ECON 758 HW 2

1. **Why would you expect income to respond to tax rate changes? Give examples of different potential adjustment reactions that would lead to income changes.**

*A change in the tax on income will change the net income remaining that taxpayers have to dispose of into other consuming or investing activities. A taxpayer’s natural response is to engage in activities that minimize additional tax burden or maximizes a decreasing tax burden.*

*Taxpayers facing an increase in the marginal tax rate may choose to decrease labor force participation. This reaction may be more pronounced for individuals that are clustered near an end of a step between two income brackets.*

*Higher income taxpayers are likely to be more sensitive to tax changes and may engage in tax aversion strategies, or shift forms of compensation to compensation schemes less exposed to tax changes.*

1. **Familiarize yourselves with the data. Provide a table (Table 1) with summary statistics (means and standard deviations) of the variables included in the dataset.**

Table 1: Summary Statistics

|  |  |
| --- | --- |
|  | (1) |
|  | Summary Statistics |
|  | mean/sd |
| nchild | .5135882 |
|  | (.8474785) |
| married | .7967143 |
|  | (.4024742) |
| selfemp | .1300476 |
|  | (.3363816) |
| grossincr1000 | 2.977842 |
|  | (3.744029) |
| mtr | .4118874 |
|  | (.1287702) |
| mtr\_02 | .4057751 |
|  | (.1386803) |
| entrepreneur | .0741032 |
|  | (.2619594) |
| *N* | 6513 |

1. **Write down an estimation equation like equation (3) in GS02, but with the following modifications:**

* **Instead of the net-of-tax rate, use the marginal tax rate.**
* **Do not include the term used to estimate the income effect (GS02 did not include this term in their main Table 4 either).**
* **Do not include year dummies**
* **Do not include a spline function of income, but only the log of gross income in the base year (like in column (3) of Table 4 in GS02).**
* **Instead of the time indices 1 and 2, use t-1 and t, respectively. This will help you to translate this into program code later on.**
* **Include the “married” dummy and the number of children (both in t-1) instead of mars.**

1. **Estimate the equation from c) using OLS. Do not include log (gross income), you are asked to include this in l) only. Be careful about where to use logs, differences over time, or time lags. Do not use weighting, you are asked to use weighting in k) only. Present the results as well as the following IV results jointly in Table 2.**

*Please review part h for Table 2.*

1. **How large is the estimated tax rate elasticity of income? Describe this in words.**

*The OLS model reveals that the estimated tax rate of income is 0.0420857. This means that a change in gross income is close to being perfectly inelastic with respect to a change in marginal tax rates. A 10% increase in the change of marginal tax rate would increase gross income by 0.42%.*

1. **Why do you think this OLS estimate could be biased? In which direction do you expect the bias to go, and why? Hint: Germany has a progressive personal income tax schedule. Below you can find the schedule for 2002, 2007 and 2012.**

*We anticipate that the OLS estimate is downward bias because of measurement error. Many individuals may have a difficult time recalling the exact amount of gross income earned which results in imprecise measurement of that variable and an under-representation of gross income earned. Additionally, due the progressive personal income tax schedule, we anticipate a downward bias. The German progressive tax system over time between panel years has decreased marginal tax rates overall. We expect our X1 (current mtr) to be negatively correlated with X2 (decrease in mtr in later panel years). We would expect the coefficient on X2 to be positive since higher income taxpayers face a higher gross income from a lower tax burden in an environment with the decrease in mtr over time, decreasing mtr gives greater incentive to earn more and increase gross income of individual taxpayers. We can decompose the effects of the German progressive tax system on gross income overtime through an income and substitution effect. For an example, a less motivated tax payer might choose to not work more for a higher gross income and be satisfied by the lower marginal tax rate due to the progress tax system, illustrating an income effect. On the other hand, some tax payers might recognize the decrease in the marginal tax rate as an incentive to increase gross income and still a smaller marginal tax rate than the previous year, hinting at a substitution effect.*

1. **Discuss whether the change in log (mtr\_02) over time can be used as an instrument for the change in log(mtr). Comment on the relevance and exogeneity of the instrument and how the IV solves the endogeneity problem discussed in f). Why is it important that the tax schedule shown in f) changed between the observation years? (It also changed between 2007 and 2012, but not much, which is why this is hard to see in the graph.) Hint: The idea is essentially the same as the idea for the instrument in GS02. Instead of updating income from year 1 to year 2 in a 2-year pair in GS02, here we always use updated income from 2002 (the first year in our data), but this does not change the basic idea.**

*In our OLS model, is endogenous. To address this endogeneity, log(mtr\_02) is valid instrument because the virtual income earned in prior tax year 2002 is not dependent on motivation to earn income in year 2007 or 2012. Using 2002 income (exogenous variable) to calculate virtual income for 2007 and 2012 would also be exogenous since it is stimulated by the TAXSIM calculator and not “actual” income. The CPI index is exogenous because it is macro-economic index to make gross income in 2002 comparable to gross income that might have been earned in later panel years and making adjustments to purchasing power. This fulfills the exclusion restriction for a valid instrument. Furthermore, instrument is relevant because the change in log (mtr\_02) is calculated using the actual mtr of year 2007 and 2012. The mtr\_02 is correlated with mtr because it is tax schedule actually applied to the gross income during specific years.*

1. **Now re-estimate your regression equation using the IV method. Treat the change in the log tax rate as endogenous and use the instrument discussed in g).How does the estimated elasticity change? Again describe the elasticity in words. Is this effect consistent with your expectations concerning tax responsiveness? What are you learning about the direction of the bias in your OLS estimation, and is this consistent with your expectation in f)?**

The elasticity in the IV regression changed to -0.4746915 with standard error of 0.3117119 which is not significant at the 10% level. When compared to the initial regression coefficient value of *0.0420857* it is still quite inelastic. It is consistent with our hypothesis of downward bias as we expected the OLS to be overestimating the change of log marginal tax rate on the change of log gross income.

An increase in the change of the marginal tax rate of 10% would yield a 4.7% decrease in change of gross income. Since the stimulus of a 10% increase in the change of the marginal tax rate is greater than the gross income response to that stimulus, we would say that taxpayers would be inelastic which is consistent with our expectations of tax responsiveness in the German progressive tax system.

**i. Is the instrument strong enough, and how do you see that?**

*When evaluating whether or not an instrument is strong enough, we run the first stage model (reg log change in mtr on log change in mtr\_02 and control variables) and then run an F-test of joint significance. Although the first stage regression shows that log change in the mtr\_02 ratio is significant in the first stage model, upon further investigation we get an F-Statistic of 5.43. This is indicative of the fact that we may have a weak instrument because the F-Statistic is not greater than 10.*

**j. Bonus (not needed to achieve 100% of the grade): Test the endogeneity of the change in the log tax rate. What does the test result imply about your OLS and IV estimates? You might have to look into an econometrics textbook for this.**

*To test the endogeneity of the change in the log tax rate, we utilize the Durbin-Wu Hausman test. The Durbin-Wu Hausman test evaluates the residuals of the reduced form. We first ran a regression with the potential endogenous variable on the left hand side and the instrument and other control variables on the right hand side (Reduced Form). Next, we predicted the residuals of this model. The final step is to run a regression with the variable of interest (log change of gross income) on the predicted residual and control variables. Based on this final regression, we see that “mtr\_residual” is statistical significant at the 5% level, hinting at the endogeneity and inconsistency of OLS.*

*Although this test may give us some insight on endogeneity, the exact validity of the test is questionable because it is testing the residuals from the best fit of our first regression, which is not the same thing as actually testing the unobservable characteristics of the population. The Hausman test is useful for gaining an initial understanding to start from as it provides a piece of evidence to whether the residuals themselves contain endogeneity.*

**k. Repeat this IV regression, but now weight by gross income as in Table 4 of GS02. How does the estimated elasticity change?**

*When we repeat this IV regression with weights by gross income, the coefficient on the change in mtr is -0.1952986 with a standard error of 0.1129137 and statistical significance at the 10% level. In comparison to the IV model without weights, the elasticity is less inelastic but overall, the coefficient is still inelastic. The elasticity is still consistent with our hypothesis of a downward bias of the OLS model.*

*An increase in the change of the marginal tax rate of 10% would yield a 1.9% decrease in change of gross income. Similar to the IV regression without weights, since the stimulus of a 10% increase in the change of the marginal tax rate is greater than the gross income response to that stimulus, we would say that taxpayers would be inelastic which is consistent with our expectations of tax responsiveness in the German progressive tax system.*

**l. Include base year log (gross income) as an additional control variable in your IV regression. What is this supposed to control? How does this change the elasticity estimate?**

*Using the log of gross income as a control addresses mean reversion as well as allowing us to easily determine the income and substitution effects. This addresses differences in incomes that are not due to changes in marginal tax rates. Controlling for log gross income parses out the impact of taxes on gross income and how mean reversion and distribution of income can potentially bias the results for IV as noted by Gruber & Saez.*

*The elasticity estimate changed to a figure closer to our initial results of IV without weight. This coefficient -0.466621 indicates that for a 10% increase in the change in marginal tax rates corresponds to a response in gross income of a 4.66% decrease. Now however, our coefficient result is statistically significant at the 99% level.*

**m. Interact base year log (gross income) with a linear time trend and briefly comment on this. The idea is similar as in Table 7 in GS02.This will be the last column of your Table 2.**

*When we interact the base year log (gross income) with a linear time trend, the coefficient is -1.257 with a standard error of 0.484. In comparison to our previous IV models, the coefficient on the marginal tax rate is statistical significant at the 99% confidence level and shows an elastic tax response of German tax payers. That is, if marginal rate of tax increases by 10% then the change in gross income would decrease by 12.57% for an individual tax payer. This illustrates that with a progressive tax system, German tax payers are actually very sensitive to marginal tax rate changes.*

**n. Use your IV regression from h) and analyze potential effect heterogeneity. Similar to Table 9 in GS02, split your sample by annual real gross income below 50k euro, between 50k and 100k euro, and above 100k euro. Present these results in Table 3. Are your results consistent with the findings in GS02?**

**o. Now analyze effect heterogeneity between the self-employed and those not self-employed and between business owners and non-business owners (Table 4). Here, business ownership is defined as owning equity in a private business. This definition overlaps with self-employment, but is not the same. Provide interpretation of your findings and possible explanations.**