Wydział Nauk Ekonomicznych i Zarządzania
Uniwersytetu Szczecińskiego

Folia Oeconomica Stetinensia
DOI: 10.2478/v10031-008-0029-4

CONSIDERATIONS CONCERNING THE IMPACT OF PROPENSITIES ON BASIC MACROECONOMIC OCCURRENCES

Mariusz Doszyń, Ph.D.

Department of Econometrics and Statistics
Faculty of Economics and Management
University of Szczecin
Mickiewicza 64, 71–101 Szczecin
e-mail: mariusz.doszyn@gmail.com

Received 7 May 2008, Accepted 20 October 2008

Abstract

In the article theoretical deliberations relating to impact of propensities on basic macroeconomic phenomena were presented. A general definition of propensity was discussed. The influence of propensity for consumption, propensity for investment and propensity for thesaurization on national income, interest rates, consumption expenditures, investments and money supply was analyzed. Derivatives that make it possible to identify quantitative effects of propensities were introduced. On the basis of the discussed Keynesian model it is possible to say that the propensity to consume increases interest rate and national income, the propensity to invest makes investments, national income and interest rates higher and the propensity for thesaurization could increase interest rates by lowering money supply.

Keywords: propensities, propensity for consumption, propensity for investment, propensity for thesaurization, Keynesian models.

JEL numbers: E12, E21, E22, E51.

Most economical processes depend on objective and subjective factors. Objective factors are crucial but they should be corrected with respect to propensities, emotions, etc. It is important both on the microeconomic and macroeconomic level. Every society (and every person) is different so the impact of objective elements on economical events is diversified and correlated with personality traits that determine propensities.

Propensity could be defined as a 'slope of posture' to something (or somebody) that makes probabilities of certain events higher (Hozer, Doszyń, 2004). Propensities cause the analyzed events occurring in given objective circumstances to be more probable. For instance, consumption expenditures of two persons in the same objective situation (the same incomes and prices) are usually different because of various propensities to consume that affect behaviors. In many cases a propensity is a factor that increases the frequency of certain occurrences. Deterministic equations describing basic macroeconomic variables that make allowance for propensities could be written as follows[1]:

$$c_t = c(y_t, r_t) + s_c \tag{1}$$

$$i_t = f(y_t, r_t) + s_i \tag{2}$$

$$m_t = l(y_t, r_t) - s_t \tag{3}$$

$$y_t = c_t + i_t \tag{4}$$

where:

c_t – consumption level in period t,

$c(y_t, r_t)$ – consumption function with income (y_t) and interest rate (r_t) as an independent variables,

s_c – propensity to consume,

i_t – investments,

$f(y_t, r_t)$ – investment function,

s_i – propensity to invest,

m_t – money supply,

$l(y_t, r_t)$ – money demand function,

s_t – propensity for thesaurization (liquidity preference).

In equations (1)-(4), among such objective factors as national income (y_t) and an interest rate (r_t), subjective elements (propensities) were also involved. This attitude to propensities is different than Keynes' proposals. According to J. M. Keynes[2] the average

propensity to consume (invest) could be understood as a share of consumption (investment) expenditures in income. This is rather the rate of consumption (investment) that depends on the propensity to consume (invest) but it is not identical with it.

The propensity to consume could be defined as a 'slope of posture' towards acts of purchasing that increase the probability of consumption. The propensity to invest and to thesaurize could be defined in the same way. The propensity to invest makes the probability of investment for given objective factors higher. The propensity for thesaurization increases the probability of money storing (apart from the objective factors). The propensity for thesaurization could induce higher interest rates. Propensities depend on personal orientations that make them stable.

The equations (1)-(4) could be rewritten in the following way:

$$c(y_t, r_t) - y_t + i_t = -s_c, \tag{5}$$

$$f(y_t, r_t) - i_t = -s_i, \tag{6}$$

$$l(y_t, r_t) = (m_t + s_t) = p_t. \tag{7}$$

In the presented analysis it has been assumed that s_c, s_i and $p_t = m_t + s_t$ are parameters affecting consumption, investment and income.

The Jacobian of the presented system has to be different than zero:

$$J = \begin{vmatrix} \frac{dc}{dr_t} & \frac{dc}{dy_t} - 1 & 1 \\ \frac{df}{dr_t} & \frac{df}{dy_t} & -1 \\ \frac{dl}{dr_t} & \frac{dl}{dy_t} & 0 \end{vmatrix} = \left(1 - \frac{dc}{dy_t}\right)\frac{dl}{dr_t} + \frac{df}{dr_t}\frac{dl}{dy_t} - \frac{df}{dy_t}\frac{dl}{dr_t} + \frac{dl}{dy_t}\frac{dc}{dr_t} \neq 0 \tag{8}$$

The Jacobian is the determinant of matrix of all first-order partial derivatives of the specified functions. It is possible to analyze economical occurrences with respect to propensities by means of implicit functions. The dependencies (5)-(7) constitute system of implicit functions that could be solved with respect to the parameters s_c, s_i and p_t:

$$r_t = r(s_c, s_i, p_t), \tag{9}$$

$$y_t = y(s_c, s_i, p_t), \tag{10}$$

$$i_t = i(s_c, s_i, p_t). \tag{11}$$

The impact of propensities and money supply (corrected with respect to the propensity for thesaurization s_t) could be analyzed on the basis of the following derivatives:

$$\frac{dr_t}{ds_c} = \frac{-dl/dy_t}{J}, \tag{12}$$

$$\frac{dr_t}{ds_i} = \frac{-dl/dy_t}{J}, \tag{13}$$

$$\frac{dr_t}{dp_t} = \frac{1-dc/dy_t - df/dy_t}{J}, \tag{14}$$

$$\frac{dy_t}{ds_c} = \frac{dl/dr_t}{J}, \tag{15}$$

$$\frac{dy_t}{ds_i} = \frac{dl/dr_t}{J}, \tag{16}$$

$$\frac{dy_t}{dp_t} = \frac{df/dr_t + dc/dr_t}{J}, \tag{17}$$

$$\frac{di_t}{ds_c} = \frac{df/dy_t \cdot dl/dr_t - df/dr_t \cdot dl/dy_t}{J}, \tag{18}$$

$$\frac{di_t}{ds_i} = \frac{(1-dc/dy_t)\cdot dl/dr_t + dc/dr_t \cdot dl/dy_t}{J}, \tag{19}$$

$$\frac{di_t}{dp_t} = \frac{df/dy_t \cdot (df/dr_t + dc/dr_t) + df/dr_t \cdot (1-dc/dy_t - df/dy_t)}{J}. \tag{20}$$

According to the Keynesian theory it is assumed that:

$$0 < \frac{dc}{dy_t} < 1 \text{ and } \frac{dc}{dr_t} > 0 \vee \frac{dc}{dr_t} < 0 \vee \frac{dc}{dr_t} = 0, \tag{21}$$

$$\frac{df}{dy_t} > 0 \text{ and } \frac{df}{dr_t} < 0, \tag{22}$$

$$\frac{dl}{dy_t} > 0 \text{ and } \frac{dl}{dr_t} < 0. \tag{23}$$

The derivatives computed in relation to the parameter $p_t = m_t + s_t$ show how the changes in money supply (m_t), impact interest rate (r_t), income (y_t) and investment (i_t) take place with the premise that propensity for thesaurization (s_t) is constant. It is possible

that an increasing propensity for thesaurization could absorb money and make money supply smaller and interest rates higher.

The equations (1)-(3) could be estimated by means of econometric methods with the use of real data. This approach gives the possibility to compute the presented derivatives and make judgments about the influence of propensities on the analyzed macroeconomic variables. The signs of derivatives (12)-(20) could be also identified by means of the dynamic Keynesian model proposed by P.A. Samuelson[3].

In a model presented by P.A. Samuelson[4] it is assumed that planned (*ex ante*) investments $\left(i_t^a\right)$ and savings $\left(s_t^a\right)$ are different from real investments $\left(i_t\right)$ and real savings $\left(s_t\right)$:

$$s_t^a = s_t = i_t \neq i_t^a . \tag{24}$$

The changes in the national income are proportional to differences among expected and true investments:

$$\frac{dy_t}{dt} = i_t^a - i_t . \tag{25}$$

The dynamic model could be written as a system of differential equations:

$$\begin{cases} \dfrac{dy_t}{dt} = i_t - \left[y_t - c\left(y_t, r_t\right) - s_c\right] \\ f\left(y_t, r_t\right) - i_t + s_i = 0 \\ l\left(y_t, r_t\right) - p_t = 0 \end{cases} . \tag{26}$$

The solution of scheme (26) is as follows:

$$y_t = \bar{y}_t + A_1 e^{\lambda t} , \tag{27}$$

$$r_t = \bar{r}_t + A_2 e^{\lambda t} , \tag{28}$$

$$i_t = \bar{i}_t + A_3 e^{\lambda t} , \tag{29}$$

where:

$\bar{y}_t$, $\bar{r}_t$, $\bar{i}_t$ – specific integers of system (26),

A_1, A_2, A_3 – constants obtained for given initial conditions,

λ – root of characteristic equation:

$$\Delta(\lambda)=\begin{vmatrix} \frac{dc}{dr_t} & \frac{dc}{dy_t}-1-\lambda & 1 \\ \frac{df}{dr_t} & \frac{df}{dy_t} & -1 \\ \frac{dl}{dr_t} & \frac{dl}{dy_t} & 0 \end{vmatrix}=J+\lambda\frac{dl}{dr_t}=0. \tag{30}$$

The stability of the system requires that $\lambda<0$ where $\lambda=-\frac{J}{dl/dr_t}$. The Jacobian has to be negative $(J<0)$ because $dl/dr_t<0$. This makes it possible to identify the signs of derivatives (12), (13), (15) and (16):

$$\frac{dr_t}{ds_c}=\frac{-dl/dy_t}{J}>0, \tag{31}$$

$$\frac{dr_t}{ds_i}=\frac{-dl/dy_t}{J}>0, \tag{32}$$

$$\frac{dy_t}{ds_c}=\frac{dl/dr_t}{J}>0, \tag{33}$$

$$\frac{dy_t}{ds_i}=\frac{dl/dr_t}{J}>0. \tag{34}$$

On the basis of the dependencies (31)-(34) it is possible to say that both the propensity to consume (s_c) and the propensity to invest (s_i) make the interest rate (r_t) and the national income (y_c) higher.

In order to identify impact of money supply on the interest rate it has been assumed that the interest rate is constant so the function of liquidity preference has been omitted. In such a case the system (26) is reduced to the following form[5]:

$$\begin{cases} \frac{dy_t}{dt}=i_t-\left[y_t-c(y_t,r_t)-s_c\right] \\ f(y_t,r_t)-i_t+s_i=0 \end{cases}. \tag{35}$$

A characteristic equation of (35):

$$\Delta(\lambda)=\begin{vmatrix} \frac{dc}{dy_t}-1-\lambda & 1 \\ \frac{df}{dy_t} & -1 \end{vmatrix}=1-\frac{dc}{dy_t}+\lambda-\frac{df}{dy_t}=0. \tag{36}$$

Stability requires that $-\lambda = 1 - \frac{dc}{dy_t} - \frac{df}{dy_t} > 0$ because $\lambda < 0$. It is possible to establish the sign of the next (14) derivative:

$$\frac{dr_t}{dp_t} = \frac{1 - dc/dy_t - df/dy_t}{J} < 0 . \tag{37}$$

Higher money supply (m_t) causes lower interest rate (r_t) (with premise that the propensity for thesaurization (s_t) is constant). It is worth to remember that sometimes higher propensity for thesaurization (s_t) could absorb changes in money supply.

Assuming that the interest rate and savings are positively correlated, the $dc/dr_t < 0$ signs of derivatives (17), (19) and (20) could be determined:

$$\frac{dy_t}{dp_t} = \frac{df/dr_t + dc/dr_t}{J} > 0 , \tag{38}$$

$$\frac{di_t}{ds_i} = \frac{(1 - dc/dy_t) \cdot dl/dr_t + dc/dr_t \cdot dl/dy_t}{J} > 0 , \tag{39}$$

$$\frac{di_t}{dp_t} = \frac{df/dy_t \cdot (df/dr_t + dc/dr_t) + df/dr_t \cdot (1 - dc/dy_t - df/dy_t)}{J} > 0 . \tag{40}$$

Higher money supply (if the propensity for theasurization is constant) increases the national income and investments. The propensity to invest results in investments being higher. It is difficult to establish the sign of derivative (18).

Summing up, the identification of the impact of propensities on basic macroeconomic variables is possible with the use of the system of equations presented as implicit functions. Propensities could be defined as a 'slope of posture' to something (or somebody) that makes probabilities of certain events higher[6].

On the basis of the discussed Keynesian model it is possible to say that:

- the propensity to consume increases interest rates and the national income,
- the propensity to invest makes investments, national income and interest rates higher,
- the propensity for thesaurization could increase interest rates by limiting money supply.

Notes

[1] Equations (1)-(4) were constructed on the basis of models presented in Jakimowicz (2005), Samuelson (1970).

[2] Keynes (2003).

[3] See Jakimowicz (2005), p.221-223.

[4] Samuelson (1970).

[5] Jakimowicz (2005), p.223.

[6] See Hozer (2004).

References

Hozer, J. & Doszyń, M. (2004). *Ekonometria skłonności.* Warszawa: PWE.

Jakimowicz, A. (2005). *Od Keynesa do teorii chaosu.* Warszawa: PWN.

Keynes, J.M. (2003). *Ogólna teoria zatrudnienia, procentu i pieniądza.* Warszawa: PWN.

Samuelson, P.A. (1970). *Foundations of Economic Analysis.* New York: Atheneum.