行政院國家科學委員會專題研究計畫　成果報告

消費外部性與經濟成長

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計畫參與人員：陳榮峻、高正吉、吳月賢

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行政院國家科學委員會補助專題研究計畫 ■ 成 果 報 告
□期中進度報告

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計畫類別：■ 個別型計畫　　□ 整合型計畫
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中文摘要及關鍵詞

摘要:

Lucas (1993)曾以南韓和菲律賓的資料為例指出，這兩國的期初條件(initial condition)是如此相似，但他們往後的成長現象確有如此鮮明的差異，許多經濟學家因此提出「多重收斂路徑」的理由來解釋這個發現。所謂的多重收斂路徑指的是經濟體系呈現出全域安定的動態性質，也就是經濟體系跳躍變數的個數小於正的特性根個數，因此經濟體系存在無數多條路徑可以收斂到均衡值。然而，大多的經濟學家多將「多重收斂路徑」發生的原因指向生產面的因素或是政府政策的差異。本文與既存文獻不同的地方在於強調消費面的外部性也可能造成經濟體系發生「多重收斂路徑」。本文將消費會累積消費習慣的觀念納入內生成長模型中，強調以往的消費經驗會累積消費習慣，進而影響民眾現在消費水準。此外，為了與強調生產面外部性重要性的既存文獻作一區隔，我們忽略掉所有形式的生產面外部性，因此在生產面採用最簡單的 *AK* 形式的生產函數，藉此凸顯出消費外部性的重要性。利用這個僅強調消費面外部性的模型，本文發現消費外部性的存在是導致經濟體系呈現出全域安定的特質，也就是經濟體系存在無限多組的路徑都可以收斂到長期均衡值。

關鍵詞：沈溺行為、內生成長、多重收斂路徑、消費習慣

英文摘要及關鍵詞

Abstract

Indeterminacy means that there will be multiple paths converging to a given steady state. One of the novel features of the most existing literatures are that it emphasizes the *supply-side* factors are crucial to emerge indeterminacy. In contrast to the existing literatures, this paper sharpens that consumption externality may be a source of indeterminacy. Using an AK-type endogenous growth model in which the consumer's preference is subject to habitual consumption, it is found that indeterminacy can arise in a simple *AK*-type growth model when consumption externality is present.

Key words: addictions; endogenous growth; indeterminacy; habits.

1. Introduction

The presence of indeterminacy has been one of major research in recent years. (Locally) Indeterminacy means that there will be multiple paths converging to a given steady state. One of the novel features of the most existing literatures are that it emphasizes the *supply-side* factors are crucial to emerge indeterminacy.[1] For example, Benhabib and Farmer (1994) and Farmer and Guo (1994) propose that indeterminacy arises in dynamic economies that exhibits an increasing-return technology. Bond et al. (1996) and Raurich (2001) show that asymmetric factor taxation will get indeterminacy.

The purpose of this paper is to examine the role of consumption externality in affecting the dynamic properties of macroeconomics. The relevant literature on the consumption externality has recently been expanding and developing at a rapid place. In his pioneering paper, Duessenberry (1949) posits that the consumption experience of overall previous periods generates a *demonstration effect* on the current consumption behavior. Becker and Murphy (1988) develop a theory of rational addiction which emphasizes that a learning-by-doing effect does work in the process of consumption. Specifically, when the agent gets used to the consumption pattern formed in the past, his preference is then related to this consumption experience. More recently, Carroll et al. (2000) and Shieh et al. (2000), assume that the subject that consumer's preference is subject to habitual consumption, and use it to discuss the habit persistence in governing the rate of economic growth.

To our best knowledge, Weder (2000) constructs a two sector model with consumption externality, and use it to show that consumption externality will reduce the degree of increasing returns needed to generate indeterminacy. Although, Weder (2000) tell the similar story as this paper does, however, he specifies the consumption externality as "catching up with the Joneses" (or an external criterion), in which individual try to keep up with the norms of the social group or

[1] Cazzavillan (1996) is few exceptions. He stresses that the government consumption expenditure can emerge indeterminacy.

the average level of consumption for all households. Departing from Weder (2000), this paper put our attention on an inward looking consumption externality (i.e., habit formation), in which individuals care own past consumption levels. In order to sharpen the role of habit persistency in affecting the dynamic properties of macroeconomics, in constructing the analytical framework we do not take into account any production externalities.

The rest of this paper proceeds as follows. Section 2 constructs the analytical framework. More importantly, we discuss the dynamic properties of the macro system. Finally, Section 3 concludes the paper.

2. The Model

Following Becker and Murphy (1988), Obstfeld (1992) and Orphanides and Zervos (1995), we assume that the representative agent not only cares about the current consumption, but also is concerned with the consumption experience from the past. Accordingly, the representative agent's discounted lifetime utility can be expressed as:

$$\int_0^{\infty} U(c,S)e^{-\rho t}dt, \tag{1}$$

where U is the instantaneous utility function, c is the consumption of goods, S is the habitual stock, and ρ is the rate of time preference.

The instantaneous utility function is specified as follows:

$$U(c,S)=\frac{(cS^{\eta})^{1-\sigma}-1}{1-\sigma}, \tag{2}$$

where σ is the inverse of the elasticity of intertemporal substitution. In order to satisfy $U_c>0$ and $U_{cc}<0$, we impose the restriction $\sigma>0$. Moreover, in line with Becker and Murphy (1988), we specify that $\eta<0$ ($\eta>0$) when consumption habits are harmful (beneficial) to the representative agent.[2] Moreover, $\eta[\eta-\sigma(1+\eta)]>0$ is imposed to ensure that the utility

[2] It follows from equation (2) that:

$$\frac{\partial U}{\partial S}=\eta c^{1-\sigma}S^{\eta(1-\sigma)-1}\gtreqless 0;\ \ if\ \eta\gtreqless 0$$

Since harmful habits of smoking, alcohol, cocaine, and heroin, for example, are detrimental to an agent's health or

function is concave in the quantities, c and S.

Following Ryder and Heal (1973), Obstfeld (1992), and Mansoorian (1996) specify that the habitual stock is formed by a weighted average flow of overall past consumption, we specify that the habitual stock S evolves according to the following manner:

$$\dot{S} = \beta(c - S);\ \beta > 0, \tag{3}$$

where β is the rate of habitual adjustment.

In order to sharpen the impact of consumption habits on economic growth, in constructing the analytical framework we do not take into account production externalities. Accordingly, following Barro (1990) and Rebelo (1991), we specify that output y is produced by using a stock of broad-concept capital, k, that is $y = Ak$ ($A > 0$). The consumer's budget constraint can then be expressed by:

$$\dot{k} = Ak - c. \tag{4}$$

From equations (1)-(4) the current-value Hamiltonian function, H, is given by:

$$H = \frac{(cS^{\eta})^{1-\sigma} - 1}{1-\sigma} + \lambda_1(Ak - c) + \lambda_2\beta(c - S),$$

where λ_1 and λ_2 are the co-state variables which can be interpreted as the imputed value of the stock of physical capital and consumption capital, respectively.

The optimum conditions necessary for optimization are:

$$c^{-\sigma} S^{\eta(1-\sigma)} = \lambda_1 - \lambda_2\beta, \tag{5}$$

$$-\dot{\lambda}_1 + \rho\lambda_1 = A\lambda_1, \tag{6}$$

$$-\dot{\lambda}_2 + \rho\lambda_2 = \eta c^{1-\sigma} S^{\eta(1-\sigma)-1} - \lambda_2\beta, \tag{7}$$

together with equations (3) and (4). In addition, the following transversality conditions must be met:

$$\lim_{t\to\infty} \lambda_1 k e^{-\rho t} = 0, \tag{8}$$

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mood, we specify that they generate a negative effect on the agent's utility. The reverse is true for beneficial habits, such as sports and music.

$$\lim_{t\to\infty}\lambda_2 S e^{-\rho t}=0\,. \tag{9}$$

We now turn to discuss the steady-growth equilibrium. Dividing equation (3) by S and equation (4) by k gives:

$$\frac{\dot{S}}{S}=\beta(\frac{c}{S}-1)\,, \tag{3a}$$

$$\frac{\dot{k}}{k}=A-\frac{c}{k}. \tag{4a}$$

In addition, using equations (5), (6), and (7) yields:

$$\frac{\dot{\lambda}_1}{\lambda_1}=\rho-A\,, \tag{6a}$$

$$\frac{\dot{\lambda}_2}{\lambda_2}=\rho+\beta-\eta\frac{c}{S}(\frac{\lambda_1}{\lambda_2}-\beta)\,. \tag{7a}$$

Differentiating equation (5) with respect to time, we have:

$$\frac{\dot{c}}{c}=\frac{1}{\sigma}[\eta(1-\sigma)\frac{\dot{S}}{S}-\theta\frac{\dot{\lambda}_1}{\lambda_1}-(1-\theta)\frac{\lambda_2}{\lambda_2}]\,, \tag{10}$$

where $\theta=\lambda_1/(\lambda_1-\beta\lambda_2)$.

Along a balanced growth path, with $\dot{k}/k$, $\dot{S}/S$, $\dot{\lambda}_1/\lambda_1$, and $\dot{\lambda}_2/\lambda_2$ being constant, it follows that both c/S and c/k must remain constant over time.[3] Let γ be the steady-state growth rate of output. From equations (3a) and (4a) with $y=Ak$, we have $\gamma=\dot{y}/y=\dot{c}/c=\dot{k}/k=\dot{S}/S$, and using equations (6a) and (7a) $\dot{\lambda}_1/\lambda_1=\dot{\lambda}_2/\lambda_2$. Equipped equations (6a), and (10) with the previous information, we have:

$$\gamma=\frac{A-\rho}{\sigma-\eta(1-\sigma)}. \tag{11}$$

Given that the utility function is concave in the quantities, c and S, and that the economy exhibits a positive sustained growth, we then have the restrictions $A-\rho>0$ and $\sigma-\eta(1-\sigma)>0$ ($A-\rho<0$ and $\sigma-\eta(1-\sigma)<0$) if $\eta>0$ ($\eta<0$).

The evolution of the system can proceed as follows. First of all, following Barro and Sala-i-Martin (1995), we define the following three transformed variables: $x=c/S$, and $z=\lambda_1/\lambda_2$.

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[3] It should be noted that ρ, β, η, and A are given parameters.

Using equations (3a), (6a), (7a), and (10), the optimal change in consumption is given by:

$$\frac{\dot{c}}{c} = \frac{-1}{\sigma(z-\beta)}\{(z-\beta)\{\beta\eta[1+\sigma(x-1)]+\rho]\} - Az - \beta^2\}. \quad (10a)$$

We then can use equations (3a), (6a), (7a), and (10a) to derive a dynamic system in terms of the transformed variables, x and y, as follows:

$$\frac{\dot{x}}{x} = \frac{1}{\sigma(z-\beta)}\{Az + \beta^2 - (z-\beta)[\beta\eta + \sigma\beta(1+\eta)(x-1)+\rho]\}, \quad (12)$$

$$\frac{\dot{z}}{z} = \eta x(z-\beta) - \beta - A. \quad (13)$$

At steady-growth equilibrium, the economy is characterized by $\dot{x} = \dot{z} = 0$, and x and z are at their stationary levels, namely x^* and z^*. Next, linearizing equations (12) and (13) around the steady-state equilibrium, we have:

$$\begin{bmatrix}\dot{x}\\ \dot{z}\end{bmatrix} = \begin{bmatrix}a_{11} & a_{12}\\ a_{21} & a_{22}\end{bmatrix}\begin{bmatrix}x-x^*\\ z-z^*\end{bmatrix}, \quad (14)$$

where $a_{11} = -\beta x^*(1+\eta)$, $a_{12} = x^*\{A-\rho-\beta[\eta+\sigma(1+\eta)(x^*-1)]\}/\sigma(z^*-\beta)$, $a_{21} = \eta z^*(z^*-\beta)$, and $a_{22} = \eta x^* z^*$.

Let ν_1 and ν_2 be the two characteristic roots of the dynamic system. From equation (14), we then have:

$$\nu_1 + \nu_2 = a_{11} + a_{22} = x^*[\eta(z^*-\beta) - \beta], \quad (15)$$

$$\nu_1\nu_2 = a_{11}a_{22} - a_{12}a_{21} = -\frac{\eta x^* z^*}{\sigma}\{\beta[\sigma - \eta(1-\sigma)] + A - \rho\}. \quad (16)$$

Substituting equation (3a) into (7a) into the transversality condition stated in equation (9), we then have $x^*[\beta - \eta(z^*-\beta)] < 0$. Accordingly, $\nu_1 + \nu_2 > 0$ can be derived. In addition, given that utility function is concave in the quantities, c and S, and that the economy exhibits a positive sustained growth, we have $\nu_1\nu_2 < 0$. Obviously, the two characteristic roots of the system are of *opposite* signs. This implies that the system displays the *saddlepoint stability*. As claimed by the literature of dynamic rational expectations models, e.g., Burmeister (1980), Buiter (1984) and Turnovsky (1995), if the number of positive roots is less than the number of jump variables, then the analysis will involve the problem of *nonuniqueness*. Since the dynamic system consisting of equations (14) involves two jumping variables, x and z, but the

dynamic system with one unstable root, there may bring the non-unique problem (local indeterminacy).

3. Concluding Remarks

The vast body of literature on the source of emerging indeterminacy of equilibrium, however, is often only stressed the supply-side factors and aspect concerning the demand-side factors are frequently neglected. The purpose of this paper is to examine the role of habit persistency in governing the indeterminate equilibria in dynamic general equilibrium models. Based on our analyzing, it finds that local indeterminacy will emerge even in the simple *AK* type endogenous growth model when habit persistency is present. This finding is in contrast to the existing literatures.

Appendix

This Appendix provides a detailed derivation of equation (10a) in the text. Differentiating equation (5) in the text with respect to time yields:

$$(c^{-\sigma} S^{\eta(1-\sigma)})[-\sigma \frac{\dot{c}}{c} + \eta(1-\sigma)\frac{\dot{S}}{S}] = \dot{\lambda}_1 - \beta\lambda_2 . \quad \text{(A1)}$$

Substituting equation (5) into equation (A1) gives:

$$-\sigma \frac{\dot{c}}{c} + \eta(1-\sigma)\frac{\dot{S}}{S} = \theta \frac{\dot{\lambda}_1}{\lambda_1} + (1-\theta)\frac{\lambda_2}{\lambda_2}, \quad \text{(A2)}$$

where $\theta = \lambda_1 /(\lambda_1 - \beta\lambda_2)$. Then, rearranging equation (A2), we have:

$$\frac{\dot{c}}{c} = \frac{1}{\sigma}[\eta(1-\sigma)\frac{\dot{S}}{S} - \theta\frac{\dot{\lambda}_1}{\lambda_1} - (1-\theta)\frac{\lambda_2}{\lambda_2}], \quad \text{(A3)}$$

Substituting equations (3a), (6a), and (7a) into (A3), we can derive equation (10a).

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計畫成果自評

1. 文獻上指出，當模型將勞動休閒決策納入考量時，將很容易造成經濟體系多重收斂路徑現象，原先編寫計畫書時的構想是想檢視消費外部性對於多重收斂路徑現象的影響。然而，在實際執行計畫時卻發現，只要民眾的消費行為會累積消費習慣，進而影響現在的消費水準時，將會造成經濟體系發生多重收斂路徑的現象。發現了這個現象後，我們更加詳細地研讀既存研究文獻。我們發現：大部分的學者都將多重收斂路徑現象發生的原因歸咎到生產面的外部性上，少部份將這個現象歸納到政府政策的影響上。卻尚未有文章提出消費面的外部性亦可能是造成經濟體系存在多重收斂路徑現象的原因。是以，本研究的結果確實可以彌補既存文獻發展中的不足，確有其學術價值，也適合於發表於著名的國際學術期刊。
2. 本計畫的成果已經撰寫成學術論文，我們將聽取專家學者意見並稍做修正後，投稿至國際學術期刊。

附件二

可供推廣之研發成果資料表

□ 可申請專利　□ 可技術移轉　日期：93 年 10 月 30 日

國科會補助計畫	計畫名稱：消費外部性與經濟成長 計畫主持人：謝智源 計畫編號：NSC-92-2415-H-034-002　學門領域：經濟
技術/創作名稱	
發明人/創作人	
技術說明	中文： （100~500 字）
	英文：
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技術特點	
推廣及運用的價值	

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