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我國銀行業經濟效率分析——Fourier 富伸縮函數應用於隨機邊界模型

Estimation of Technical and Allocative Inefficiencies Using the Fourier Flexible Cost Frontiers for Taiwan's Banking Industry

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一、中文摘要

由於目前廣泛使用的 translog 成本函數，僅是真正（但未知）成本函數的二階 Taylor 展開型式，它祇在某點上近似真正成本函數而已。Gallant (1981,1982)發展出 Fourier 富伸縮函數型式（Fourier flexible functional form），簡稱 FF 函數，可全域地近似（globally approximate）真正函數，故優於 translog 成本函數。本研究依據 Gallant 的理論，建構 FF 成本函數；迴歸模型中同時考慮技術與配置無效率因素；使用我國銀行業的縱橫資料（panel data），同時估計成本函數與要素份額函數，同時估計技術與配置無效率。

計算經濟無效率因素導致我國銀行廠商成本上升 18.39%，其中技術無效率因素導致成本上升 6.34%，配置無效率導致成本上升 12.05%，顯示後者比前者情況嚴重。

關鍵詞：經濟效率、技術效率、配置效率、Fourier 富伸縮成本函數

Abstract

Since the commonly used translog function form can only locally approximate a true (but unknown) cost function, this paper constructs a Fourier flexible functional form (FF function), which was first developed by Gallant (1981,1982) and which can globally approximate the unknown true function. The function includes both technical inefficiency (TI) and allocative inefficiency (AI) components to avoid possible specification error. Empirical results suggest that TI alone raises bank cost about 6.34% on average, that AI alone raises an average bank's cost 12.05%, and that the cost increase due to AI decreases over time, while the cost increase due to TI shows no clear trend, indicating that financial deregulation starting from 1991 in Taiwan seems to have only been effective at improving banks' allocative efficiency. It is most likely that newly entered private banks have intensified the degree of competition in the banking industry and have attracted so many customers away from the sample banks that the output of sample banks necessarily decreased, while input usage did not adjust swiftly enough, at the same time. Translog evidence on economic efficiency suggests a much higher cost savings when achieving both technical and allocative efficiency than does the FF function.

Keywords: economic efficiency; technical efficiency; allocative efficiency; Fourier flexible cost function

二、緣由與目的

White(1980)證明，以最小平方法估計 translog 成本函數，其估計值易有偏誤發生，故並非恰當函數型式。尤有甚者，利用此不恰當函數進行實證分析所得到的結論，其妥當性不無疑問。McAllister and McManus(1993)發現用 translog 成本函數估計各種規模的銀行，結果不甚理想。

Gallant(1981,1982)發展出 Fourier 富伸縮函數型式（Fourier flexible functional form），簡稱 FF 函數，可用來近似成本函數。它包含兩個部分，一部分爲 translog 成

本函數，另一部分爲 Fourier 序列，是由三角函數中 sine 和 cosine 等項構成。此 FF 函數可被用來近似任何成本函數，在資料涵蓋範圍內，可全域地近似（globally approximate）真正函數，故優於 translog 成本函數，祇在某點上近似真正函數。Elbadawi et al.(1983)和 Chalfant and Gallant(1985)證明以 FF 函數的係數估計值計算替代彈性（elasticity of substitution），在大樣本下其偏誤情況極其輕微。

雖然 FF 函數有如此多優點，在應用方面尚未普遍。原因可能是此函數不易建構，必須經過許多道繁複過程，並加上若干限制條件。在現有少數應用 FF 函數的研究中，有關經濟效率部分，皆未作適當考慮和處理。例如，Berger and DeYoung (1997)與 Berger et al.(1997)祇考慮技術無效率問題，忽略配置無效率，且僅估計成本函數，忽略成本份額函數。

三、研究方法與進行步驟

詳細建構 FF 成本函數過程省略，此地祇列出成本及份額函數如下：

$$\ln C = -\ln B + g_K\left\langle x^* \middle| \theta \right\rangle + \ln \sum_i S_i^* h_i^{-1}, \quad (3\text{-}1)$$

$$S_i = \ln(S_i^* h_i^{-1}) - \ln \sum_i S_i^* h_i^{-1}, \quad i=1,\ldots,N, \quad (3\text{-}2)$$

$\ln C$ 爲實際對數成本，$x^{*\prime} = (l^{*\prime}, q')$，其中 $l_i^* = l_i + \ln h_i$，$i=1,\ldots,N$，爲影子要素價格；$g_K\left\langle x^* \middle| \theta \right\rangle$ 爲 FF 影子成本函數，$S_i^* = \partial g_k(x^* \mid \theta)/\partial l_i^*$ 是影子成本份額函數。

(3-1)與(3-2)組成成本函數的聯立迴歸方程式體系，一旦加上傳統隨機干擾項後，成爲聯立迴歸方程式，採用非線性最小平方法聯立估計，可將模型中參數估計出來。

有關使用的資料、樣本統計量以及係數估計值在此從略。僅列出成本函數與經濟無效率估計結果於表 1 和 2 中，經濟無效率導致成本上升估計結果於表 3 和 4 中。

FF 成本函數估計結果，經濟無效率導致成本上升 17.85%，遠低於 translog 成本函數估計結果，此發現與 Berger and Humphrey (1997)一致。

四、結論

The picture that emerges from the estimated FF shadow cost function is: (1) the lack of production efficiency raises an average bank's cost around 6.34%, small but nevertheless pervasive, (2) banks operate at observed costs approximately 17.85% greater than efficient frontier costs, due mainly to deficient labor utilization, (3) financial liberalization only helped to enhance our sample banks' allocative efficiency. The gradual improvement in efficiency may be one of the reasons that these banks were capable of withstanding the severe impacts from the aforementioned Asian financial crisis.

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表 1　經濟無效率估計結果--Fourier

Fourier Cost Function					
Groups	Total Assets+	Technical Efficiency	Allocative Efficiency		Number of Firms (Sample size)
			Labor(X_2)	Capital(X_3)	
I	12,000 - 50,000	1	4.8225*** (0.7388)	0.3745** (0.1464)	4 (68)
II	50,001 - 90,000	0.8818*** (0.0272)	3.4632*** (0.5203)	0.3219*** (0.1234)	5 (84)
III	90,001 - 220,000	0.9168*** (0.0337)	5.2106*** (0.7950)	0.4080*** (0.1564)	4 (68)
IV	220,001 - 460,000	0.9992*** (0.0406)	6.2263*** (1.0260)	0.4561*** (0.1756)	4 (68)
V	460,001 - 800,000	0.9112*** (0.0410)	6.1017*** (1.1092)	0.5434*** (0.2094)	5 (85)
Input-specific (with TI)			4.5843*** (0.5507)	0.4949*** (0.1753)	22 (373)
Input-specific (without TI)			4.3825*** (0.5010)	0.3550** (0.1639)	22 (373)

表 2　經濟無效率估計結果--Translog

Translog cost function					
Groups	Total Assets+	Technical Efficiency	Allocative Efficiency		Number of Firms (Sample size)
			Labor(X_2)	Capital(X_3)	
I	12,000 - 50,000	0.7831*** (0.0330)	9.4338*** (1.6740)	0.5161*** (0.1565)	4 (68)
II	50,001 - 90,000	0.7738*** (0.0255)	7.9632*** (1.5308)	0.5151*** (0.1542)	5 (84)
III	90,001 - 220,000	0.8794*** (0.0234)	20.818*** (2.4822)	0.7467*** (0.2325)	4 (68)
IV	220,001 - 460,000	1	27.551*** (3.9444)	0.8656*** (0.2718)	4 (68)
V	460,001 - 800,000	0.7004*** (0.0267)	7.3532*** (1.7744)	0.7238*** (0.2106)	5 (85)
Input-specific (with TI)			12.123*** (1.7745)	0.8641*** (0.2845)	22 (373)
Input-specific (without TI)			1.5831*** (0.3112)	0.0124 (0.0864)	22 (373)

+: Measured in millions of New Taiwan's Dollar.

Numbers in parentheses are standard errors.

** : Significant at the 5% level.

*** : Significant at the 1% level.

表 3　成本無效率導致的成本上升百分比--Fourier

Fourier Cost Function							
Groups	Total Assets +	Technical Inefficiency (%)	Allocative Inefficiency(%)			Economic Inefficiency (%)	Number of Firms (Sample size)
			X_2	X_3	$X_2 + X_3$		
I	12,000 - 50,000	0	16.63	2.19	18.44	18.44	4 (68)
II	50,001 - 90,000	11.83	11.71	3.19	14.54	24.72	5 (84)
III	90,001 - 220,000	8.32	10.25	1.93	11.99	19.44	4 (68)
IV	220,001 - 460,000	0.08	8.78	1.27	9.96	10.15	4 (68)
V	460,001 - 800,000	8.88	5.36	0.88	6.21	14.75	5 (85)
Full Sample		6.34	10.36	1.90	12.05	17.85	22 (373)
1981-1991		6.33	12.16	1.70	13.65	19.25	22 (241)
1992-1997		6.36	7.07	2.26	9.14	15.22	22 (132)

表 4　成本無效率導致的成本上升百分比--Translog

Translog Cost Function							
Groups	Total Assets +	Technical Inefficiency (%)	Allocative Inefficiency(%)			Economic Inefficiency (%)	Number of Firms (Sample size)
			X_2	X_3	$X_2 + X_3$		
I	12,000 - 50,000	21.69	15.28	1.27	16.35	34.50	4 (68)
II	50,001 - 90,000	22.62	13.61	1.37	14.79	34.07	5 (84)
III	90,001 - 220,000	12.07	18.81	0.25	19.01	28.78	4 (68)
IV	220,001 - 460,000	0	20.11	0.07	20.16	20.16	4 (68)
V	460,001 - 800,000	29.97	7.86	0.33	8.17	35.69	5 (85)
Full Sample		18.69	14.74	0.67	15.32	31.02	22 (373)
1981-1991		18.69	14.38	0.67	14.96	30.70	22 (241)
1992-1997		18.71	15.39	0.67	15.97	31.58	22 (132)