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THE LONG-RUN EFFECT OF GEOGRAPHICALLY-STAGGERED LEGALIZATIONS: WAS THERE A FIRST-ADOPTER ADVANTAGE FOR STATES THAT LEGALIZED BEER MORE QUICKLY IN 1933?[1]

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Over the last two decades a geographically staggered-legalization of marijuana has commenced in the United States. Early-legalizing states may subsequently enjoy a first-mover advantage which will help them stake a long-run foothold in what may evolve into a national market. To gain insight, we examine another geographically-staggered legalization—that of 3.2 percent beer. Between April 1933 and May 1937 every state legalized the production and sale of beer. Indeed we find that those states that legalized beer earlier in this period had more breweries not just in the years immediately following legalization, but also in 1977, just prior to the beginning of the craft brewing movement in the US. This finding holds even when variables related to long-term brewing tradition are held constant.

[1] Jason Taylor is the immediate past-Editor of this journal, and Eline Poelmans is currently an Associate Editor. This paper was submitted after the end of Taylor's term as Editor, and was accepted by the current Editors after the usual double-blind review process to which all articles published in the journal are subject.

Introduction

Over the last two decades a geographically-staggered legalization of marijuana has commenced in the United States. California was the first state to legalize medical marijuana in 1996 and, as of this writing in 2018, medical marijuana is legal in 30 states. In 2012, Colorado and Washington became the first states to legalize the recreational use of marijuana, and the substance is currently legal for recreational use in nine states. In the long run, states that legalize in the earliest stages of this staggered removal of the drug's prohibition may enjoy an early-adopter advantage with respect to the production and sale of marijuana as they gain a foothold in what may soon become a national (or international) market for the product.

To gain insight, we look to another geographically-staggered legalization—that of beer in 1933. The so-called "Beer Bill," which was passed on March 21, 1933, relaxed the nation's prohibition of alcohol giving states the ability to legalize 3.2 percent alcohol beer. Over the next eight months the majority of states legalized the production, consumption, and sale of beer. We take advantage of the variation in the timing of state legalization to examine whether states that legalized beer sooner subsequently experienced differential outcomes with respect to the number of breweries located within their borders over the short and long run. We find that the number of breweries in a state in both 1934 and 1935 was higher in those states that legalized more quickly after passage of the "Beer Bill" of 1933, other factors held constant. Importantly, this effect persisted. We show that states that legalized beer more quickly in 1933 had more breweries in 1977, just prior to the craft brewing movement's beginning in the US. This finding holds even when variables related to long-term brewing tradition are held constant, suggesting it could be related to a first-adopter advantage.

Background and Data

Beginning in 1920, the 18th Amendment to the US Constitution and its companion Volstead Act prohibited the sale, manufacture, and transportation of beverages containing more than 0.5 percent alcohol by volume (ABV). Prohibition ended in December 1933 with the passage of the 21st Amendment. However nine months earlier, Congress passed the Cullen-Harrison Act—more commonly known as the "Beer Bill"—which

allowed states to legalize beer with 3.2 percent alcohol by weight (around 4 percent ABV). Twenty-one states legalized on April 7, 1933. Twenty-two other states legalized sporadically over the rest of 1933 and the remaining five states legalized over the following three and a half years. Kansas was the last state to legalize beer in May 1937. Table 1 lists the date that beer became legal in each state.

Proponents of legalization claimed that beer would bring economic gains and tax revenue to legalizing states. Indeed Eline Poelmans, Samuel Raisanen, and Jason Taylor (2018) find that legalizing states, and particularly those that had a substantial brewing tradition, experienced faster monthly employment growth in restaurants and manufacturing establishments in 1933. Our interest here is on the long run effects of this geographically-staggered legalization and whether early legalizers experienced an early-adopter advantage that persisted over time. Marvin Lieberman and David Montgomery (1998) survey the vast theoretical literature on first-mover advantages, which includes advantages gained through technological leadership, preemption of assets, and the presence of buyer switching costs. This literature suggests that a state such as Wisconsin, which legalized beer in April 1933, may have had an economic advantage over a state like Texas, which did not legalize until September 1933, if this five-month head start allowed its brewers to gain a foothold in the national or regional market. We test this hypothesis by looking at the number of breweries in a state over time as it relates to the speed of legalization after passage of the Beer Bill of 1933.

Methodology and Empirical Results

To obtain data on the number of breweries in each state over time, we use a database compiled by the American Breweriana Association, which details the years of operation and the location of every brewery in the United States from the seventeenth century to today. In aggregate, there were 1,425 breweries in the US in 1914. This number fell to 997 in 1919, the year prior to Prohibition, as 17 states enacted their own Prohibitions between 1914 and 1919. In 1932, the year prior to relegalization, there were 201 registered breweries. These were generally long-standing firms that produced beer prior to Prohibition and then switched to making non-

Table 1
Date of Beer Legalization by State

Alabama	March 22, 1937	Nebraska	May 8, 1933
Arizona	June 16, 1933	Nevada	April 7, 1933
Arkansas	August 24, 1933	New Hampshire	May 2, 1933
California	April 7, 1933	New Jersey	April 7, 1933
Colorado	April 7, 1933	New Mexico	June 9, 1933
Connecticut	April 20, 1933	New York	April 7, 1933
Delaware	April 7, 1933	North Carolina	April 28, 1933
Florida	May 8, 1933	North Dakota	July 1, 1933
Georgia	May 23, 1935	Ohio	April 7, 1933
Idaho	June 21, 1933	Oklahoma	July 15, 1933
Illinois	April 7, 1933	Oregon	April 7, 1933
Indiana	April 7, 1933	Pennsylvania	April 7, 1933
Iowa	April 15, 1933	Rhode Island	April 7, 1933
Kansas	May 1, 1937	South Carolina	April 14, 1933
Kentucky	April 7, 1933	South Dakota	August 5, 1933
Louisiana	April 13, 1933	Tennessee	May 1, 1933
Maine	June 30, 1933	Texas	Sept. 15, 1933
Maryland	April 7, 1933	Utah	Jan. 1, 1934
Massachusetts	April 7, 1933	Vermont	April 7, 1933
Michigan	April 27, 1933	Virginia	Sept. 3, 1933
Minnesota	April 7, 1933	Washington	April 7, 1933
Mississippi	Feb 26, 1934	West Virginia	April 12, 1933
Missouri	April 7, 1933	Wisconsin	April 7, 1933
Montana	April 7, 1933	Wyoming	May 19, 1933

Source: Brewer's Almanac 2013, "Beer Excise Changes by State." This source incorrectly listed May 5, 1933 as Pennsylvania's legalization date, suggesting that only 20 states legalized on April 7, 1933. However, newspapers consistently referred to 21 states legalizing on April 7 and mentioned Pennsylvania as being amongst them. April 8 articles referring to the events of the day before also specifically discussed beer-related celebrations in Philadelphia.

alcoholic beer or other products such as malt syrup, carbonated soda, cheese, and ice cream. Kate Vinton (2015) notes that the Pabst brewery of Milwaukee, Wisconsin produced a cheese spread named "Pabst-ett," which was aged in the brewery's cold storage cellars. According to Vinton Anheuser-Busch of St. Louis, Missouri used its cold-storage facilities and trucks in the production and distribution of ice cream and soda. Thus, rather than fold during Prohibition, some breweries repurposed their capital toward the production of other foodstuffs. After beer's relegalization the number of breweries that operated in 1933 rose to 903, and further increased to 1,101 in 1934, before declining to 821 breweries in 1935. During the peak year of 1934, Pennsylvania had the most breweries with 164 (in population-adjusted terms, Wisconsin had the most). The average state had 23 breweries in 1934.

We begin our analysis by examining the number of breweries in each state in 1934 to see whether this quantity was related to the timing of state legalizations, most of which occurred in 1933. To test our hypothesis, we run the following least squares state-level cross-sectional regression employing White heteroscedasticity-consistent standard errors[2]:

$$BREWERIES_i = \beta_0 + \beta_1 MONTHSTOLEGAL_{\ i} + \beta_2 POP_i + \beta_3 LANDAREA_i + \beta_4\ MFG_i\ + \beta_5 BARLEY_i + \beta_6 BREWERIES1932_i + \beta_7 BEERPRODUCED1914 + \varepsilon_i$$

The dependent variable, *BREWERIES,* represents the number of breweries in state *i*—the year in which the number of breweries is measured varies by specification. The primary variable of interest is *MONTHSTOLEGAL* which represents the number of months past April 1933 that a state legalized—for example a state legalizing in April is assigned a value of 0 for this variable, while a state legalizing in May 1933 is assigned a value of 1, in June 1933 a value of 2, and so on. Thus a negative sign on the coefficient of *MONTHSTOLEGAL* implies that earlier legalization meant more future breweries. *BARLEY* is the value of barley produced in a state in 1929, *LANDAREA* represents the number of square

[2] The Halbert White (1980) heteroskedasticity consistent covariance matrix estimator provides consistent estimates of the coefficient covariances in the presence of conditional heteroskedasticity of unknown form—i.e. it allows subpopulations of the variables to have different variances.

miles in a state, *POP* represents each state's 1930 population, and *MFG* represents the value of manufacturing in each state in 1929. *BREWERIES1932* represents the number of breweries the state had in 1932 producing non-alcoholic beverages and finally *BEERPRODUCED1914* represents the number of barrels of beer produced in the state in 1914, the year before many state-level prohibitions went into effect.[3]

The results are reported in Table 2. Specification (1), which includes only the first five independent variables in the regression equation above, suggests that the timing of the state's legalization of beer impacted the number of breweries a state had in 1934 as those states that legalized faster had more breweries in 1934, ceteris paribus—this result is statistically significant at the 1 percent confidence level. The coefficient suggests that a state legalizing the average number of months (3.77) after April 1933 in our sample would have had 0.8 fewer breweries in 1934 than a state that legalized in April, ceteris paribus.[4] In terms of the control variables, the number of breweries in each state in 1934 was positively associated with barley production as well as the value of manufacturing in the state.

Specification (2), adds the number of breweries in each state in 1932 as well as the quantity of beer the state produced in 1914 as control variables. Effectively we want to see whether the number of breweries in a state in 1934, a year after passage of the beer bill, was related to the number of non-alcohol producing breweries that were already in a state prior to the bill's passage and/or whether the state had a strong tradition of brewing prior to Prohibition. Perhaps the significance of the *MONTHSTOLEGAL* coefficient is driven by the state's longstanding suitability to produce beer or by the fact that some breweries were already in existence even prior to relegalization. Indeed, there is a strong relationship between the number of breweries a state had in 1934 and

[3] Barrels of beer production in 1914 are from Earnest Cherrington (1915). Unfortunately state-level beer production in other years like 1919 or 1932 is not available—we have number of breweries for each year but for beer production data prior to relegalization in 1933, we have only data for 1914.

[4] To get this result the coefficient of -0.207 is multiplied by 3.77, the average number of months a state waited to legalize.

Table 2
Determinants of Number of Breweries per State in 1934, 1935, and 1970

	Dependent Variable					
	Breweries per State in 1934		*Breweries per State in 1935*		*Breweries per state in 1977*	
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-1.946	-1.776	-0.960	-0.600	-0.162	0.1662
	(-0.54)	(-0.59)	(-0.31)	(-0.26)	(-0.30)	(0.47)
Months After April	-0.2070	-0.1661	-0.158	-0.111	-0.053	-0.037
1933 Beer Legal	(-2.19)**	(-2.87)***	(-2.02)**	(-2.65)***	(-4.86)***	(-4.01)***
Barley Value 1929 (1969)	0.000001	0.00000	0.00000	-0.00000	0.00000	0.00000
	(2.02)**	(1.02)	(1.76)*	(0.39)	(1.61)	(0.98)
Population 1930 (1970)	-0.00000	0.000001	-0.0000	0.000001	0.000001	0.000001
	(0.68)	(0.71)	(-0.95)	(0.30)	(2.40)**	(3.23)***
Land Area, Square Miles	0.00004	0.00002	0.00003	0.00001	0.00001	-0.00000
	(1.16)	(0.63)	(1.20)	(0.69)	(1.73)*	(-0.20)
Manufacturing Output	0.00002	0.00001	0.00001	0.00001	0.00000	-0.00012
1933 (1972)	(7.02)***	(2.61)**	(6.07)***	(1.67)*	(0.11)	(-0.97)
Number of Breweries		3.227		2.8449		0.2768
In 1932		(4.15)***		(4.25)***		(4.61)***
Quantity of Beer Produced		-0.00000		-0.00002		-0.00000
In 1914		(-1.16)		(-0.81)		(-1.80)
R-squared	0.801	0.879	0.748	0.858	0.539	0.719
Number of Observations	48	48	48	48	48	48

Notes: t-statistics in parentheses. We employ robust standard errors. *** p<0.01, ** p<0.05, * p<0.10.
Sources: 1929 Barley value data are from the 1930 *Census of Agriculture* and data from 1969 are from the 1969 *Census of Agriculture*. State population data are from http://www.demographia.com/db-state1900.htm. Land area are obtained from http://water.usgs.gov/edu/wetstates.html. Manufacturing data are from the 1933 and 1972 *Census of Manufacturing.* Beer production in 1914 is from Cherrington (1915). Number of breweries in each state in various years is from author's dataset, assembled from the American Breweriana Association (see text for more details).

1932. For every one additional brewery a state had in 1932, it had 3.2 more breweries in place in 1934, ceteris paribus. However, beer production in 1914 was not related to the number of breweries in a state in 1934, ceteris paribus—this suggests that the presence of a longstanding beer tradition, as proxied by beer production prior to Prohibition, did not affect the number of breweries after beer legalization. In fact this variable remains insignificant even if we drop the number of breweries in 1932 from specification (2). When we add the 1914 and 1932 brewing variables to the regression, the coefficient on the number of months it took for a state to legalize beer loses around 20 percent of its value, but it is statistically significant at the 1 percent level—the quicker a state legalized, the more breweries it had in 1934.

Specifications (3) and (4) duplicate this analysis, but examine the number of breweries registered in a state in 1935 as the dependent variable. The same general pattern holds—states that legalized beer more quickly had significantly more breweries in 1935. This result holds even when the number of breweries in 1932, which could have quickly transitioned to the production of 3.2 percent beer, is held constant in specification (4). While the results are not reported in the interest of space, we repeated this process for 1936 and 1937 and the coefficient on *MONTHSTOLEGAL* remains statistically significant at the 10 percent level or better in all regressions.

Was there a Long Run First-Adopter Advantage?

That states experienced a short run first-adopter advantage is not too surprising. Next we examine the potential long run impact of being an early adopter. The brewing industry underwent a massive consolidation between World War II and the late 1970s—the number of breweries decreased dramatically, while the size of each of the remaining breweries increased (Kenneth Elzinga, 2011). Our database suggests that the number of breweries fell by a factor of 13 between 1934 and 1977 after controlling for changes in the population—specifically the number of breweries per million people fell from an average of 8 per state in 1934 to only 0.6 per state in 1977. Victor Tremblay and Carol Tremblay (2005) credit the exploitation of economies of scale (thanks to technical progress that made possible the automation of the brewing industry and an acceleration of packaging) and mass advertising (with large advantages for first-movers

due to the sunk investments necessary in advertising on the television) as two of the major factors behind the postwar consolidation. This consolidation of breweries began to reverse after 1977—and this reversal accelerated dramatically in the 1980s, 1990s, and early 2000s—when a plethora of craft or "micro" brewers entered the market. These breweries tend to produce a more diverse variety of beer rather than focusing on the traditional lager beer of the "macro" breweries.[5] The number of breweries in the United States rose from 106 in 1977 to 323 in 1990 and to 1,771 in 2000. By 2014 the number of breweries had swelled to 3,303, surpassing the prior peak of 3,163 in 1875.

Were the locations of the breweries that survived the postwar consolidation movement up to 1977 influenced by the state-level timing of relegalization of beer in the 1930s? Table 3 reports some statistics regarding the survival of breweries chartered in 1933 and 1934, the two years after beer's relegalization.

Table 3
Survival Attributes of Breweries Opening in 1933 and 1934

	Number of New Breweries Chartered	Average Years of Survival	Median Years of Survival	Number Still in Operation in 1950	Number Still in Operation in 1977
1933	722	9.93	4	179	19
1934	467	4.91	0	56	3

Source: Authors' database of breweries in each state and year created from the American Breweriana Association.

[5] See the edited volume by Christian Garavaglia and Johan Swinnen (2018) for more on the global craft brewing industry. Regarding craft brewing in the United States, Elzinga, Tremblay, and Tremblay's (2018) contribution to that volume cites the Anchor Brewing Company of San Francisco as the first craft brewer in 1965, however, they say that it was not until around 1977 that Anchor's success began to inspire other entrepreneurs to join the movement.

The 722 breweries that were chartered in 1933 survived an average of 9.93 years, while the median brewery survived 4 years. In 1950, when the number of breweries in the United States had fallen to around half of its 1935 number, 24.8 percent of the breweries chartered in 1933 were still in existence. In 1977, when the postwar consolidation was complete and just prior to the entry of many craft brewers, 2.6 percent of these breweries remained. In comparison, the 467 breweries chartered in 1934 survived only half as long—an average of 4.91 years. In fact, just over half (51.8 percent) of the breweries chartered in 1934 did not survive that year as an independent business and thus the median brewery survived zero years.[6] Furthermore, only 12 percent of the breweries chartered in 1934 survived until 1950 and just 0.6 percent of them made it until 1977. These data strongly suggest that first movers had a powerful longevity advantage.

Still, there may have been other factors aside from being an early adopter of legalization that caused early breweries to survive longer. To better explore causality, specifications (5) and (6) of Table 2 follow those of the two earlier years, but now the dependent variable in each is the number of breweries in each state in 1977 (we continue to examine only the 48 contiguous states).[7] The independent variables in these regressions are updated so that we now employ the value of barley produced in each state in 1969, state population in 1970, and state manufacturing output in 1972—each corresponding to the closest census year prior to 1977.

The results of these specifications suggest that those states that legalized beer more quickly had more breweries in 1977, over four decades after passage of the Beer Bill. The coefficient suggests that for

[6] The difference in survival between breweries formed in 1933 and 1934 does not appear to be related to the business cycle knocking out the 1934 newcomers. The economy grew fairly steadily between 1933 and 1937, with a slight acceleration occurring in the summer of 1935, before falling into recession in May 1937.

[7] Of course breweries in 1977 could produce beer that was higher than the 4.0 percent ABV (i.e. 3.2 percent alcohol by weight). Still most American beer in 1977 was lager and was typically between 4.5 and 5 percent ABV, which is only a marginally higher alcohol volume than that being produced between April and December of 1933 when the 4 percent ABV requirement constrained brewers. Subsequently, the craft brewing revolution has seen the production of many beers that are between 6 and 8 percent ABV or higher.

every month that a state waited to legalize, the number of breweries in that state in 1977 was 2.4 percent lower.[8] Thus, ceteris paribus, a state like Texas, which waited five months to legalize beer, would have had 12 percent fewer breweries in 1977 than a state like Wisconsin, which legalized right away. When the number of breweries in each state in 1932 and a state's beer production in 1914 are included in the regressions (specification 6), we continue to find a strong correlation between the state-level quantity of breweries in 1977 and breweries just prior to relegalization in 1932. While the coefficient on the timing of 1930s beer legalization falls by around 30 percent when these brewing tradition controls are added to the regression, it remains statistically significant at the 1 percent level. As a robustness check, we tried other dates, specifically 1970, 1975, and 1980, for the end of the consolidation and the results are not qualitatively different from those for 1977—the coefficient on *MONTHSTOLEGAL* remains statistically significant at the 1 percent confidence level in all regressions.

Staggered Legalizations of Beer and Marijuana: Comparisons and Contrasts

We have taken advantage of the variation in states' timing of beer legalization to show that states legalizing earlier had both short- and long-run first-mover advantages with respect to the subsequent number of breweries located within that state. Whether this can lend insight into the potential long- and short-term outcomes from the staggered state-level legalization of marijuana is worthy of discussion. Both beer and marijuana are relatively durable and can potentially be transported across state or international lines before being consumed and they each face relatively similar distribution and marketing challenges. While US federal laws have restricted interstate transportation of marijuana as of this date, as more states legalize recreational use, pressure to ease interstate trade is likely to increase. Additionally, both products are heavily regulated by government and have constraints placed upon them such as a minimum age for

[8] The average number of breweries per state in 1977 was 2.21. Dividing the coefficient of -0.053 by this number yields the 2.4 percent decline in breweries for every month legalization was delayed.

consumers. Furthermore, while beer and marijuana can be produced by an individual, there are clear economies of scale in both industries. These economies of scale lead the industries to be higher than the national average with respect to capital intensity.[9] In fact, Jacquie McNish and Vipal Monga (2018) note that Tilray Inc., a large-scale marijuana producer in Canada, has a market capitalization of $11 billion, which far exceeds that of longstanding companies such as US Steel, Harley-Davidson, and Wendy's. Tilray's CEO, Brendan Kennedy, predicts that marijuana will soon become a global industry that will "rival alcohol in size and scope" (McNish and Monga, 2018).

There are some key differences however. Beer has been widely consumed throughout US history, while marijuana usage has been less widespread. Of course beer was prohibited at the federal level for only 13 years from 1920 to 1933 (in many states it was prohibited prior to and after these dates). With respect to marijuana, the city of El Paso was the first to outlaw the drug in 1914, and the entire state of Texas followed in 1919. A few other states subsequently passed marijuana prohibitions and Matthew Hodroff (2014) suggests that anti-immigrant sentiment, particularly against Mexicans and Chinese, drove many of these bans. The first federal regulation of the substance was the 1937 Marihuana [sic] Tax Act. As a result of the high taxes it imposed most production and consumption was done illegally via the underground economy. In 1970 the production and use of marijuana was effectively prohibited across the United States by the Controlled Substances Act. State level relaxations of the prohibition for medical use began in the 1990s, but these have been controversial (Joseph Spillane, 2004 and Hodroff, 2014) and the legalization has moved much more slowly than did the relegalization of beer.[10]

[9] IBISWorld (2018a; 2018b) industry reports give the capital expenditures of $0.66 and $0.27 per labor dollar expenditure for breweries and marijuana growing respectively, while the economy-wide average is $0.12. Additionally, IBISWorld notes that higher capital-intensity indoor growers of marijuana are likely to be the focus of future industry growth. See also Erik Madsen and Wu Yanqinq (2016) for more about economies of scale and capital intensity of the brewing industry.

[10] Another important factor to consider is political. In 1932, the Democratic Platform called for the relegalization of beer and Franklin Roosevelt won that year's election in a landslide. Neither of the two major US political parties are uniformly calling for the legalization of marijuana today, although the two largest

Conclusion

Our results suggest that the timing of the relegalization of beer in the 1930s had not just a short-term, but also a long-term, effect upon the location of breweries. Indeed, it appears that those states legalizing sooner after April 1933 (when the federal prohibition on beer was removed) gained a foothold in the beer industry that persisted through the great consolidation of breweries in the late 1970s. This may provide valuable insight into the potential gains that early-adopting states of marijuana legalization may experience in the coming years and decades.

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