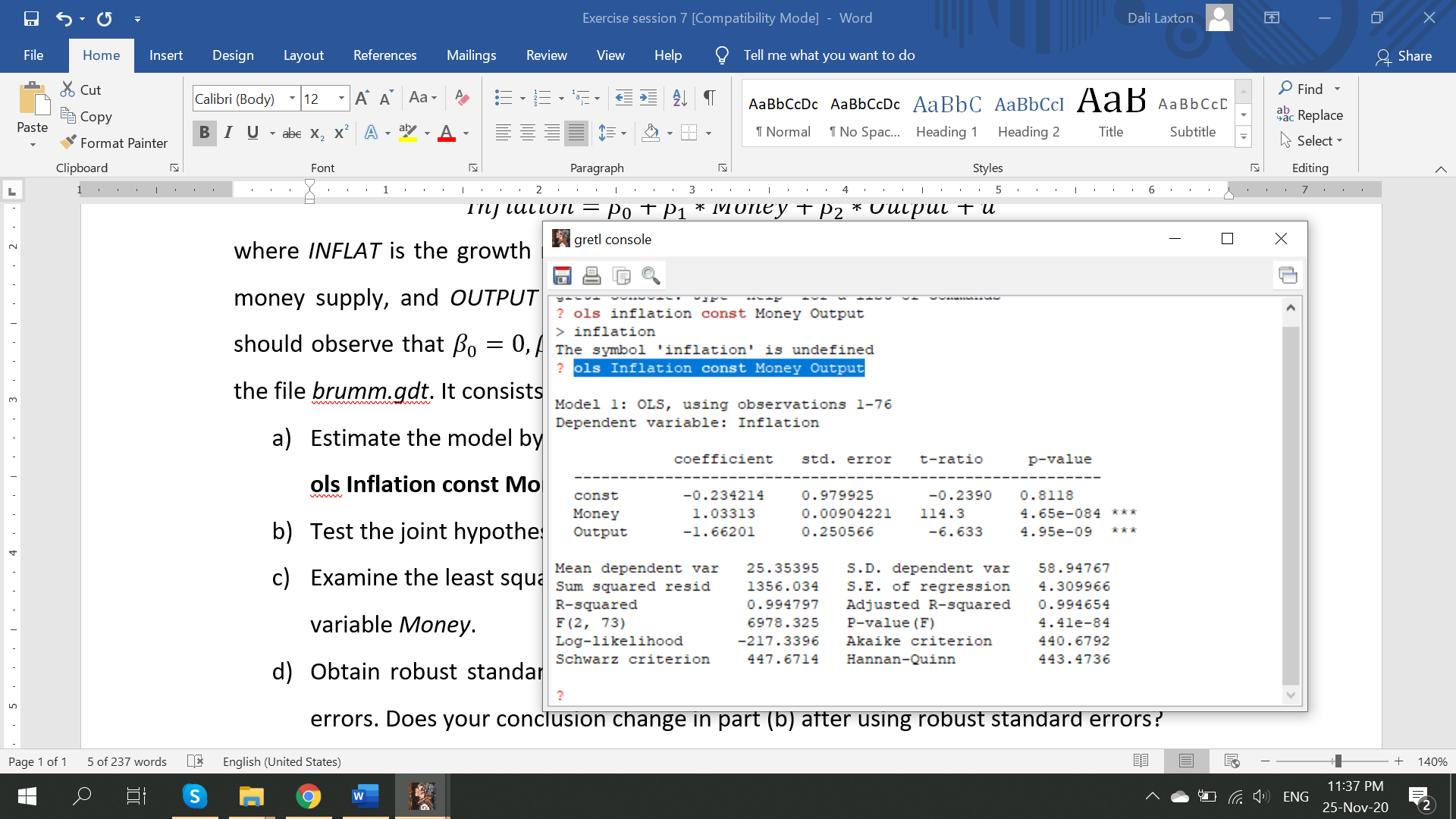
**Exercise 7**

To examine the quantity theory of money, Brumm (2005) [‘‘Money Growth, Output Growth, and Inflation: A Reexamination of the Modern Quantity Theory’s Linchpin Prediction,’’ *Southern Economic Journal*, 71(3), 661–667] specifies the equation:

where *INFLAT* is the growth rate of the general price level, *MONEY* is the growth rate of the money supply, and *OUTPUT* is the growth rate of national output. According to theory we should observe that and . The data used in this paper is contained in the file *brumm.gdt*. It consists of 1995 year data on 76 countries.

1. Estimate the model by OLS and interpret all the parameters.

**ols Inflation const Money Output**



1. Test the joint hypothesis that and . What do you conclude?

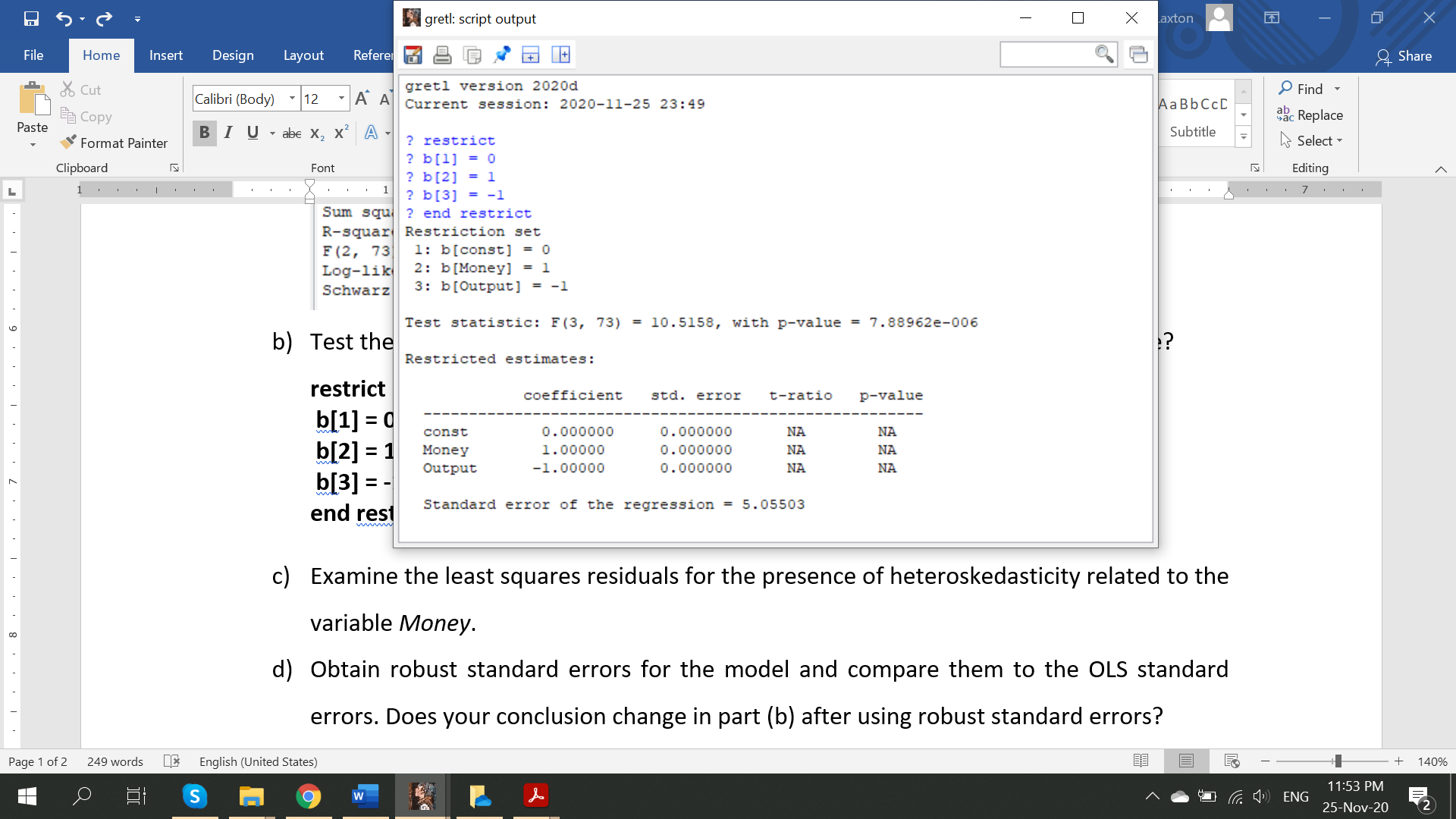
**restrict**

**b[1] = 0**

**b[2] = 1**

**b[3] = -1**

**end restrict**

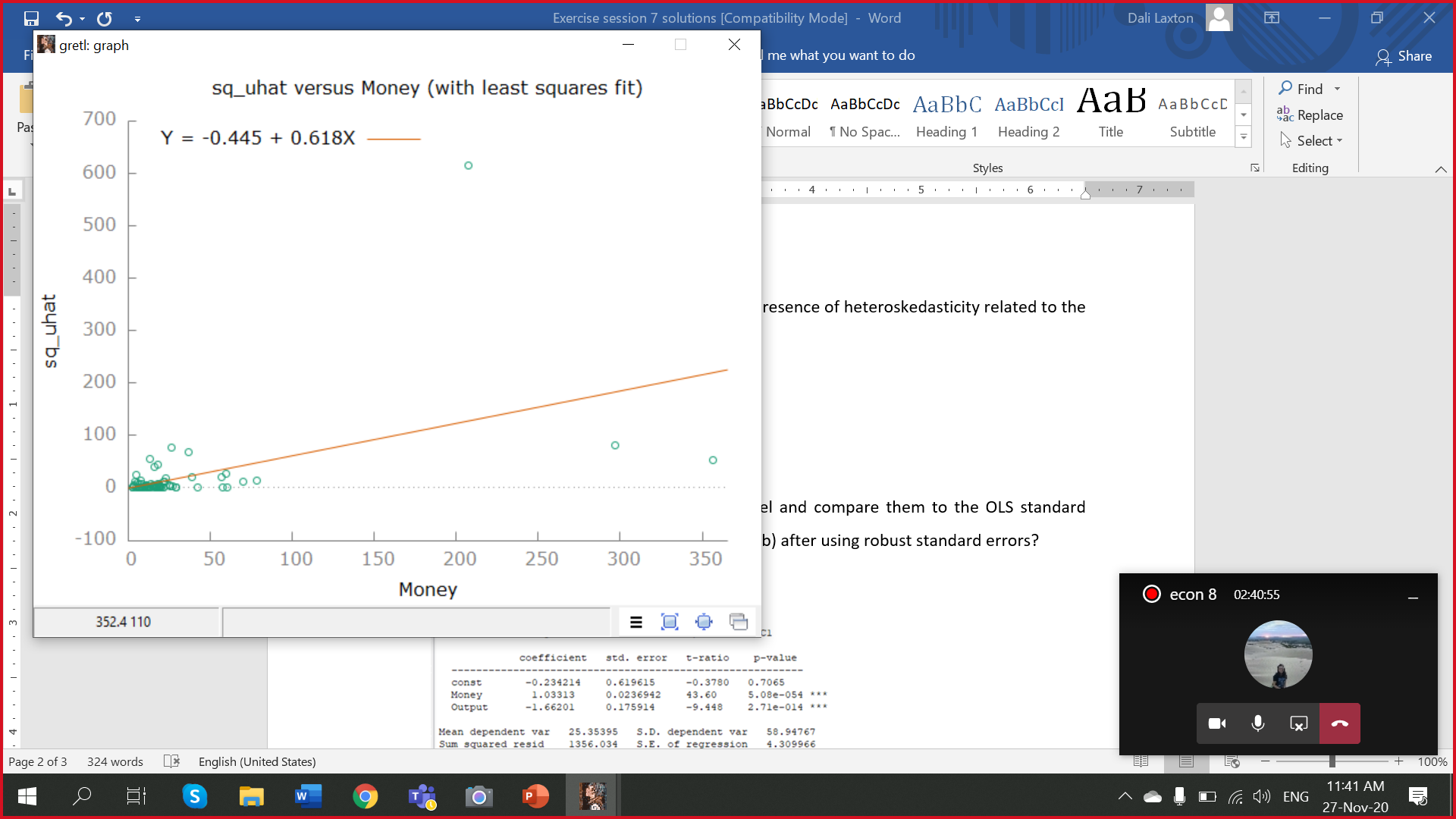


**We reject H0, therefore, restrictions do not hold**

1. Examine the least squares residuals for the presence of heteroskedasticity related to the variable *Money*.

**series resid=$uhat**

**gnuplot sq\_resid Money**



**modtest –white (this tests all explanatory variables for heteroskedasticity**

**Manually:**

**genr mout=Money\*Output**

**ols sq\_resid const Money Output sq\_Money sq\_Output mout**

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Description automatically generated

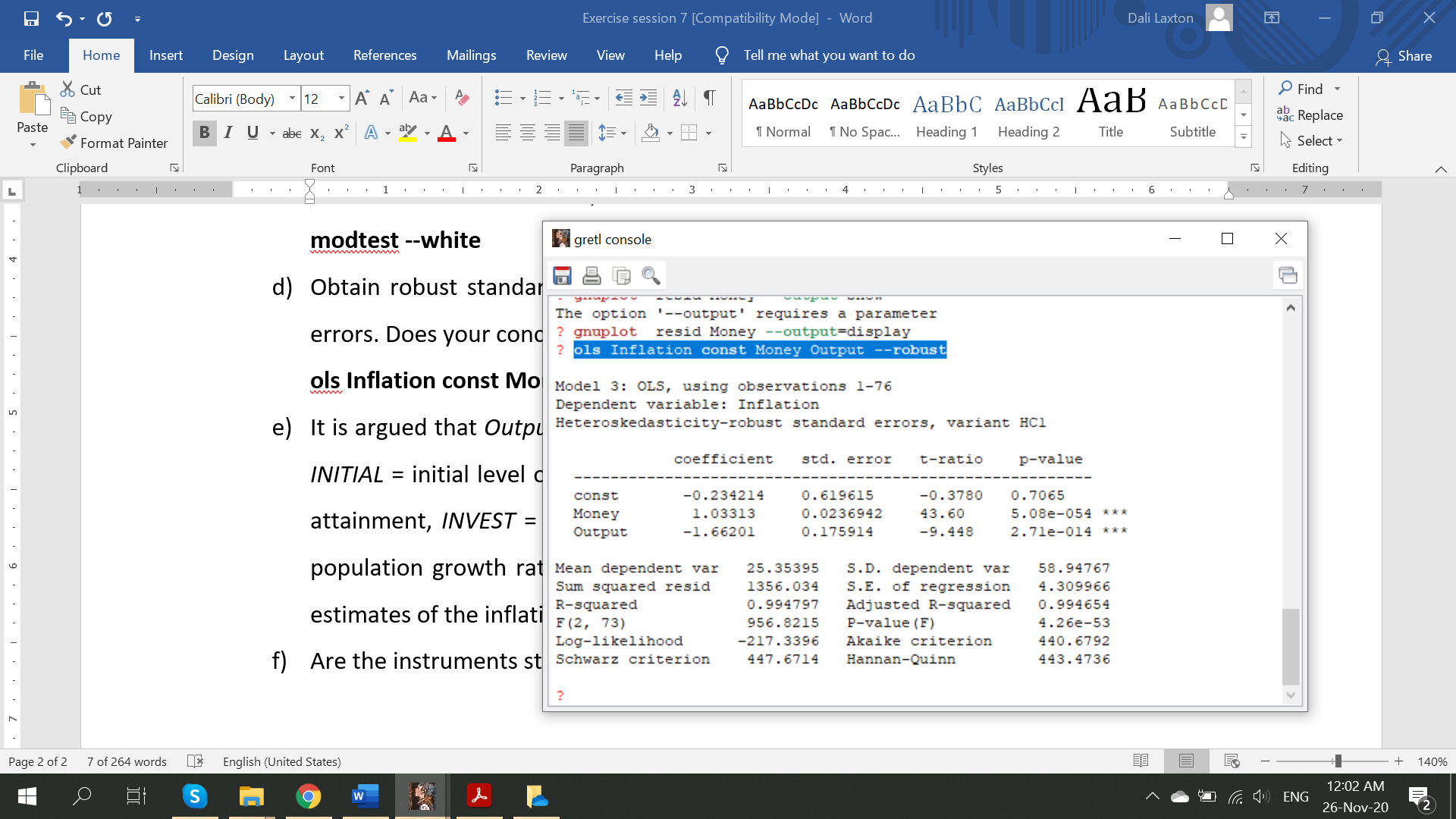
**LM= R2\*n=0.3794\*76=28.83**

**Critical value at 1% significance**

**Therefore, we reject the hypothesis that there is no heteroskedasticity with respect to the variable Money**

1. Obtain robust standard errors for the model and compare them to the OLS standard errors. Does your conclusion change in part (b) after using robust standard errors?

**ols Inflation const Money Output –robust**



**Conclusion does not change – they are jointly not equal to the theoretical parameters**

1. It is argued that *Output* may be endogenous. Four instrumental variables are proposed, *INITIAL* = initial level of real GDP, *SCHOOL* = a measure of the population’s educational attainment, *INVEST* = average investment as a share of GDP, and *POPRATE* = average population growth rate. Using these instruments, obtain instrumental variables (2SLS) estimates of the inflation equation (do the two stage procedure).

**First stage:**

**ols Output const initial poprate school invest Money**

**series Output\_hat=$yhat**

**Second stage:**

**ols Inflation const Money Output\_hat**

Graphical user interface, text, application, Word

Description automatically generated

**Alternatively, we can use Gretl command**

**tsls Inflation 0 Output Money ; 0 initial invest poprate school Money**

**OR**

**tsls Inflation const Output Money ; const initial invest poprate school Money**

1. Are the instruments strong? **Only invest predicts the Output significantly, other variables are weak instruments. The theoretical parameters are again jointly rejected. The impact of output on the inflation is now lower than before.**

**According to F test, instrument is weak because it falls below 10.27, where bias could have been roughly around 10% only but this is beyond the scope of our course**

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