The Impact of Electronic Cigarette Sales on Cigarette Sales, 2007-2013

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Introduction

Use and awareness of e-cigarettes has doubled in recent years. E-cigarette availability has dramatically increased since their introduction in food, drug and mass (FDM) and convenience (CV) stores.

• For FDM stores e-cigarettes were only sold in two Nielsen markets in the 1st quarter of 2011, by the 4th quarter they were sold in all Nielsen Markets.

• For CV stores e-cigarettes were first available in the 3rd quarter of 2010, by the 2nd quarter of 2012 they were sold in all Nielsen Markets.

Recent empirical studies have found that using e-cigarettes is associated with quitting intentions[1], quit attempts[2], and reduced daily cigarette consumption[3].

However, little is known about how aggregate sales of combustible cigarettes have been affected by the introduction of electronic cigarettes (e-cigarettes).

Sales Volume: Electronic Cigarette Products
U.S. Market 2010 - 2013
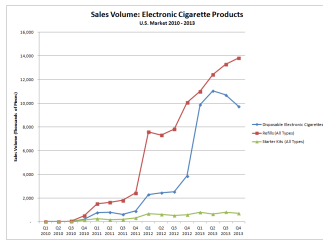
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2. Vickerman, K. A., Carpenter, K. M., Altman, T., Nash, C. M. & Zbikowski, S. M. Use of Electronic Cigarettes Among State Tobacco Cessation Quitline Callers. *Nicotine Tob. Res.* ntt061 (2013). doi:10.1093/ntr/ntt061
3. Adkison, S. E. *et al.* Electronic nicotine delivery systems: International tobacco control four-country survey. *Am. J. Prev. Med.* **44**, 207–215 (2013).

Aim

The aim of this study is to estimate how the sales of cigarettes was affected by the introduction of e-cigarettes.

We hypothesize that the entry of e-cigarettes would accelerate the decline in cigarette consumption in the U.S.

Method

Data:
• Quarterly per capita e-cigarette sales
• Quarterly per capita cigarette sales
• Average cigarette prices
• Average e-cigarette prices
Data Range:
• 2007 – 2013
Data Source:
• Store scanner data from Nielsen
Markets:
• 52 participating U.S. markets for food, drug and mass stores
• 30 participating U.S. markets for convenience stores.

Models Used:

1. Fixed-Effects models

Per Capita Sales Volume of Cigarettes $_{Market/Yr-Q/Store}$ = $\beta_0 + \beta_1$ Avg. Price of Cigarettes $_{Market/Yr-Q/Store} + \beta_2$ E-cig Entry Dummy $+ \beta_3$ Year-Quarter $+ \beta_4$ Market-Store $+ \varepsilon$

Per Capita Sales Volume of Cigarettes $_{Market/Yr-Q/Store}$ = $\beta_0 + \beta_1$ Avg. Price of Cigarettes $_{Market/Yr-Q/Store} + \beta_2$ Per Capita Sales of E-cig $_{Market/Yr-Q/Store} + \beta_3$ Year-Quarter $+ \beta_4$ Market-Store $+ \varepsilon$

2. First Difference models

Δ Per Capita Sales Volume of Cigarettes $_{Market/Yr-Q/Store}$ = $\Delta \beta_1$ Avg. Price of Cigarettes $_{Market/Yr-Q/Store} + \Delta \beta_2$ E-cig Entry Dummy $+ \delta_1 + \delta_2 d2007_t + \delta_3 d2008_t + \delta_4 d2009_t + \delta_5 d2010_t + \delta_6 d2011_t + \delta_7 d2012_t + \delta_8 d2013_t + \varepsilon$

Δ Per Capita Sales Volume of Cigarettes $_{Market/Yr-Q/Store}$ = $\Delta \beta_1$ Avg. Price of Cigarettes $_{Market/Yr-Q/Store} + \Delta \beta_2$ Per Capita Sales of E-cig $_{Market/Yr-Q/Store} + \delta_1 + \delta_2 d2007_t + \delta_3 d2008_t + \delta_4 d2009_t + \delta_5 d2010_t + \delta_6 d2011_t + \delta_7 d2012_t + \delta_8 d2013_t + \varepsilon$

3. Models accounting for the cumulative impact of e-cigarette entry (Interaction)

Per Capita Sales Volume of Cigarettes $_{Market/Yr-Q/Store}$ = $\beta_0 + \beta_1$ Avg. Price of Cigarettes $_{Market/Yr-Q/Store} + \beta_2$ E-cig Entry Dummy * Year-Quarter $+ \beta_4$ Market-Store $+ \varepsilon$

4. Instrumental Variable Model

Per Capita Sales Volume of Cigarettes $_{Market/Yr-Q/Store}$ = $\beta_0 + \beta_1$ Avg. Price of Cigarettes $_{Market/Yr-Q/Store} + \beta_2$ (Per Capita Sales of E-cig = Number of Ecig Brands) $_{Market/Yr-Q/Store} + \beta_3$ Year-Quarter $+ \beta_4$ Market-Store $+ \varepsilon$

Main Measures and Summary Statistics

Cigarette Sales Volume, Average Cigarette Price, and E-cig Sales by Year and Store type

	Per Capita Cigarette Sales Volume (FDM)	Per Capita Cigarette Sales Volume (CV)	Average Cigarette Price - per piece (FDM & CV)	Per Capita E-Cig Sales (FDM)	Per Capita E-Cig Sales (CV)
2007	26.28		$ 0.19		
2008	23.42		$ 0.20		
2009	20.61		$ 0.24		
2010	18.32	140.90	$ 0.26		< $0.01
2011	17.09	140.50	$ 0.27	< $0.01	$ 0.05
2012	16.04	139.87	$ 0.27	$ 0.01	$ 0.14
2013	16.20	136.19	$ 0.27	$ 0.03	$ 0.35
Overall	49.43		$ 0.25	$0.04	

Results

The total impact of the entry of e-cigarettes on the change of cigarette consumption during our study period ranged from 0.5% to -3.5% of cigarette sales.

VARIABLES	Electronic Cigarette Entry - Results			Per Capita E-cig Sales - Results		
	FE	FD	Interaction (E-cig entry with year-quarter)	FE	FD	IV (E-cig Per Capita Sales = Number of Brands)
Cigarette Average Price (per piece)	-42.19**	-88.27***	-42.15**	-37.08**	-83.33***	-37.05***
	(19.59)	(17.26)	(19.53)	(18.38)	(16.37)	(6.712)
Electronic Cigarette Presence Dummy	0.247	-0.674	-1.720***			
	(0.845)	(0.425)	(0.331)			
Per Capita Electronic Cigarette Sales Dollars				2.825	-24.79***	4.172
				(5.479)	(8.461)	(3.049)
Observations	1,932	1,850	1,932	1,876	1,794	1,876
R-squared	0.259	0.238	0.270	0.346	0.249	0.3459
Number of Market/Stores	82	82	82	82	82	82
Results in Percentages						
Result for CV Store	0.18%	-0.48%	-1.23% ***	0.30%	-2.65% ***	0.45%
Result for FDM Store	1.25%	-3.42%	-8.72% ***	0.16%	-1.26% ***	0.21%
Result Overall	0.50%	-1.36%	-3.48% ***	0.23%	-2.01% ***	0.34%

Notes: The results are computed at the average per capita cigarette volume. CV: 140, FDM: 20, and Overall: 49

Notes: These results reflect the fact that increasing e-cig sales by a $1 is substantially greater than the average per capita e-cig sale. The percentages are deflated as follows: CV: $0.15 (by a factor of 6.7), FDM: $0.01 (by a factor of 100), and Overall: $0.04 (by a factor of 25).

Models:
* FE stands for Fixed Effects; models are computed using robust SEs.
* FD stands for First Difference; models are computed using SEs at the market-store level.
* The **Interaction** model uses the cumulate effect of the entry of e-cigs by interacting the entry of e-cigs with year quarter; the model is computed using robust SEs.
* **IV**-stands for Instrumental Variables, this model instruments e-cig sales using the growth of e-cig brands over time within each market store type; the model is computed using conventional SEs.

Notes:
* Year 2007 and 1st quarter are the excluded reference group.
* Market-store dummies , year-quarter dummies, interaction variables, and the constant terms are not shown in the table.
* For the IV model the R-squared estimate is the within R-squared estimate.

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusions

The results from our study suggest that the entry of e-cigarettes may reduce the sales of combustible cigarettes.

More data is needed to further assess the causal impact of e-cigarettes on combustible cigarette consumption.

Acknowledgments

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