The (Endogenous) Elasticity of Taxable Income: A Meta-Regression Analysis *

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The elasticity of taxable income (ETI) is a key parameter in optimal tax and welfare analysis. However, estimates reveal substantial heterogeneity. Potential reasons for the variation are: different estimators and specifications (e.g. Kopczuk, 2005 and Weber, 2014), different tax systems and the underlying reform itself (ETI as a policy choice), different data sets and differences in behavior across countries. To explore different dimensions of this heterogeneity, I conduct a comprehensive meta-regression analysis. Information from 80 different studies containing 1800 estimates is used. Special emphasis is placed on the influences a government (e.g. tax base, degree of enforcement, and remittance rules) might have to control the size of the ETI and how characteristics of the underlying reform used for identification (e.g. large vs. small reform, tax increase vs. tax decrease and tax base broadening) influence the behavior of taxpayers.

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1 Introduction

The elasticity of taxable income (ETI) is a key parameter in optimal tax research, since it summarizes all behavioral responses to taxation (e.g. labor supply, tax avoidance and evasion or income shifting) into one single parameter. Behavioral responses to taxation create distortions and therefore a loss of efficiency. The ETI serves as a behavioral parameter in optimal tax models (e.g. Mirrlees (1971), Diamond (1998), Saez (2001), Piketty and Saez (2013)) and under certain assumptions, it is a sufficient statistic for deadweight loss calculation (Feldstein (1999) or Chetty (2009)).[1]

The literature on the estimation of behavioral responses has grown rapidly over the last years. Much of this work is based on the US. In recent years tax admin data became available in other countries as well and studies based on different identification strategies and datasets have been published. Overall, we observe large variation in ETI estimates and a bunch of different explanations.

Lindsey (1987) and Feldstein (1995) have started to estimate the ETI based on simple Differences-in-Differences (DID) approach. To overcome endogeneity problems induced by a progressive tax system and non-tax related factors, Auten and Carroll (1999) and Gruber and Saez (2002) have started to use an instrumental variable (IV) approach along with income control variables. However, a major problem of IV estimation is to find instruments that satisfy all relevant conditions to estimate consistent estimates. Recently more sophisticated estimation methods involving different instruments have been developed (e.g. Weber (2014) and Burns and Ziliak (2015)) resulting in larger estimates. Another branch of research tries to explain the factors behind the ETI and they explain why estimates differ from study to study or even within a study. Some studies shed light into shifting behavior (Kreiner et al. (2016)) while others explore the anatomy of tax compliance (Kleven et al. (2011)). Fack and Landais (2016) show that the magnitude of behavioral responses is extremely sensitive to

[1] In this article, I consider elasticity estimates based on other income concepts like gross or adjusted gross income as well. The term elasticity of taxable income/ ETI is used as a synonym for all other income concepts in general descriptions/discussions. When it comes to the results and descriptives, I am more specific.

the level of tax enforcement and Kleven and Schultz (2014) find that behavioral elasticities are larger when estimated from large tax reform episodes. Similar to Chetty et al. (2011) and Chetty (2012), they highlight the role of tax salience. Slemrod and Kopczuk (2002) explicitly show how behavioral responses to a tax rate change may be manipulated by policy makers and Kopczuk (2005) shows how the ETI varies with the tax base. The ETI is considerably larger in tax systems with more deduction possibilities. Hence, the magnitude of the ETI is influenced by the design of the tax system itself and hence a policy choice (Slemrod (1995). Another important source of heterogeneity is tax complexity.

As a result, there is little agreement on the magnitude of the elasticity that should be used in economic policy analyses. Instead of providing new estimates, I use existing empirical evidence to explore different sources of heterogeneity. I conduct a comprehensive meta-regression analysis of the relevant literature and make use of estimates received from over 80 studies (published in a peer reviewed journal or working paper). A vast amount of characteristics for each study is coded and provide the basis for my meta-dataset. A meta study allows me to isolate different explanations. I examine the following dimensions of heterogeneity in more detail: (1) different specifications of the theoretical and empirical model, (2) estimation techniques, (3) individual characteristics and sample restrictions, (4) dataset used and (5) tax reform and tax system characteristics. This paper tries to assess relevance of these different explanations by quantifying them.

My paper contribute to the literature by giving an objective overview of empirical evidence on behavioral elasticities on taxation. I examine the systematic impact of various factors on the reported elasticity estimates. Although the ETI literature has been reviewed by Saez et al. (2009, 2012b), I am not aware of any meta-analysis of taxable income elasticities. I highlight the fact that the ETI is rather a policy choice and therefore endogenous. I explicitly show how the ETI varies with tax system and reform characteristics. Additional data from OECD and World Bank is collected as well.

My meta-regression analysis offers the following (preliminary) key results. Elasticity estimates in Germany are smaller compared to US but larger compared with Scandinavia and

they increase with income. Estimates are smaller when individuals face a tax decrease compared with a tax increase and they are larger with a narrow tax base. I agree with Slemrod and Gillitzer (2013) and argue that future research should consider a "broader"perspective. A tax system does not consists only of tax rates and setting tax rates and tax base are not the only choice a policymaker has. Rather administration, compliance, and remittance play as an important role as tax rates and tax bases.

The remainder of this paper is structured as follows. In Section 2, I explore various dimensions of heterogeneity in the estimates of the elasticity (2.1) and provide descriptive statistics for my meta data (2.2). In Section 3, I introduce my meta regression model and the underlying estimation strategy. I present and discuss my results in section 4. Section 5 concludes.

2 The meta sample and sources of heterogeneity

A comprehensive review and examination of the ETI literature delivers the data for my meta-analysis. I rely on a survey of earlier ETI studies by Saez et al. (2009, 2012b) to identify relevant studies published prior to 2011. I also checked for the search terms "elasticity of taxable income", "eti", "taxable income", "new tax responsiveness" and "tax elasticity". All studies included in my data are either listed in Google scholar/ IDEAS RePEc or given in the reference list of previously identified papers. Finally, the search process lasted from February 2015 to December 2015.

I consider only estimates based on Differences-in-Differences (DID) estimations and do not cover share/time-series analysis and bunching because resulting estimates are not comparable to each other. I coded only studies that provide own empirical estimates and rely on commonly used income concepts as described below.

Overall, I identify 203 studies dealing with the ETI. Based on this sample, I find 41 studies with 859 (own) estimates that are published in a peer reviewed journal. Additional (relevant) working paper increase the number of articles to 80. This leaves me with 1800 estimates. Adding unpublished papers to my meta-sample can lead to a lower quality of included

estimates. However, most working papers are newer and use better datasets and improved estimation techniques. Based on this sample, I first collect the point estimate, standard error[2], number of observations and control for heteroscedasticity and autocorrelation. Additional information on journal, year of publication, where do we find these estimates (passage, table), country and time period is coded. In general, a particular study provides not only one single estimate and I consider every estimate if they are derived from different specifications of the theoretical and empirical model, estimation procedure or when they are group specific (so-called multiple sampling).[3] Hence, I consider the full range of evidence without judging about the quality. A possible quality indicator might be whether the article is published (and where) or if it is a working paper.

2.1 General Model

In this section, I provide a consistent framework in order to discuss potential problems and reasons for heterogeneous estimation results found in the empirical literature. In section 2.2 I provide more details about each dimension. I outline a general model of the ETI as described in Saez (2001) and Gruber and Saez (2002). The taxable income literature uses an extension of the traditional labor supply model. Individuals maximize a utility function $u(c, z)$, where z is income and c consumption. The corresponding first order derivatives are $u_c > 0$, $u_z < 0$. The budget constraint is defined as $c = (1 - \tau)z + R$, where τ is the marginal tax rate (resp. (1-τ) is the NTR) and R is virtual income that is generated by the tax/ transfer system. The uncompensated elasticity is defined as

$$\zeta^u = \frac{1-\tau}{\tau}\frac{\delta z}{\delta(1-\tau)}. \tag{1}$$

[2]There are only a few cases where no standard error is reported. In this case, a standard error is calculated by dividing the elasticity value by the t-statistic. As a robustness check, I estimate the model without these observations.

[3]A list of identified but non-included studies and estimates is provided in the appendix along with a short explanation.

Income effects are captured by the parameter

$$\eta = (1-\tau)\frac{\delta z}{\delta R}. \tag{2}$$

The compensated elasticity is necessary for welfare evaluations and it is defined as

$$\zeta^c = \left[\frac{(1-\tau)}{z}\right] \left.\frac{\delta z}{\delta(1-\tau)}\right|_u \tag{3}$$

The Slutsky equation defines the relationship between the three parameters:

$$\zeta^c = \zeta - \eta \tag{4}$$

To discuss necessary estimation techniques, I first ignore income effects for simplicity. The regression specification is derived as explained in Gruber and Saez (2002)

$$log\left(\frac{z_2}{z_1}\right) = \zeta log\left(\frac{1-\tau_2}{1-\tau_1}\right) + \epsilon. \tag{5}$$

The marginal tax rate and reported income are jointly determined for each individual. In progressive tax systems, the tax rate increases mechanically if income increases. To overcome this endogeneity problem, researchers use an Instrumental Variable (IV) approach. So-called non tax related factors - heterogeneous income trends and mean reversion - further complicate the estimation.

The specification approach is extended to:

$$\Delta ln(z_{it}) = \zeta \Delta ln(1-\tau_{it}) + \delta f(z_{it-k}) + \theta X_{it-k} + \mu_t + \epsilon_{it}, \tag{6}$$

where k is the time window that is set either to two or three years. X_{it-k} is a vector of base-year demographics like age, age squared, number of children or marital status. Time dummies μ_t control for any omitted variables in differences that are the same on average for all individuals. $f(z_{it-k})$ denotes the income control in order to capture non-tax related

factors. Typically, it is some function of base-year income such as the log of income or spline in log of income.

2.2 Sources of heterogeneity

In this section, I explain different dimensions of heterogeneity and what key characteristics are extracted from each study. The ETI measures the responsiveness of taxable income to changes in the net-of-tax rate (NTR). More precisely, it is the percentage change in taxable income in response to a one percent increase in the NTR - defined as one minus the marginal tax rate. Ideally, a method where the only changing factor is the marginal tax rate is needed in order to measure the effect of tax rate changes on income. Researchers use tax reforms as natural experiments because they provide exogenous variation in the NTR that is not driven by variation in income caused by other factors. Since tax reforms take place in a changing economic environment, the main objective is to find a method that allows the measurement of a pure elasticity that is free of any non-tax induced trends in reported income. Many factors lead to an incorrect estimate. To assess the relevance of different explanations, I first define different dimensions of heterogeneity: (1) different specifications of the theoretical and empirical model, (2) estimation techniques, (3) individual characteristics and sample restrictions, (4) dataset used, and (5) tax reform and tax system characteristics. Whereas (1) and (2) indicate conceptually different specifications, (3), (4) and (5) account for potential heterogeneity across countries, groups, tax system and reforms. For explanation (5) I collect additional data from the OECD Tax Database, World Bank and additional tax system/reform relevant information is gathered in each study that is merged with the meta dataset.

Different specifications of the theoretical and empirical model. The theoretical model mainly differs in the way of how income effects are regarded and estimated. The empirical model can estimate behavioral responses with respect to different income concepts. Weighted regressions is another issue in the empirical model. Besides sample weights, estimations are usually weighted by income.

Role of Income Effects The relevant elasticity for welfare analysis is the compensated elasticity of taxable income. Most studies, however, estimate an elasticity without explicitly reporting both income and substitution effects. Either by assuming a quasi linear utility function or by simply saying that empirical research (e.g. Gruber and Saez (2002)) has estimated income effects close to zero. There exist only a few studies that explicitly try to estimate income effects as well. First, I outline an approach conducted by Gruber and Saez (2002). Another approach is to consider not only the NTR (= 1 - marginal tax rate) but also 1- average tax rate in order to estimate income effects.

Income Concepts The dependent variable in the general model above is $\Delta ln(z_{it}$, where z is income. A central question is what income should be used. The ETI literature mainly uses the following three income concepts: adjusted gross earnings, total earnings and taxable income. Total earnings (= gross income) is the sum of all source income. Subtracting adjustments or deductions, adjusted gross income is received. To reach taxable income, personal exemptions and itemized deductions are reduced. Sometimes only wage or self-employed income is used. However, complete uniformity among empirical studies is difficult to ensure, since - among other things - different tax simulations and (artificial) constant tax bases are used to isolate tax rate changes from tax base changes. Nevertheless, it is conceptually the same concept among all studies.

Income Weighting Almost all regression results are weighted by income (either broad or taxable income). Weighted elasticity parameters are relevant for welfare analysis. Again, by definition the ETI measures the percent increase in average income when the NTR increases by one percent. Responses are not homogeneous along the income distribution (e.g. high income taxpayers have larger elasticity values). If estimates are weighted by income, proportionally more weight is given to high-income taxpayers such that individual contribution to the aggregated elasticity is in proportion to income. Typically, the weights are censored at 1 Million monetary units to avoid the influence of a few very high income earners. Weber (2014) raises concerns that weighting estimates with an endogenous variable - base-year income - is not valid. Regression estimates are not weighted when income effects

are considered. The income effect coefficient gives the direct (and not percentage) change in reported income. In case of income effects, weighting estimates by income is not necessary.

Estimation techniques. Ideally, one would like to compare two randomly selected groups before and after the introduction of a policy change. One group should have experienced a change (=treated) and the other group not (=control). This approach results in unbiased estimates if the group composition remains constant and the common trend assumption holds. Lindsey (1987) and Feldstein (1995) have pioneered by using a DID approach. When more sophisticated data (panel + tax admin data) became available, researchers were able to follow the same people over time. This allows to get rid of unobserved heterogeneity among taxpayers. However, as we see in the regression specification, in progressive tax system a clear causal relationship between tax rate changes and income changes is difficult to establish. Researchers face an endogeneity problem and therefore an instrumental variable (IV) technique is used. Non-tax related factors (mean reversion and heterogeneous income trends) are captured by income control variables. There are many ways how to control for them.

Instruments Researchers need to find a variable that is correlated with the observed difference in marginal tax rates (relevance) but uncorrelated with the observed change in reported income (exclusion). To find instruments that satisfy the conditions for a consistent estimation is difficult. Especially due to the nature of administrative tax return data. It contains of every income component and deduction possibility but sociodemographic information is scarce. Another problem is that many statistical offices do not allow to merge tax admin data with other datasets. Researchers are forced to build instruments based on income data. The very first instrumental variable approach is conducted by Auten and Carroll (1999) and Gruber and Saez (2002). More sophisticated instruments have been developed. Weber (2014). Burns and Ziliak (2015) and Carey et al. (2015) and Blomquist and Selin (2010). More information about each employed instrument is provided in the appendix.

Non-tax related factors Tax progressivity leads to increasing tax rates in case of a positive income shock and potential income responses are captured by the ETI as well. In case of different income growth rates across the population, time dummies are not sufficient. Reversion to the mean is another issue. A taxpayer with an exceptional high income in period $t-1$ will have a lower income in period t. Both problems - heterogeneous income trends and mean reversion - lead to wring estimates. Researchers have started to include initial income as explanatory variable in the model. By now, not only base-year income is one kind of income control variables. Different forms of splines and income types are used to control for a taxpayer's wealth (e.g. Kopczuk (2005)).Weber (2014) criticizes the income controls employed.

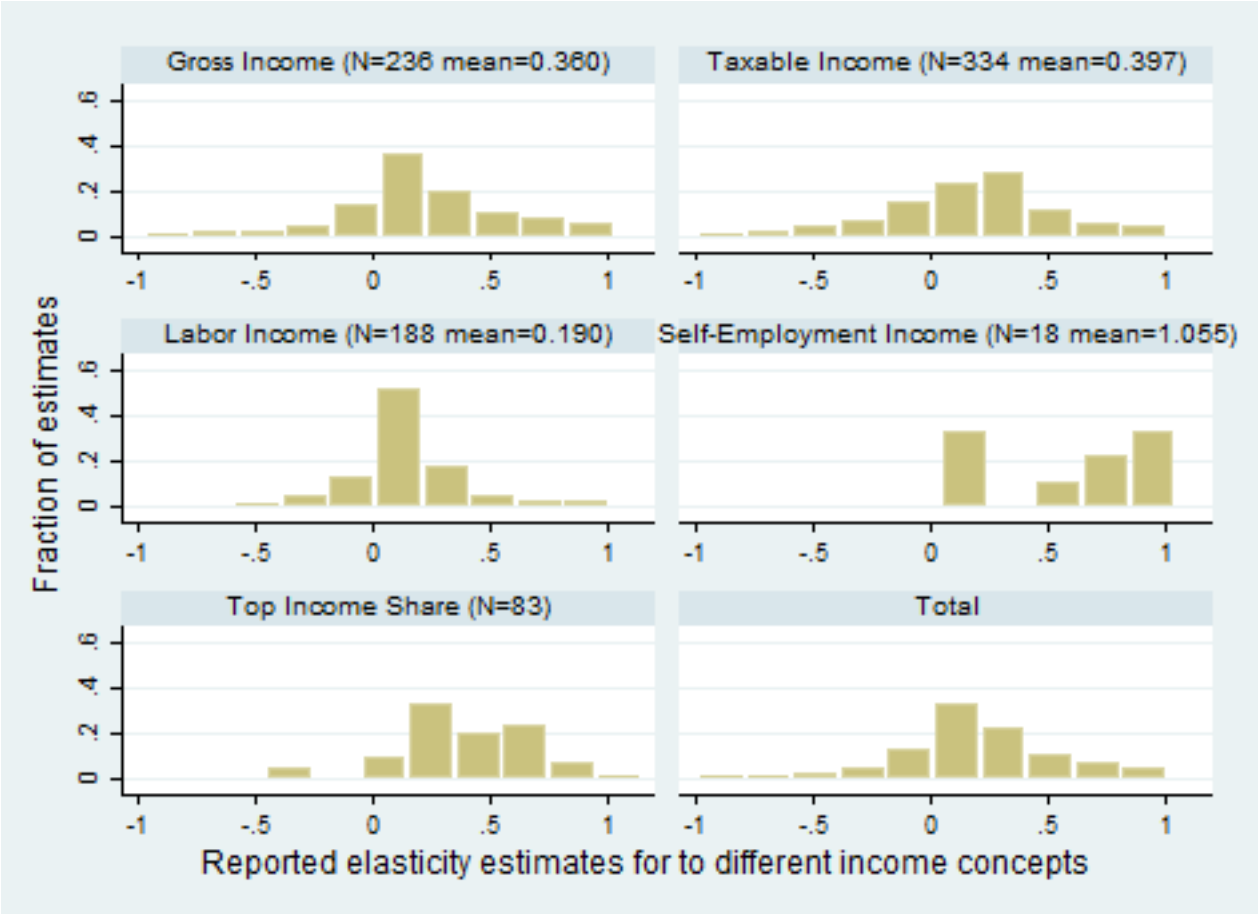
Individual characteristics and sample restrictions. Since tax administrative data does not include many socioeconomic characteristics, most studies only include control variables for age and family context. However some researchers have the possibility to connect admin data with survey data (example). To restrict problems due to mean reversion, age and income cutoffs are applied in almost every empirical study. Most researchers use a cutoff 10,000 monetary units since mean reversion is more pronounced at the bottom of the income distribution.However, the choice of the income cutoff is arbitrary. The age cutoff is typically used to limit the sample to the working population and to exclude pensioners. I coded every included control variable, controls for time trends, age, family context, occupation, itemizer status etc..

The dataset. Precise information on taxable income and its components is essential when estimating the elasticity of taxable income. In contrast to survey data, measurement error in income is minimized when admin data is used. On the other hand, survey data offers more sociodemographic information. By relying on panel rather than cross-sectional data, researchers can account for unobserved heterogeneity among taxpayers.

Tax reform and tax system characteristics. Tax reforms are necessary to generate variation that can be exploited. I code reform name, period and characteristics like who (e.g. income group) is affected. Does the reform involve tax base changes or only tax rate changes? Country characteristics are collected as well. Kleven (2014) asks in his paper how Scandinavian countries are able to impose very high taxes and still perform strongly on measured of tax compliance on real activity. My meta sample is completed with additional data by the OECD.

2.3 Descriptive Statistics

The vast majority of estimates lies within the interval of -1 and 1. Figure 2.3 shows the distribution of elasticity estimates in our data. The mean of all studies estimating the ETI is 0.39 and the elasticity of gross income is 0.36. Figure xy shows the chronological development of published estimates.



Countries: Austria, Canada, Denmark, Finland, France, Germany, Hungary, Iceland, Japan, Netherlands, New Zealand, Norway, Poland, Spain, Sweden, USA.

3 Meta-regression analysis

I follow standard meta-regression analysis techniques (e.g. Feld and Heckemeyer (2009, 2011), Nelson and Kennedy (2009), Lichter et al. (2015)).[4] Suppose that every primary study estimates a single unbiased value of the same unknown elasticity and each study has been conducted in a similar way such that it does not influence the expected value of the elasticity estimates. If these values are also stochastically independent from each other, then the differences in elasticity estimates arise only due to sampling-estimation errors within each studies:

$$\widehat{\zeta_s} = \zeta_s + \epsilon_s, \tag{7}$$

where $\widehat{\zeta_s}$ is the estimate of the elasticity of taxable income in primary study s and ϵ_i denotes the sampling- estimation error. However, this case it not realistic. Using all estimates creates within-study dependence will bias my results. Between-study dependence can be a problem when researchers in primay studies use the same data to estmiate different models in separate articles. The purpose of meta-regression analysis is to explain variation aross estimates and studies found in the empirical literature. Moderator variables try to explain all the heterogeneity beyond the sampling error. The moderator (independent) variables in the regression include general characteristics of the primary data, charactersitics on theoretical/ empirical specification, estimation technique, individual characteristics, data restrictions, the dataset itself and tax reform and tax system characteristics.[5] I denote the i-th estimate of the elasticity of taxable income collected from study s as $\hat{\zeta_{is}}$. I assume that they are explained by

$$\widehat{\zeta_{is}} = \zeta_0 + \beta X_i + \delta Z_{is} + \epsilon_{is}, \tag{8}$$

[4]Detection of publication bias is a standard tool in meta-regression analysis. Up to now, I haven't checked for such bias.

[5]A full list of all coded variables and characteristics (Codebook) is provided in the appendix.

where ζ_0 is the true elasticity value and X_i and Z_{is} represent study and estimate-specific variables respectively. To account for heterogeneity in the meta-regression model, I use the variance of the individual estimate of the elasticity $V(\hat{\zeta_{is}}) = \sigma_{is}^2$ that is given by its (known) standard error. I estimate the model by Weighted Least Squares (WLS) estimation with the inverse of the error term variance (= inverse of the squared standard error of the parameter estimate) as analytic weights. Hence, I give observations with smaller variances a larger weight and a greater influence on the estimates. Standard errors are clustered at the study level to control for study dependence in the estimates. Stanley and Doucouliagis (2013) show that the estimator above is the most preferable meta-regression estimator. As a robustness check, I apply various estimators (FE, RE, WLS with different weights, OLS). To explorer the effect of including working paper as well, I run additional estimations based on the full and restricted (= only published articles) sample. Like Lichter et al. (2015), I control for the study's year of publication to account for methodological advances in the literature.

4 Results

tbc

5 Conclusion

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A Distribution of taxable income elasticities by country

B Distribution of estimates by year of publication

C Dimensions of heterogeneity and source (baseline sample)

D Dimensions of heterogeneity and source (extended sample)

E Full meta-regression results