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THE DEMAND FOR NICOTINE REPLACEMENT THERAPIES

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ABSTRACT

This paper is the first econometric study to examine the determinants of nicotine replacement therapy (NRT) demand. Pooled cross-sectional time-series scanner-based data for 50 major metropolitan markets in the United States covering the period between the second quarter 1996 and the third quarter 1999 are used in the analysis. Fixed-effects modeling is employed to assess the impact of NRT prices, cigarette prices, and other determinants on NRT demand. The estimates indicate 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 elasticity of demand for Nicoderm CQ, Nicorette, and Nicotrol is -1.4, -1.5, and -1.1 respectively. The average cross-price elasticity of demand for Nicoderm CQ and Nicorette is 0.68 and 0.81 respectively.

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I. Introduction

Cigarette smoking is associated with a multitude of serious pathological conditions including: ischemic heart disease, chronic lung disease, stroke, lung cancer, and esophageal cancer (USDHHS, 1989). Cigarette smoking has also been shown to contribute to cancer of the bladder, cervix, oral cavity, larynx, pancreas, and kidney (USDHHS, 1989). In the United States (U.S.), cigarette smoking is considered to be the leading cause of preventable death, responsible for more than 400,000 premature deaths each year (CDC, 1999). Cigarette smoking has had an enormous impact on global public health as well. The World Health Organization (WHO) estimated that approximately 4 million deaths were attributed to tobacco worldwide in 1998 (WHO, 1999). A study conducted by Murray and Lopez (1996), estimated that global tobacco related mortality is likely to increase to 8.3 million deaths annually by 2020.

Despite the deleterious health consequences of cigarette smoking, approximately 47.2 million adults in the U.S. aged 18 and over were current smokers in 1998, representing nearly one quarter (24.1%) of the total U.S. adult population (CDC, 2000). Globally, approximately 1.1 billion adults aged 15 and over were daily smokers in 1995, representing 29% of the total adult world population (Gajalakshmi et.al, 2000).

The tenacity of smokers to continue smoking in the face of such abysmal health consequences speaks to the significant addictive nature of cigarettes. In countries where the widespread dissemination of information on the health hazards of cigarette smoking is prevalent, a significant proportion of smokers contemplate or attempt to quit smoking each year. For example, in the U.S., 68.2% of current smokers wanted to quit smoking completely in 1995 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 stoking (CDC, 1997). However, despite a strong desire to quit smoking, only a very small proportion of smokers ever succeed. In the U.S., only about 2.5% of smokers quit smoking permanently each year (CDC, 1993).

The inability of many smokers to quit smoking is in large part due to the addictive properties of nicotine (USDHHS, 1988). Nicotine is a pharmacologic agent that reinforces the consumption of cigarettes and produces significant withdrawal in its absence (USDHHS, 1988). Several pharmacotherapies are currently being used for smoking intervention including sustained-release bupropion and nicotine replacement therapy (NRT). Bupropion is a monocyclic antidepressant that inhibits the re-uptake of dopamine and norepinephine, and is the only non-nicotine medication approved by the United States Food and Drug Administration for use in smoking intervention.[1] NRT is designed to aid smokers by alleviating withdrawal symptoms associated with smoking cessation by replacing the nicotine formerly obtained from cigarettes.

Numerous nicotine replacement therapy products are currently available including nicotine transdermal patches, nicotine polacrilex (nicotine gum), nicotine nasal sprays, and nicotine inhalers. Nicotine transdermal patches diffuse nicotine at a constant rate through an individual's skin into the bloodstream. Nicotine polacrilex releases nicotine upon chewing and is absorbed into the body through the buccal mucosa. Nicotine nasal sprays are inserted into the nose and nicotine is delivered through the nasal mucosa. Nicotine inhalers deliver nicotine primarily through the buccal mucosa after inhalation has taken place. A great deal of research on the efficacy of these products has been

[1] Nortriptyline and Clonidine are often used as second-line medications to facilitate smoking cessation, but neither has been formally approved by the FDA for smoking intervention.

conducted in recent years.[2] This body of research has concluded that all NRT products are effective in increasing the probability of smoking cessation (USDHHS, 2000).

Globally, most smokers attempt to quit smoking with little or no assistance (Novotny et.al, 2000). However, the prevalence of assisted smoking cessation has increased in many high income countries over the past few decades. Using the 1986 Adult Use of Tobacco Survey, Fiore and colleagues found that approximately 15% of smokers in the U.S. who made a serious quit attempt in the previous decade used some form of assistance to aid in their cessation effort and that 7.9% of smokers reported using assistance in their most recent attempt[3] (Fiore et. al 1990). A more recent study by Zhu and colleagues employed the 1996 California Tobacco Survey and concluded that nearly one-fifth (19.9%) of smokers who tried to quit in the previous year used some form of assistance and approximately 11.7 % of smokers used NRT[4] (Zhu et. al, 2000).

The dollar sales volume of NRT products is substantially smaller than that of cigarettes. The World Health Organization estimated that the global retail market for cigarettes was approximately $300 billion in 1999. This compares to an estimated $725 million in NRT sales in 1998 (Script Magazine, 1999). The United States dominates all other countries in terms of NRT dollar sales. The United States spent $553 million on NRT sales in 1998 representing more than 76% of the total world spending on NRT.

Given the documented efficacy of NRT, a greater acceptance of NRT by smokers would likely increase the probability of achieving the Healthy People goal of reducing the prevalence of adult smoking in the United States to 12% or less by the year 2010. This paper is the first econometric analysis to examine the determinants of NRT demand.

[2] For a comprehensive list of studies, see Reducing Tobacco Use A Report of the Surgeon General, 2000.
[3] Assistance consisted of NRT, counseling, hypnosis, acupuncture, or smoking cessation program.
[4] Assistance consisted of self-help, counseling, and NRT.

In particular, this paper focuses on the impact of NRT prices, changes in cigarette prices, and other determinants on the demand for NRT products in the U.S..

II. Previous Studies

While much is known about the effects of prices and tobacco control policies on cigarette smoking, relatively little is known about the determinants of smoking cessation and demand for NRT. Four studies have examined the impact of economic factors on individual's decisions to quit smoking. The first was conducted by Douglas (1998). He used the 1987 National Health Interview Survey: Cancer Risk Factor Supplement to investigate the determinants of the decisions to start and quit smoking in the context of an economic model of addiction. He estimated several alternative parametric duration models in his assessment of smoking initiation and cessation. Douglas concluded that current, future, and past prices of cigarettes have an insignificant effect on the probability of initiation. Likewise, current and past prices were found to be statistically insignificant in the probability of quitting. However, his estimates suggest that increases in future cigarette prices will significantly increase quitting rates. Douglas estimated a quitting hazard elasticity of 1.07 to 1.30 with respect to future price. This suggests that a 10% permanent increase in the future price of cigarettes will reduce the average duration of smoking by 11%-13%. In addition, the study indicated that information dissemination regarding the adverse health consequences of smoking, bans on cigarette advertising, and state level regulations significantly increase the probability of quitting.

While the study by Douglas (1998) made significant contributions to the existing literature by modeling the decisions to start and quit smoking, many of his findings, particularly those that deal with prices, are at odds with a majority of the research on the

determinants of smoking behavior conducted over the past several decades. One possible explanation why Douglas found insignificant current and past price effects may be due to the fact that he used one year of cross-sectional data. The application of duration methods in the econometric analysis of cigarette smoking requires relatively high quality longitudinal data that can accurately measure cigarette consumption, cigarette prices, government enacted policies, income, and socio-demographic variables over a relatively long time period. Indeed, Douglas' study employed cross-sectional data with retrospective information on smoking initiation and cessation. Therefore, incorrect recall by participants would likely have a strong influence on any results obtained. A second possible explanation stems from the error in matching prices to respondents' previous states of residence. Douglas based all previous prices that a respondent would have paid for cigarettes on the respondent's current state of residence. Therefore, if a respondent lived in a different state in the past, significant errors in price matching would be likely. As Douglas noted, the panel data requirements needed to use duration modeling were not met in this study, and future investigation is needed using true longitudinal data.

In a more recent study, Forster and Jones (1999) used both parametric and semi-parametric techniques to investigate the determinants of smoking initiation and cessation. As did Douglas, Forster and Jones used cross-sectional data (British Health and Lifestyle Survey) with retrospective information on cigarette smoking to approximate the length of time each individual smoked and abstained from smoking. Furthermore, in line with Douglas' work, they allowed cigarette tax to act as a time-varying covariate.[5] They found cigarette taxes to be an insignificant determinant of smoking initiation. In

[5] Although Douglas allowed price to vary at the state level over time, whereas Forster and Jones allow tax to vary solely at the national level over time. Allowing only national level variation reduces the probability of a price matching problem, but also has the consequence of decreases the variation in prices.

addition, they found that the estimated elasticity of the number of years smoked before quitting with respect to tax fell in a range of -0.40 to -0.63, suggesting that a 5% increase in tax would lead to a reduction in smoking of approximately 6 to 9.5 months. However, the authors found strong evidence of 5 and 10-year recall bias in their quitting models. To control for the effect of recall bias, they included dummy variables equal to one for individual's who recall quitting either 5 or 10 years ago and zero otherwise. The authors concluded that recall bias had limited impact on the parameter estimates.

Tauras and Chaloupka (1999) employed data from the Monitoring the Future Surveys (MTFS) to estimate smoking cessation equations for young adult men and women separately. The MTFS are longitudinal data that track individual's smoking behaviors and other socio-economic characteristics over time for up to fourteen years. Using a single-failure semi-parametric Cox regression model, they concluded that price had a positive and significant impact on the probability of first-time cessation for both young adult males and females. In addition, they found that policies restricting smoking in private worksites increased the probability of smoking cessation among employed females.

While the study by Tauras and Chaloupka (1999) made substantial contributions to the economic determinants of smoking cessation by avoiding both recall bias and incorrect price-matching through the use of longitudinal data, it had its own limitations. First, the authors only modeled first time smoking cessation. Second, the authors only modeled smoking cessation decisions of individuals who were allowed to enter the risk pool at two distinct periods of time. Individuals who were not smoking in either of those two distinct time periods but were smoking in different time periods were never allowed

to enter the risk pool. Modeling multiple cessation attempts and allowing all individuals at risk of quitting to be allowed to enter the models would significantly improve the estimates of the impact prices and tobacco control policies have on smoking cessation.

Tauras (2000) addressed the limitations of Tauras and Chaloupka (1999) by modeling multiple quit attempts of young adults. He used longitudinal data from the MTFS and employed both parametric and semi-parametric duration methods in his assessment of the impact of prices and clean indoor air laws on multiple cessation attempts. The estimates indicated that increases in the price of cigarettes increase the probability of initial smoking cessation as well as subsequent cessation for those individuals who were unable to remain smoke-free after at least one prior cessation attempt. The average price elasticity of cessation was estimated to be 0.343. In addition, stronger restrictions on smoking in private worksites and public places other than restaurants were found to increase the probability of young adult smoking cessation.

While no studies have examined the economic determinants of NRT demand, Hu and colleagues (2000) examined the effect of NRT sales on cigarette consumption. They used United States aggregate quarterly time-series data and employed an autoregressive moving average model. They found that NRT products play a significant role in decreasing per capita cigarette sales. They concluded that the promotion of NRT product sales could be used to discourage cigarette sales.

To summarize, the research conducted to date suggests that NRT availability, cigarette prices, and clean indoor air laws all have a positive influence on individual's decisions to quit smoking. However, no published econometric research has examined

the demand for NRT. This paper addresses this limitation in the literature by providing the first econometric analysis of the determinants of NRT demand.

III. Data and Methods

Pooled cross-sectional time-series data on cigarette sales, cigarette prices, over the counter 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 1996 and the third quarter 1999.[6] [7] Three separate brands of NRT are used in the analyses including: Nicorette nicotine polacrilex (nicotine gum), Nicoderm transdermal patch, and Nicotrol transdermal patch. Since prices of products within brands vary by milligram (mg) of nicotine and number of units per packet, separate analyses by products within a brand are conducted. Four separate Nicorette products are analyzed including: 48 count packet of 2mg gum, 48 count packet of 4 mg gum, 108 count packet of 2mg gum, and 108 count packet of 2mg gum. Four separate Nicoderm products are analyzed including: 7 count packet of 7mg patch, 7 count packet of 14mg patch, 7 count packet of 21mg patch, and 14 count of 21mg patch. Four separate Nicotrol products are analyzed including: 7 count starter kit of 15mg patch, 14 count starter kit of 14mg patch, 7 count refill kit of 15mg patch, and 14 count refill kit of 14mg patch. 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 and Nicotrol products went OTC during the third quarter 1996, data prior to the third quarter 1996 are excluded from the analyses for Nicorette products and

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

data prior to the fourth quarter 1996 are exclude for analyses using Nicoderm and Nicotrol products.

The dependent variables in all model specifications are adult per-capita NRT sales. The per-capita sales are created using quarterly interpolated county level population data from the U.S. Census Bureau.[8]

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 average per-unit prices for NRT products are created by dividing the total dollar sales of each product by the number of pieces sold in a given market in a given quarter. In addition, 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).

Similarly, based on economic theory and the literature on tobacco demand, we expect NRT demand to be positively related to the number of potential customers, or in other words, to the stock of smokers. To account for this, a variable measuring adult per-capita cigarette consumption in the previous quarter is created using quarterly scanner-based cigarette sales and the interpolated county-level population data.

Given the expected positive relationship between the stock of smokers and NRT demand, 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 and the positive relationship between cigarette prices and cessation (USDHHS, 2000), we

[8] Adult population refers to the population aged 18 and over.

predict that increases in the real price of cigarettes will increase the demand for NRT. To account for this, a variable capturing the market level change in the price of cigarettes from one quarter to another is created. Since the lagged price of cigarettes will be captured by previous consumption of cigarettes, controlling for the change in the real price of cigarettes is the most appropriate model specification. 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).[9]

Since many people make attempts to stop smoking as part of their "New Year's resolution" each year, 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).

Given the difficulties in obtaining consistent quarterly data by market for other socioeconomic determinants of NRT demand, ordinary least squares fixed-effects modeling is employed. 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 in the model, can be fully captured by the market and time fixed effects.[10]

[9] An attempt was made to include clean indoor air laws as determinants of NRT demand, however, there were no changes in state laws during the time period covered by our data, and no comprehensive source of local level clean indoor air laws exists.

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

IV. Results

Table 1 contains the estimates for the Nicoderm CQ brand demand equations. Columns 1, 2, 3, and 4 correspond to demand equations for the 21mg 7 count packet, 14mg 7 count packet, 7mg 7 count packet, and 21mg 14 count packet respectively. Table 2 contains the estimates for the Nicorette brand demand equations. Columns 1, 2, 3, and 4 represent demand equations for the 2mg 108 count packet, 4mg 108 count packet, 2mg 48 count packet, and 4mg 48 count packet respectively. Table 3 contains the estimates for the Nicotrol brand. Columns 1, 2, 3, and 4 represent demand equations for 15mg 14 count starter kit, 15mg 14 count refill kit, 15mg 7 count starter kit, and 15mg 7 count refill kit respectively. Each demand equation in Tables 1, 2, and 3 includes the following regressors: the real price of the relevant NRT product, the change in the real price of cigarettes, per capita cigarette consumption (a proxy for the stock of smokers), quarterly seasonality dichotomous indicators, year fixed effects, and market fixed effects.

The results generally conform to a priori expectations. The real price of NRT has a negative and significant impact on NRT demand at at least the 1% significance level for all products except 7mg 7 count Nicoderm, where price is significant at the 10% significance level. These estimates clearly indicate that decreases in the real price of NRT products will significantly increase sales of these products. The own-price elasticity of demand for Nicoderm products ranges from –0.81 to –1.69 and has an average own-price elasticity of –1.38. In addition, the own-price elasticities for Nicoderm imply that consumers will be more responsive to changes in price for higher mg than lower mg nicotine patches. No significant differences are found between the

number of pieces per packet and consumer price responsiveness for Nicoderm products. The own-price elasticity of demand for Nicorette products ranges from –1.04 to –1.90 and has an average own-price elasticity of –1.51. Unlike the positive relationship between nicotine content and price elasticity of demand for Nicoderm products, it appears as though an inverse relationship between nicotine content and price responsiveness exists for Nicorette gum. That is, holding the number of pieces in a pack constant, the demand for 2mg Nicorette gum is somewhat more elastic than that of 4mg Nicorette gum. Finally, the own-price elasticity of demand for Nicotrol products ranges from –0.743 to –1.42 and has an average own-price elasticity of –1.13. The estimates imply that the demand for refill kits is more elastic than that for starter kits. Overall, the average demand for all NRT brands is elastic. The estimates suggest that a 10% decrease in the real price of NRT will increase average Nicoderm CQ, Nicorette, and Nicotrol demand by approximately 14%, 15%, and 11% respectively. The estimated elasticities are brand/product specific elasticities and are likely to exceed the overall NRT price elasticity due to the substitutability between NRT products.

A change in the real price of cigarettes from the previous quarter to the current quarter has a positive and significant impact on the demand from all Nicoderm and Nicorette products with the exception of the 7mg 7 piece Nicoderm patch. In addition, cigarette price changes have a positive and significant impact on purchases of 15mg 14 count Nicotrol starter kits, but have an insignificant impact on the demand for all other Nicotrol products. The generally insignificant cross-price effects for Nicotrol products are likely due to market irregularities associated with Nicotrol demand. The irregularities include several Nicotrol products entering and exiting different markets at varying times

as well as fading sales and exit from the market for some of these products. These irregularities combined with the smaller number of observations make the Nicotrol estimates somewhat less reliable than the estimates for Nicoderm and Nicorette, the two more established product brands. The average cross-price elasticity of demand for Nicoderm CQ and Nicorette are 0.68 and 0.81 respectively. The positive and significant cross-price elasticities imply that NRT and cigarettes are substitutes in consumption and clearly indicate that increases in the price of cigarettes will increase the use of NRT products. In fact, the cross price elasticities imply that a ten percent increase in the price of cigarettes will increase Nicoderm and Nicorette demand by approximately 6.5% and 8.0% respectively.

In general, a positive relationship exists between the number of smokers in the previous quarter and the demand for NRT in the current quarter. This suggests that the greater the market base for NRT products, the greater will be NRT demand. An implication of this finding is that if NRT is efficacious in its usage, then changes in factors that would lead many smokers to successfully quit smoking will erode the potential number of customers for NRT.

Finally, with respect to seasonality, NRT demand is in general 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.

V. Discussion

Cigarette smoking is the single most preventable cause of death and disability in the United States, responsible for more than 400,000 premature deaths each year (CDC,

1999). Globally, it has been estimated that approximately 4 million people died prematurely in 1998 due to tobacco (WHO, 1999). Smoking cessation represents the single most important step that smokers can take to enhance the quality and length of their lives (USDHHS, 1999). A great deal of research has concluded that NRT is an effective aid to smoking cessation (USDHHS, 2000). A greater acceptance of NRT by smokers is likely to increase the number of smokers who quit and decrease the future burden of tobacco related disease.

This paper is the first to examine the determinants of NRT demand. The findings in this paper indicate that if the real price of NRT fell, the use of NRT products would increase considerably. Given the documented efficacy of NRT and the strong own-price effects found in this paper, measures to reduce the costs associated with obtaining and using NRT would be very 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 decrease the cost associated with 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. In addition, the estimated cross-price effects from this study imply that government action to increase the excise tax on cigarette would be an effective means to increase the use of NRT.

A possible limitation of subsidized NRT is that the reduction in cost may attract smokers who are not far enough along the continuum of motivational readiness to quit smoking, leading to less successful quit attempts. A second possible limitation of subsidized NRT is a reduction in the perception of risk of addiction for tobacco products.

Although NRT has been shown to be effective in increasing the probability of smoking cessation, the health impacts of long term NRT are unclear, although they are almost certainly much smaller than the health impacts of continued cigarette smoking.

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Table 1

Nicoderm CQ Demand Equations

	1	2	3	4
Independent Variables	21mg 7 count	14mg 7 count	7mg 7 count	21mg 14 count
Real Price NRT	-0.812 (-4.38)	-0.682 (-3.06)	-0.144 (-1.48)	-1.458 (-4.82)
Real Price Change Cigarettes	16.949 (4.74)	9.225 (2.15)	-0.216 (-0.10)	20.364 (3.53)
Stock of Smokers	0.001 (3.85)	0.001 (7.59)	0.001 (5.61)	0.000 (0.27)
Quarter 2	-0.003 (-9.56)	-0.003 (-8.83)	-0.002 (-8.90)	-0.005 (-10.37)
Quarter 3	-0.004 (-13.98)	-0.005 (-14.26)	-0.002 (-13.63)	-0.007 (-14.19)
Quarter 4	-0.005 (-13.93)	-0.006 (-15.27)	-0.003 (-14.63)	-0.006 (-11.27)
Constant	0.033 (7.03)	0.018 (3.24)	0.006 (2.28)	0.058 (8.79)
R-squared	0.91	0.89	0.85	0.92
Own-Price Elasticity of Demand, NRT	-1.69	-1.48	-0.81	-1.54
Cross Price Elasticity of Demand, Cigarettes	0.896	0.508	NS	0.643

All equations also include 49 dichotomous market indicators and 3 dichotomous year 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.

Table 2

Nicorette Demand Equations

	1	2	3	4
Independent Variables	2 mg 108 count	4 mg 108 count	2 mg 48 count	4 mg 48 count
Real Price NRT	-12.593 (-5.15)	-7.466 (-4.14)	-8.457 (-4.63)	-3.425 (-3.27)
Real Price Change Cigarettes	15.369 (2.67)	22.351 (4.05)	20.876 (4.29)	24.270 (6.43)
Stock of Smokers	0.000 (0.44)	0.000 (0.50)	0.001 (4.70)	0.001 (6.65)
Quarter 2	-0.001 (-1.33)	0.000 (0.13)	-0.002 (-4.62)	-0.001 (-2.45)
Quarter 3	-0.001 (-2.14)	0.001 (1.11)	-0.003 (-7.53)	-0.001 (-3.54)
Quarter 4	-0.001 (-0.93)	0.000 (0.47)	-0.003 (-7.19)	-0.001 (-4.00)
Constant	0.065 (9.53)	0.043 (7.45)	0.048 (7.30)	0.019 (4.41)
R-squared	0.92	0.91	0.92	0.93
Own-Price Elasticity of Demand, NRT	-1.73	-1.37	-1.90	-1.04
Cross Price Elasticity of Demand, Cigarettes	0.484	0.833	0.801	1.117

All equations also include 49 dichotomous market indicators and 3 dichotomous year 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.

Table 3

Nicotrol Demand Equations

	1	2	3	4
Independent Variables	15 mg 14 count Starter Kit	15 mg 14 count Refill Kit	15 mg 7 count Starter Kit	15 mg 7 count Refill Kit
Real Price NRT	-0.050 (-2.14)	-0.143 (-3.72)	-0.050 (-2.28)	-0.125 (-3.83)
Real Price Change Cigarettes	2.158 (1.72)	-1.223 (-0.58)	-0.749 (-0.51)	0.537 (0.31)
Stock of Smokers	0.000 (3.32)	0.000 (4.86)	0.000 (6.56)	0.000 (5.43)
Quarter 2	0.000 (2.92)	-0.001 (-3.92)	-0.001 (-6.43)	-0.001 (-5.09)
Quarter 3	-0.001 (-7.63)	-0.001 (-7.83)	-0.001 (-9.44)	-0.001 (-9.02)
Quarter 4	-0.001 (-8.97)	-0.002 (-10.18)	-0.002 (-10.92)	-0.002 (-10.74)
Constant	0.000 (0.08)	0.000 (0.10)	-0.001 (1.56)	0.001 (0.97)
R-squared	0.61	0.69	0.73	0.74
Own-Price Elasticity of Demand, NRT	-0.967	-1.40	-0.743	-1.42
Cross Price Elasticity of Demand, Cigarettes	1.263	NS	NS	NS

All equations also include 49 dichotomous market indicators and 3 dichotomous year 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.