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# Smoking for the poor and vaping for the rich? Distributional concerns of new smoking methods

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## Abstract

We compare income-related inequalities in the use of traditional and of new smoking methods (e-cigarettes and other nicotine delivery products (NPD)) and we apply a regression-based decomposition method for rank-dependent inequality measures to estimate the source of inequalities in the new smoking methods. Using data from the 2013 wave of the Health Survey for England, we find that taking into account the new smoking methods reduces the extent of pro-poor inequalities in smoking. Significant pro-rich inequalities are found in e-cig and NDP consumption due to higher take-up among richer, younger and better-educated smokers. These patterns might lead to a long-run equilibrium with higher average health *and* higher socioeconomic health inequalities.

**Keywords:** smoking; income-related health inequalities; electronic-cigarettes.

**JEL codes:** I12;I14.

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## 1. Introduction

Electronic cigarettes (e-cigs) and other nicotine delivery products (NDP) represent the most important innovations in the smoking market. E-cigs are battery-operated devices that aim to simulate combustible cigarettes, while other NDP encompasses alternative methods to administer nicotine to the brain without the harms of combustion (i.e. chewing gum, nicotine patches). E-cigs are the newest and the most used nicotine delivery products. They don't contain tobacco but operate by heating nicotine and other chemicals into a vapour that is inhaled.<sup>1</sup> Since their introduction to the market in 2004, global usage of e-cigarettes has risen exponentially (Cobb *et al.*, 2010; Rom *et al.*, 2014)<sup>2</sup>.

The reasons for increasing prevalence are that these new methods are perceived as healthier, cheaper, and more socially acceptable than conventional cigarettes (Rom *et al.*, 2014). However, the primary objective of users is essentially that of quitting smoking (Pepper and Brewer, 2013). Both the health benefits and the ability to help quitting smoking are the two most explored issues in the empirical literature. Despite some side effects and some debate on their effectiveness to aid quitting<sup>3</sup>, e-cigs and NDP are generally evaluated as much safer than smoking and a valid aid for quitting (Public Health England, 2015). As a consequence, in 2015, the UK's Royal College of Physicians recommended that e-cigs should be offered to smokers and that “with the right checks and measures, vaping could improve the lives of millions of people” (Public Health England, 2015).

The distributional consequences of these new smoking methods, and, in particular, whether their take-up varies systematically across socio-economic groups remains to be clarified. This is relevant in order to properly assess the desirability of any health promotion activity (as e-cigs and NDP might be considered) and to identify welfare-improving interventions. Importantly, Contoyannis and Förster (1999a; 1999b) show that when responsiveness to health promotion policies vary across socio-economic groups, i.e. a higher take-up rate among the better off, a striking conflict between efficiency and equity may arise: average population health *and* relative inequalities in health may both increase.

This paper fills this gap using fresh data on e-cig and NDP consumption from the latest wave of the Health Survey for England (2013). Our analysis follows three steps. First, we analyse whether e-cig and NDP re-shape the income-related inequalities in smoking, comparing the level of inequalities in traditional smoking with the inequalities in all smoking methods, which encompasses both traditional and new methods. Secondly, we estimate the level of income-related inequalities in e-cig and NDP take-up. Finally, we investigate the sources of income-related inequalities in e-cig and NDP take-up rate using a regression-based decomposition method for rank-independent inequality measures, and assessing the contribution of income, education and demographics to inequality.

The paper is organized as follows: the next section presents the data and the methods; Section 3 presents the results; and the final section discusses the implication of our findings and concludes.

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<sup>1</sup> Inhaling from e-cigarettes is called *vaping*.

<sup>2</sup> In the UK, there are an estimated 2.6 million e-cigs users (ASH, 2016), while, in 2014, 12.6% of adults had ever tried an e-cig even one time in the USA (Schoenborn and Gindi 2015). The e-cigs market is estimated to be worth £ 91.3 million a year (Chittock, 2014). It increased by 340% in 2013 to reach £193 million, and is expected to be worth £340 million by 2015 (Clarke, 2014).

<sup>3</sup> E-cigs have been found as effective, though not more, than nicotine patches for short-term cigarette cessation (Dockrell *et al.*, 2013; Etter and Bullen, 2011; Bullen *et al.*, 2013), and cartridge analyses find fewer toxins than are found in traditional cigarettes (Goniewicz *et al.*, 2013). However, in a randomized trial 29% of e-cig users continued e-cigs at 6-months compared to only 8% of patch users (Bullen *et al.*, 2013), suggesting e-cig use might persist after other cessation methods. In addition, cartridges have been found to contain hazards, such as cytotoxic heavy metal and silicate particles (Williams and Talbot, 2011).

## 2. Data and Empirical Methodology

We use a sample of 10,980 individuals (including 1,697 current smokers) from the latest wave (2013) of the Health Survey for England (HSE), which contains information on traditional smoking, the use of e-cigs and other nicotine delivery products (NDP) along with information on demographics and socio-economic variables.

The main variable we use asks individuals to report whether they currently or ever used e-cigs or other NDP products, and their current smoking status (never/ex-regular smoker/ex-occasional smoker/current smoker). We define two dummy variables: equal to one for e-cig/NDP users and current smokers, respectively.

With the aim of estimating and comparing income-related inequalities in traditional smoking *vs* both traditional and “new” smoking methods, we use the Erreygers (2009) index for both outcomes. The Erreygers index is a rank-dependent inequality measure for bounded dependent variables that can be conveniently calculated as follows<sup>4</sup>:

$$EI(S_i) = \frac{8}{b-a} cov(S_i, R_i) \quad (1)$$

Where  $b$  and  $a$  are the upper and lower bounds of the dependent variable (1 and 0 in our case),  $S_i$  indicates the individual take-up of smoking (traditional smoking or both traditional smoking and new methods) while  $R_i$  designates the  $i^{\text{th}}$  individual' relative rank within the income distribution. The Erreygers index varies from  $\mu-1$  to  $1+\mu$ , where  $\mu$  is the mean of variable whose inequality is being investigated. Positive (negative) values of the index indicate pro-rich (pro-poor) inequalities. As a measure income, we use equivalised household income including total income of a household from all sources, after tax and other deductions, divided by the number of household members converted into equivalised adults.

To measure income-related inequalities in the new smoking methods, we calculate the EI defined in (1) using e-cig and NDP take-up as dependent variable. As e-cigs and NDP are used as smoking cessation methods, we restrict the attention to the subsample of current smokers (1,697 observations). We consider current (instead of ex-) smokers, in order to evaluate potential consequences of these methods on the expected long-run smoking (and health) gradient across income. Lastly, for the purpose of investigating the main sources of inequality in the new smoking methods, take-up of e-cig and NDP ( $y_i$ ) is modelled as follows:

$$y_i = \alpha + \beta_{inc}x_i^{inc} + \beta_{edu}x_i^{edu} + \beta_{dem}x_i^{dem} + \varepsilon_i \quad (2)$$

Where  $x^{inc}$ ,  $x^{edu}$ ,  $x^{dem}$  represent income and the set of education and demographic variables, while  $\beta_{inc}, \beta_{edu}, \beta_{dem}$  the corresponding coefficients, and  $\varepsilon_i$  is the error term. The set of demographic variables include six age group variables (11-18, 18-34, 35-44, 45-64, 65-74, 75+), for each gender, while the set of education variables include one dummy for each of the following categories: degree or national vocation qualification (NVQ) 4 or 5; higher education below degree; NVQ 3 or General Certificate of Education (GCE) Advanced Level; NVQ 2 or GCE Ordinary Level; NVQ1 or Certificate of Secondary Education (CSE); Other qualifications from outside England; no qualification. Omitted categories in our analysis are males, aged 11-18 and with no qualification.

Assuming linearity of (2) and recalling that our dependent variable is bounded between 0 and 1, the Erreygers index can be decomposed as follows:

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<sup>4</sup> We use the Erreygers index because it is the only rank-dependent inequality measure for bounded variables satisfying two desirable properties: *mirror condition* - the invariance of the inequality index to the coding of the dependent variable as 0 or 1 - and the *quasi-absoluteness* - i.e. it weights inequality constantly and independently of the average use in a society.

$$EI(y_i) = 4 * [\beta_{inc} * GCI(x)_{inc} + \beta_{edu} * GCI(x)_{edu} + \beta_{dem} * GCI(x)_{dem} + GCI(\varepsilon_i)] \quad (3)$$

Equation (3) indicates that the contribution of income, education and demographics to overall income-related inequalities in  $y_i$  depends on: i) the effect of each set of variables ( $\beta$ ) on  $y_i$  taken from OLS estimates of equation (2) and ii) the generalized concentration index ( $GCI(x)$ ) of each set of variables with respect to income (given by the concentration index  $CI(x)$  multiplied by the mean of the variable). The last term of equation (3) is the generalized concentration index for  $\varepsilon_i$  and reflects the unexplained part of inequalities in e-cig and NDP take-up.

### 3. Results

Column 1 of Table 1 shows that traditional smoking take-up is more concentrated among poorer individuals. Estimated EI is significantly pro-poor and very close to the theoretical lower bound ( $0.1545-1 = -0.846$ ). Column 2 shows that pro-poor inequalities in smoking are reduced by around 15% when all smoking methods (both traditional and e-cig and NDP) are considered ( $-0.063$  vs  $-0.054$ ). This suggests that a considerable share of smokers in the upper tails of the income distribution consume e-cig and NDPs. This pattern is more clearly depicted in Column 3 of Table 1 where EI of the use of new smoking methods on the sample of smokers is reported. Column 3 shows significant take-up rates of e-cig and NDP (around 54% of current smokers are current or past users of new smoking methods) and high pro-rich inequalities in the use of these new methods among current smokers.

**Table 1. Estimates of income-related inequalities: Traditional vs New methods**

	<b>Traditional smoking</b>	<b>All methods</b>	<b>E-cig and NDP</b>
<b>Take-up rate</b>	15.45%	20.39%	53.8%
<b>EI</b>	-0.063***	-0.054***	0.074**
<b>Std. Error</b>	0.008	0.008	0.028
<b>Observations</b>	10,980	10,980	1,697

\*\*\*,\*\* indicate significance at 1% and 5%, respectively.

Table 2 shows the main contributors to inequalities in e-cig and NDP take-up based on the decomposition shown in equation (3). Income itself contributes 30% of the total income-related inequalities. This is due to a positive relationship with e-cig and NDP take-up (positive  $\beta$ ) and the positive generalised concentration index for income. Education is the second leading contributor to inequality. More educated individuals (degree, higher education or NVQ3) have a higher take-up rate (positive  $\beta$ ) and a larger share of income (positive GCI). The total contribution of these education variables is equal to around 17%. Demographics also display a positive contribution due to a lower take-up rate among older men and women (75+) (negative  $\beta$ ) and a lower concentration of income among these groups (negative GCI). These variables account for around 5.5% of the total inequalities.

**Table 2. Decomposition of income-related inequalities in E-cig and NDPs**

<b>Variables</b>	<b>B</b>	<b>GCI</b>	<b>Contribution</b>	<b>% Contr.</b>
Income	0.000	11960.05	0.022	29.27
M (18-34)	-0.031	0.001	0.000	-0.11
M (35-44)	-0.095	0.005	-0.002	-2.34
M (45-64)	-0.002	0.008	0.000	-0.09
M (65-74)	-0.019	0.001	0.000	-0.06
M (75+)	-0.197	-0.003	0.002	3.364
F (11-18)	-0.094	0.002	-0.001	-0.95
F (18-34)	-0.017	-0.009	0.001	0.84
F (35-44)	0.022	0.003	0.000	0.37
F (45-64)	0.094	0.003	0.001	1.27
F (65-74)	0.161	-0.004	-0.003	-3.64
F (75+)	-0.106	-0.004	0.002	2.28
Degree- NVQ 4,5	0.008	0.054	0.002	2.32
Higher Education	0.140	0.015	0.008	11.41
NVQ 3- GCE A	0.041	0.014	0.002	2.98
NVQ 2 – GCE 0	0.021	-0.012	-0.001	-1.32
NVQ1 – CSE	0.047	-0.009	-0.002	-2.30
Other Qualifications	0.069	0.000	0.000	-0.10
<b>Total</b>			0.032	43.17
<b>Residuals</b>			0.042	56.83
<b>Erreygers Index</b>			0.074	100%
<b>Observations</b>				1,697

#### 4. Conclusions

The twin objectives of health promotion activities are to increase average health and to reduce health inequalities. This paper analyses distributional issues related to the introduction of e-cig and NDP which are generally evaluated as much safer than traditional smoking methods.

Using data from the 2013 wave of the Health Survey for England, we find that new smoking methods reduce the extent of pro-poor inequalities in smoking. Significant pro-rich inequalities are found in e-cig and NDP consumption due to a higher take-up among richer, younger and better-educated smokers. Provided that these smoking cessation methods will effectively reduce the number of smokers, these results will lead to a long-run equilibrium with higher average health *and* higher health inequalities. As e-cig and NDPs are generally cheaper than traditional cigarettes, the equality of access in these smoking cessation methods needs to be improved through alternative methods, such as medical recommendations or advertising campaigns. Greater focus on less educated and older smokers could be beneficial for the purpose of narrowing the health gap between rich and poor.

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