540): 519–522.

Kerr, W. C., T. K. Greenfield, J. Bond, Y. Ye, and J. Rehm. 2004. "Age, Period and Cohort Influences on Beer, Wine and Spirits Consumption Trends in the US National Alcohol Surveys." *Addiction* 99 (9): 1111–1120. doi:10.1111/j.1360-0443.2004.00820.x.

Kesse, E., F. Clavel-Chapelon, N. Slimani, and M. van Liere. 2001. "Do Eating Habits Differ according to Alcohol Consumption? Results of a Study of the French Cohort of the European Prospective Investigation into Cancer and Nutrition (E3N-EPIC)." *The American Journal of Clinical Nutrition* 74 (3 Jan.)): 322–327.

Levin, A., C.-F. Lin, and C.-S. J. Chu. 2002. "Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties." *Journal of Econometrics* 108 (no. 1 (May)): 1–24. doi:10.1016/S0304-4076(01)00098-7.

Männistö, S., A.-K. Uusitalo, H. P. Roos, M. Fogelholm, and P. Pietinen. 1997. "Alcohol Beverage Drinking, Diet and Body Mass Index in a Cross- Sectional Survey." *European Journal of Clinical Nutrition* 51 (no. 5 (April)).

Piron, E., and E. Poelmans. 2016. “Beer, the Preferred Alcoholic Drink of All? Changes in the Global and National Beer Consumption since 1960 and Convergence and Trends since the 1990s.” In *Brewing, Beer and Pubs: A Global Perspective*, edited by I. Cabras, D. Higgins, and D. Preece, 205–227. London: Palgrave Macmillan UK. doi:10.1057/9781137466181_11.

Poelmans, E., and J. F. M. Swinnen. 2011. “From Monasteries to Multinationals (And Back): A Historical Review of the Beer Economy*.” *Journal of Wine Economics* 6 (2): 196–216. doi:10.1017/S1931436100001607.

Ruidavets, J.-B., V. Bataille, J. Dallongeville, C. Simon, A. Bingham, P. Amouyel, D. Arveiler, P. Ducimetière, and J. Ferrières. 2004. “Alcohol Intake and Diet in France, the Prominent Role of Lifestyle.” *European Heart Journal* 25 (13 Jan.)): 1153–1162. doi:10.1016/j.ehj.2003.12.022.

Siegel, M. B., T. S. Naimi, J. L. Cremeens, and D. E. Nelson. 2011. “Alcoholic Beverage Preferences and Associated Drinking Patterns and Risk Behaviors among High School Youth.” *American Journal of Preventive Medicine* 40 (4): 419–426. doi:10.1016/j.amepre.2010.12.011.

Skog, O.-J. 1986. “An Analysis of Divergent Trends in Alcohol Consumption and Economic Development.” *Journal of Studies on Alcohol* 47 (1 Jan.)): 19–25.

Tjønneland, A., M. Grønbæk, C. Stripp, and K. Overvad. 1999. “Wine Intake and Diet in a Random Sample of 48763 Danish Men and Women.” *The American Journal of Clinical Nutrition* 69 (1 Jan.)): 49–54. doi:10.1093/ajcn/69.1.49.

Toniolo, P., E. Riboli, and A. P. M. Cappa. 1991. “A Community Study of Alcohol Consumption and Dietary Habits in Middle-Aged Italian Women.” *International Journal of Epidemiology* 20 (3 Jan.)): 663–670. doi:10.1093/ije/20.3.663.

Wagenaar, A. C., M. J. Salois, and K. A. Komro. 2009. “Effects of Beverage Alcohol Price and Tax Levels on Drinking: A Meta-Analysis of 1003 Estimates from 112 Studies.” *Addiction* 104 (2): 179–190.

Appendix A. Additional information

Appendix A1. List of countries in alphabetical order

Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bangladesh, Barbados, Belarus, Belgium-Luxembourg, Belgium, Belize, Benin, Bermuda, Bolivia (Plurinational State of), Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Cambodia, Cameroon, Canada, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Congo, Costa Rica, Croatia, Cuba, Cyprus, Czech Republic, Czechoslovakia, Cote d'Ivoire, Denmark, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia PDR, Ethiopia, Fiji, Finland, France, French Polynesia, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea-Bissau, Guinea, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Lao Peoples Democratic Republic, Latvia, Lebanon, Lesotho, Liberia, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands Antilles, Netherlands, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Republic of Korea, Republic of Moldova, Romania, Russian Federation, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia and Montenegro, Serbia, Sierra Leone, Slovakia, Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, Sudan (former), Suriname, Swaziland, Sweden, Switzerland, Taiwan (China), Tajikistan, Thailand, The former Yugoslav Republic of Macedonia, Timor-Leste, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, USSR, Uganda, Ukraine, United Arab Emirates, United Kingdom, United Republic of Tanzania, United States of America, Uruguay, Uzbekistan, Vanuatu, Venezuela (Bolivarian Republic of), Viet Nam, Yemen, Yugoslav SFR, Zambia and Zimbabwe

Appendix A2. Correlation matrix of variables

Tables A1 and A2 summarize correlation coefficients between the nominal level of beer consumption and potential drivers investigated in this study. Values are calculated based upon a balanced sample. Demographic variables are denoted as follows: GDP growth *(GDP)*, public spending on education *(spending)*, share of population aged 15–64 *(pop_15-64)*, tertiary school enrolment *(tertiary)*, urban population *(urban)* and male population *(male)*.

Table A1. Correlation matrix – demographics & economics.

	Beer	GDP	Spending	pop_15-64	Tertiary	Urban	Male
Beer	1.000	0.528	0.260	0.552	0.531	0.527	−0.350
GDP		1.000	0.294	0.474	0.677	0.533	−0.095
Spending			1.000	0.197	0.343	0.260	−0.096
pop_15-64				1.000	0.704	0.641	−0.326
Tertiary					1.000	0.641	−0.328
Urban						1.000	−0.108
Male							1.000

Table A2. Correlation matrix – food supply.

	Beer	Bovine	Pork	Poultry	Potato	Rice	Wheat	Cheese	Eggs	Nuts	Wine
Beer	1.000	0.470	0.753	0.339	0.553	−0.349	0.227	0.558	0.629	0.209	0.295
Bovine		1.000	0.344	0.303	0.361	−0.317	0.284	0.413	0.456	0.127	0.419
Pork			1.000	0.306	0.604	−0.285	0.305	0.658	0.689	0.361	0.429
Poultry				1.000	0.148	−0.138	0.217	0.371	0.393	0.223	0.138
Potato					1.000	−0.436	0.503	0.516	0.580	0.274	0.365
Rice						1.000	−0.444	−0.398	−0.286	−0.190	−0.279
Wheat							1.000	0.447	0.416	0.299	0.364
Cheese								1.000	0.618	0.536	0.476
Eggs									1.000	0.317	0.341
Nuts										1.000	0.385
Wine											1.000