The Impact of Juul® Market Entry on Cigarette Sales: Evidence of Store-Level Sales Declines from Canada

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Research Objective

Electronic Nicotine Delivery Systems (ENDS) are alternative products for adult smokers who seek to switch away from combustible cigarettes.

One example is JL Electronic Nicotine Delivery System (ENDS; JUUL Labs, Inc.), which entered the Canadian market in September 2018, and has gained substantial market share since its launch. This study examines if JL ENDS market entry has impacted cigarette sales in Canada.

We utilize a natural experiment in the availability of JL ENDS products at the city-level due to quasi-random variation in the rollout of these products in 2018-19 to assess the impact of market entry.

Identifying the impact of ENDS products can help policymakers understand the role of alternative products in the commercial tobacco product market, and better evaluate the impact of harm reduction products and policies.

Study Design

Data:

Outcomes were monthly data on cigarette sales volume and value (in CAD) at the store level, drawn from a large convenience store retailer's dataset in stores across 5 provinces from Oct. 2017 - Aug. 2019.

Dummy variables for city-level and store-level JL ENDS entry were included based on market entry date, along with a measure of JL ENDS market share among cigarette and ENDS products.

Control variables included average store-level cigarette sales price and city-level measures of Consumer Price Index, temperature, gasoline prices, unemployment rate and population size, measured monthly. Models also included fixed effects for store-level (to control for time-invariant factors) and calendar month (to control for time trends).

Methods:

Difference-in-difference panel regression models were used to examine if variation in the (quasi-random) timing of JL ENDS entry in a city, and level of JL ENDS market share had a significant impact on retailer cigarette sales volume, after controlling for macroeconomic variables and seasonal and location-specific variation with fixed effects.

The Empirical Specification was as follows:

$$\begin{aligned} &log(cigarette\ sales)_{store,t} \\ &= \beta_0 + I.(JL\ ENDS\ Entry_{city,t}) \#1.(JL\ ENDS\ Entry_{store,t}) \\ &+ \beta_1(JL\ ENDS\ market\ share_{store,t}) + \beta_2\ (Cigarette\ price_{store,t}) \\ &+ \alpha(Demographics_t) + I.(Time) + I.(Store) + \varepsilon_{store,t} \end{aligned}$$

Stratified models were also run to compare the results for stores in urban vs. rural areas, and to compare if the impact differed for sales of low vs. high-priced cigarettes (>$14 CAN per pack, based on stick price and avg. pack size).

Robustness checks included:

- Testing multiple conservative empirical specifications
- Incremental lag and lead tests for timing of city-level JUUL entry
- Random permutation test for JL ENDS Entry date: Redistribution of JL ENDS entry dates to different stores at random, to assess whether the observed effect could be better explained by anything other than JL ENDS market entry.

Principal Findings

Model Results:

JL ENDS market entry at the city-level likely led to a 1.5% (p<0.001) decrease in store-level cigarette sales volume on average within the first 6-12 months of entry, within the one retailer chain, regardless of whether an individual store carried JL ENDS products or not at the time of city-level entry.

The decline in cigarette sales was positively correlated to JL ENDS market share at the store-level. A 1% increase in JL ENDS market share of tobacco products in a store was associated with an average 0.5%-0.6% (p<0.001) reduction in cigarette sales. (**Table 1**. Col [a][b])

The overall impact was largely driven by significant changes in cigarette sales in urban areas. (**Table 1**. Col [c] vs. [d])

The impact of JL ENDS market entry was largely driven by a reduction in sales of high-priced cigarettes (>14CAN$), rather than low-priced cigarettes, suggesting that those purchasing JL ENDS products may primarily have been consumers of high-cost cigarettes. However, increases in JL ENDS market share had a significant impact on reducing sales of both low and high-priced cigarettes. (**Table 2**)

Figure 1. Descriptive Trends in Weekly JL ENDS and Cigarette Sales in Canada, April 2017-Aug 2019 (Source: Syndicated Commercial Data; Nielsen 2020)

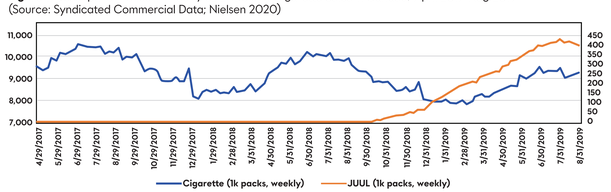

Table 1. Difference-in-Difference Model Results of the Impact of JL ENDS Market Entry and JL ENDS Market Share on Store-level Cigarette Sales Volume

	Mean (Range)	All Stores [a]	All Stores [b]	Urban Stores [c]	Rural Stores [d]
JL ENDS City Level Entry	0/1	-0.0152**			
JL ENDS City x Store City = 1 || Store = 0 City = 1 || Store = 1	0/1		Base (no entry) -0.0155** -0.00126	Base -0.0126** -0.0122	Base 0.00003 0.0158
JL ENDS market share (%)	0.0071 (0, 0.362)	-0.582***	-0.588***	-0.498**	-0.415*
Weighted cigarette price	0.598 (0.43, 0.68)	-0.467*	-0.461**	-0.223	-1.255**
CPI	135 (125, 144)	0.0150**	0.0150**	0.0067	0.020*
Gasoline price	125 (90, 165)	0.0019***	0.0019***	0.0021***	0.00058
Temperature	3.9 (-23.6, 20.9)	0.0030***	0.0030***	0.0030***	0.00099
Unemployment Rate (%)	0.058 (0.043-0.077)	2.75***	2.76***	2.10***	5.06***
Population (1,000)	4153 (879, 12140)	-0.00014*	-0.00014*	0.00006	-0.00064***
Year-month Fixed Effects		Yes	Yes	Yes	Yes
Store Fixed Effects		Yes	Yes	Yes	Yes
N (store x time period)		13,983	13,983	9,407	4,577
R-square		0.9710	0.9710	0.9749	0.9682

+p<0.1, *p<0.05, **p<0.01, ***p<0.001

Table 2. Impact of JL ENDS Market Entry and Market Share on Low Price vs. High Price Cigarettes

	Low Price (<$14 CAN/pack)	High Price (>$14 CAN/pack)
JL ENDS City x Store City = 1 || store = 0 City = 1 || store = 1	Base (no entry) -0.0106 -0.0097	Base (no entry) -0.0254*** -0.0132
JL ENDS market share (%)	-0.781***	-0.433**
Weighted cigarette price	0.207	-1.193***
R-squared	0.9742	0.9720

Note: the regressions also include demographics, fixed effects for year-month and stores (results not shown).

Table 3. Random Permutation Test for the Causality of JL ENDS Entry Date

Avg. Coeff. of (Randomized) "JL ENDS Entry"	Avg. Std Dev.	Avg. p-value of Coefficient	Repetitions
-1.33E-05	0.00468	0.49	2000

Avg. Coefficient with randomized city-level entry date is not significant

Robustness Checks:

Random redistribution of JL ENDS entry dates had no effect on cigarette sales (**Table 3**). The random permutation test for causality suggested that the decline in cigarette sales was better explained by JL ENDS market entry than random variation or other events.

Multiple specifications using different control variables demonstrated statistically significant effects of JL ENDS market entry.

Similar to other difference-in-difference approaches, this model accounts for observable sources of variation in cigarette sales and uses a strong empirical specification with several robustness checks to understand causal impact. If cities or stores differ in other unobservable ways that coincide with the variation in timing of JUUL city-level entry and cannot be captured by observed data or city-level fixed effects, this would limit the interpretation of our results. To the extent possible, we have accounted for these potential sources and validated our findings, but future research will also determine if any other causes of endogeneity are present.

Overall, we estimate that JL ENDS entry in a market likely led cigarette sales to decrease by 16 million sticks (or ~700,000 packs) of cigarettes within the first year of JL ENDS entry in one retailer chain,which implies a reduction of over 407 million sticks (or ~18 million packs) of cigarettes in Canada overall in the same time period, based on estimates of the relative market share of cigarette sales across retailers.

Implications for Policy or Practice

This work provides strong evidence that the availability of ENDS products reduces cigarette sales, and implies that providing alternative products to adult smokers can drive down cigarette consumption. A measurable impact in one retailer chain in the early stages of market entry also suggests a larger effect of product availability would be plausible and measurable across all retailers in Canada in the long-term.

Conclusion

JL ENDS market entry decreased cigarette sales based on this difference-in-difference model, especially in urban markets. Store-level cigarette sales decreased by 1.5% across Canada in one representative retailer chain in the first year of JL ENDS entry. This could translate to over 400 million fewer cigarettes sold across Canada, under similar modelling assumptions. Findings were robust to multiple specifications and robustness checks.

Cigarette sales decline was associated with incremental JL ENDS market share increases in stores, suggesting that local tobacco market competition may play a strong role in uptake and purchase of ENDS.

Further research is needed to determine the long-term impact of alternative products on cigarette sales, and the net population health impact of the observed decline in cigarette sales.

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