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Viability of the contributory pension scheme in Nigeria: an elasticity theoretic approach

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Abstract

In this study, we propose a necessary condition for a pension scheme to be adjudged viable based on the concept of elasticity in microeconomic theory. Findings reveal that the variation in total retirement savings with the employee-employer contributions in the new pension scheme (i.e. the contributory pension scheme) is not significantly elastic for a Pension Fund Administrator in Nigeria. On the strength of these findings, we make some recommendations in order to enhance the success of the new pension scheme.

Keywords: elasticity; Matlab; pension scheme; retirement savings.

1.0 Introduction

Life after retirement is one of the dreaded periods of most workers in an organizational system. Sequel to this, there has been a surge of anxiety among researchers on the framework of a viable pension scheme. Bikker et al. [1] examined the impact of stock market performance on investment policies of pension funds. They found that investment policies on pension funds are partially driven by the cyclical performance of the stock market. Romano [2] studied the debate over shareholders activism in corporate governance in the wave of pension funds investment conflicts. Stewart and Yermo [3] highlighted the benefits from strengthening pension fund governance. The success of the Chilean pension reform and the likely consequences of implementing the reform in Nigeria have also been examined [4]. Binuomoyo and Ogbewo [5] discussed the features of the various kinds of pension plans (or schemes) viz.: the defined benefit plan, the defined contribution plan, and the hybrid and cash balance plans. Odia and Okoye [6] posited that many countries have opted for the contributory pension scheme (CPS) where employers and their employees pay a certain percentage of the employee's monthly earnings to a retirement savings account (RSA) from which they would be drawing their pension benefits after retirement.

The history of pension administration in Nigeria dates back to the 1950s. In spite of this, Nigeria is still faced with the problem of managing a proper pension scheme for its retirees [5, 7]. This is coupled with lack of adequate record keeping and poor social security arrangement on the part of the government. In most cases, families of deceased retirees find it difficult to secure the entitlement of the beneficiaries several years after their death. It has been reported that between 1998 and 2000, pension entitlements increased by about 750% [4]. The implication of this is that a pensioner on an allowance of N10000 per month in 1998 was, as at 2000 receiving about N75000 per month. In this light, the defined benefit Pay-As-You-Go (PAYG) pension scheme, as it is often called, became unsustainable with outstanding liabilities nationwide. It has also been stated that the increase in government spending on pensions was estimated at 4.8% of the national budget and 1.15% of GDP [4]. Thus, a reform of the pension system became necessary as the government could no longer adequately meet her pension obligations.

As a panacea this problem, the Federal Government sets up a committee to review the problems of pension in the country and to provide recommendations to reform the system. Consequent upon this, the Pension Reform Act (PRA) 2004 was brought to focus [8]. The PRA 2004 proposes a contributory pension scheme (CPS). In the CPS, the rate of the employee-employer contributions to pension funds is fixed (see Table 1).

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Table 1: Outlay of employee-employer contributions to pension funds by sector

Sector	Employee	Employer
Federal public service (including the FCT)	Minimum of 7.5% contribution	Minimum of 7.5% contribution
Military	Minimum of 2.5% contribution	Minimum of 12.5% contribution
Others (particularly the private sector and other state and local governments)	Minimum of 7.5% contribution	Minimum of 7.5% contribution

Source: PenCom (2005) as cited by [5].

The retirement benefit in this plan is variable because it depends on the performance of the investment selected. Exempted from the CPS are employees with three years or less to retirement, judicial officers and those in the fully funded pension schemes in the private sector. Odia and Okoye [6] stated that the new pension scheme (i.e. the CPS) is broader, inclusive and fully funded, while the old pension scheme was unfunded. The regulation and supervision of the new pension scheme is by PenCom whereas the Securities and Exchange Commission (SEC), National Insurance Commission (NAICOM) and the Joint Tax Board (JTB) were jointly responsible for the old pension scheme. To protect contributors' pension funds and ensure maximum returns on investments, institutional framework has been put in place in the CPS such as PenCom and Pension Fund Administrators (PFAs). PenCom serves as a regulatory agency to ensure that pension funds are safe through the issuance of guidelines and regulations for licensing, approving, regulating and monitoring the management and investment activities of PFAs. The body also resolves complaints, serves as a watchdog and makes sure that pension businesses are carried out with minimum exposure to fraud and risk. The PFAs are limited liability companies licensed by PenCom to manage pension funds by opening a retirement savings account (RSA) for each employee, invest and manage the funds and assets in accordance with the provisions of the PRA 2004 [8]. The licensed PFAs in Nigeria are presented in Table2.

Table 2: List of Pension Fund Managers in Nigeria and their Website.

S/N	Company	Website
1.	AIICO Pension Managers Limited	www.aiicopension.com
2.	ARM Pension Managers	www.armpensions.com
3.	Crusader Pensions Limited	www.crusaderpensions.com
4.	First Alliance Pensions and Benefits Limited	www.firstalliancepension.com
5.	First Guarantee Pension Limited	www.firstguaranteepension.com
6.	Leadway Pensure PFA Limited	www.pensure-nigeria.com
7.	Legacy Pension Managers Limited	www.legacypension.com
8.	NLPC Pension Fund Administrators Limited	www.nlpcpfa.com
9.	Oak Pensions Limited	www.oakpensions.com
10.	Pension Alliance Limited	www.pensionalliance.com
11.	Premium Pension Limited	www.premiumpension.com
12.	Sigma Vaugn Sterling Pensions Limited	www.sigmapensions.com
13.	Stanbic IBTC Pension Managers	www.ibtcpension.com
14.	UBA Pensions Limited	www.ubapensions.com
15.	Trust Funds Pensions Plc	www.trustfundpensions.com

Source: www.blackherald.egoon.com

Tijjani [9] stipulated that when an employee in the CPS dies, his entitlements under the life assurance policy shall be paid into his RSA and the PFA shall disburse the balance in the account in favour of beneficiaries of: a will prepared by the deceased; spouse(s), children of the deceased; recorded next-of-kin; or an approved administrator. Since the inception of the CPS, over seven years have elapsed. During these intervening years, there are still speculations among Nigerians about the success of the scheme. Specifically, some have asked the following questions [10]: Would there be financial security after retirement? What is the fate of the retiree's households? Does life after retirement imply signing a bond with poverty? All these questions point to whether or not the retirement savings in the CPS is viable. Put differently, the employees' concern is whether or not retirement savings in the CPS increases significantly more than proportionally with the increase in employee-employer contributions. It is against this background that we are motivated to study the new pension scheme in Nigeria.

This study provides an academic platform to analyse the viability of the CPS in Nigeria using the gain/loss in total retirement savings and the employee-employer contributions. We achieve this by employing the concept of elasticity in economic theory [11] as a theoretical underpinning for the variation in total retirement savings with the employee-employer contributions as a predictor variable. The t-test and R-statistics are also brought to focus. The t-test and R-statistics are respectively used to evaluate the significance of the model parameters and the percentage of variation in total retirement savings explained by the employee-employer contributions.

2.0 Methodology

Let δRS_i denote the variation (i.e. gain or loss) in total retirement savings for an individual employee i, and let C_i denote the corresponding total employee-employer contributions. We define the elasticity coefficient, b, of pension funds managed by a PFA using the two variables δRS_i and C_i symbolically as

$$b = \frac{d\delta RS_i}{\delta RS_i} \Big/ \frac{dC_i}{C_i}. \tag{1}$$

Equation (1) is analogous to the expression in [11]. The value of the elasticity coefficient, b, in equation (1) plays an important role in microeconomic theory. If

$$b: \begin{cases} <1 & \text{inelastic} \\ =1 & \text{unitary} \\ >1 & \text{elastic} \end{cases}.$$

Further simplification of equation (1) using the variable separable method yields

$$b\int d\log C_i + a = \int d\log \delta RS_i,$$

where a is an arbitrary constant and $\exp(a)$ defines the proportionate increase in retirement savings with the increase in employee-employer contributions. Thus, we obtain

$$\log \delta RS_i = a + b\log C_i. \tag{2}$$

Since under the defined contribution plan, the employee-employer contributions are managed and invested by the PFA in accordance with the provisions of the PRA 2004, it is therefore reasonable to anticipate gains in retirement savings for an employee when the pension scheme is viable. However, the accumulation in the employee-employer contributions does not necessarily imply a significant gain in the retirement savings. This is due to the elasticity of retirement savings with the total employee-employer contributions. From equation (2), the pension scheme is inelastic when $b < 1$. The implication of this is that the gain in retirement savings is achieved not necessarily by the periodic increase in employee-employer contributions. Conversely, when the pension scheme is not inelastic, $b \geq 1$. This implies that greater gain in retirement savings is achieved by the periodic increase in employee-employer contributions. From the foregoing, we state the following proposition for a pension scheme to be adjudged viable.

Proposition 1: A necessary condition for a pension scheme to be adjudged viable is that the relation $\frac{d\delta RS_i}{\delta RS_i} < \frac{dC_i}{C_i}$ must be significant, i.e. the variation in retirement savings with the increase in total employee-employer contributions is inelastic.

Proof

In a pension scheme, it is pertinent to assume that the system aims to maximize the retirement savings with respect to employee-employer contributions. Given the model

$$\log \delta RS_i = a + b\log C_i,$$

the first-order derivative of δRS_i with respect to C_i is

$$\frac{1}{\delta RS_i}\frac{d\delta RS_i}{dC_i} = \frac{b}{C_i}.$$

Taking the second-order derivative, we obtain

$$\frac{d^2\delta RS_i}{dC_i^2} = \delta RS_i\left(-\frac{b}{C_i^2} + \frac{1}{\delta RS_i^2}\left(\frac{d\delta RS_i}{dC_i}\right)^2\right).$$

Recall that the sufficient condition for the maximum point of a given function is achieved when the second-order derivative of the function is negative at that point [12]. Now, $\frac{d^2\delta RS_i}{dC_i^2} < 0$ only if $\delta RS_i\left(-\frac{b}{C_i^2} + \frac{1}{\delta RS_i^2}\left(\frac{d\delta RS_i}{dC_i}\right)^2\right) < 0$.

Since $\delta RS_i > 0$, then $\left(-\frac{b}{C_i^2} + \frac{1}{\delta RS_i^2}\left(\frac{d\delta RS_i}{dC_i} \right)^2 \right) < 0$. Equivalently,

$$\left(\frac{1}{\delta RS_i}\left(\frac{d\delta RS_i}{dC_i} \right) - \frac{\sqrt{b}}{C_i} \right)\left(\frac{1}{\delta RS_i}\left(\frac{d\delta RS_i}{dC_i} \right) + \frac{\sqrt{b}}{C_i} \right) < 0.$$

But $C_i > 0$ and $\frac{d\delta RS_i}{dC_i} > 0$, since retirement savings increase with the increase in total employee-employer contributions. Thus,

$$\left(\frac{1}{\delta RS_i}\left(\frac{d\delta RS_i}{dC_i} \right) + \frac{\sqrt{b}}{C_i} \right) > 0.$$

It is therefore required that

$$\left(\frac{1}{\delta RS_i}\left(\frac{d\delta RS_i}{dC_i} \right) - \frac{\sqrt{b}}{C_i} \right) < 0, \text{ or } \frac{C_i}{\delta RS_i}\left(\frac{d\delta RS_i}{dC_i} \right) < \sqrt{b}.$$

If the variation in retirement savings with the increase in total employee-employer contributions is inelastic, then there exists a strict upper bound for the elasticity coefficient as $b < 1$. In particular, let $0 < b < 1$. Thus,

$$\frac{C_i}{\delta RS_i}\left(\frac{d\delta RS_i}{dC_i} \right) < 1 \text{ so that } \frac{d\delta RS_i}{\delta RS_i} < \frac{dC_i}{C_i}.$$

This completes the proof.

By the assertion in Proposition 1, it becomes imperative to estimate the elasticity coefficient, b, of pension funds managed by a PFA. To estimate b it is pertinent to use data for total retirement savings and employee-employer contributions from a cross-section of employees whose pension funds are managed by the same PFA. Suppose we have data available for N individual employees. Then, we can rewrite equation (2) as

$$\log \delta RS_i = a + b \log C_i + \in_i,\ i = 1, 2, \cdots, N, \tag{3}$$

where $\in_i$ is the i^{th} error term. The error term $\in_i$ is included in the model to accommodate errors that may arise due to misspecification of the model and approximations whenever the natural logarithmic values are irrational. Taking $\mathbf{\Phi}$ as an $N \times 1$ vector with its entry being the natural logarithm of the C_i's and $\mathbf{N}^{\sim}$ as an $N \times 1$ vector with its entry being the natural logarithm of the δRS_i's, equation (3) in matrix-vector notation becomes

$$\mathbf{N}^{\sim} = [\mathbf{e}',\ \mathbf{\Phi}]\begin{bmatrix} a \\ b \end{bmatrix} + \in, \tag{4}$$

where $\in = [\in_1\ \ \in_2\ \ \ldots\ \ \in_N]'$ and $\mathbf{e}'$ is an $N \times 1$ vector of ones. Equation (4) is the econometric model for determining a viable pension scheme. We estimate the constants a and b in equation (4) using the least squares method as follows

$$\in'\in = \left(\mathbf{N}^{\sim} - [\mathbf{e}',\ \mathbf{\Phi}]\begin{bmatrix} a \\ b \end{bmatrix} \right)'\left(\mathbf{N}^{\sim} - [\mathbf{e}',\ \mathbf{\Phi}]\begin{bmatrix} a \\ b \end{bmatrix} \right) = \left(\mathbf{N}^{\sim} - [a\ ,\ b]\begin{bmatrix} \mathbf{e}' \\ \mathbf{\Phi} \end{bmatrix} \right)\left(\mathbf{N}^{\sim} - [\mathbf{e}',\ \mathbf{\Phi}]\begin{bmatrix} a \\ b \end{bmatrix} \right),$$

$$= \mathbf{N}^{\sim}\mathbf{N}^{\sim} - 2[a\ ,\ b]\begin{bmatrix} \mathbf{e}' \\ \mathbf{\Phi} \end{bmatrix}\mathbf{N}^{\sim} + [a\ ,\ b]\begin{bmatrix} \mathbf{e}' \\ \mathbf{\Phi} \end{bmatrix}[\mathbf{e}',\ \mathbf{\Phi}]\begin{bmatrix} a \\ b \end{bmatrix}.$$

Taking partial derivatives of the sum of squared errors $\in'\in$ with respect to a and b, and then setting the derivatives to zero, we obtain the following results:

$$\hat{b} = [0\ ,\ 1]\left(\begin{bmatrix} \mathbf{e}' \\ \mathbf{\Phi} \end{bmatrix}[\mathbf{e}',\ \mathbf{\Phi}] \right)^{-1}\begin{bmatrix} \mathbf{e}' \\ \mathbf{\Phi} \end{bmatrix}\mathbf{N}^{\sim}, \tag{5}$$

and

$$\hat{a} = [1\ ,\ 0]\left(\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}[\mathbf{e}'\ ,\ \mathbf{\Phi}]\right)^{-1}\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}\mathbf{N}^{\sim}. \tag{6}$$

The significance of the estimated elasticity coefficient, $\hat{b}$, is obtained by testing the hypothesis $H_0 : b = 1$ against $H_{1a} : b < 1$ if $\hat{b} < 1$, or against $H_{1b} : b > 1$ if $\hat{b} > 1$, using the t-test statistic where the t-value, $t_{cal}(\hat{b})$, is computed as

$$t_{cal}(\hat{b}) = (\mathbf{cov}(2,2))^{-0.5}\left([0\ ,\ 1]\left(\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}[\mathbf{e}'\ ,\ \mathbf{\Phi}]\right)^{-1}\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}\mathbf{N}^{\sim} - 1\right), \tag{7}$$

$\mathbf{cov}(2,2)$ is the $(2,2)$ diagonal entry in the 2×2 variance-covariance matrix

$$\mathbf{cov} = \frac{1}{N-2}\left(\mathbf{N}^{\sim\prime}\left(\mathbf{I} - [\mathbf{e}'\ ,\ \mathbf{\Phi}]\left(\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}[\mathbf{e}'\ ,\ \mathbf{\Phi}]\right)^{-1}\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}\mathbf{N}^{\sim}\right)\left(\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}[\mathbf{e}'\ ,\ \mathbf{\Phi}]\right)^{-1}, \tag{8}$$

and $\mathbf{I}$ is an $N\times N$ identity matrix. The trend in the variation of the total retirement savings for each individual employee is estimated as

$$\delta\hat{R}S_i = \exp\left([1\ ,\ \log C_i]\left(\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}[\mathbf{e}'\ ,\ \mathbf{\Phi}]\right)^{-1}\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}\mathbf{N}^{\sim}\right). \tag{9}$$

To validate the model, we determine the percentage of the variation in total retirement savings explained by the employee-employer contributions using the statistic R^2:

$$R^2 = \frac{\mathbf{N}^{\sim}[\mathbf{e}'\ ,\ \mathbf{\Phi}]\left(\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}[\mathbf{e}'\ ,\ \mathbf{\Phi}]\right)^{-1}\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}[\mathbf{e}'\ ,\ \mathbf{\Phi}]\left(\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}[\mathbf{e}'\ ,\ \mathbf{\Phi}]\right)^{-1}\begin{bmatrix}\mathbf{e}'\\ \mathbf{\Phi}\end{bmatrix}\mathbf{N}^{\sim} - \frac{(\mathbf{e}\mathbf{N}^{\sim})^2}{N}}{\mathbf{N}^{\sim\prime}\mathbf{N}^{\sim} - \frac{(\mathbf{e}\mathbf{N}^{\sim})^2}{N}}, \tag{10}$$

as well as the overall significance of the model using the F-test statistic:

$$F_{cal} = \frac{(N-2)R^2}{1-R^2}. \tag{11}$$

3.0 Numerical illustration

In this section, we demonstrate the utility of the models given in Section 2 using data obtained from a PFA. On the grounds of anonymity, we do not mention the registered trademark of the PFA. The PFA charges an administration fee of ₦100 monthly which is deducted from each employee's contribution. In addition, investment management fees are charged and included in the unit price of the fund. These charges are subject to change from time to time as they are regulated by PenCom. The pension manager may invest up to 25% of the pension in the stock market. Consequent upon this, the retirement savings fluctuate over time so much so that the past performance of the retirement savings is not a guarantee of it future performance. Table 3 contains the gain/loss in total retirement savings and the total employee-employer contributions of twelve employees, whose contributory pensions are managed by the PFA from the period 1st May, 2006 to 30th June, 2011.

Table 3: Gain/loss in retirement savings and the employee-employer contributions

Employee	Gain/loss in retirement savings	Employee-employer contributions
1	272054.97	1226435.74
2	636309.90	2632371.58
3	116222.72	662723.26
4	264408.43	1192243.84
5	289431.72	1195982.67
6	615602.99	2827055.94
7	497716.39	2098184.70
8	119681.30	477613.68
9	953104.60	4049814.82
10	544451.79	2337176.94
11	38363.62	183560.40
12	353242.58	1557466.85

Source: Pensions retirement savings account for various employees of a PFA.

Using the information in Table 3, we estimate the coefficient of elasticity for the PFA in Matlab R2007b environment (see appendix) as $\hat{b} = 1.039$, and the arbitrary constant as $\hat{a} = -2.0399$. The value $\hat{b} = 1.039$ indicates that greater gain in retirement savings is achieved by the periodic increase in employee-employer contributions. The variance of $\hat{b}$ is obtained as $\mathbf{cov}(2,2) = 0.001$. The estimated trend in variation of total retirement savings vis-a-vis the total employee-employer contributions (to four decimal places) is given as

$$\delta\hat{R}S_i = \exp\left([1\ ,\ \log C_i] \begin{pmatrix} 23.9482 & -1.6952 \\ -1.6952 & 0.1204 \end{pmatrix} \begin{bmatrix} 0.1510 \\ 2.1351 \end{bmatrix} \times 10^3 \right). \qquad (12)$$

The computed statistics are given as: $t_{cal}(\hat{b}) = 1.2224$, $R^2 = 0.9907$, $F_{cal} = 1.0608 \times 10^3$. The F-value, $F_{cal} = 1.0608 \times 10^3$, is very large and over 99% ($R^2 = 0.9907$) of the variation in total retirement savings are explained by the employee-employer contributions. Thus, the model is significant. Since $\hat{b} = 1.039 > 1$, we perform a one-tailed t-test at the 5% significance level using the hypotheses: $H_0 : b = 1$ against $H_{1b} : b > 1$. The t-value, $t_{cal}(\hat{b}) = 1.2224$, indicates that the elasticity coefficient of the variation in total retirement savings with respect to the employee-employer contributions, $\hat{b} = 1.039$, is not significantly elastic at the 5% level. Conversely, the constant term, $\hat{a} = -2.0399$, is significant at the 5% level (by executing the Matlab program in the appendix). Evaluation of the right-hand side of equation (12) shows that a fixed value of about 13% ($\exp(-2.0399)$) of the employee-employer contributions is added to the portfolio value of pension funds managed by the PFA. From these results, we infer that the total retirement savings increase proportionally with the increase in employee-employer contributions during the period under investigation. In this regard, employees whose pension funds are managed by the PFA may have reasons to doubt the ability of the CPS to provide adequate, affordable, sustainable and robust income after retirement.

4. Conclusion

This study highlights pension schemes in Nigeria with particular reference to the new pension scheme, i.e. the contributory pension scheme (CPS). Although the study identified that the CPS is fully funded, yet there is poor perception among employees on the viability of the CPS. In view of this, we propose a necessary condition for a pension scheme to generate a robust retirement income based on the concept of elasticity in microeconomic theory. The variables considered are the variation in total retirement savings and the employee-employer contributions. We use our proposal to evaluate the viability of the CPS using data obtained from a PFA in Nigeria. Thus, we found that: the total retirement savings increase proportionally with the increase in employee-employer contributions and the value of elasticity coefficient of the retirement savings with respect to the employee-employer contributions is not significantly elastic at the 5% level. Based on these findings, we make the following recommendations:

a. vigorous enlightenment campaign: employees and employers of labour should be properly sensitized on the benefits of the contributory pension scheme. This will not only motivate more workers to register with PFAs, but also increase the funds available for investment.
b. proper monitoring and implementation: the government should put strict measures in place to ensure proper monitoring and implementation of the provisions of the Pension Reform Act 2004.
c. investment in more profitable ventures: PFAs should engage asset management experts to identify profitable ventures for possible investment. This is essential to enhance the returns to the RSA.

If these recommendations are adhered to, it will further strengthen the confidence of employees on the new pension scheme and increase total retirement savings.

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Appendix: The Matlab R2007b codes for estimating and analyzing the econometric model

```
%Declaration of data.
RS=[272054.97 636309.90 116222.72 264408.43 289431.72 615602.99 497716.39 119681.30 953104.60 544451.79
38363.62 353242.58]';
C=[1226435.74 2632371.58 662723.26 1192243.84 1195982.67 2827055.94 2098184.70 477613.68 4049814.82 2337176.94
183560.40 1557466.85]';

%Logarithmic transformation of the dataset.
LY=log(RS), e=ones(12,1); LX=[e log(C)],

%Least squares estimates of the regression parameters.
betahat=inv(LX'*LX)*LX'*LY,
%Estimate of the elasticity coefficient.
b1=[0 1]*betahat,

%t-test for the significance of parameters.
I=eye(12); N=length(RS); p=length(betahat); s=inv(LX'*LX);
se=sqrt((LY'*(I-LX*s*LX')*LY)/(N-p)),
covbeta=(se^2)*s,
tcal0=([1 0]*betahat)/sqrt(covbeta(1,1)),
tcal1=(([0 1]*betahat-1))/sqrt(covbeta(2,2)),
tTab1=2.718; tTab2=1.796;

%Decision rule.
if abs(tcal0)>3.106
   disp('Reject H0: the constant term is significant at 1% level')
else
   if abs(tcal0)<3.106
      disp('We do not reject H0: the constant term is not significant at 1% level')
   end
end

if abs(tcal0)>2.201
   disp('Reject H0: the constant term is significant at 5% level')
else
   if abs(tcal0)< 2.201
      disp('We do not reject H0: the constant term is not significant at 5% level')
   end
end

if tcal1>tTab1
   disp('Reject H0: the elasticity coefficient is significantly elastic at 1% level')
else
   if tcal1<tTab1
      disp('We do not reject H0: the elasticity coefficient is not significantly elastic at 1% level')
   end
end

if tcal1>tTab2
   disp('Reject H0: the elasticity coefficient is significantly elastic at 5% level')
else
   if tcal1<tTab2
      disp('We do not reject H0: the elasticity coefficient is not significantly elastic at 5% level')
   end
end
```

```
Rsquare=(betahat'*LX'*LX*betahat-N*(mean(LY))^2)/(LY'*LY-N*(mean(LY))^2),

Fcal=(N-2)*Rsquare/(1-Rsquare),
Ftab=4.84;

if Fcal>Ftab
   disp('Reject H0: the model is significant at 5% level')
else
   if Fcal<Ftab
      disp('We do not reject H0: the model is not significant at 5% level')
   end
end
```

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