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The impact of advertising on nicotine replacement therapy demand

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Abstract

While much is known about the economic determinants of tobacco use, very little is known about the economic determinants of nicotine replacement therapy (NRT) use. This paper is the first econometric study to examine the impact of advertising on NRT demand. Pooled cross-sectional time-series scanner-based data for 50 major metropolitan markets in the USA covering the period between the second quarter of 1996 and the second quarter of 2002 are used in the analysis. Fixed-effects modeling is employed to estimate the NRT demand equation. The estimates indicate that increased advertising of Nicoderm CQ transdermal patches and Nicotrol transdermal patches increases per-capita sales of established Nicoderm CQ and Nicotrol products, respectively. However, increased advertising of Nicorette polacrilex (gum) was found not to significantly increase sales of established Nicorette products. Moreover, decreases in the price of NRT and increases in the price of cigarettes were found to increase per-capita sales of NRT products. Given the documented efficacy of NRT, measures to increase peoples' awareness of NRT products through advertising, measures to decrease the price of NRT, and measures to increase the price of cigarettes would be effective means to increase the use of NRT, likely leading to decreased cigarette smoking and reductions in the future public health burden caused by tobacco use.
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Introduction

Cigarette smoking is the single most preventable cause of death and disability in the United States (US), responsible for more than 400,000 premature deaths each year (Centers for Disease Control and Prevention (CDC), 2002a). Despite the deleterious health effects of cigarette smoking, approximately 46.5 million adults in the US aged 18 and over were current smokers in 2000, representing nearly one quarter (23.3%) of the total US adult population (CDC, 2002b).

The obstinacy of smokers to continue smoking in the face of substantial health consequences speaks to the significant addictive nature of cigarettes. While a vast majority of adult smokers in the US contemplate or attempt to quit smoking each year, a very small fraction succeed. According to the Centers for Disease Control and Prevention, 68.2% of current smokers in 1995 wanted to quit smoking completely and 45.8% of current everyday smokers did not smoke for at least 1 day during the preceding 12 months in an effort to stop smoking (CDC, 1997). However, despite a strong desire to quit smoking, only about 2.5% of

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smokers in the US quit smoking permanently each year (CDC, 1993).

A substantial body of research has concluded that nicotine replacement therapy (NRT) is effective in increasing the probability of smoking cessation (US Department of Health and Human Services (USDHHS), 2000). NRT is designed to aid smokers by alleviating withdrawal symptoms associated with smoking cessation by replacing a proportion of the nicotine formerly obtained from cigarettes. Given the documented efficacy of NRT, a greater acceptance of NRT by smokers may contribute to achieving the Healthy People goal of reducing the prevalence of adult smoking in the US to 12% or less by the year 2010.

By conveying information to smokers on the attributes of different types of NRT products and on the health benefits of smoking cessation, NRT advertising has the potential to increase the demand for NRT products and increase the number of people who quit smoking. However, no previous studies have examined the relationship between NRT advertising and NRT demand. This paper is the first econometric study to do so. In particular, this paper examines the impact of Nicoderm CQ, Nicorette, and Nicotrol brand advertising on the demand for Nicoderm CQ transdermal products, Nicorette gum products, and Nicotrol transdermal products, respectively, employing pooled cross-sectional time-series scanner-based data for 50 major metropolitan markets in the US covering the period between the second quarter of 1996 and the second quarter of 2002.

Brief literature review

Throughout the last three decades, numerous econometric studies have examined the impact of advertising on cigarette demand. These studies have used diverse data, theoretical modeling, and estimation techniques. The results from these studies provide mixed results with respect to the impact of advertising on cigarette demand. A majority of the studies found that cigarette advertising is an insignificant determinant of cigarette demand (Hamilton, 1972; Grabowski, 1976; Schmalensee, 1972; Baltagi & Levin, 1986; Porter, 1986; Wilcox & Vacker, 1992; Duffy, 1995). However, a few studies found that cigarette advertising had a positive and significant impact on cigarette demand (Lewit, Coate, & Grossman, 1981; Goel & Morey, 1995; Roberts & Samuelson, 1988). Saffer and Chaloupka (2000) showed that most of the studies that found advertising not to be an important predictor of cigarette demand employed national level aggregate expenditures to measure cigarette advertising. They argued that studies that employ national expenditures are very likely to find insignificant results of advertising because national expenditures lose variance from aggregation and these expenditures measure advertising where the marginal product of advertising is near zero.

While much is known about the determinants of cigarette demand, relatively little is known about the determinants of NRT. Several studies in the medical literature have found that third party coverage of NRT has a positive and significant impact on the use of NRT (Cox & McKenna, 1990; Johnson, Hollis, Stevens, & Woodson, 1991; Hughes, Wadland, Fenwick, Lewis, & Bickel, 1991; Curry, Grothaus, McAfee, & Pabiniak, 1998). These findings are consistent with economic theory and the literature on the determinants of tobacco demand.

Only one previous econometric study has examined the economic determinants of NRT demand. Tauras and Chaloupka (2003) estimated product-specific NRT demand equations employing pooled cross-sectional time-series scanner-based data for 50 major metropolitan markets in the US covering the period between the second quarter of 1996 and the third quarter of 1999. The estimates from the demand equations implied that decreases in the price of NRT and increases in the price of cigarettes would lead to substantial increases in per-capita sales of NRT products. The average own-price elasticities of demand for Nicoderm CQ and Nicorette were –2.33 and –2.46, respectively. The average cross-price elasticities of demand for Nicoderm CQ and Nicorette with respect to cigarette price were 0.772 and 0.764, respectively.

To date, no prior econometric studies have examined the impact of advertising on NRT demand; this paper attempts to fill that void.

Data

Pooled cross-sectional time-series data on cigarette sales, cigarette prices, over the counter (OTC) NRT sales, and NRT prices were obtained through special agreement with AC Nielsen. These data are quarterly scanner-based price and sales data for 50 major metropolitan markets covering the period between the second quarter of 1996 and the second quarter of 2002.[1] The sales and price data are collected from scanners in food stores and combination food stores and pharmacies in all 50 markets. In addition, potential exposure to NRT advertising on television across 75 major media markets was obtained from the Nielsen Media Research company (NMR).

[1]The 50 markets represent approximately 77.5% of the total United States population. AC Nielsen provided data going back to the fourth quarter of 1994; however, no NRT data was available from AC Nielsen prior to the second quarter of 1996.

To ensure sufficient time series variation, only established products, defined as products that went OTC prior to the fourth quarter of 1998 and had positive sales through the second quarter of 2002 are included in the analyses. Three brands of NRT are used in the analyses: Nicorette nicotine polacrilex (nicotine gum), Nicoderm CQ transdermal patch, and Nicotrol transdermal patch. Four separate Nicorette products are analyzed including 48 count packet of 2 mg gum, 48 count packet of 4 mg gum, 108 count packet of 2 mg gum, and 108 count packet of 4 mg gum. Four separate Nicoderm CQ products are analyzed including seven count packet of 7 mg patch, seven count packet of 14 mg patch, seven count packet of 21 mg patch, and 14 count packet of 21 mg patch. Two separate Nicotrol products are analyzed including: seven count packet of 15 mg patch starter kit and seven count packet of 15 mg patch refill kit. Since NRT data from AC Nielsen are based on OTC scanner sales, and Nicorette products went OTC during the second quarter of 1996 and Nicoderm CQ and the Nicotrol products went OTC during the third quarter of 1996, data prior to the second quarter of 1996 are excluded from the analyses for Nicorette products and data prior to the third quarter of 1996 are excluded from the analyses for the Nicoderm CQ and Nicotrol products. This corresponds to estimating demand equations for Nicorette brand products on 1250 observations (25 quarters of data and 50 markets) and for Nicoderm CQ and Nicotrol products on 1200 observations (24 quarters of data and 50 markets).

Because the daily usage of NRT patches and gum is distinct, we employed the adult per-capita daily dose of NRT as the dependent variable in all the product-specific demand equations. It is assumed that one patch or six pieces of gum produce one daily dose of NRT.[2] The per-capita daily doses are created using quarterly interpolated county level population data from the US Census Bureau.

A variety of covariates that are likely to impact NRT demand are constructed. Based on economic theory and the literature on cigarette and other tobacco demand, we predict that lower NRT prices will increase NRT demand. Therefore, separate daily dose prices for each NRT product were created by dividing the total dollar sales of each product by the number of daily doses sold in a given market in a given quarter. To account for changes in the relative price of NRT products over time, all NRT product prices are deflated by the national Consumer Price Index published by the Bureau of Labor Statistics (1982–1984 = 100).

Since the demand for a specific NRT product may be influenced by the prices of other NRT products,[3] we constructed a sales weighted average price of all other NRT products (other than the specific NRT product under investigation) available in a given market in a given quarter. To account for changes in the relative prices over time, the average prices of other NRT products are deflated by the national Consumer Price Index published by the Bureau of Labor Statistics (1982–1984 = 100).

We predict that factors that would raise the probability of cessation and lower the demand for cigarettes will lead to an increase in the demand for NRT. Therefore, given the documented inverse relationship between cigarette prices and cigarette demand (USDHHS, 2000) and the positive relationship between cigarette prices and cessation (Tauras & Chaloupka, 1999; Tauras, 2004), we predict that increases in the real price of cigarettes will increase the demand for NRT. To account for this, a variable capturing the price of cigarettes is created. These prices are inclusive of federal, state, and local excise taxes on cigarettes. In addition, to account for changes in the relative price of cigarettes over time, the cigarette prices are deflated by the national Consumer Price Index published by the Bureau of Labor Statistics (1982–1984 = 100).

Since many people make attempts to stop smoking as part of either a "New Year's resolution" or the American Cancer Society sponsored Great American Smokeout, seasonality indicators of NRT demand are created. Four quarterly dummy variables are created to capture seasonal changes in demand for NRT (quarter one—omitted; quarter two, quarter three, and quarter four included in regressions).

Finally, we match potential exposure to Nicoderm CQ, Nicorette, and Nicotrol brand advertising across the top 75 media markets to the 50 major metropolitan markets covered by the scanner data. The advertising information was obtained from the National Cancer Institute sponsored Youth Smoking and the Media Project (YSM) under NCI Grant #1 RO 1 CA86273-01. NMR measures potential exposure to advertising through individual ratings of television programs across markets. A rating is an estimate of the size of the television audience relative to the total television

[2]Other quantities of gum, including 5 and 7 pieces were used to create a daily dose. The results from these analyses are very similar to the results presented here, and are available upon request. The Physicians' Desk Reference (2001) recommends using 1 piece of gum every 1–2 h, 2–4 h, and 4–8 h during weeks 1–6, 7–9, and 10–12, respectively. Moreover, Shiffman, Paty, Rohay, DiMarino, and Gitchell (2000) found that smokers who purchased nicotine gum and enrolled in a smoking cessation study used between 4.1 and 4.9 pieces of gum per day on average.

[3]It is also likely that the demand for a specific NRT product may be influenced by the amount of advertising for other NRT products. Unfortunately, we are unable to explore this relationship because the adverting variables are aggregated at the brand (not product) level.

audience. It is often expressed as a percentage. For example, if 30 households out of a total of 100 were tuned into the same program, the program would receive a 30 rating, meaning that it was seen by 30% of television households. It is customary for the advertising industry to sum rating points for a program in a given period, usually in weekly intervals. These are called Gross Ratings Points (GRPs). GRPs provide estimates of audience size for all television households. NMR obtains ratings estimates for television programs and advertisements in a given market by monitoring individual family audiences, called households.[4] A designated market area (DMA) or media market consists of a group of counties, which comprise a major metropolitan area. We matched the counties from the top 75 DMAs to the counties that comprised the scanner-based NRT sales and price data to obtain potential exposure to Nicoderm CQ, Nicorette, and Nicotrol brand advertising in the scanner markets; these investigator-generated brand-specific advertising measures will henceforth be named Nicoderm CQ GRPs, Nicorette GRPs, and Nicotrol GRPs, respectively.[5] There is significant overlap between the counties that make up the top 75 DMAs and the counties that make up the 50 scanner markets. Approximately 90% of the population in the scanner markets overlaps with the counties that make up the top 75 DMA markets. We assume that the scanner counties not covered by a DMA take the average market and quarter specific GRP of the counties covered by a DMA.[6] Finally, since the scanner data is aggregated quarterly we aggregate GRPs on a quarterly (not weekly) basis.

Methods

The scanner data provide information on the transaction price and quantity of each NRT product in a given market in a given quarter. These quantities and prices are jointly determined reflecting both supply and demand factors. A simultaneity problem may occur if the NRT price is endogenous and therefore correlated to the error term in the NRT demand equation. The application of a single equation method with an endogenous right-hand-side variable will likely result in inconsistent estimates. An asymptotic equivalent of Hausman's (1976) specification error test is used to test whether or not the NRT prices are correlated with the error term.[7] The null hypothesis of no simultaneity is rejected in three out of 10 NRT products including 2 mg 48 count, 2 mg 108 count, and 4 mg 108 count packets of Nicorette gum. The null hypothesis of no simultaneity cannot be rejected in the remaining seven NRT products. The Hausman test results imply that ordinary least squares (OLS) is a consistent and more efficient estimator for seven out of 10 NRT products than is instrumental variables (IV). A two-stage least-squares technique was used on the three NRT products in which the null hypothesis of no simultaneity was rejected. No changes in sign or significance and only very minor changes in magnitude are observed between the IV and OLS results. Therefore, for consistency, only the OLS results are presented in the paper.

OLS fixed-effects modeling is employed in the analyses. These fixed effects control for market-specific and time-specific determinants of NRT demand. The fixed-effects approach amounts to including a dichotomous indicator for each market (less one) and each year (less one) as explanatory variables in the models. This assumes that the differences across markets and over time, not captured by the other covariates included in the model, can be fully captured by the market and time fixed effects.[8] With time and market fixed effects, the estimated advertising and price elasticities are generated from market level deviations from the overall time trend. That is, the variation in prices and advertising within markets over time is used to identify the impact of advertising and prices on NRT demand.

After extensive specification testing,[9] a log-linear model was deemed the most appropriate functional

[4]As part of the Nielsen Monitor Plus database, NMR linked average quarter hour ratings and program ratings with commercial occurrences. The authors associated those ratings with particular NRT brands in commercial occurrences.

[5]Advertising of NRT is usually done at the brand level, and therefore we employ brand-specific advertising measures and not product-specific advertising measures.

[6]Numerous sensitivity analyses were conducted to validate this assumption. In particular, the regressions were run on scanner markets that had perfect DMA coverage; a variable capturing the percent of the scanner market population that was not covered by a DMA was included as a covariate in all analyses, and a dichotomous indicator was included in the regressions that reflected whether or not the scanner market was fully covered by a DMA was employed as a covariate. The results from these sensitivity analyses are comparable to those presented here, and are available upon request.

[7]It is assumed that the quantity of NRT supplied depends on the current price of NRT and the price lagged one period, a functional form often applied when cost structures of production are not known. The Hausman test uses OLS to estimate a reduced form equation for NRT price. The reduced form error term is then used as a covariate in the NRT demand equation and a t-test on the coefficient of the reduced for error term is used to assess the simultaneity problem.

[8]Given the short period of time covered by the data, this is a very reasonable assumption.

[9]In particular, a Box and Cox (1964) power transformation analysis was conducted in which the transformation parameter, λ, was allowed to vary from -3 to 3 with a step size of 0.5. A transformation parameter of zero yielded the smallest error sum of squares, and consequently the largest log-likelihood for all

form to employ to estimate the NRT demand equations. Specifically, the log-linear model regresses a natural log transformation of the dependent variable on a set of untransformed (raw-scale) explanatory variables. We corrected the standard errors from the regressions for heteroscedasticity and autocorrelation up to the first lag using an algorithm developed by Newey-West (1987).[10]

Results

Table 1 contains the estimates for the NRT demand equations. Models 1–4, 5–8, 9 and 10 contain the Nicoderm CQ, Nicorette, and Nicotrol demand equations, respectively. Models 1, 2, 3, and 4 correspond to Nicoderm CQ demand equations for the 21 mg 14 count packet, 21 mg 7 count packet, 14 mg 7 count packet, and 7 mg 7 count packet, respectively. Models 5, 6, 7, and 8 represent Nicorette demand equations for the 2 mg 48 count packet, 4 mg 48 count packet, 2 mg 108 count packet, and 4 mg 108 count packet, respectively. Models 9 and 10 represent Nicotrol demand equations for the 15 mg 7 count starter packet and 15 mg 7 count refill packet, respectively. Each demand equation in Table 1 includes the following regressors: the investigator generated own-GRPs for the brand under investigation, the real price of the relevant NRT product, the sales weighted average real price of all other NRT products, the real price of cigarettes, quarterly seasonality dichotomous indicators, year fixed effects, and market fixed effects.

Advertising results

Nicoderm CQ GRPs are found to have a positive and significant impact on the sale of all Nicoderm CQ products with the exception of 7 mg 7 count packet which is not significantly different from zero at conventional levels. The Nicoderm CQ product-specific GRP elasticities of demand range from 0.030 to 0.163.[11] The GRP elasticity of demand is defined as the percent change in the quantity of NRT demanded for a 1% change in the GRPs. These estimated GRP elasticities for Nicoderm CQ imply that a 10% increase in Nicoderm CQ GRPs will result in between a 0.3% and 1.6% increase in Nicoderm CQ sales, holding all other factors constant. Nicotrol GRPs are found to have a positive impact on the sale of Nicotrol products; however, only the relationship between 15 mg 7 count starter kit and advertising approached conventional significance levels (6% of a one-tailed test). The estimated GRP elasticity of demand for the 15 mg 7 count Nicorette starter kit was 0.039. Whereas Nicoderm CQ advertising and to a lesser extent Nicotrol advertising were found to increase Nicoderm CQ and Nicotrol sales, respectively, Nicorette advertising was found not to significantly stimulate sales of any of the Nicorette branded products.

Real own-price results

The real price of NRT has a negative and significant impact on NRT demand in all the demand equations that are estimated with the exception of 14 mg 7 count packet of Nicoderm CQ which is not significant at conventional levels. These estimates clearly indicate that decreases in the real prices of NRT would significantly increase per-capita sales of these products. The product-specific own-price elasticities of demand range from -0.770 to -3.74, -2.56 to -4.65, and -1.82 to -1.97 for Nicoderm CQ, Nicorette, and Nicoderm branded products, respectively. The own-price elasticity of demand is defined as the percent change in the quantity of NRT demanded for a 1% change in the price of NRT. The own-price elasticities for all but two of the NRT products were found to be quite elastic suggesting that a 10% decrease in the real price of NRT will increase average NRT sales by more than 10%.

Cross-price results: other NRT products

A positive and significant relationship exists between the demand for any given NRT product and the average price of all other NRT products for all the models that were estimated except for 21 mg 14 count Nicoderm CQ, 14 mg 7 count Nicoderm CQ, and 2 mg 108 count Nicorette which are not significant at conventional levels. The cross-price elasticity of demand with respect to other NRT products ranges from 0.0801 to

(*footnote continued*)
the NRT demand equations implying that a natural log transformation of the dependent variable was more appropriate than an untransformed (raw-scale) dependent variable. Moreover, A P_E test developed by Davidson and MacKinnon (1981) rejected the use of an untransformed dependent variable in favor of a natural log transformation in all the models that were estimated. Further, the adjusted coefficient of determination from the log-linear specification exceeded the adjusted coefficient of determination from the log–log specification and the root mean squared error (RMSE) from the log-linear specification is smaller than the RMSE from the log–log specification in all the models that were estimated.

[10]Additional lag structures up to the third lag were also tested. However, only very minor differences were observed in the estimated standard errors.

[11]When using a log-linear functional form, the estimated coefficients are equal to $(\partial Y/\partial X) \times (1/Y)$, where Y is the dependent variable and X is an explanatory variable of interest. The elasticity of Y with respect to X in this model is therefore $\beta * X$ where $\beta = (\partial Y/\partial X) \times (1/Y)$.

Table 1
Product-specific demand equations

	Nicoderm CQ				Nicorette				Nicotrol	
	21 mg 14 count	21 mg 7 count	14 mg 7 count	7 mg 7 count	2 mg 48 count	4 mg 48 count	2 mg 108 count	4 mg 108 count	15 mg 7 count Starter Kit	15 mg 7 count Refill Kit
Quarterly brand-specific GRPs (in 10,000s)	1.846	1.561	3.501	0.656	0.322	−0.587	−0.201	0.016	2.600	0.108
	(4.50)	(3.09)	(4.38)	(0.44)	(0.91)	(−2.23)	(−0.71)	(0.06)	(1.62)	(0.07)
Real price per daily dose of NRT (in 10s)	−1.039	−1.540	−0.316	−0.323	−10.984	−6.405	−17.680	−14.386	−0.818	−0.784
	(−2.28)	(−7.26)	(−1.39)	(−1.71)	(−9.06)	(−5.16)	(−9.47)	(−11.08)	(−5.29)	(−3.49)
Average real price of other NRT	0.453	1.122	−0.047	0.812	0.410	0.733	0.107	0.513	1.173	1.268
	(1.05)	(4.65)	(−0.12)	(1.90)	(2.70)	(4.59)	(0.44)	(2.16)	(2.30)	(2.30)
Real price cigarettes	2.981	3.053	6.017	−0.963	2.332	−0.367	−0.376	−1.418	10.971	10.498
	(2.34)	(1.90)	(2.24)	(−0.31)	(1.83)	(−0.30)	(−0.28)	(−0.88)	(2.31)	(2.10)
1997	0.627	0.603	0.714	0.798	0.228	0.305	0.241	0.264	−1.064	−0.971
	(8.33)	(8.85)	(7.91)	(7.81)	(5.14)	(6.43)	(4.99)	(5.01)	(−6.70)	(−5.97)
1998	0.650	0.610	0.575	0.710	0.183	0.351	0.372	0.544	−1.721	−1.545
	(7.29)	(8.14)	(5.10)	(5.14)	(3.73)	(6.61)	(7.09)	(10.42)	(−7.94)	(−6.90)
1999	0.581	0.475	−0.153	0.207	−0.345	0.007	0.031	0.314	−2.942	−2.794
	(5.49)	(5.03)	(−1.00)	(1.13)	(−4.94)	(0.10)	(0.38)	(4.15)	(−9.37)	(−8.90)
2000	0.131	0.010	−1.017	−0.394	−0.913	−0.426	−.615	−0.142	−4.181	−4.018
	(1.03)	(0.09)	(−5.45)	(−1.78)	(−11.22)	(−5.04)	(−5.94)	(−1.48)	(−10.55)	(−9.85)
2001	−0.341	−0.482	−3.683	−2.341	−1.281	−0.699	−0.971	−0.457	−4.255	−4.564
	(−2.40)	(−3.83)	(−16.63)	(−8.99)	(−13.61)	(−7.05)	(−7.87)	(−4.21)	(−9.46)	(−10.16)
2002	−0.380	−0.602	−4.679	−3.256	−1.469	−0.843	−1.202	−0.631	−4.317	−4.680
	(−2.39)	(−4.12)	(−15.78)	(−9.97)	(−13.28)	(−7.38)	(−8.62)	(−5.17)	(−8.83)	(−9.65)
Quarter 2	−0.261	−0.244	−0.400	−0.373	−0.155	−0.088	−0.083	−0.025	−0.496	−0.436
	(−11.18)	(−10.76)	(−8.82)	(−7.58)	(−6.58)	(−3.60)	(−3.14)	(−0.94)	(−6.55)	(−5.55)
Quarter 3	−0.542	−0.523	−0.890	−0.872	−0.155	−0.067	−0.067	0.007	−0.849	−0.799
	(−14.82)	(−16.71)	(−17.20)	(−14.39)	(−6.10)	(−2.41)	(−2.20)	(0.23)	(−10.15)	(−8.98)
Quarter 4	−0.347	−0.322	−0.793	−0.601	−0.233	−0.114	−0.122	−0.083	−0.941	−0.829
	(−9.25)	(−9.61)	(−12.61)	(−8.86)	(−7.98)	(−3.98)	(−3.64)	(−2.56)	(−9.44)	(−8.31)
Brand-specific GRP elasticity	0.083	0.071	0.163	0.030	0.013	−0.024	−0.008	0.001	0.039	0.002
Own price elasticity	−2.113	−3.742	−0.770	−0.785	−3.931	−2.557	−4.653	−4.26	−1.972	−1.820
Cross-price elasticity (other NRT products)	0.888	2.177	−0.092	1.612	.801	1.421	.220	1.028	2.401	2.585
Cross-price elasticity (cigarettes)	0.433	0.443	0.857	−0.137	0.337	−0.053	−0.054	−0.205	1.483	1.429

All equations also include an intercept and 49 dichotomous market indicators. Asymptotic *t*-ratios are in parentheses. The critical values for the *t*-ratios are 2.58 (2.33), 1.96 (1.64), 1.64 (1.28) at the 1, 5, and 10% significance levels, respectively, based on a two-tailed (one-tailed) test.

2.5850.[12] The cross-price elasticity of demand with respect to other NRT products is defined as the percent change in the quantity of NRT demanded for a 1% change in the average price of all other NRT products. These results suggest that the demand for any given NRT product increases as the average price of all other NRT products increases. This suggests that NRT products are economic substitutes in consumption for one another.

Cross-price results: cigarettes

A positive and significant relationship exists between the real price of cigarettes and the demand for NRT products in all the models that are estimated with the exception of 7 mg 7 count Nicoderm CQ, 4 mg 48 count Nicorette, 2 mg 108 count Nicorette, and 4 mg 108 count Nicorette products, where the real price of cigarettes is found to have an insignificant impact on the demand for these products. The cross-price elasticity of demand with respect to cigarettes ranges from 0.337 to 1.483.[13] The cross-price elasticity of demand with respect to cigarettes is defined as the percent change in the quantity of NRT demanded for a 1% change in the price of cigarettes. The positive and significant cross-price elasticities imply that NRT and cigarettes are substitutes in consumption and indicate that increases in the price of cigarettes will increase the use of NRT products.

With respect to seasonality, NRT demand is generally lower during the second, third, and fourth quarters of the year than it is in the first quarter. This finding is consistent with the notion that NRT is being used as a smoking cessation aid to achieve New Year's smoking cessation resolutions.

Finally, the dichotomous year indicators imply that in general, the demand for established Nicoderm CQ and Nicorette products was larger in 1997 and 1998 than it was in 1996, the year these products went OTC. However, the demand for established Nicoderm CQ and Nicorette products was lower for the years 1999–2002 as compared to 1996 sales. In addition, the dichotomous year indicators imply that the demand for the two established Nicotrol products was significantly lower in all subsequent years than it was in 1996. It is likely that greater competition via the entrance of new NRT products is driving the decrease in sales for established products. A variety of new OTC and prescription NRT products were launched post 1996 including new Nicoderm CQ and Nicorette products, generic patches, generic gums, nicotine nasal sprays, nicotine inhalers, and other products.

[12]The range of the cross-price elasticities is for products that had statistically significant cross-price effect.

[13]The range of the cross-price elasticities is for products that had statistically significant cross-price effect.

Discussion

While much is known about the economic determinants of tobacco use, very little is known about the economic determinants of NRT demand. This paper is the first econometric analysis to examine the impact of NRT advertising on the demand for NRT products. The findings from this paper indicate that increases in advertising increase the sale of Nicoderm CQ and Nicotrol branded products, but do not significantly increase the sale of Nicorette branded products. This paper also finds strong negative own-price effects and positive cross-price effects with respect to both cigarette and other NRT products.

Given the documented efficacy of NRT, measures to increase peoples' awareness of NRT products through advertising, measures to decrease the price of NRT, and measures to increase the price of cigarettes would be effective means to increase the use of NRT, likely leading to decreased cigarette smoking and reductions in the future public health burden caused by tobacco use.

Policy options to increase peoples' awareness of NRT products include government-sponsored media campaigns and subsidization of NRT manufacturers advertisements. Policy options to decrease the cost associated with purchasing NRT include: mandating private health insurance coverage of NRT, including NRT coverage in public health insurance programs, subsidizing NRT for uninsured or underinsured individuals, and deregulating NRT product markets. A policy option to increase the price of cigarettes is to increase the excise tax on cigarettes.

A possible limitation of increased advertising and subsidization of NRT is a reduction in the perception of risk of addiction for tobacco products. A second limitation is that a greater number of smokers who are not far enough along the continuum of motivational readiness to quit smoking try NRT, leading to less successful quit attempts. Although the proportion of successful NRT-assisted smoking cessation would likely decrease, a positive net effect on the absolute number of individuals who successfully quit would almost certainly result (Oster, Delea, Hulse, Regan, & Colditz, 1996).

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