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An Estimation of Laffer Curve in Iran: A Non-Linear Approach

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Abstract

Laffer curve indicates the relationship between tax rate and tax income. The aim of this paper is to estimate the Laffer curve for the Iranian economy. To do so, we have used threshold regression method. Empirical results indicate that since the tax rate is low (the threshold value is less than 0.0848) in two-regime model, tax rate and tax income have a significant positive relationship, but when the tax rate is high (the threshold value is larger than 0.0848), tax rate and tax income have a significant negative relationship.

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1. Introduction

Tax rate is one of the most important macroeconomic variables which affects on many other macroeconomic variables. Laffer curve indicates the non-linear relationship between tax rate and tax incomes. There are many studies on laffer curve as Feldstein (1995), Goldsbee (1999), Sillamaa and Veal (2000), Gruber and Saez (2002). In economics, the Laffer curve is a representation of the relationship between possible rates of taxation and the resulting levels of government revenue [Tucker (2010)]. It illustrates the concept of taxable income elasticity—i.e., taxable income will change in response to changes in the rate of taxation [Tucker (2010)]. It postulates that no tax revenue will be raised at the extreme tax rates of 0% and 100% and that there must be at least one rate where tax revenue would be a non-zero maximum [Tucker (2010)]. The Laffer curve is typically represented as a graph which starts at 0% tax with zero revenue, rises to a maximum rate of revenue at an intermediate rate of taxation, and then falls again to zero revenue at a 100% tax rate. The actual existence and shape of the curve is uncertain and disputed [Tucker (2010)]. Laffer explains the model in terms of two interacting effects of taxation: an "arithmetic effect" and an "economic effect" [Laffer(2004)]. The "arithmetic effect" assumes that tax revenue raised is the tax rate multiplied by the revenue available for taxation (or tax base) [Laffer(2004)]. At a 0% tax rate, the model assumes that no tax revenue is raised [Laffer (2004)]. The "economic effect" assumes that the tax rate will have an impact on the tax base itself [Laffer(2004)]. At the extreme of a 100% tax rate, the government theoretically collects zero revenue because taxpayers change their behavior in response to the tax rate: either they have no incentive to work or they find a way to avoid paying taxes [Laffer(2004)]. Thus, the "economic effect" of a 100% tax rate is to decrease the tax base to zero [Laffer(2004)]. If this is the case, then somewhere between 0% and 100% lies a tax rate that will maximize revenue [Laffer(2004)]. Graphical representations of the curve sometimes appear to put the rate at around 50%, but the optimal rate could theoretically be any percentage greater than 0% and less than 100% [Laffer(2004)]. Similarly, the curve is often presented as a parabolic shape, but there is no reason that this is necessarily the case [Laffer(2004)].

There are many studies about laffer curve in developed countries in recent years such as Dahlby and Ferede (2011), Kuo (2012), Laffer

(2012), Francesco (2012), Ihori and Yang (2012), Gross (2012), Berman and Milanes-Reyes (2013), Tsuchiya (2013), Usher (2013), Burian & Brčák (2013) and Creedy and Gemmell (2014), but there are lack studies about laffer curve in Iran. The previous studies in Iran have focused on linear model of laffer curve, but this paper has estimated the Laffer curve with a non-linear model. The aim of this paper is estimating of laffer curve in Iranian economy. For do it, we have used threshold regression method. Some studies in Iran have used the threshold regression method such as Abounoori and Nademi (2010), Jafari Samimi, Nademi, and Zobeiri (2010) and Jafari Samimi et. al (2012).

This paper is organized by five sections. The next section is devoted to review of literature, section 3 presents model specification and data description, section 4 is devoted to empirical results and final section concludes.

2. Review of Literature

Claessens (1990) has presented some estimates, using secondary market prices of commercial bank debt, of the Debt Laffer curves for the highly indebted and sub-Saharan African countries. The empirical evidence suggested that only a few indebted countries were on the wrong side of their Debt Laffer curve.

Hsing (1996) re-examined the Laffer curve for the U.S. based on time-series data during 1959–1991. Total personal income tax revenue is specified as a quadratic function of the income tax rate. Different functional forms such as the linear, the log-log, and the semi-log forms are considered. Major findings showed that the bell-shaped Laffer curve is statistically significant and that the revenue-maximizing tax rate is between 32.67% and 35.21%.

Goldsbee (1999) has indicated that the responsiveness of high-income people seems to be relatively modest in almost all time periods except the 1980s. The lowest estimates of the elasticity based on the 1980s data exceed even the highest estimates from data on any previous tax change.

Heijman and Van Ophem (2005) have taken both effects into account: decreasing activities in the white sector combined with increasing activities in the black sector. It examined the computation of the maximum tax revenue generating taxation rate for a number of OECD

countries. It concluded that, with the exception of Sweden, the marginal taxation rate in these countries was below its optimum.

Trabandt and Uhlig (2009) have compared Laffer curves for labor and capital taxation for the US, the EU-14 and individual European countries, using a neoclassical growth model featuring "constant Frisch elasticity" (CFE) preferences. They have provided new tax rate data. The US can increase tax revenues by 30% by raising labor taxes and by 6% by raising capital income taxes. For the EU-14 we obtain 8% and 1%. Dynamic scoring for the EU-14 shows that 54% of a labor tax cut and 79% of a capital tax cut are self-financing. The Laffer curve in consumption taxes does not have a peak. Endogenous growth and human capital accumulation located the US and EU-14 close to the peak of the labor tax Laffer curve. They derived conditions under which household heterogeneity does not matter much for the results. By contrast, transition effects matter: a permanent surprise increase in capital taxes always raises tax revenues.

Jafari Samimi, Nademi and Zobeiri (2010) estimated the rate and effect of threshold tax on economic growth in Iran during 1980 -2008. They divided Iran's economy into two sectors namely, public and non-public sector. Then they estimated a linear model .Due to poor results of the estimated linear model they specified a nonlinear model on explain the role of tax on economic growth in Iran. Their results indicate that there exists a threshold tax rate of 22%. In other words, when tax rate is less than 22% then as a result of an increase in tax revenue rate of economic growth will increase and beyond a tax rate of 22%. It will have a detrimental effect on economic growth of the country.

Jafari Samimi, Nademi and Zobeiri (2010) applied a two-sector production function developed by Ram (1986) to estimate the threshold regression model for Islamic countries, regarding the effect of government size on economic growth. The ratio of final government consumption on GDP is used to find out the threshold points. Their empirical results indicate that there is a nonlinear relationship between government size and economic growth in the selected Islamic countries under consideration.

Jafari Samimi et. al (2011) examined the Laffer curve for inflation tax in Iran. They have used threshold regression model to study a non-linear relationship between inflation Tax and inflation based on two regimes of inflation (low and high inflation regimes). Their findings

support a standard Laffer curve shape in Iran with a threshold inflation rate of 15.24 percentage points. In other words, only at inflation below this rate inflation tax will increase as a result of higher inflation.

Becsi (2012) has observed that a good place to start in understanding the impacts of tax policy is with what is popularly known as the Laffer curve. This curve became famous early in the 1980s when tax rates fell but tax revenues did not rise as the curve predicted, and the United States resorted to deficit spending. He examined the macroeconomic and conceptual issues that may have made a difference. ; Because most analyses of the Laffer curve occur in a static framework that has proved inadequate, this analysis presented a simple dynamic model useful for analyzing the long-run effects of tax policies. The model also can easily be extended to analyze the disposition of government revenues and the consequent effects on national income. ; It turns out that how the government spends its tax revenues-on consumption, investment, or transfers-is important for understanding the Laffer curve.

Fève, Matheron and Sahuc (2012) have investigated the characteristics of the Laffer curve in a neoclassical growth model with incomplete markets and heterogeneous, liquidity-constrained agents. They have shown that the shape of the Laffer curves related to taxes on labor, capital and consumption dramatically changes depending on which of transfers or government debt are adjusted to make the government budget constraint hold. When transfers are adjusted, the Laffer curve has the traditional shape. However, when debt is adjusted, the Laffer curve looks like a horizontal S, in which case fiscal revenues can be associated with up to three diferent levels of taxation. This finding occurs because the tax rates change non monotonically with public debt when markets are incomplete.

Busato and Chiarini (2013) have studied equilibrium effects of fiscal policy within a dynamic general equilibrium model where tax evasion and underground activities are explicitly incorporated. They showed that a dynamic general equilibrium with tax evasion may give a rational justification for a variant of the Laffer curve for a plausible parameterization. From a revenue maximizing perspective, the key policy messages are that bringing tax payers to compliance would be better than threatening to punish them if convicted and that an economy without problems of compliance is much more sensitive to myopic behavior.

Oliveira and Costa (2013) have estimated a VAT Laffer Curve for the EU-27 countries in the period 2000-2010. Their results show that countries such as Portugal are already in the prohibitive range of the curve. Structural differences exist between low growth years and high growth years. Collected VAT revenue is smaller in low growth years than in high growth years, which illustrates the existence of a VAT automatic stabilizer effect. The VAT rate that maximizes VAT revenue is slightly higher in low growth years, which can be explained by changes in the structure of consumption and of VAT collection enforcement. A procyclical VAT rate policy increases the underlying business cycle volatility and may also have as an outcome the increase of overall government intertemporal collected VATR.

Colombatto (2013) emphasis that the Laffer curve is often used to analyze revenue-maximizing tax pressure and to provide normative suggestions to policymakers. Colombatto (2013) suggest that although the Laffer curve provides valuable insights, revenue maximization is not the only factor guiding policymakers' decisions in regard to the suitable tax pressure. Thus, he try to broaden the spectrum by replacing the Laffer curve with a different graphical instrument, which takes into account three key variables: the quality of public expenditure, ideology (the role of populism) and rent-seeking. By means of this new graphical instrument, he derive results that shed light on the nature of the equilibria various countries can hope to obtain, as well as on the features of the imbalances. He then extends our insights to an open-economy contest featuring tax competition. Colombatto (2013) assess when tax competition is relevant, and we investigate whether the proposed remedy–tax harmonization–is credible. It is argued that tax harmonization is inferior to cooperation and that it is in fact an intermediate step on the way towards tax centralization.

Cung, Zhou and Liu (2014) have accounted revenue of personal income tax for a higher and higher proportion in Vietnam's total tax revenue. They have combined some different methods to find the causes of this issue. They find that the growth rate of this tax depends on economic growth, perfection of tax law, professionalism of the tax authority system and some other factors. In which the increase of GDP/GDP per capita is the most important factor. In addition, they also find that the annual average burden of this tax in the applied period of the Ordinance is nearly 2.34 times lower than the applied period of the Law.

Creedy and Gemmell (2014) have provided a detailed examination of the analysis underlying this conclusion, and considered whether other tax rates in the US income tax system are on the 'right' side of the Laffer curve. Conceptual expressions for 'Laffer-maximum' or revenue-maximizing ETIs, based on readily observable parameters, are presented for individuals and groups of taxpayers in a multi-rate income tax system. Applying these to the US income tax in 2005, with its complex effective marginal rate structure, demonstrates that a wide range of revenue-maximizing ETI values can be expected for individual taxpayers within and across tax brackets, and in aggregate. For many taxpayers these revenue-maximizing ETIs are well within the range of empirically estimated elasticities.

Megersa (2014) has tried to address the question of non linearity in the long term relationship between public debt and economic growth. Specifically, He sets out to test if there exists an established 'laffer curve' type relationship, where debt contributes to economic growth up to a certain point (maximal threshold) and then starts to have a negative effect on growth afterwards. He has used a methodology that delivers a superior test of bell shapes, in addition to the traditional test based on a regression with a quadratic specification. His results show evidence of a bell-shaped relationship between economic growth and total public debt in a panel of low income Sub-Saharan African economies. This supports the hypothesis that debt has some positive contribution to economic growth in low-income countries, albeit up to a point. If debt goes on increasing beyond the level where it would be sustainable, it may start to be a drag on economic growth.

Holter, Krueger & Stepanchuk (2014) have studied the importance of household heterogeneity and the progressivity of the labor income tax schedule for the ability of the government to generate tax revenues. They developed an overlapping generations model with uninsurable idiosyncratic risk, endogenous human capital accumulation as well as labor supply decisions along the intensive and extensive margins. They calibrated the model to macro, micro and tax data from the US as well as a number of European countries, and then for each country characterize the labor income tax Laffer curve under the current country-specific choice of the progressivity of the labor income tax code. They have found that more progressive labor income taxes significantly reduce tax revenues. For the US, converting to a flat tax code raises the peak of the

laffer curve by 7%. They also have found that modeling household heterogeneity is important for the shape of the Laffer curve.

3. Model Specification and Data Description

3.1. Model Specification

Figure 1 represents the Laffer curve and t* is the threshold value. The threshold tax rate is a point at which any rise in tax rate lower than this value will have positive effects, while more than that will have negative effects on tax income.

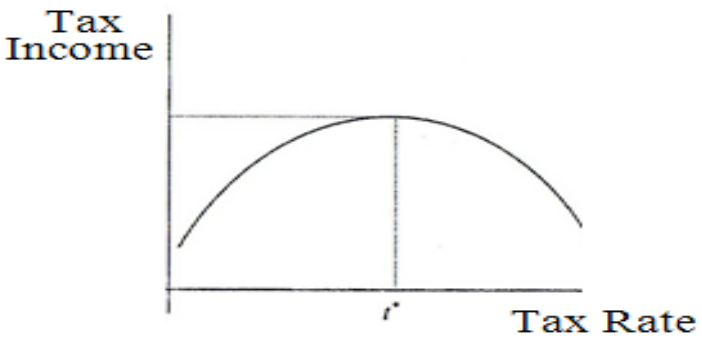

Figure1. Laffer Curve

The positive effects may be due to providing substructures, and public goods and the negative effects could be due to the crowding-out effect of government monopolistic activities.

We have used the following model based on Laffer curve:

$$TaxIncome_t = \beta_0 + \beta_1 GNP_t + \beta_2 TaxRate_t + e_t \qquad (1)$$

Regression (1) shows that the variables which affect on real tax income including the real GNP and tax rate. We have used the consumer price index for converting nominal variable to real variable. Regression (1) is a traditional linear economic growth model, but we alter the linear model into the two regime TAR model of Hansen (1996). The model can be shown as follows:

$$TaxIncome_t = (\delta_{10} + \delta_{11} GNP_t + \delta_{12} TaxRate_t) + (\delta_{14} TaxRate_t) I[q_t > \gamma] + e_t \qquad (2)$$

The threshold value γ can be found by estimating the regression (2) through finding the minimum Error Sum of Squared in a re-order

threshold variable. In this paper, we set tax rates as the threshold variable. We can also apply the statistic coming from the threshold variable. For instance, we adopt the heteroskedasticity-consistent Lagrange multiplier (LM) of Hansen (1996) to test the null hypothesis of the linear assumption.

Once the estimator can be found, we then start with the statistical test, but the test procedure of Eq. (2) is different from the traditional test. Under the null hypothesis of no threshold effect, the threshold parameters will be unidentified. This will cause the traditional test statistic in a large sample distribution to not belong to the χ^2 distribution, but rather to a non-standard and non-similar distribution which is affected by nuisance parameters. This will cause the critical value of the distribution to not be estimated through simulation. In order to overcome the difficulty, Hansen (1996) uses a statistic of his own large sample distribution function to transfer and calculate the asymptotic p-value of a large sample. Under the null hypothesis, the distribution of the p-value statistic is uniform, and this kind of transformation can be calculated through bootstrap. The null hypothesis to test Eq. (2) is as follows:

$$H_0: \delta_{12} = \delta_{14} \tag{3}$$

If H_0 is not rejected then the relationships between tax income and the tax rate would be the linear regression as the regression (1). This means there exists no threshold effect. Otherwise, if H_0 hypothesis is rejected, it means that there exist different effects between the two regimes of δ_{12} and δ_{14}. The F-test statistics is as follows:

$$F = \frac{RSS_0 - RSS_1(\hat{\gamma})}{\hat{\sigma}^2} \tag{4}$$

In which RSS_0 and RSS_1 are the residual sum of squares under the null hypothesis and the alternative, respectively.

3.2. Data Description

The resent socio-economic history of Iran has been subject to the past and political-strategic volatility of the region. Iran has not experienced a relatively free market economy due to the share of oil revenue at large. We have used the annual data from 1970 to 2011 available on the website of the Central Bank of Iran (CBI).

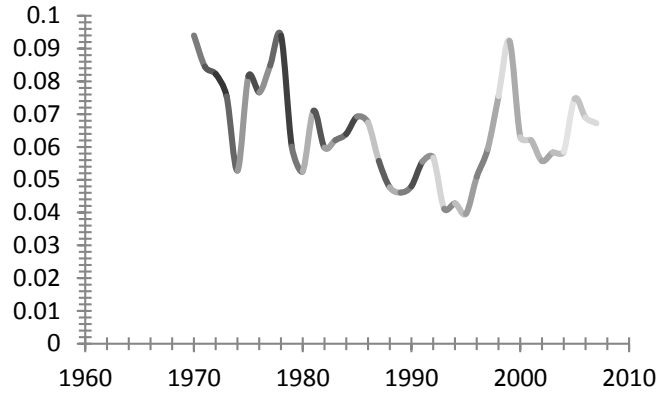

Figure 2. Tax Rate Series

Figure 2 indicates tax rate series. In this paper we have used the tax income divided by GNP as Tax rate series. Tax rate has high volatility in Iran economy. The maximum of tax rate is about 0.094 and the minimum of tax rate is about 0.04.

Figure 3 indicates tax income series. Tax income increased at 1970-2011 period. Tax income increased moderately at 1970-1990 period, but this variable increased rapidly after 1990 decade. The maximum of tax income is about 239741 billion Rials at 2008 year and the minimum of tax income is about 71 billion Rials at 1995 year.

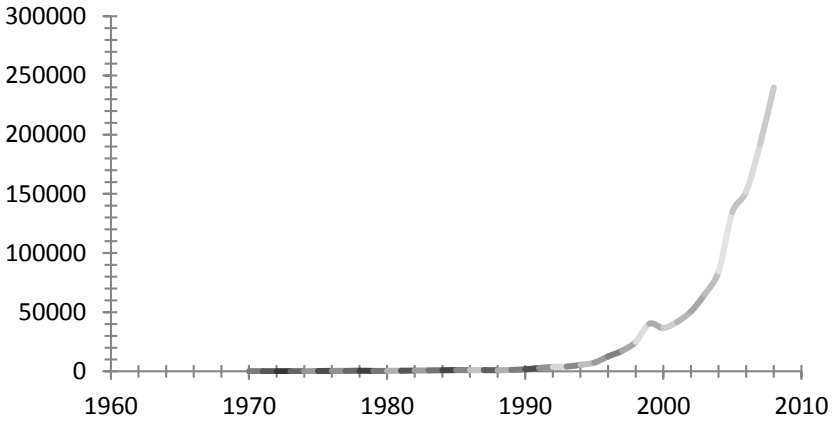

Figure 3. Tax Income Series

Then, we have tested unit root test for the variables. Table 1 indicates the results of Phillips-Perron test statistic for variables of the model.

Table 1. Unit Root Test (Phillips-Perron Statistic)

Variables	Critical Value 1%	Critical Value 5%	Critical Value 10%	Phillips-Perron statistic	Results
Real Tax Incomes	-3.615588	-2.941145	-2.609066	17.42453	Non-STATIONARY
Real GNP	-3.621023	-2.943427	-2.610263	48.52413	Non-STATIONARY
Tax Rate	-3.621023	-2.943427	-2.610263	4.457093	Non-STATIONARY

Table 1 indicates that the variables are non-stationary. So, we have tested unit root test for first difference of the variables in Table 2.

Table 2. Unit Root Test (Phillips-Perron Statistic)

Variables	Critical Value 1%	Critical Value 5%	Critical Value 10%	Phillips-Perron statistic	Results
D(Real Tax Incomes)	-3.621023	-2.943427	-2.610263	-6.513037	STATIONARY
D(Real GNP)	-3.626784	-2.945842	-2.611531	-9.821588	STATIONARY
D(Tax Rate)	-3.626784	-2.945842	-2.611531	-7.640932	STATIONARY

Table 2 indicates that the first differences of all variables are stationary. Therefore, we have tested cointegration of the model based on Engle-Granger methodology. For do it, we have tested the residual of the model (1).

Table 3. Unit root test for Residual Series

Null Hypothesis: RESIDUALS has a unit root Exogenous: Constant Bandwidth: 3 (Fixed using Bartlett kernel)			
		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.391031	0.0010
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

Table 3 indicates unit root test for Residual series. Phillips-Perron test statistic indicates that the residual series is stationary. Therefore, there is a long-run relationship between tax incomes and tax rates based on Engle-Granger methodology.

4. Empirical Results

This paper uses Hansen (1996, 2000) threshold regression model to study whether a non-linear Laffer curve exists in Iran. As Table 4 shows, we adopt Hansen (1996, 2000) advice to use the bootstrapping model. While the threshold variable is "tax rate", we find that F-statistic is (3.81), which is significant at 1% level. The threshold value is about 8.5%, and this means that one threshold exists. After making sure that the tax rate has threshold effect and achieve the threshold regimes, we analyze the linear and non-linear tax rate effects in different tax regimes and discuss how the tax rate affects the tax income in different threshold regimes.

Table 4. Threshold Tests

Threshold Variables	Tax Rate	P-value
Fvalue of threshold test	3.81	0.00
Threshold regime (%)	0.08484	

Source: Research Findings

Table 5. Estimation Results

Variables	Linear Model		Tax Rate Regimes			
Threshold Value (%)	Coefficient	prob	≤0.0848	prob	>0.0848	prob
Interception	-7341.3	0.00	-6153.1	0.01	351417	0.02
Real GNP	0.0631	0.00	0.066	0.00	0.066	0.00
Tax Rate	137231	0.00	131043.2	0.02	-6701163	0.02
R^2	0.993		0.995			

Source: Research Findings

As Table 5 shows, while "tax rate" is the threshold variable, tax rate has a significantly positive relationship with real tax income in the linear model. Since the tax rate is low (the threshold value is less than 0.0848) in two-regime model, tax rate and real tax income have a significantly positive relationship, but when the tax rate is high (the threshold value is larger than 0.0848), tax rate and real tax income have a significantly negative relationship. Thus, we can make sure that the non-linear situation of the Laffer curve exists in Iran when "tax rate" is the threshold variable. Moreover, the real GNP has a significantly positive impact on tax income in linear and non-linear models.

5. Conclusion

Laffer curve indicates relationship between tax rate and tax incomes. The threshold tax rate is a point at which any deviation from this value reduces the tax income. The positive effects may be due to providing substructures, and public goods and the negative effects could be due to the crowding-out effect of government monopolistic activities.

Following the non-linear theory of Laffer, we have tested the presence of a non-linear Laffer curve relationship between tax rate and tax income in Iran. Doing so, we have used a threshold regression model with Hansen (1996, 2000) method to test the threshold effect. The empirical results indicate that threshold effect exist between tax rate and tax income in Iran.

Empirical results indicate that when the tax rate is less than 0.0848, tax rate and real tax income have a significant positive relationship, but when the tax rate is larger than 0.0848, tax rate and real tax income have a significant negative relationship.

Reforming the tax system in Iran is necessary for increasing the tax incomes. This paper indicates that the tax rate of 8 percent maximizes real tax revenue for Iranian government.

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Appendix: Threshold Program in Eviews

```
delete tab
MATRIX(100,1) RES
'.....best threshold
smpl @all
scalar maxr2=0
for !t= 0.04 to 0.094 step 0.000001
equation eq1.ls TR=C(1)+C(2)*GNP+c(3)*tax + (tax>!t) * (c(4) + c(5)*GNP
+c(6)* tax)
RES(100,1)=eq1.@r2
if eq1.@r2>maxr2 then
   maxr2=eq1.@r2
  !threshold=!t
scalar yyyyyy=!threshold
endif
next !
'.....f & ki square statistics
equation eq1.ls TR=C(1)+C(2)*GNP+c(3)*tax + (tax>!t) * (c(4) + c(5) * GNP +
c(6)* tax)
equation eq2.ls  TR=C(1) + C(2)*GNP+c(3)*tax
'make resids
eq1.makeresids residuals
'!a is number of restrictions
```

```
!a=1
scalar f=41*(eq2.@se^2-eq1.@se^2)/eq1.@se^2
scalar ki=f/!a
'.....................................................
!n=100
vector(!n,1) res_f
vector(!n,1) res_k
!y=0
smpl @all
for !i=1 to !n
!y=!y+1
genr yy=nrnd*residuals
'.....................................................supremum:k & f which is the same az
supremum:R2
smpl @all
scalar maxr2=0
!min=!threshold-0.001
!max=!threshold+0.001
for !t= !min to !max step 0.0001
equation eq_test1.ls yy= C(1)+C(2)*GNP+c(3)*tax+(tax>!t) *(c(4) + c(5)*GNP
+ c(6)* tax)
if eq_test1.@r2>maxr2 then
  maxr2=eq_test1.@r2
  !th=!t
endif
next !t
'.....................................................
equation eq_test1.ls yy= C(1)+C(2)*GNP+c(3)*tax+(tax>!t) *(c(4) + c(5)*GNP
+ c(6)* tax)
equation eq_test2.ls yy= C(1) + C(2)*GNP+c(3)*tax
!f=41*(eq_test2.@se^2-eq_test1.@se^2)/eq_test1.@se^2
!k=!f/!a
res_f(!y,1)=!f
res_k(!y,1)=!k
next !i
```