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# Tax-Price Elasticities of Charitable Giving and Selection of Declaration: Panel Study of South Korea*

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**Abstract**

This study estimates the tax-price elasticity of donations, considering the bias caused by the fact that the claim of tax incentives for charitable giving depends on the taxpayer's decision. We first present a way to eliminate this bias by supporting the intention-to-treat analysis. We then estimate the price elasticity by our method, using exogenous variation in tax incentives due to the 2014 tax reform in South Korea. We find that a 1% increase in donation prices reduces donor contributions by 1.6% and the donor ratio by 2.6%. Next, we use the control function approach, one of the instrumental variable methods, to examine how endogeneity from the decision to use tax incentives biases the estimation of price elasticity. We find that those with large amounts of charitable giving without tax incentives do not declare their giving, leading to an underestimation (in absolute value) of the price elasticity of donors' contribution amount.

*Keywords*: Charitable giving, Tax incentives, Price elasticities, Selection, Declaration.
*JEL*: D64, H24, H31.

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# 1 Introduction

In many countries, governments provide tax relief for charitable giving, and many papers attempt to estimate the price elasticity of giving as a key variable to understand the impact of the tax relief for giving (e.g., Almunia et al., 2020). However, taxpayers may not declare all of their giving to tax agencies. In the U.S., 35 % of total individual giving is estimated to be nondeclared giving (Giving USA, 2022, p.337). Such a large nondeclared giving share implies that donors may not use tax relief as policymakers intended, and the estimation of the impact of the giving price on charitable giving may be biased if the existence of taxpayers who do not declare their giving (nondeclarers) is not considered (Rehavi and Shack, 2013). Therefore, understanding the impact of tax relief on charitable giving while accounting for nondeclarers is important for the evaluation of tax expenditure policy.

In this paper, we estimate the price elasticity of giving while recognizing that declaring giving is optional by exploiting the Korean government's change in the tax relief for charitable giving from an income deduction to a tax credit in 2014. Although the giving price determined by the amount of giving and income results in reverse causality, the distinctive quasi-experiment in Korea where income deduction for giving turned to a tax credit equal to 15% of total giving exogenously creates variation in the change of the giving price.

In addition, we also offer the estimation that mitigate the selection bias that only donors who gain will declare their giving. Depending on whether or not the declaration is taken into account, there are two giving prices: that is applicable for all taxpayers if declared (the *applicable price* hereafter) and that is effective only for declarers (the *effective price* hereafter). Since the 2014 tax reform brings the exogenous variations in applicable prices, the estimation of the applicable price elasticity should not suffer from self-selection bias and is equivalent to the estimand called intention-to-treat (ITT).[1] However, this might differ from a key parameter to evaluate welfare shown by Saez (2004). Moreover, the simple fixed-effect (FE) estimation of the effective price elasticity generates bias since declaration is self-selected.[2] Corresponding to this issue, we propose the two-stage least squares (2SLS) estimation where the effective price is the endogenous variable and the applicable price is an instrument. We theoretically predict that the effective

[1] As policymakers cannot compel taxpayers to declare all of their giving but only can offer tax relief, the result of the applicable price elasticity may be valuable to understand the effect of offering tax relief for giving.

[2] Although Saez (2004) does not consider the existence of declaration, we argue that the effective price elasticity in this paper corresponds to the price elasticity of giving in his model in the sense that both elasticities identify the extent to which taxpayers increase their giving when they face a 1% reduction in the giving price, not a reduction in the offered giving price. See also Fack and Landais (2016) for related theoretical discussion.

price elasticity will be more elastic than the applicable price elasticity.

We use household survey panel data from Korea called the National Survey of Tax and Benefit (NaSTaB), which include the total amount of giving and whether a taxpayer declared such giving. From this data, we obtain both applicable and effective giving prices and show that the effective and applicable price elasticities for the intensive margin are $-1.422$ and $-0.979$, respectively. The former value is more elastic than $-1$, which is the standard result in the empirical literature on the giving price elasticity, and the latter is close to $-1$. Following Almunia et al. (2020), we also find that the estimated applicable and effective price elasticities for the extensive margin are $-0.712$ and $-2.308$, respectively. The results are in line with the prediction that the applicable price elasticity will be less elastic than the effective price elasticity. Moreover, we find that the simple FE estimation of the effective price elasticity generates upward bias for the intensive margin and downward bias for the extensive margin.

Although the proposed method is very attractive because of its feasibility, it does not directly address the fact that the optional declaration of giving causes self-selection. Therefore, we examine the self-selection bias in declaration by using the control function approach and check whether the proposed method corrects the bias in the right direction. Since the endogeneity of the giving price comes from the correlation between the declaration and the error term, we can address the endogeneity by controlling the correlation. The control function approach utilizes this idea by adopting an instrumental variable (Wooldridge, 2015) and enables us to check the direction of bias and the correlation between the error term and the endogenous variable. We use a wage earner dummy as an instrumental variable because wage earners may have the opportunity to give through a program offered by their company, and the declaration process of offered giving is considerably simpler than others such as the self-employed in Korea. As giving behavior would be irrelevant to whether the donor is a wage earner after controlling for occupation and income level, we exploit the wage earner dummy as an instrument.

The result of the control function approach shows that the estimated price elasticity is $-1.23$ for the intensive margin. Considering that the result of the simple FE estimation is $-0.840$, the control function approach confirms that the simple FE estimation generates upward bias and the proposed method corrects the bias in the right direction. Moreover, the correlation between the giving price and the error terms is negative, which implies that taxpayers with a higher preference for giving tend to hesitate to declare their giving. As behavioral economics suggests that one motivation for donation is image, this result may indicate that image-motivated donors who give substantially may be hesitant to claim the donation deduction since the declaration will harm their altruistic image (e.g., Ariely et al., 2009; Eckel and Grossman, 2008).

This paper contributes to the empirical literature examining the price elasticity of giving inaugurated Feldstein and Taylor (1976) by filling the gap between two strands of studies: studies using exogenous policy change and studies using panel survey data. In the first strand, Almunia et al. (2020) and Fack and Landais (2010) utilize the change in income tax rates in the U.K. and the tax credit rate in France, respectively, as an identification strategy.[3] However, extant studies in this strand use tax record data, which do not include data on nondeclared giving, and estimate the price elasticity of tax-relieved giving.[4]

The studies in the second strand, which utilize panel survey data, have addressed the issue of nondeclared giving utilizing the fact that the data contain nondeclared giving data. Most of extant studies in this strand use U.S. panel survey data and capture nondeclared giving (Backus and Grant, 2019; Rehavi and Shack, 2013; Zampelli and Yen, 2017).[5] However, these studies do not exploit exogenous policy change but utilize tax rate changes using the change in income level as identifying variation, which may entail several endogeneity issues, such as endogenous income determination.[6]

This study attempts to fill this gap between the two strands of literature and utilizes a policy change and panel survey data focusing on the Korean context. Due to the policy change, we can exogenously estimate the elasticity. In this sense, this paper closely relates to Duquette (2016), who exploits changes in state income tax rates in the U.S. and charities' data. Our novelty in the literature on the giving price elasticity is, while addressing the issue of declaring giving, to suggest the existence of two different giving price elasticities and to estimate them.[7]

Another novelty of this paper is that we consider the self-selection bias generated the fact that the declaration of giving is optional. Recent studies address this issue by modeling taxpayer

[3] In addition, Fack and Landais (2016) and Gillitzer and Skov (2018) exploit policy changes that change the cost of the declaration of giving.

[4] Because of the lack of the data on nondeclaration, the applicable price and effective price cannot be obtained in tax record data.

[5] Using the same data, Brown et al. (2012) and Brown et al. (2015) examine the determinant of donations for the 2004 Indian Ocean tsunami and the giving behavior of poor and wealthy taxpayers, respectively, by constructing structural models.

[6] By using tax record data, Randolph (1995), Auten et al. (2002) and Bakija and Heim (2011) also utilize tax rate changes by the change in income level as a variation for identification.

[7] Although Almunia et al. (2020) and Fack and Landais (2016) are aware that the giving price elasticity estimated from tax record data using reduced-form regressions should differ from the price elasticity of total giving (including nondeclared giving), they do not derive it directly from the data. Duquette (2016) does not address the issue of declaring giving.

behavior.[8] In this paper, we address the self-selection issue by proposing a simple method and checking its validity with the control function approach. Moreover, by accounting for the difference in the costs of declaring giving using an instrumental variable and the issue of self-selection, we also contribute to the growing literature addressing the declaration cost of tax relief (Benzarti, 2020; Fack and Landais, 2016; Gillitzer and Skov, 2018; Zwick, 2021).

This paper consists of six sections. Sections 2 and 3 explain the institutional background and data, respectively. Section 4 examines the difference between the applicable and effective price elasticities based on ITT. Section 5 addresses self-selection problem when estimating the effective price elasticity using the control function approach. Section 6 concludes the paper.

# 2 Institutional Background

We describe the 2014 tax reform in Korea used as an identification strategy for estimating price elasticities. We also state that the application for tax incentives differs depending on whether a taxpayer is a wage earner, demonstrating that a dummy variable to indicate a wage earner is an appropriate instrument.

## 2.1 2014 Tax Reform

The Korean tax system offers tax incentives for charitable giving in the income tax. To explain how tax incentives determine the giving price, we introduce a simple budget constraint. Assume that a taxpayer with pretax income, $y_i$, has a choice between private consumption, $x_i$, and charitable giving, $g_i$. When a taxpayer decides to declare charitable giving, the budget constraint that the taxpayer faces is $x_i + g_i = y_i - T(y_i, g_i)$, where $T$ is the tax amount that depends on the pretax income and charitable giving. Since the marginal income tax rate is progressive in Korea, we assume that $T(\cdot, \cdot)$ satisfy $T_y(\cdot, \cdot) > 0$ and $T_{yy}(\cdot, \cdot) > 0$, where the subscript means partial differentiation.

Before 2014, the income deduction was a tax relief system for charitable giving in Korea. This system reduced the amount of taxable income before determining the marginal income tax rate. Thus, the amount of tax is $T(y_i, g_i) = T(y_i - g_i)$ when taxpayers claim. The total differential of the budget constraint by $x_i$ and $g_i$ is $dx_i + (1 - T'(y_i - g_i))dg_i = 0$. This leads to

[8] Almunia et al. (2020) construct a structural model with a self-selection process and estimate a fixed cost for declaring giving. Backus and Grant (2019) addresses the endogeneity issue generated by the fact that the giving declaration is selected depending on the amount of other tax relief measures in the U.S. tax system.

Table 1: Marginal Income Tax Rate

<table>
<tr><th>Income/Year</th><th>2008</th><th>2009</th><th>2010 - 2011</th><th>2012 - 2013</th><th>2014 - 2016</th><th>2017</th><th>2018</th></tr>
<tr><td>(A) - 1200</td><td>8%</td><td>6%</td><td>6%</td><td>6%</td><td>6%</td><td>6%</td><td>6%</td></tr>
<tr><td>(B) 1200 - 4600</td><td>17%</td><td>16%</td><td>15%</td><td>15%</td><td>15%</td><td>15%</td><td>15%</td></tr>
<tr><td>(C) 4600 - 8800</td><td>26%</td><td>25%</td><td>24%</td><td>24%</td><td>24%</td><td>24%</td><td>24%</td></tr>
<tr><td>(D) 8800 - 15000</td><td rowspan="4">35%</td><td rowspan="4">35%</td><td rowspan="4">35%</td><td rowspan="2">35%</td><td>35%</td><td>35%</td><td>35%</td></tr>
<tr><td>(E) 15000 - 30000</td><td rowspan="3">38%</td><td rowspan="2">38%</td><td>38%</td></tr>
<tr><td>(F) 30000 - 50000</td><td rowspan="2">38%</td><td>40%</td></tr>
<tr><td>(G) 50000 -</td><td>40%</td><td>42%</td></tr>
</table>

Notes: Marginal income tax rates applied from 2008 to 2018 are summarized. The income level is shown in terms of 10,000 KRW, which is approximately 10 United States dollars (USD) at an exchange rate of 1,000 KRW to one USD.

the giving price (relative to private consumption), $1 - T'(y_i - g_i)$. Since the marginal income tax rate is progressively determined as shown in Table 1, taxpayers facing a higher marginal income tax rate can enjoy a lower giving price for each 1 KRW donation. In other words, the giving price was regressive before 2014.

In 2014, to relax the regressivity of giving prices, the Korean government reformed the tax system, where a tax credit was introduced instead of the income deduction. The new tax relief system directly reduces the amount of tax. That is, the amount of tax is $T(y_i, g_i) = T(y_i) - mg_i$, where $m$ is the tax credit rate. Thus, the total differential of the budget constraint leads to the relative giving price, $1 - m$. The Korean government allows 15% of the total amount of declared charitable giving as a tax credit ($m = 0.15$), which means that the giving price fromin 2014 was $0.85$ KRW for each 1 KRW of donation regardless of income level[9].

In short, the applicable giving price, which is the giving price that declaring taxpayers face, is $1 - q$, where $q$ represents tax incentives. The tax incentives were $q = T'(y_i - g_i)$ before 2014 and $q = m = 0.15$ after 2014.[10] Therefore, high-income households, whose income tax rate was more than 15% before 2014 (income brackets (C)–(G) of Table 1 in 2013), face a higher giving prices due to the 2014 tax reform. On the other hand, low-income households, whose (average) income tax rate was less than 15% (income bracket (A) in Table 1 in 2013), have faced lower giving prices due to the 2014 tax reform. Finally, among middle-income households, whose

[9]During the transition period, taxpayers were able to declare donations made prior to 2014 after 2014. In this case, the taxpayer would still be eligible for the income deduction system.

[10]We here review the deductibility limits for donations. During the income deduction period, the upper limit was 15% of income during the years 2008-2010, 20% of income in 2011, and 30% of income during the years 2012-2013. Note that the deduction limit for religious-related donations was always 10% of income. For the tax credit period, the limit is KRW 30 million, regardless of the purpose of the donation. Note that the tax credit rate for donations exceeding KRW 30 million is 25%.

income tax rate was equal to 15% (income bracket (B) in Table 1 in 2013), the 2014 tax reform does not affect the giving prices. We exploit the variation in the giving price generated by the 2014 tax reform as our main identification source to estimate the giving price elasticity.

## 2.2 Claiming Tax Relief for Donations

An important aspect, which is perhaps often ignored, is that receiving a tax incentive depends on the taxpayer's choice. If taxpayers donate but do not declare it, they cannot obtain the tax incentive. To construct a simple decision-making model for this application, let $R$ be the indicator of a claim. Let $V_R(\cdot)$ be the indirect utility of each claiming status. Thus, $R = 1$ if $V_1(y, q) - V_0(y) \geq K_i$, where $K_i$ is the fixed compliance cost.[11] That is, the taxpayer claims tax relief only if the benefit exceeds the fixed compliance cost. Then, given the optimal claiming status, the effective giving price, which is the actual donation price the taxpayer faces, is $p = 1 - Rq$.

We provide an overview of the application process for tax relief for charitable giving in Korea. In Korea, personal income tax is assessed for one year, from 1 January to 31 December. In principle, taxpayers submit their income tax returns and pay income taxes in May of the following year. Unlike the U.S., Korea has introduced year-end settlements, so wage earners do not need to file an income tax return. Instead, in January or February of the following year, wage earners collect receipts and certificates, prepare income and tax credit documents, and submit them to their employer. Note that wage earners can file unclaimed tax relief in the year-end settlement when filing their income tax return in May.

Although taxpayers have to claim tax relief for charitable giving through the year-end settlement or income tax return, some wage earners can receive tax incentives for donations from their employers without having to prepare receipts and documentation. In such a donation opportunity, the employer, instead of the wage earner, deducts a portion of the worker's salary to donate and submits receipts and documents to the tax agency.

Since this system is not available for others, such as the self-employed, we expect that the fixed compliance cost, $K_i$, for wage earners is lower than that for others. Thus, we use a dummy variable indicating wage earners to capture the different declaration costs for taxpayers. In Section 5, we address the selection issue in claiming using the control function method with the

[11] If the donor does not apply ($R = 0$), no tax incentive $q$ is received, so indirect utility $V_0$ is a function of income $y$. Additionally, the benefit of applying $V_1(y, q) - V_0(y)$ includes tax savings.

wage-earner dummy as an instrument.

# 3 Data

This study uses the NaSTaB, conducted by the Korea Institute of Taxation and Finance since 2008, which is annual panel data on household tax burden and public assistance. The survey targets 5,634 households nationwide, with 5,634 household heads and economically active household members aged 15 or older. The survey asks about income, charitable giving, demographics such as years of education, and attitudes toward the tax system.

To focus on an exogenous change in the giving price due to the 2014 tax reform, we use 2010–2017 NaSTaB data, excluding observations in income brackets (F) and (G) shown in Table 1. This sample exclusion ensures that changes in the giving price depend only on income (before 2014) and the 2014 tax reform. Thus, once we control for annual income, variation in the giving comes from the 2014 tax reform. Since we determine income brackets based on an individual's pretax gross income, we exclude samples with pretax income of KRW 1 million (equivalent to approximately USD 1,000) around the threshold for each bracket to remove price changes due to income manipulation such as bracket shifting through income deduction without charitable giving.

In addition, to focus on taxable respondents who have sufficient income and assets, we use respondents aged 24 or older who are not unpaid family workers, housewives, or students.[12] We present descriptive statistics for the final sample in Table 2. The analysis sample consists primarily of older men. Approximately 70% of the analysis sample is male, and the average age is 51. The average pretax gross income is KRW 30 million, similar to the average income shown in the National Tax Statistical Yearbook 2012-2018 published by the Korean National Tax Service (KRW 32.77 million). Figure 1 shows the pretax gross income distribution for 2013.

The solid stepwise line and the dashed horizontal line in Figure 1 are the giving prices when the tax incentive is applied (applicable giving prices). The solid stepwise line shows the applicable giving prices for the income deduction period (2010–2013), and the dashed horizontal line shows the applicable prices for the tax credit period (2014–2017). As stated in Section 2, the

[12] We also establish exclusion requirements related to donations. First, we exclude observations for which donations exceed total income ($N = 226$). Second, we exclude observations that claim tax incentives and whose total contributions exceed the deduction limit for religious-related contributions ($N = 210$).

Table 2: Descriptive Statistics

| | N | Mean | Std.Dev. |
|---|---|---|---|
| *Income and giving price* | | | |
| Annual labor income (unit: 10,000KRW) | 37901 | 1924.13 | 2631.33 |
| Annual total income (unit: 10,000KRW) | 37901 | 3088.10 | 2808.14 |
| Appricale price | 37901 | 0.85 | 0.05 |
| *Charitable giving* | | | |
| Annual chariatable giving (unit: 10,000KRW) | 37901 | 32.48 | 122.76 |
| Dummary of donation > 0 | 37901 | 0.23 | 0.42 |
| Dummy of declaration of a tax relief | 37901 | 0.11 | 0.31 |
| *Demographics* | | | |
| Age | 37901 | 51.33 | 15.95 |
| Wage earner dummy | 37893 | 0.48 | 0.50 |
| Number of household members | 37901 | 3.20 | 1.26 |
| Dummy of having dependents | 37901 | 0.68 | 0.47 |
| Female dummy | 37901 | 0.35 | 0.48 |
| Academic history: University | 37900 | 0.46 | 0.50 |
| Academic history: High school | 37900 | 0.32 | 0.47 |

Notes: Our data is unbalanced panel data consisting of 8,441 unique individuals and 8 years period (2010–2017)

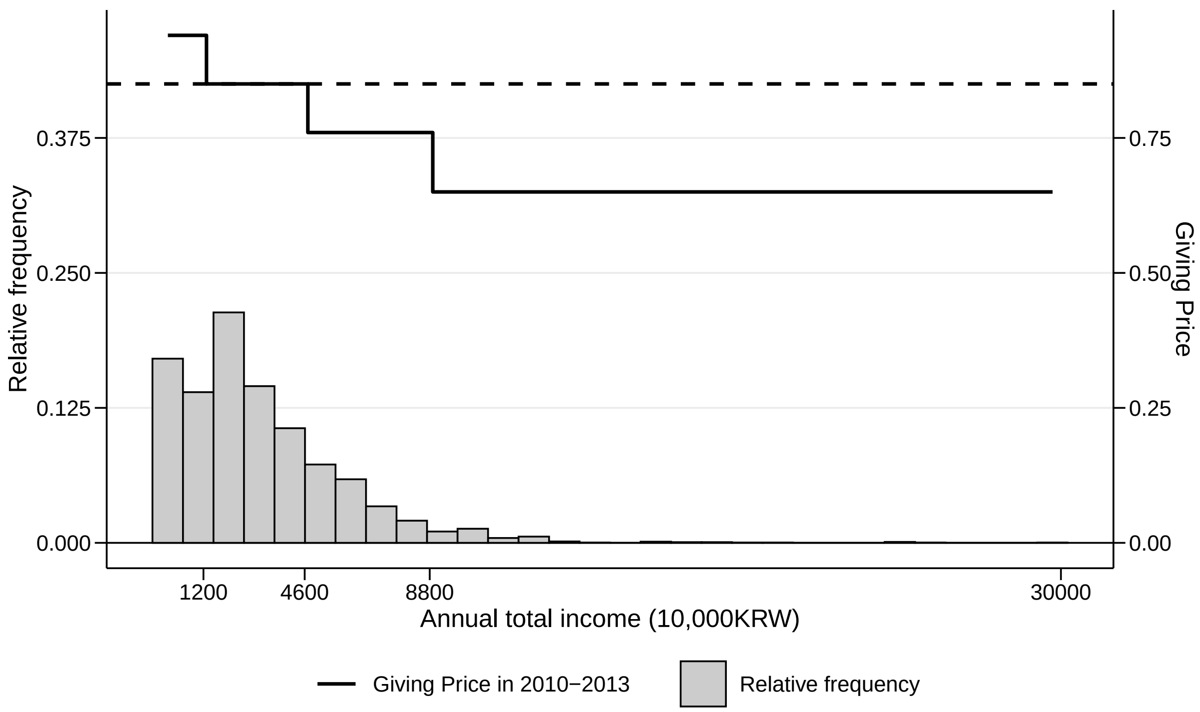


Figure 1: Income Distribution in 2013 and Relative Giving Price. *Notes*: The left and right axes measure the relative frequency of respondents (grey bars) and the relative giving price (solid step line and dashed line), respectively. The solid stepwise line represents the relative giving price in 2010–2013. The dashed horizontal line represents the giving price in 2014–2017.

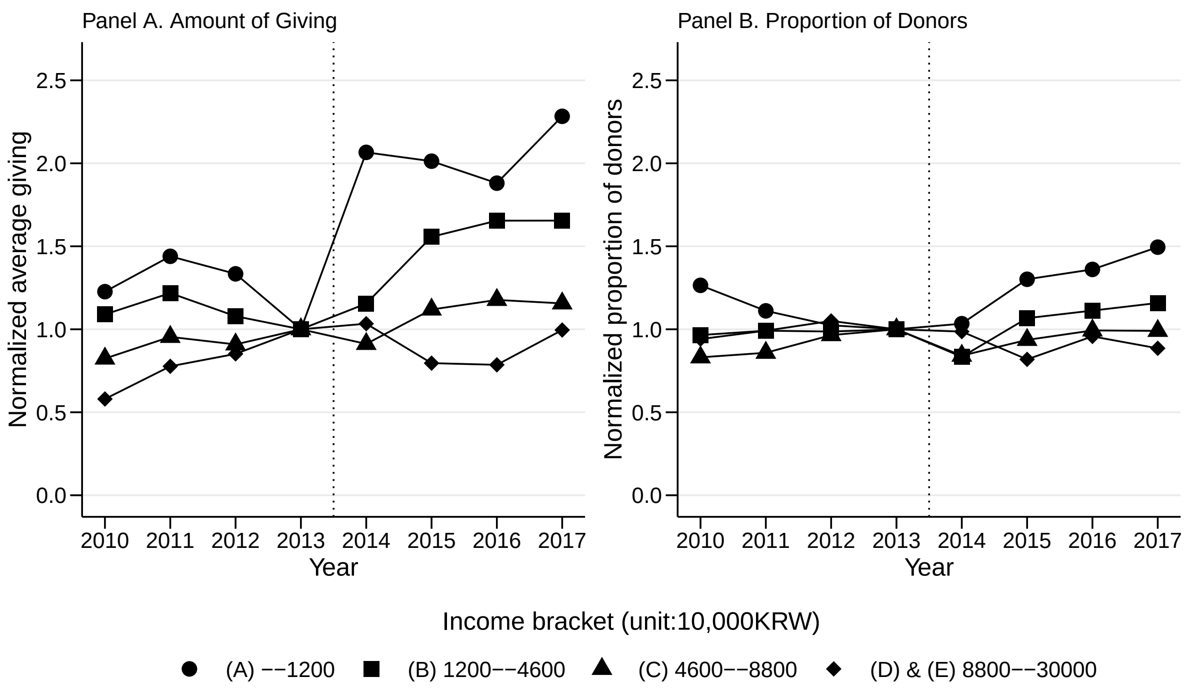


Figure 2: Average Giving Amount (Panel A) and Proportion of Givers by 2013 Income bracket.
*Notes*: The group averages are normalized to one in 2013.

changes in tax incentives due to the 2014 tax reform differ for three income groups. The first income group is below KRW 12 million (bracket (A) in Table 1), for which the tax reform expanded tax incentives and decreased the applicable giving prices. The second group is between KRW 12 million and KRW 46 million (Bracket (B) in Table 1), for which the tax reform did not affect tax incentives and the applicable giving prices. The last group is above KRW 46 million (Brackets (C), (D), and (E) in Table 1), for which the tax reform reduced tax incentives and increased the applicable giving prices. Exploiting this variation, we identify the price elasticity of donations based on DID analysis.

The two outcome variables that capture donation behavior are the amount of giving and a dummy variable indicating donors. Table 2 shows that the average donation amount is KRW 360,000 (equivalent to USD 300), approximately $1.1\%$ of pretax gross income. In comparison, the amount the United Kingdom is $0.5\%$ (Almunia et al., 2020), and that in the United States is $1.5\%$ (Backus and Grant, 2019). In addition, the proportion of donors is 23%.

Figure 2 divides the sample by income bracket based on gross income in 2013 and shows changes in average donation amounts (Panel A) and donor ratios (Panel B) in each group. The increase in average donation amounts and proportion of donors in income bracket (A) in Table 1, where the applicable giving price decreased after the tax reform, was more significant than

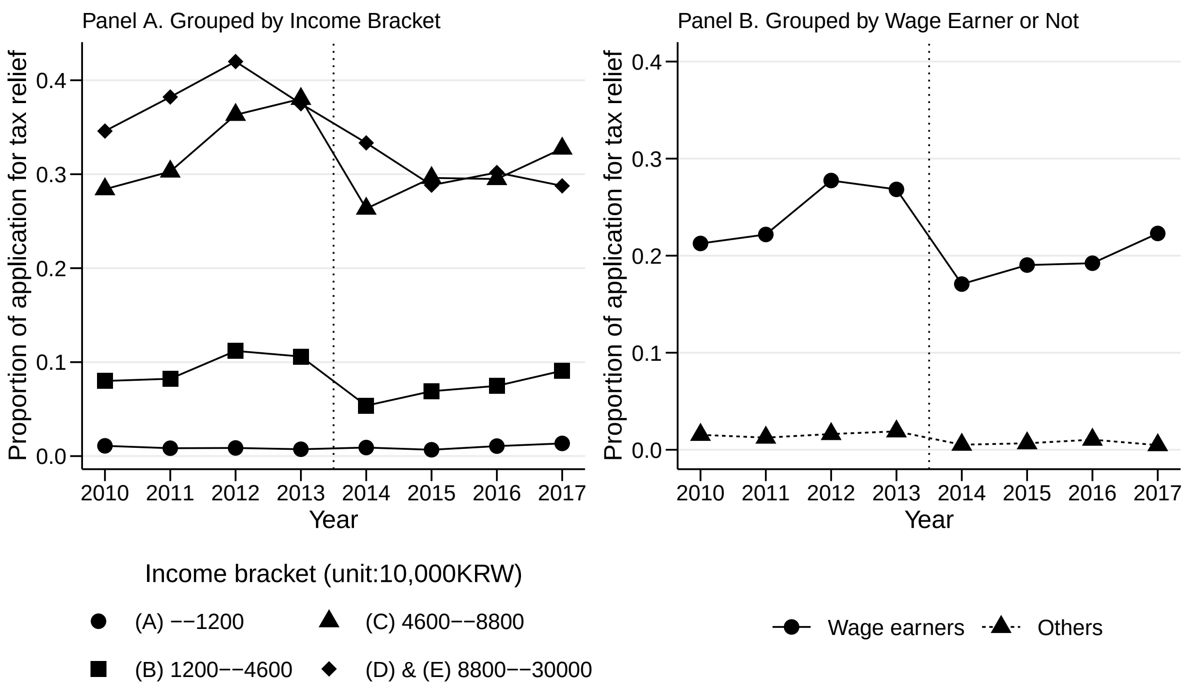


Figure 3: The proportion Having Applied for Tax Incentives by 2013 Income Bracket (Panel A) and Wage Earner Status (Panel B).

that in income bracket (B) in Table 1, where the applicable giving prices remained unchanged after the tax reform. On the other hand, the increase in average donations and donor ratios in income brackets (C)–(E) in Table 1, where the applicable giving prices increased following the tax reform, was smaller than that in income bracket (B) in Table 1. Thus, we expect a standard price effect on donation behavior.

In addition to income, the giving price, and giving behavior, another important variable is claiming status. Since NaSTaB examines whether a taxpayer filed a charitable contribution in each year-end adjustment and tax return system, we create a dummy variable that takes value one if the taxpayer filed in either system. We use this variable to identify the price that individuals actually face (effective giving price). If taxpayers claim, the effective price will be equivalent to the applicable price shown in Figure 1; otherwise, the effective price is 1. Table 2 shows that the proportion applying for tax incentives is 11%, indicating that only approximately half of all donors declare their giving. Panel A of Figure 3 shows the percentage of tax benefits claimed in each income bracket. The income brackets with lower applicable prices for the tax deduction period have a higher proportion of applications and a significant decrease in application rates due to the introduction of the tax credit system.

Panel B of Figure 3 shows the transition in the proportion applying for the tax benefit, classified by whether the respondent is a wage earner. We find that the percentage applying for tax incentives among wage earners is higher throughout all periods than among the remaining observations. This finding may reflect the differences in application costs described in Section 2. However, the difference in application ratios shown in Panel B of Figure 3 may also be influenced by income and other factors. Therefore, while controlling for income and other effects, we use the wage earner dummy as a proxy variable for a fixed compliance cost and as an instrumental variable for application for tax benefits (see Section 5).

# 4 Estimating Price Elasticities

## 4.1 Estimation Model and Parameter of Interest

In this section, we provide a simple method to obtain unbiased effective price elasticities and estimate them. To begin, we clarify the parameters of interest. As introduced in Section 2, the effective price of individual $i$ in year $t$ is $p_{it} = 1 - R_{it}q_{it}$, where $R_{it}$ is a dummy variable indicating application for tax incentives and $q_{it}$ represents the tax incentives.[13] Outcome variables, $Y_{it}$, are determined by the following two-way fixed effects model:

$$Y_{it} = \mu_i + \theta_t + \beta_e \ln p_{it} + \delta X_{it} + \epsilon_{it}, \tag{1}$$

where $\mu_i$, $\theta_t$, and $X_{it}$ are individual fixed effects, year fixed effects, and a vector of covariates (including pretax income, $y_{it}$), respectively. The term $\epsilon_{it}$ is an idiosyncratic error.

Our parameter of interest is a coefficient $\beta_e$. Using this estimate, we obtain the effective price elasticities. As in previous studies (e.g. Backus and Grant, 2019; Almunia et al., 2020), we estimate two types of elasticities. The first is the intensive-margin price elasticity, which indicates by what percentage a 1% price increase leads to an increase in the amount donors give. In this estimation, we restrict our sample to donors and use the log value of donations,

[13] In the pre-2014 tax deduction period, the tax incentive is the marginal income tax rate $T'(y_{it} - g_{it})$. Since that tax rate depends on the amount of giving, the endogeneity of the effective price is due not only to $R_{it}$ but also to the marginal income tax rate. To avoid this, we calculate the relative giving price (*first* price) using the marginal income tax rate $T'(y_{it})$ when the donation amount is set to zero. We estimate the price elasticities using the first price. As a robustness check, we also calculate the giving price based on the marginal income tax rate $T'(y_{it} - g_{it})$ under the actual donation amount (*last* price) and estimate the price elasticities by a fixed effects two-stage model (FE-2SLS) with the first price as an instrumental variable. The results are quantitatively similar to the first price elasticities. See Section 4.4 for details. If income $Y_{it}$ is determined simultaneously with giving behavior, we cannot completely rule out the endogeneity problem of marginal income tax rates. However, since we add pretax income as an explanatory variable, we believe that this endogeneity can be eliminated to some extent.

$\ln g_{it}$, as the outcome variable. Then, the coefficient $\beta_e$ indicates the price elasticity.

The second is the extensive-margin price elasticity, which indicates by what percent the donor ratio increases with a 1% price increase. For estimation, we include donors and non-donors in our analysis sample and use a dummy variable $D_{it} = 1[g_{it} > 0]$ indicating donors as the outcome variable. Because we have a binary outcome variable, we cannot interpret the coefficient $\beta_e$ in this estimation as an elasticity. Therefore, using the estimate $\beta_e$, we obtain the implied extensive-margin price elasticity as $\hat{\beta}_e/\bar{D}$, where $\bar{D}$ is the sample mean of $D_{it}$.

Since claiming, $R_{it}$, depends on the taxpayer's decision, the effective price can be endogenous due to the selection of claiming. Thus, standard fixed effects models (1) may estimate a biased $\beta_e$. In this section, we propose a simple method to obtain an unbiased $\beta_e$, aided by ITT analysis.

## 4.2 Recovering Effective Price Elasticities

ITT analysis recognizes that some individuals assigned to a treatment do not actually receive that treatment and examines the effect of providing the opportunity for treatment. We can estimate this effect using an estimation model assuming that all persons assigned to treatment receive the treatment. In the context of tax incentives, we acknowledge that some people who are eligible for tax incentives do not actually receive them. We then estimate the following model:

$$Y_{it} = \mu_i + \theta_t + \beta_a \ln(1 - q_{it}) + \delta_a X_{it} + \eta_{it}. \tag{2}$$

The variable $\ln(1 - q_{it})$ is the log value of applicable prices. We refer to the price elasticity using the coefficient $\beta_a$ estimated in Equation (2) as an *applicable price elasticity*. This elasticity is a valuable measure for the policy evaluation of tax reform because policymakers cannot directly manipulate individuals' application for tax incentives. When policymakers implement a reduction in tax incentives equivalent to a 1% increase in donation prices, the amount of donors' giving changes by $\hat{\beta}_a$% (intensive margin), and the donor ratio changes by $(\hat{\beta}_a/\bar{D})$% (extensive margin).

For estimation of the applicable price elasticities, our identification strategy is a DID model exploiting the exogenous change in tax incentives $q_{it}$ due to the 2014 tax reform. Thus, the standard fixed-effects model (2) obtains unbiased applicable price elasticities.

However, since the ITT analysis assumes that nonapplicants for tax incentives receive tax incentives, the applicable price elasticity is different from our parameter of interest, $\beta_e$, the effective price elasticity. To illustrate this point, we derive the estimator of $\beta_a$. By the regression anatomy theorem (Angrist and Pischke, 2009), the estimator of $\beta_a$ is

$$\hat{\beta}_a = \frac{\text{Cov}(Y_{it}, \hat{r}_{it})}{\text{Var}(\hat{r}_{it})}, \tag{3}$$

where $\hat{r}_{it}$ is a residual of the following auxiliary regression model:

$$\ln(1 - q_{it}) = \mu_i + \theta_t + \lambda X_{it} + r_{it}. \tag{4}$$

Since the residual is a linear combination of all explanatory variables and fixed effects in Equation (4), the residual $\hat{r}_{it}$ should be uncorrelated with the explanatory variables and fixed effects in Equation (4). In addition, since the covariate vector includes gross income, which determines the income tax rate, the change in the residual should depend only on the 2014 tax reform. Therefore, we assume that the residual $\hat{r}_{it}$ is uncorrelated with the error term $\epsilon_{it}$ in Equation (1).

The ITT analysis estimates Equation (2), but the outcome variable $Y_{it}$ is determined by Equation (1). Thus, substituting Equation (1) into Equation (3) yields

$$\hat{\beta}_a = \frac{\text{Cov}(Y_{it}, \hat{r}_{it})}{\text{Var}(\hat{r}_{it})} = \frac{\text{Cov}(\beta_e \ln p_{it}, \hat{r}_{it})}{\text{Var}(\hat{r}_{it})} = \beta_e \cdot \frac{\text{Cov}(\ln p_{it}, \hat{r}_{it})}{\text{Var}(\hat{r}_{it})}. \tag{5}$$

Furthermore, since $\hat{r}_{it}$ is a residual of auxiliary regression (4), the regression anatomy theorem implies that the parameter $\text{Cov}(\ln p_{it}, \hat{r}_{it})/\text{Var}(\hat{r}_{it})$ is a coefficient $\gamma_1$ in the following model:

$$\ln p_{it} = \mu_i + \theta_t + \gamma_1 \ln(1 - q_{it}) + \gamma_2 X_{it} + u_{it}. \tag{6}$$

Thus, the applicable price elasticity is the product of two effects: (i) an effective price elasticity (parameter $\beta_e$) and (ii) the partial correlation between effective and applicable prices (parameter $\gamma_1$).

If the residual $\hat{r}_{it}$ and application for tax incentives are mean independent, then the parameter $\gamma_1$ will always be in the range from 0 to 1 (See Appendix B for the proof). In this case, the applicable price elasticity is more inelastic than the effective price elasticity. Furthermore, the fewer nonclaimants of the tax incentive there are, the stronger the correlation between effective and applicable prices, and the closer the values of the two elasticities. As an extreme example, when all taxpayers donate and apply for tax incentives, $\gamma_1 = 1$ because the effective price is equal to the applicable price. Therefore, Equation (5) implies that $\hat{\beta}_a = \beta_e$. Conversely, when no taxpayers apply for tax incentives, the logarithm of the effective price must be $0$, and Equation (5) implies that $\hat{\beta}_a = 0$.

Some donors do not apply for tax incentives (Table 2), and nondonors cannot claim the deduction. Therefore, in our estimation of price elasticities, $\beta_a$ is not equal to $\beta_e$. We can also estimate Equation (6), which allows us to accurately measure the extent to which applicable price elasticities differ from effective price elasticities. Table A.1 in Appendix A shows the estimation results of Equation (6) for the intensive-margin price elasticity and the extensive-margin price elasticity. By the estimated value of $\gamma_1$, the applicable price elasticity is $0.688$ times the effective price elasticity for the intensive-margin price elasticity. For the extensive-margin price elasticity, the applied price elasticity is $0.297$ times the effective price elasticity.

Equation (5) presents a way to recover the effective price elasticity from the applicable price elasticity. Since we can estimate Equation (2), we obtain an estimate of the parameter $\beta_a$. We also already have an estimate of the parameter $\gamma_1$ from the estimation results presented in Table A.1 in Appendix A. Thus, by computing $\beta_a/\gamma_1$, we can recover the coefficient $\beta_e$ used to estimate the effective price elasticity. The parameter $\beta_a/\gamma_1$ is also a Wald estimator of $\beta_e$ in the following two-stage model with fixed effects (FE-2SLS):

$$\begin{aligned} Y_{it} &= \mu_i + \theta_t + \beta_e \ln p_{it} + \delta X_{it} + \epsilon_{it}, \\ \ln p_{it} &= \mu_i + \theta_t + \gamma_1 \ln(1 - q_{it}) + \lambda X_{it} + u_{it}, \end{aligned} \tag{7}$$

Here, the logarithm of the applicable price $\ln(1 - q_{it})$ is the instrumental variable for the endogenous variable, the logarithm of the effective price $\ln p_{it}$. Again, once we control for income, $\ln(1-q_{it})$ is independent of $\epsilon_{it}$. Thus, $\ln(1-q_{it})$ is a valid instrument for $\ln p_{it}$. We use Equation (7) as the main model to estimate the parameter $\beta_e$ and obtain the effective price elasticity.

## 4.3 Estimation Results

Table 3 presents the estimation results for price elasticities. Columns (1)–(3) report the estimation results for the intensive-margin price elasticities. In this case, we estimate models using only donors as the sample, with the log value of donations as the outcome variable. Column (1) estimates the applicable price elasticities. The estimated elasticity is $-1.072$, which is statistically significant.

Table 3: Estimation Results of Price Elasticities

| | Log donation | | | Dummy of donor | | |
|---|---|---|---|---|---|---|
| | FE | | FE-2SLS | FE | | FE-2SLS |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Applicable price ($\beta_a$) | $-1.072$*** | | | $-0.182$*** | | |
| | (0.330) | | | (0.058) | | |
| Effective price ($\beta_e^{FE}$) | | $-0.640$** | | | $-2.728$*** | |
| | | (0.254) | | | (0.073) | |
| Effective price ($\beta_e^{IV}$) | | | $-1.559$*** | | | $-0.615$*** |
| | | | (0.487) | | | (0.182) |
| Log income | 1.624 | 1.846 | 1.274 | 1.454*** | 0.674*** | 1.411*** |
| | (1.333) | (1.321) | (1.333) | (0.208) | (0.189) | (0.201) |
| *Implied price elasticity* | | | | | | |
| Estimates | | | | $-0.783$*** | $-11.707$*** | $-2.639$*** |
| | | | | (0.248) | (0.314) | (0.783) |
| *1st stage information (Excluded instrument: Applicable price)* | | | | | | |
| F-statistics of instruments | | | 1379.445 | | | 1796.440 |
| Wu-Hausman test, p-value | | | 0.004 | | | $< 0.001$ |
| Num.Obs. | 7786 | 7786 | 7786 | 30 280 | 30 280 | 30 280 |
| RMSE | 0.66 | 0.66 | 0.66 | 0.26 | 0.23 | 0.25 |

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors clustered at household level are in parentheses. An outcome variable is logged value of amount of charitable giving for models (1)–(3) and a dummy of donor for models (4)–(6). For estimation, models (1)–(3) use donors only (intensive-margin sample), and models (4)–(6) use not only donors but also non-donors (extensive-margin sample). For outcome equation, we control squared age (divided by 100), number of household members, a dummy that indicates having dependents, employee dummy, a set of dummies of industry a set of dummies of residential area, and individual and time fixed effects. For FE-2SLS, we use a logged applicable price as an instrument. To obtain the extensive-margin price elasticities in models (4)–(6), we calculate implied price elasticities by divding estimated coeffcient on price by sample proportion of donors.

We then turn to the effective price elasticity. The elasticity estimated in Column (1) differs from the effective price elasticity because only approximately half of the donors apply for tax incentives. Thus, we estimate the FE-2SLS model (7) to obtain an unbiased estimate of the effective price elasticity. In Column (3), the results show that the effective price elasticity is $-1.559$, which is statistically significant. Thus, a 1% increase in the price of giving decreases the donor's contribution by $1.6$%. This value is consistent with the ratio of the applicable price elasticity estimated in Column (1) to the estimated value of the parameter $\gamma_1$ in Equation (6) presented in Column (1) of Table A.1 of Appendix A ($-1.072/0.688 = -1.558$). In addition, there is no weak instrumental variable problem in this estimation because the F-value of the instrument is sufficiently high. Therefore, the effective price elasticity estimated in Column (3) is reliable.

Column (2) estimates the effective price elasticity using the standard FE model (1). By comparing this result with that in Column (3), we can discuss the direction of the estimation bias in the effective price elasticity estimated by the standard FE model. The estimate obtained in Column (2) is more inelastic than the unbiased effective price elasticity (Column (3)). This suggests that the logarithm of the effective price is positively correlated with unobservable donation behavior (the error term $\epsilon_{it}$ in model (1)). The logarithm of the effective price varies and negatively correlates with the claiming decision. Since the source of endogeneity in effective prices is the claiming decision, Columns (2) and (3) suggest that unobservable donation behavior negatively correlates with the claiming decision. Section 5 explicitly tests this suggestion using the control function method and discusses it in detail.

Columns (4)–(6) present the estimation results for the extensive-margin price elasticities. We estimate models with donor dummies as the outcome variable, using donors and nondonors as the sample. Column (4) estimates the applicable price elasticities. The estimated value of the coefficient on the applicable price is $-0.182$, which is statistically significant. Since the outcome variable is binary, we cannot directly interpret this coefficient estimate as an elasticity. Therefore, we calculate the implied elasticity by dividing the coefficient value by the sample proportion of donors. As a result, the applicable price elasticity is $-0.783(= -0.182/0.23)$, which is also statistically significant.

We turn to the effective price elasticity. Since nondonors cannot claim the donation deduction, the elasticity estimated in Column (4) differs from the effective price elasticity. This motivates us to estimate the FE-2SLS model (7). Column (6) indicates that the estimated coefficient on the effective price is $-0.615$, which is statistically significant. Dividing this value by the sample proportion of donors yields $-2.639(= -0.615/0.23)$. Thus, a 1% increase in the donation price decreases the donor ratio by approximately 2%. This elasticity is quantitatively consistent with the ratio of the applicable price elasticity to the estimated value of the parameter $\gamma_1$ in Equation (6) presented in Column (2) of Table A.1 of Appendix A ($-0.783/0.297 = -2.636$). In addition, there is no weak instrumental variable problem in this estimation because the F-value of the instrument is sufficiently high. Thus, the effective price elasticity estimated in Column (6) is reliable.

Column (5) estimates the effective price elasticity with bias using the standard FE model (1) and finds that it is more elastic than the unbiased effective price elasticity obtained in Column (6). This suggests that the logarithm of the effective price is negatively correlated with unobservable decisions about whether to donate. In other words, the claiming decision is positively correlated with the unobservable decision of whether to donate, which stems from the institutional factor that only donors can file for tax benefits.

### 4.4 Robustness Check

*Excluding Announcement Effect*. Since the Korean government announced the 2014 tax reform in 2013, intertemporal substitution may have occurred. Individuals who anticipated that the 2014 tax reform would result in higher donation prices may have reduced their donations in 2014 and beyond and increased their giving in 2013. Since this would introduce positive bias in the elasticity, the results in Table 3 show the lower bound of the elasticity in absolute value. To rule out these announcement effects, we exclude observations from 2013 and 2014 by assuming that intertemporal substitution occurs only in that period and estimate elasticities (Table A.2 in Appendix A). As expected, the estimated elasticities are somewhat elastic when we exclude the announcement effect.

*Last-Price Elasticities*. The tax incentive in the income deduction period is the marginal income tax rate. The marginal income tax rate varies with the amount of the donation. The analysis thus far has used the marginal income tax rate in the case when the amount of giving is zero to calculate the relative price (*first*-unit price). However, the actual effective and applicable prices are the relative prices used in actual donation amounts, referred to as the *last*-unit price. Thus, we estimate elasticities using the last-unit price. Since the last-unit price depends on the amount of giving, we estimate an FE-2SLS model with the applicable first price as the instrumental variable (see Table A.3 in Appendix A for the intensive-margin price elasticities; see Table A.4 in Appendix A for the extensive-margin price elasticities). The results are quantitatively similar to the elasticities estimated in Table 3.

## 5 Control Function Approach

In the previous section, we noted that the effective price elasticity estimated by the simple FE model is biased because the effective price can be endogenous and proposed FE-2SLS for the estimation of the effective price elasticity. Although this method assumes that the effective price is determined as (6), considering that the effective price is written as $\ln p_{it} = R_{it} \ln(1 - q_{it})$, the root of the endogeneity is in the self-selection into declaration, $R_{it}$.[14] Therefore, in this section, we examine the size and direction of the bias in declaration, $R_{it}$, by using the control function approach and check whether the method proposed in the previous section corrects the bias in

[14] If $R_{it} = 1$, then $\ln p_{it} = \ln(1 - R_{it} q_{it}) = \ln(1 - q_{it})$. If $R_{it} = 0$, then $\ln p_{it} = \ln(1 - R_{it} q_{it}) = 0$. Thus, $\ln p_{it} = \ln(1 - R_{it} q_{it}) = R_{it} \ln(1 - q_{it})$.

the right direction.

## 5.1 Framework

Our aim in this section to examine the bias in the estimation of the giving price elasticity by using the control function approach (Wooldridge, 2015). This approach considers the dummy variable $R_{it}$ indicating the application for tax incentives as an endogenous variable and explicitly models the endogeneity of $R_{it}$.

To demonstrate this point precisely, let us consider (1), which is shown as

$$Y_{it} = \mu_i + \theta_t + \beta_e R_{it} \ln(1 - q_{it}) + \delta X_{it} + \epsilon_{it}. \tag{1'}$$

If $R_{it}$ is endogenous, the simple FE estimation of this model yields $\hat{\beta} = \beta + \text{Cov}(R_{it} \ln(1 - q_{it}), \epsilon_{it})/\text{Var}(R_{it} \ln(1-q_{it}))$, and this corresponds to the results in Columns (2) (for the intensive margin) and (5) (for the extensive margin) in Table 3. This estimation is clearly incorrect because the endogeneity issue comes from the correlation between the error term and the explanatory variables. In particular, considering $\ln(1 - q_{it}) \leq 0$, we can expect that the positive (negative) correlation between $R_{it}$ and $\epsilon_{it}$ generates negative (positive) bias for $\hat{\beta}$.

The control function approach fixes the estimation bias by controlling for the correlation between the endogenous variable and the error term. Recall that taxpayers should declare their giving $R_{it} = 1$ if $V_1(y, q) - V_0(y) \geq K_i$, where $V_1(y, q)$ and $V_0(y)$ are the indirect utility if giving is declared and not declared, respectively, and $K_i$ is the compliance cost for declaration. This means that the structure of $R_{it}$ can be written as $R_{it} = 1(V_1(y, q) - V_0(y) - K_i \geq 0)$. In this paper, we define a reduced-form model to determine $R_{it}$ as follows:

$$R_{it} = E(R_i | 1 - q_{it}, X_{it}, Z_{it}, \mu_t, \theta_t) + u_{it}^R = \mu_i + \theta_t + \pi_1 \ln(1 - q_{it}) + \pi_2 Z_{it} + \pi_3 X_{it} + u_{it}^R, \tag{8}$$

where $Z_{it}$ is an instrumental variable only affecting the application for tax incentives but not affecting $Y_{it}$. As this equation approximates the structure of $R_{it}$, the increase of each term on the right-hand side can be regarded as observed components of net utility. The last term of Equation (8), $u_{it}^R$, is an error term and can be considered the preference for declaration that cannot be explained by the covariates. $u_{it}^R$ is not correlated with the covariates but a part of $Y_{it}$, which is not explained by the covariates. Then, $\epsilon_{it} = \psi_1 u_{it}^R + e_{it}$, where $\psi_1 = \text{Cov}(\epsilon_{it}, u_{it}^R)/\text{Var}(u_{it}^R)$

and $\text{Cov}(R_{it}\ln(1-q_{it}), e_{it}) = 0$ hold since $u_{it}^R$ captures all of $R_{it}$ that is not explained by the covariates. Based on this idea, plugging $\epsilon_{it} = \psi_1 u_{it}^R + e_{it}$ into (1') yields

$$Y_{it} = \mu_i + \theta_t + \beta_e R_{it}\ln(1-q_{it}) + \delta X_{it} + \psi_1 u_{it}^R + e_{it}. \tag{9}$$

The inclusion of $u_{it}^R$ in the estimation works to control the endogeneity of $R_{it}$. Since $\text{Cov}(R_{it}, \epsilon_{it}) = \text{Cov}(u_{it}^R + E(R_{it}|1-q_{it}, X_{it}, Z_{it}, \mu_t, \theta_t), \epsilon_{it}) = \text{Cov}(u_{it}^R, \epsilon_{it})$ and $\psi_1 = \text{Cov}(\epsilon_{it}, u_{it}^R)/\text{Var}(u_{it}^R)$ hold, we can find that $\psi_1$ shows the opposite direction of the estimation bias, $\hat{\beta} - \beta = \text{Cov}(R_{it}\ln(1-q_{it}), \epsilon_{it})/\text{Var}(R_{it}\ln(1-q_{it}))$, where $\ln(1-q_{it}) \leq 0$.

To estimate Equation (9), we use the residual of (8), $\hat{u}_{it}^R$, instead of $u_{it}^R$.[15] In addition, we use a dummy variable indicating wage earners as the instrument $Z_{it}$. As discussed in Section 2, the application process for the donation deduction differs depending on whether a taxpayer is a wage earner or self-employed. Wage earners are offered the chance of giving from their company, and the declaration process for such giving is considerably simpler than declaration through the tax return, although such a system is absent for the self-employed. We assume that, once we control for income, residence, and industry, the amount of giving does not directly correlate with whether one is a wage earner. Thus, since wage earners have lower declaration costs, $K_{it}$, than the self-employed, we use a dummy variable indicating wage earners as the instrument.

However, the dummy for wage earners may violate the exclusion restriction in the estimation of the extensive margin since the company's donation offer not only reduces the cost of giving but also increases the opportunity for donation. Although this issue is not a problem in the estimation of the intensive margin since the sample is limited to donors in the estimation of the intensive margin, it is problematic in the estimation of the extensive margin. Therefore, we concentrate on the estimation of the intensive margin in this part.[16]

Our aim in this part is to examine the self-selection bias coming from the fact that declaring giving is optional for taxpayers by using the control function approach. The sign of $\psi$ is not known a priori since each positive and negative $\psi$ can be the result of different self-selection biases. Recall that $\epsilon_{it}$ is the amount of giving conditional on the covariates including the price

[15]When applying the control function approach to panel data, Wooldridge (2015) suggests replacing individual fixed effects with the Chamberlain-Mundlak device. This device assumes that individual fixed effects, $\mu_i$, follow a normal distribution with mean $\alpha_0 + \alpha_1 \bar{X}_{it} + \alpha_2 \bar{Z}_{it}$ and variance $\sigma_\mu^2$ and models the individual fixed effects with $\mu_i = \alpha_0 + \alpha_1 \bar{X}_i + \alpha_2 \bar{Z}_i + \eta_i$, where $\bar{X}_i$ and $\bar{Z}_i$ are time averages (for example, $\bar{X}_i = T^{-1}\sum_{t=1}^T X_{it}$) and $\eta_i$ is error term (Papke and Wooldridge, 2008). Then, we can replace the individual fixed effects in Equation (9) with $\alpha_1 \bar{X}_{it} + \alpha_2 \bar{Z}_{it}$. We use this device in our estimation.

[16]The results of the analysis for the extensive margin are included in the Appendix for reference. See Table A.6 in Appendix A.

of giving. Therefore, the preference for giving will be captured by $\epsilon_{it}$ in the regression. If $\psi > 0$ is observed, this implies that, conditional on the covariates, the donors with preferences to donate more ($\epsilon_{it} > 0$) will select into declaration ($R_{it} > 0$). In this story, conditional on the covariates, donors with giving preferences are likely to enjoy tax relief. If $\psi < 0$ is observed, this implies that taxpayers with a greater preference for donation ($\epsilon_{it} > 0$) do not declare their giving ($R_{it} < 0$). In this case, taxpayers with giving preferences hesitate to declare their donations.

## 5.2 Estimation Results

To begin, we review the results of estimating Equation (8) with a linear probability model using a sample that includes nondonors (Table A.5 in Appendix A). The wage earner dummy positively correlates with application. As expected, this correlation reflects that wage earners apply for tax incentives more easily than others. In addition, the higher the applicable giving price (that is, the lower the possible tax incentive), the less likely they are to declare their giving.[17] This result implies that the decrease in tax incentives lowers the benefit of tax savings and that those with higher tax benefits are more likely to apply. There are two notable findings for individual attributes. First, the older a taxpayer is, the more likely the taxpayer is to declare his or her giving. Second, the fewer household members and the more dependents a taxpayer has, the more likely the taxpayer is to claim his or her giving. This may be because older taxpayers may have more experience with tax payments and taxpayers with more dependents attempt to save tax payments and make money for dependents.

We estimate Equation (9), using the residuals obtained from the estimated model shown in Table A.5 in Appendix A for an explanatory variable. Table 4 presents the estimation results of the intensive-margin price elasticity by restricting the sample to donors only.

The coefficient on the effective price represents the effective price elasticity. It shows that the effective price elasticity to donor contributions is $-1.646$. This result is reasonable in the sense that it is similar to the result from the FE-2SLS in the previous section, $-1.559$. Moreover, since the simple FE estimation of (1) yields the results of Column (2) (for the intensive margin) in Table 3, -0.840, we find that the result of the control function approach corrects for the upward/positive bias, as in FE-2SLS. The results of $\hat{\psi}$ also support this view since the negative $\hat{\psi}$ indicates that the simple FE estimators have positive bias. Thus, we confirm that the method

[17] The coefficient on the applicable price is $-0.233$. Since the application ratio is 11%, the price elasticity of claiming is $-2.29$ ($= -0.252/0.11$). Almunia et al. (2020) estimates the price elasticity of claiming using tax return data and finds it to be $-0.9$.

Table 4: Estimation Results of Control Function Model (Intensive-margin Sample)

| | Log donation |
|---|---|
| | (1) |
| Effective price ($\beta_e$) | $-1.646$*** |
| | (0.355) |
| Log income | 3.216*** |
| | (1.180) |
| Residuals of Application ($\psi_1$) | $-0.425$*** |
| | (0.084) |
| Num.Obs. | 7786 |
| R2 Adj. | 0.095 |

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors clustered at household level are in parentheses. An outcome variable is logged value of amount of charitable giving. For estimation, we use only donors (intensive-margin sample). We control squared age (divided by 100), number of household members, a dummy that indicates having dependents, a set of dummies of industry, a set of dummies of residential area, and time fixed effects. We use an wage earner dummy as an instrument to obtain residuals of application. Instead individual fixed effects, we control a vector of individual-level sample mean of all exogenous variables including instruments (Chamberlain-Mundlak device).

proposed in the previous section corrects the bias in the right direction. The estimated effective price elasticity in this analysis is approximately 46 percentage points larger than the effective price elasticity obtained by simple FE estimation, suggesting that the size of the correct bias is quite large.

Regarding the direction of self-selection bias, $\hat{\psi}$ was negative when estimating the intensive margin. In other words, the result reveals the existence of the self-selection issue in the sense that $\hat{\psi} < 0$ suggests that the donors with a preference to donate ($\epsilon_{it} > 0$) are not more likely to declare their giving ($u_{it}^R < 0$), when controlling for covariates including the giving price. This may be because, conditional on the covariates, declarers donate less than nondeclarers. This does not support the view that declarers are more likely to donate based on financial motivation than nondeclarers.

We can explain this result by the motives for donation. Behavioral economics (e.g. Ariely et al., 2009) argues that there are three driving forces behind prosocial behaviors such as donation: (i) intrinsic motives (utility from the prosocial action itself); (ii) extrinsic motives (utility from the exogenous material rewards that accompany prosocial behavior); and (iii) image motives (utility from social reputation and praise). These motives are considered to not only affect prosocial behavior in isolation but also interact with each other. Our results suggest that donors who give more without declaring their giving have a strong intrinsic motivation and seem indifferent to extrinsic rewards such as tax incentives. In other words, our results imply that the donors' intrinsic and extrinsic motives are substitutes.

Alternatively, substitution between extrinsic and image motives can explain the result. Image-motivated donors want to send an altruistic signal to others. Here, financial incentives, such as tax incentives, will add noise to the altruistic signals they send (Bénabou and Tirole, 2006). In other words, others cannot distinguish whether donors who apply for tax incentives are altruistic or selfish. When this is the case, extrinsic rewards weaken the image motive. Thus, image-motivated donors who donate large sums without tax incentives may be hesitant to claim the donation deduction. This hypothesis was also highlighted by Eckel and Grossman (2008), who presented a field experiment on financial incentives for donations.

# 6 Discussions and Conclusions

Since tax relief application depends on taxpayer decisions, even if we exploit exogenous variation in the applicable price of giving, standard fixed effects models would estimate effective price elasticities with bias. Therefore, we proposed a simple FE-2SLS using exogenous variation in tax incentives as the instrumental variable. The estimation results showed that a 1% increase in the giving price reduces donors' contributions by 1.4–1.5% and the donor proportion by 2.1–2.3%.

This result is more elastic than previous studies. For example, a meta-analysis of studies using U.S. panel surveys finds an average elasticity of $-1.29$ (Peloza and Steel, 2005). Backus and Grant (2019) also estimate the price elasticity of donations using a U.S. panel survey, explicitly accounting for the bias that tax incentives cause due to taxpayer choice. As a result, they find that the elasticity is approximately $-1$. Testing whether our results are Korea-specific is a topic for future research.

We then discussed the selection issue of claiming and checked whether our proposed method corrects the selection bias in the right direction using a control function approach, an instrumental variable method. We found that donors who give more without tax incentives do not receive tax incentives. This finding is consistent with the direction of bias that arises in the usual fixed effects model. Using an argument from behavioral economics, we proposed one possible mechanism: substitution between intrinsic or image motives and an extrinsic motive. In other words, altruistic donors or donors who value reputation-building may not be willing to apply for tax incentives. Testing this mechanism in the context of tax incentives is a topic for future research.

There are two limitations of this study. First, we could not empirically demonstrate the validity of the instrument used in the control function approach. We exploited the fact that the application process for tax incentives in Korea differs significantly depending on whether a taxpayer is a wage earner and used a wage earner dummy as an instrument. We assumed that if we controlled for individual income and area of residence, donation behavior would not change depending on whether the individual is a wage earner. Second, we could not accurately measure taxable income. We determined income tax rates based on pretax gross income. If the income bracket in which pretax income falls differs from the bracket in which taxable income falls due to deductions and other factors, then there will be measurement error in the income tax rate, which will also cause bias in the giving price. We dropped observations whose pretax income falls around the bracket thresholds to eliminate the bracket shifting effect as much as possible.

Finally, we summarize some policy implications. If the estimated effective price elasticities are correct, this study has implications for the welfare of tax incentives in Korea. According to Saez (2004), the government should expand tax incentives if the absolute value of the elasticity exceeds 1. Furthermore, according to Almunia et al. (2020), if the sum of the intensive- and extensive-margin price elasticities is greater than 1 (in absolute value), then the expansion of tax incentives can induce donations that exceed their costs. Combining these theoretical results with our estimates, we conclude that Korea should expand tax incentives for charitable giving.

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# Appendix A Additional Tables

Table A.1: First-Stage Models

| | Effective price | |
|---|---|---|
| | Donors (Intensive-margin) | Donors and Non-donors (Extensive-margin) |
| | (1) | (2) |
| *Excluded instruments* | | |
| Applicable price | 0.688*** | 0.297*** |
| | (0.038) | (0.019) |
| *Covariates* | | |
| Wage earner | −0.030*** | −0.010*** |
| | (0.009) | (0.002) |
| Log income | −0.225 | −0.069 |
| | (0.146) | (0.047) |
| Num.Obs. | 7786 | 30 280 |
| RMSE | 0.05 | 0.04 |

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors clustered at household level are in parentheses. An outcome variable is logged value of the effective price. For estimation, model (1) use donors only (intensive-margin sample), and model (2) use not only donors but also non-donors (extensive-margin sample). In addition to logged income and wage earner dummy shown in table, covariates consist of squared age (divided by 100), number of household members, a dummy that indicates having dependents, a set of dummies of industry a set of dummies of residential area, and individual and time fixed effects. Excluded instrument is a logged applicable price.

Table A.2: Estimation of Price Elasticities Excluding Announcement Effect

| | Log donation | | | Dummy of donor | | |
|---|---|---|---|---|---|---|
| | FE | | FE-2SLS | FE | | FE-2SLS |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Applicable price ($\beta_a$) | −1.286*** | | | −0.218*** | | |
| | (0.471) | | | (0.077) | | |
| Effective price ($\beta_e^{FE}$) | | −0.616* | | | −2.807*** | |
| | | (0.343) | | | (0.088) | |
| Effective price ($\beta_e^{IV}$) | | | −1.829*** | | | −0.764*** |
| | | | (0.682) | | | (0.248) |
| Log income | 1.657 | 1.931 | 1.175 | 1.576*** | 0.816*** | 1.510*** |
| | (1.854) | (1.858) | (1.893) | (0.253) | (0.235) | (0.245) |
| *Implied price elasticity* | | | | | | |
| Estimates | | | | −0.936*** | −12.047*** | −3.278*** |
| | | | | (0.330) | (0.378) | (1.062) |
| *1st stage information (Excluded instrument: Applicable price)* | | | | | | |
| F-statistics of instruments | | | 918.108 | | | 1127.703 |
| Wu-Hausman test, p-value | | | 0.003 | | | < 0.001 |
| Num.Obs. | 5944 | 5944 | 5944 | 22 707 | 22 707 | 22 707 |
| RMSE | 0.62 | 0.62 | 0.63 | 0.25 | 0.23 | 0.24 |

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors clustered at household level are in parentheses. An outcome variable is logged value of amount of charitable giving for models (1)–(3) and a dummy of donor for models (4)–(6). For estimation, models (1)–(3) use donors only (intensive-margin sample), and models (4)–(6) use not only donors but also non-donors (extensive-margin sample). To exclude announcement effect, we exclude samples from 2013 and 2014. For outcome equation, we control squared age (divided by 100), number of household members, a dummy that indicates having dependents, employee dummy, a set of dummies of industry a set of dummies of residential area, and individual and time fixed effects. For FE-2SLS, we use a logged applicable price as an instrument. To obtain the extensive-margin price elasticities in models (4)–(6), we calculate implied price elasticities by divding estimated coeffcient on price by sample proportion of donors.

Table A.3: Estimation Results of Intensive-Margin Last-Price Elasticities

| | Log donation | | | |
|---|---|---|---|---|
| | FE | | FE-2SLS | |
| | (1) | (2) | (3) | (4) |
| Applicable last-price | −0.803** | | −1.110*** | |
| | (0.345) | | (0.343) | |
| Effective last-price | | −0.594** | | −1.623*** |
| | | (0.259) | | (0.510) |
| Log income | 1.768 | 1.867 | 1.585 | 1.215 |
| | (1.334) | (1.323) | (1.335) | (1.338) |
| *1st stage information (Excluded instrument: Applicable price)* | | | | |
| F-statistics of instruments | | | 85 032.657 | 1275.410 |
| Wu-Hausman test, p-value | | | < 0.001 | 0.002 |
| Num.Obs. | 7786 | 7786 | 7786 | 7786 |
| RMSE | 0.66 | 0.66 | 0.66 | 0.66 |

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors clustered at household level are in parenthesis. An outcome variable is logged value of amount of charitable giving. For estimation, we use donors only (intensive-margin sample). For outcome equation, we control squared age (divided by 100), number of household members, a dummy that indicates having dependents, employee dummy, a set of dummies of industry a set of dummies of residential area, and individual and time fixed effects. For FE-2SLS, we use a logged applicable price as an instrument.

Table A.4: Estimation Results of Extensive-Margin Last-Price Elasticities

| | A dummy of donor | | | |
|---|---|---|---|---|
| | FE | | FE-2SLS | |
| | (1) | (2) | (3) | (4) |
| Applicable last-price | −0.146** | | −0.185*** | |
| | (0.058) | | (0.059) | |
| Effective last-price | | −2.758*** | | −0.634*** |
| | | (0.074) | | (0.188) |
| Log income | 1.488*** | 0.656*** | 1.452*** | 1.403*** |
| | (0.209) | (0.189) | (0.208) | (0.201) |
| *Implied price elasticity* | | | | |
| Estimates | −0.625** | −11.835*** | −0.793*** | −2.720*** |
| | (0.251) | (0.317) | (0.251) | (0.806) |
| *1st stage information (Excluded instrument: Applicable price)* | | | | |
| F-statistics of instruments | | | 1 491 942.086 | 1709.919 |
| Wu-Hausman test, p-value | | | < 0.001 | < 0.001 |
| Num.Obs. | 30 280 | 30 280 | 30 280 | 30 280 |
| RMSE | 0.26 | 0.23 | 0.26 | 0.25 |

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors clustered at household level are in parentheses. An outcome variable is a dummy indicating that donor. For estimation, we use not only donors but also non-donors (extensive-margin sample). For outcome equation, we control squared age (divided by 100), number of household members, a dummy that indicates having dependents, a employee dummy, a set of dummies of industry, a set of dummies of residential area, and individual and time fixed effects. For FE-2SLS, we use a logged applicable price as an instrument. We calculate implied price elasticities by dividing estimated coeffcient on price by sample proportion of donors.

Table A.5: Estimation Results of Tax Relief Application Model (Linear Probability Model)

| | Dummy of application |
|---|---|
| | (1) |
| *Excluded instrument* | |
| Wage earner | 0.098*** |
| | (0.008) |
| *Covariates* | |
| Applicable price | −0.252*** |
| | (0.045) |
| Log income | 2.662*** |
| | (0.203) |
| Squared age (divided by 100) | 0.001** |
| | (0.001) |
| Number of household members | −0.009** |
| | (0.004) |
| Having dependents | 0.014** |
| | (0.007) |
| Num.Obs. | 30 280 |
| R2 Adj. | 0.225 |

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors clustered at household level are in parentheses. An outcome variable is a dummy of application of tax relief. For estimation, we use both donors and non-donors (extensive-margin sample). Additionally, we control a set of dummies of industry, a set of dummies of residential area, and time fixed effects. We use a wage earner dummy as an instrument. Instead individual fixed effects, we control a vector of individual-level sample mean of all exogenous variables including instrument (Chamberlain-Mundlak device).

Table A.6: Estimation Results of Control Function Model (Extensive-margin Sample)

| | Dummy of donors |
|---|---|
| | (1) |
| Effective price ($\beta_e$) | −0.268*** |
| | (0.042) |
| Log income | 2.676*** |
| | (0.151) |
| Residuals of Application ($\psi_1$) | 0.785*** |
| | (0.009) |
| *Implied price elasticity* | |
| Estimate | −1.152*** |
| | (0.179) |
| Num.Obs. | 30 280 |
| R2 Adj. | 0.483 |

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors clustered at household level are in parentheses. An outcome variable is a dummy of donor. For estimation, we use both donors and non-donors (extensive-margin sample). We control squared age (divided by 100), number of household members, a dummy that indicates having dependents, a set of dummies of industry, a set of dummies of residential area, and time fixed effects. We use an wage earner dummy as an instrument to obtain residuals of application. Instead individual fixed effects, we control a vector of individual-level sample mean of all exogenous variables including instruments (Chamberlain-Mundlak device).

# Appendix B Proof

We show that the parameter $\text{Cov}(\ln p_{it}, \hat{r}_{it})/\text{Var}(\hat{r}_{it})$ is in the range 0 to 1 if residuals $\hat{r}_{it}$ is mean independent to a dummy indicating application of tax incentives $R_{it}$. We obtain the residuals $\hat{r}_{it}$ from the following model:

$$\ln(1 - q_{it}) = \mu_i + \theta_t + \lambda X_{it} + r_{it}, \tag{B.1}$$

By $E(\hat{r}_{it}) = 0$, $\text{Var}(\hat{r}_{it}) = E(\hat{r}_{it}^2)$. Also, $E(\hat{r}_{it}) = 0$ implies $\text{Cov}(\ln p_{it}, \hat{r}_{it}) = E(\ln p_{it}\hat{r}_{it})$. By the law of iterated expectation,

$$\begin{aligned} &\frac{\text{Cov}(\ln p_{it}, \hat{r}_{it})}{\text{Var}(\hat{r}_{it})}, \\ =&\frac{E(\ln p_{it}\hat{r}_{it})}{E(\hat{r}_{it}^2)}, \\ =&\frac{E(\ln(1-q_{it})\hat{r}_{it}|R_{it}=1)\text{Pr}(R_{it}=1)}{E(\hat{r}_{it}^2|R_{it}=1)\text{Pr}(R_{it}=1) + E(\hat{r}_{it}^2|R_{it}=0)\text{Pr}(R_{it}=0)}. \end{aligned} \tag{B.2}$$

Note that $p_{it} = 1 - R_{it}q_{it}$.

By the auxiliary regression model (B.1), the variable $\ln(1 - q_{it})$ is a sum of predicted value $E[\ln(1 - q_{it})|\mu_i, \theta_t, X_{it}]$ and residual $\hat{r}_{it}$. Thus, we can reformulate the numerator of equation (B.2) as follows:

$$\begin{aligned} &E\{\ln(1-q_{it})\hat{r}_{it}|R_{it}=1\}\text{Pr}(R_{it}=1), \\ =&E\{(E[\ln(1-q_{it})|\mu_i,\theta_t,X_{it}] + \hat{r}_{it})\hat{r}_{it}|R_{it}=1\}\text{Pr}(R_{it}=1), \\ =&E\{E[\ln(1-q_{it})|\mu_i,\theta_t,X_{it}]\hat{r}_{it}|R_{it}=1\}\text{Pr}(R_{it}=1) + E(\hat{r}_{it}^2|R_{it}=1)\text{Pr}(R_{it}=1), \\ =&E[\ln(1-q_{it})|\mu_i,\theta_t,X_{it}]E(\hat{r}_{it}|R_{it}=1)\text{Pr}(R_{it}=1) + E(\hat{r}_{it}^2|R_{it}=1)\text{Pr}(R_{it}=1). \end{aligned} \tag{B.3}$$

Thus, if the residual $\hat{r}_{it}$ and the dummy variable $R_{it}$ are mean independent, that is $E(\hat{r}_{it}|R_{it} = 1) = E(\hat{r}_{it}) = 0$, then equation (B.3) reduces to $E(\hat{r}_{it}^2|R_{it} = 1)\text{Pr}(R_{it} = 1)$ and the parameter $\text{Cov}(\ln p_{it}, \hat{r}_{it})/\text{Var}(\hat{r}_{it})$ becomes

$$\frac{\text{Cov}(R_{it}\ln(1-q_{it}), \hat{r}_{it})}{\text{Var}(\hat{r}_{it})} = \frac{E(\hat{r}_{it}^2|R_{it}=1)\text{Pr}(R_{it}=1)}{E(\hat{r}_{it}^2|R_{it}=1)\text{Pr}(R_{it}=1) + E(\hat{r}_{it}^2|R_{it}=0)\text{Pr}(R_{it}=0)}, \tag{B.4}$$

which is in the range 0 to 1.