行政院國家科學委員會專題研究計畫 成果報告

高階近似下的最適消費行為:理論與實證(2/2)
研究成果報告(完整版)

計 畫 類 別 ：個別型
計 畫 編 號 ：NSC 94-2415-H-004-001-
執 行 期 間 ：94年08月01日至96年07月31日
執 行 單 位 ：國立政治大學國際貿易學系

計畫主持人：郭炳伸

計畫參與人員：博士班研究生-兼任助理：陳致綱、黃恩恩

報 告 附 件 ：出席國際會議研究心得報告及發表論文

處 理 方 式 ：本計畫可公開查詢

中 華 民 國 96年10月31日

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

（高階近似下的最適消費行為:理論與實證(2/2)）

計畫類別：☑ 個別型計畫　　□ 整合型計畫
計畫編號：NSC 94－2415－H－004－001－
執行期間：94 年 08 月 01 日至 96 年 07 月 31 日

計畫主持人：郭炳伸
計畫參與人員：陳致綱、黃恩恩

成果報告類型(依經費核定清單規定繳交)：☑精簡報告　□完整報告

本成果報告包括以下應繳交之附件：
□赴國外出差或研習心得報告一份
□赴大陸地區出差或研習心得報告一份
☑ 出席國際學術會議心得報告共二份
□國際合作研究計畫國外研究報告書一份

處理方式：除產學合作研究計畫、提升產業技術及人才培育研究計畫列管計畫及下列情形者外，得立即公開查詢
□涉及專利或其他智慧財產權，□一年□二年後可公開查詢

執行單位：國立政治大學國際經營與貿易學系

中　華　民　國　96　年　10　月　31　日

Measuring Intertemporal Preferences with Structural Relationships Between Higher Consumption Moments

Biing-Shen Kuo *

October, 2007

Abstract

Measuring intertemporal preferences is not easy. Previous studies seemed to conclude that the use of approximate Euler equation is of little use in producing meaningful estimates of the structure parameters, despite of its ease to implementation. This study returns to question whether the empirical Euler equation method should really be abandoned. Taking one step further on the 'higher-order' approximate Euler equation approach advocated by Kuo and Lan (2005), the prime goal of the research is to increase estimation efficiency at no cost of consistency. The key to the improved approach lies in the existence of structural relationships between lower and higher consumption moments. In practice, this suggests that the variations in higher consumption moments be better captured by agent-specific variables such as education and occupation that are commonly used instruments to lower counterparts in nonlinear fashions. Monte-Carlo evidence shows that less higher-order moments terms are required to include in the consumption regressions, resulting significantly smaller mean squared errors. In an empirical application to a consumption panel from PSID, the estimates using the improved approach are subject to tighter confidence intervals, as compared with those obtained by Kuo and Lan (2005).

JEL Classification Codes: E21, D91

Keywords: approximation bias, Euler equation, nonlinear instruments, higher-order approximations, instrumental variables.

*Department of International Business, National Chengchi University, No. 64, Sec.2, Zhi-Nan Rd., Wenshan District, Taipei 116, Taiwan. Tel: 886-2-29393091 ext. 81029, Fax: 886-2-29387699, Email: bsku@nccu.edu.tw.

1 Introduction and Summary

Measuring intertemporal preferences with consumption choices over life cycles has been one of central interests to macroeconomics academics. Despite many efforts were devoted, empirical successes in uncovering the parameter proved to be exceptions. Analysis provided by Carroll (2001b) and Ludvigsion and Paxson (2001) indicates that the source of the estimation anomalies comes from the approximation bias that results from the use of log-linearized or second-order approximated versions of the consumption Euler equation.

The choice to linearly approximate the Euler equation is a difficult one. The original introduction of such approximations is to resolve the measurement errors problem in consumption data (Shapiro, 1984; Runkle, 1991), rendering inconsistent estimates of the structural parameters with nonlinear GMM techniques (Amemiya, 1985). With approximations, some higher-order moments would have to be left out, and are categorized into omitted variables when applying regression technique to estimate the parameter of interest. In the situation, instrumental variables approach suggested by conventional wisdom to deal with the omitted variables problem does not work, however, because of approximation bias. The major reason for the bias coming into existence is that the education levels and occupation choices, the most commonly instrumental variables adopted in typical context of consumption panels, are argued to be not orthogonal to the regression errors that consist of omitted higher consumption moments, although they were believed to be so (Carroll, 2001b).

To cope with the difficulty, alternative approaches to estimating preferences have been proposed. Resorts to full-fledged specifications for the environment that consumers face would seem to be one natural choice. Attempts by Gourinchas and Parker (2001) and Laibsson et al. (2007) are recent representative examples along the line. To successfully conduct the estimations with the approach generally requires intensive computations and complete information on the model structures. Virtually, like any parametric-based modeling, the results are likely to be sensitive to minor mis-specifications.

In contrast, some studies continue to work on the Euler equation, but take new routes to estimate the preferences. Alan and Browning (2003) adopt a simulation method. Without simulating the whole model to generate various moments as in the aforementioned approach, this method only simulates the distribution of expectation errors. Thus, information needed to deliver reliable results for the approach is as simple as a correct specification for the underlying error distribution. As a consequence robustness of the estimations may well be anticipated. Kuo and Lan (2005), on the other hand, return to question whether the approximate Euler equation approach should really be abandoned.

Parts of their simulations uncover that the given instruments, education and occupation, become less correlated with the residuals as more higher consumption moments terms are included in the regressions. Indeed, both occupation and education may be useful in explaining the second consumption moments, roughly representing consumption risks (Dynan, 1993; Luehlwein, 1991; and Merrian and Normandian, 1996), the connections between the instruments and the higher moments are not as clear and straightforward. An important implication based on the observation is simply that as the orthogonality conditions should come to hold, as long as 'enough' orders of approximate terms are contained in the consumption regression. Consistent Monte-Carlo evidence shown in Kuo and Lan (2005) assure of the implication. Because of no need to specify the models or the error distributions, the proposed approach is very easy to implement.

This research, built on Kuo and Lan (2005), takes one step further. While the approximation bias is found to be reduced to a negligible extent when the appropriate orders of higher consumption moments are selected, simulations in Kuo and Lan (2005) also document that the estimations are typically accompanied by large variations. The loss in estimation efficiency results from inadequacy of the instrumental variables in capturing variations in the included higher consumption moments. The explanatory power of the given instruments deteriorates when predicting the included higher moments. In the second stage of instrumental variables estimations, inclusions of these less 'predicted' higher moments in essence provide little additional information and lead to the multi-collinearity problem, causing the estimation errors.

The main goal of the study is to increase estimation efficiency of the method by Kuo and Lan (2005), at no cost of consistency. The key to the improved approach lies in the existence of structural relationships between lower and higher consumption moments. It is not difficult to understand why the relationships exist because all the consumption moments are endogenously determined when consumers intend to seek optimal consumption choices over life cycles. But it is difficult to derive their analytic solutions, except in some simple setups. Our numerical simulations make it very clear the existence of the important hidden nonlinearities between moments. Of particular empirical interest is that the included higher moments can be expressed as functions of the second counterparts. This also explains why the given instruments are less capable of capturing variations in the higher moments using the Kuo and Lan (2005) approach. In which the nonlinear components in the conditional mean of higher consumption moments are left unattended.

A novelty of this paper is to exploit the structural nonlinearities to form quality instruments using the approximate Euler equations approach. The procedures to conduct estimations are extremely simple. Now that the given instruments well predict the second moments, the 'predicted' second moments are expected to explain the included higher moments as well. Thus, the 'predicted' second moments are instruments to the included higher moments. Not only so, power terms of the 'predicted' second moments should come into play due to the hidden structural nonlinearities. In notions, this is a method in the family of nonlinear instrumental variables estimator.

Our simulation evidence lends strong support to the proposed method. Throughout the experimentations, for a comparable amount of the approximation bias to be corrected, fewer higher predicted moments are required using the improved approach. This is a promising indication of efficiency improvements over the original approach. As reflections of more precise estimations, the empirical confidence intervals for the preference parameter are found to be significantly shorter, in the cases where the approximation bias is close to zero.

The rest of this paper is organized as follows. Section 2 describes the setup of the model. Section 3 explores the structural relationships between lower and higher consumption moments. Section 4 investigates empirical performance of the improved approach, using simulation methodology. For illustration, Section 5 presents an application of our nonlinear instrumental variables estimator to a consumption panel from PSID.

2 Model Setup

We work on a simple but general consumption model. Consumers are assumed to make consumption and saving decisions in each period so as to maximize their expected lifetime utility. Specifically, consumers' optimization problem can be described by

$$\text{Max } E_t\left[\sum_{j=0}^{T-t}\beta^j\left(\frac{C_{t+j}^{1-\rho}}{1-\rho}\right)\right]$$
$$\text{s.t. } A_{t+j+1} = (1+r)(A_{t+j}+Y_{t+j}-C_{t+j}), \tag{1}$$

where E_t represents the expectation conditional on all information available at time t; C_t equals real consumption at time t; $\beta = \frac{1}{1+\delta}$ is the consumer's subjective discount factor with $\beta \in (0, 1]$ and δ is the discount rate. Consumers accumulate non-contingent asset A_t which pays a gross return $1 + r$ in each period. We assume that the income process evolves according to

$$\ln(Y_{t+1}) = \ln(Y_t) + \mu + \epsilon_{t+1} - \phi\epsilon_t, \tag{2}$$

where the innovations to income growth, ϵ_t, are assumed to be normally distributed with mean zero and variance σ^2

The utility function is specified to be a CRRA one. The preference parameter of interest is ρ, as it governs the curvature of the utility function. The value of ρ thus determines many consumer's characteristics such as the coefficient of relative risk aversion and the elasticity of intertemporal substitution, $1/\rho$. As in Kuo and Lan (2005), our aim is to measure the value of the preference parameter, through higher-order approximations to the consumption Euler equation. Here, more than that, we are looking for more efficient estimations concerning the parameter, using the hidden structural relationships between consumption moments.

3 Structural Relationships between Consumption Moments

Higher-order approximation to the consumption Euler equation (**??**) implies the following relationship among various consumption moments:

$$\begin{aligned} \mathrm{E}_t\left(\frac{C_{t+1}-C_t}{C_t}\right) =& \frac{\beta(1+r)-1}{\rho} \\ &+ \sum_{j=2}^{k}(-1)^j\left[\left(\frac{1}{j!}\right)\prod_{z=1}^{j-1}(z+\rho)\right]\mathrm{E}_t\left[\left(\frac{C_{t+1}-C_t}{C_t}\right)^j\right]+\eta_t, \end{aligned}$$

where we have approximated the Euler equation to the kth order.

The structural relationships are hard to be solved analytically, only in the case with CARA utility. We shall first present the analytical results for the CARA specification. For the CRRA case, the moments relationships are given with numerical solutions.

3.1 The CARA case

The specific structural relationships of interest is those between lower and higher consumption moments. Suppose $CGi \equiv \mathrm{E}_t\left(C_{t+1}-C_t\right)^i$ and $x \equiv \sigma_w^2$, some tedious computations can give

$$CG3 = \frac{\theta}{2}\Psi^2 x(CG2) + \theta\Psi^4 x^2$$

$$CG4 = \frac{\theta^2}{4}\Psi^4 x^2(CG2) + \frac{5\theta^2}{4}\Psi^6 x^3 + 3\Psi^4 x^2.$$

where some undefined notations are the parameters regrading income process. Solutions for higher consumption moments than order 4 can be derived in a similar manner.

3.2 The CRRA case

No analytical solutions can be derived in the case. We turn to simulations. The following plot give some typical moment relationships.

Figure 1: Consumption Risk and Higher-Order Moments

Overall, either via simulations or analytical solutions, it is clear that there exist structural relationships between lower and higher consumption moments. Of interest is that the relationships presents a great nonlinearity between moments.

4 Monte-Carlo Evidence for the Improved Method

This section is to access the empirical performance of the improved method. Our hope is that by exploiting the hidden nonlinear relationship between lower and higher-order consumption moments, the estimation efficiency can improved over the Kuo and Lan (2005) approach. Without detailing, we present the most important simulation results in Table 1.

Some important messages emerge. First, for a comparable amount of the bias to be corrected, fewer higher moments are included with the improved method. Second, with fewer approximation order, gains in estimation efficiency is expected. This justifies our previous intuition about the importance of quality instruments using the approximate

Table 1: β_2 Estimates

	IV estimation								
Order	N=1000	N=2000	N=5000	N=8000	N=10000	N=20000	N=50000	N=80000	N=100000
2	1.294	1.296	1.296	1.302	1.303	1.308	1.308	1.309	1.310
	(0.158)	(0.148)	(0.100)	(0.071)	(0.063)	(0.045)	(0.032)	(0.021)	(0.019)
3	1.605	1.584	1.562	1.560	1.552	1.538	1.502	1.483	1.476
	(0.192)	(0.138)	(0.105)	(0.095)	(0.100)	(0.089)	(0.084)	(0.084)	(0.077)
4	1.511	1.662	1.755	1.768	1.768	1.738	1.680	1.674	1.653
	(0.460)	(0.331)	(0.235)	(0.210)	(0.221)	(0.207)	(0.161)	(0.152)	(0.130)
5	1.236	1.495	1.767	1.845	1.865	1.934	1.934	1.913	1.904
	(0.491)	(0.424)	(0.327)	(0.293)	(0.281)	(0.259)	(0.293)	(0.326)	(0.321)
6	1.400	1.476	1.677	1.766	1.892	1.899	2.010	2.046	2.046
	(0.506)	(0.396)	(0.326)	(0.298)	(0.303)	(0.245)	(0.285)	(0.327)	(0.336)
	NIV estimation								
Order	N=1000	N=2000	N=5000	N=8000	N=10000	N=20000	N=50000	N=80000	N=100000
2	0.765	0.775	0.781	0.783	0.784	0.787	0.789	0.789	0.789
	(0.128)	(0.091)	(0.057)	(0.046)	(0.040)	(0.029)	(0.018)	(0.014)	(0.012)
3	1.963	1.987	2.009	2.024	2.027	2.034	2.035	2.035	2.036
	(0.269)	(0.192)	(0.115)	(0.087)	(0.079)	(0.054)	(0.033)	(0.026)	(0.023)
4	1.955	1.980	1.995	2.001	2.001	2.005	2.007	2.006	2.007
	(0.291)	(0.216)	(0.135)	(0.104)	(0.095)	(0.065)	(0.040)	(0.032)	(0.028)
5	1.855	1.857	1.973	1.923	1.910	1.973	2.056	2.095	1.958
	(0.868)	(0.782)	(1.032)	(0.542)	(0.608)	(0.404)	(0.299)	(0.253)	(0.224)
6	1.427	1.293	1.368	1.331	1.367	1.404	1.521	1.583	1.567
	(1.851)	(1.695)	(1.444)	(0.822)	(0.860)	(0.522)	(0.434)	(0.375)	(0.119)

Notes. Figures reported in the table are the average estimates of β_2 among 1,000 replications. Standard errors in parentheses. β_2 should be equal to 2 when $\rho = 3$.

Table 2: Empirical Results Using the PSID Data

Order-selection criterion	Conventional	MMSC-AIC	MMSC-BIC	MMSC-HQIC
Selected order	2	5	4	5
$\hat{\beta}_2 (= (1+\rho)/2)$	0.214	2.336	2.001	2.336
Std. of $\hat{\beta}_2$	0.145	0.342	0.283	0.342
Implied value of ρ	-0.572	3.672	3.001	3.672
90% CI for ρ	[-1.08, -0.07]	[2.48, 4.87]	[2.01, 3.99]	[2.48, 4.87]

Euler equations approach.

5 An Application to a PSID Dataset

To illustrate the practical usefulness, an application of the approach to a consumption panel from PSID is presented in Table 2. As clearly demonstrated, the estimates for the parameter of concern using the improved methods have at least 2 characteristics or advantages, compared with the conventional approach: fewer orders of higher moments, shorter confidence interval. Most importantly, the estimates associated with the improved approach are very reasonable.

6 Self-Evaluation

There are a few contributions of the paper to the literature worth mentioning. The study proposes a method that is able to consistently estimate the preference parameter with no need to specify model structure or error distribution. Estimations based on the method are thus robust to misspecifications, subject to less uncertainties, and more reasonable as one typically believe.

This study is just the beginning point of a sequence of research. The contribution of the study is methodological. The next step of the research is to apply the method to various important empirical consumption issues that the conventional approach failed to address.

References

[1] Amemiya, T. (1985), "Instrumental Variables Estimator for the Nonlinear Errors-in-Variables Model," *Journal of Econometrics* 28, 273-289.

[2] Attanasio, O.P. (1999), "Consumption," in *Handbook of Macroeconomics*, ed. by T. J.B., and M. Woodford. Elsevier, North Holland.

[3] Carroll, C.D. (2001), "Death to the Log-Linearized Consumption Euler Equation! (And Very Poor Health to the Second-Order Approximation)," *Advances in Macroeconomics*, 1, Article 6.

[4] Dynan, K.E. (1993), "How Prudent Are Consumers?" *Journal of Political Economy* 101, 1104-1113.

[5] Kuo, B.-S. and C.-Y. Lan (2005), "Uncovering Preference Parameters with Higher-Order Consumption Moments," *mimeo.*

[6] Ludvigson, S. and C.H. Paxson (2001), "Approximation Bias in Linearized Euler Equations," *Review of Economics and Statistics* 83, 242-256.

[7] Merrigan, P. and M. Normandin (1996), "Precautionary Savings Motives: An Assessment from UK Time Series of Cross Sections," *Economic Journal* 106, 1196-1208.

[8] Runkle, D.E. (1991), "Liquidity Constraints and the Permanent Income Hypothesis: Evidence from Panel Data," *Journal of Monetary Economics* 27, 39-98.

[9] Shapiro, M.D. (1984), "The Permanent Income Hypothesis and the Real Interest Rate: Some Evidence from Panel Data," *Economics Letters* 14, 93-100.

[10] Amemiya, T. (1985), "Instrumental Variables Estimator for the Nonlinear Errors-in-Variables Model," *Journal of Econometrics* 28, 273-289.

[11] Andrews, D. W. K. (1999), "Consistent Moment Selection Procedures for Generalized Method of Moments Estimation," *Econometrica* 67, 543-564.

[12] Andrews, D. W.K. and B. Lu (2001), "Consistent Model and Moment Selection Procedures for GMM Estimation with Application to Dynamic Panel Data Models," *Journal of Econometrics* 101, 123-164.

[13] Attanasio, O.P. (1999), "Consumption," in *Handbook of Macroeconomics*, ed. by T. J.B., and M. Woodford. Elsevier, North Holland.

[14] Attanasio, O.P. and H. Low (2004), "Estimating Euler Equations," *Review of Economic Dynamics* 7, 406-435.

[15] Carroll, C.D. (2001b), "Death to the Log-Linearized Consumption Euler Equation! (And Very Poor Health to the Second-Order Approximation)," *Advances in Macroeconomics*, 1, Article 6.

[16] Dynan, K.E. (1993), "How Prudent Are Consumers?" *Journal of Political Economy* 101, 1104-1113.

[17] Hirshleifer, J. (1970), *Investment, Interest, and Capital*, Prentice Hall.

[18] Kuehlwein, M. (1991), “A Test for the Presence of Precautionary Saving,” *Economics Letters* 37, 471-475.

[19] Ludvigson, S. and C.H. Paxson (2001), “Approximation Bias in Linearized Euler Equations,” *Review of Economics and Statistics* 83, 242-256.

[20] Merrigan, P. and M. Normandin (1996), “Precautionary Savings Motives: An Assessment from UK Time Series of Cross Sections,” *Economic Journal* 106, 1196-1208.

[21] Runkle, D.E. (1991), “Liquidity Constraints and the Permanent Income Hypothesis: Evidence from Panel Data,” *Journal of Monetary Economics* 27, 39-98.

[22] Simkowitz, M.A. and W.L. Beedles (1978), “Diversification in a Three-Moment World,” *Journal of Financial and Quantitative Analysis* 13, 927-940/

[23] Shapiro, M.D. (1984), “The Permanent Income Hypothesis and the Real Interest Rate: Some Evidence from Panel Data,” *Economics Letters* 14, 93-100.

出席國際學術會議心得報告

計畫編號	94-2415-H-004-001-
計畫名稱	高階近似下的最適消費行為:理論與實證(2/2)
出國人員姓名 服務機關及職稱	郭炳伸 政治大學國貿系
會議時間地點	2006.7.4.~7.7, Alice Springs, Australia
會議名稱	The Econometric Society Australian Meetings
發表論文題目	Uncovering Preference Parameters with High-order Consumption

一、參加會議經過

計量經濟學會澳洲會議是南半球計量經濟學界的年度會議。這次選在中澳沙漠中的綠洲城市亞利絲泉市舉行，為期三天。該城市雖然為沙漠城市，但卻因為往南四百公里具有世界級的景點，反而成為重要中繼站。所以，在訂購機票時因逢觀光旺季，十分不易。幾經波折，才得以成行。這是一個大型會議，同時段有六個場次發表論文，不論理論或實證論文，只要有品質，皆被納入會議中，內容頗為可觀。澳洲與紐西蘭同屬大英國協，計量學術水準與英國學者同臻水平，會議中處處可以聆聽到當地學者所發表的高水準計量論文。

二、與會心得

會議所發表的論文中，仍有大部份場次，以單一時間數列為研究標的，發表論文。但是更值得注意的是，部份論文，尤其是應邀而來的世界級學者所宣讀的論文，皆圍繞在追蹤資料的相關計量議題上。最令人矚目的是來自歐洲中央銀行的 Prof. Reichlin 所發表的文章，她是最早鼓吹使用追蹤資料進行總體研究的學者。她在這個議題上提到了幾個重要的發展方向：1)如何進行更具有結構性意義的參數模型化，2)如何以 Kalman filter 對大規模的 dynamic factor model 進行估計，3)如何從追蹤資料中擷取外生變數，與 4)如何規避處理大規模資料的維度問題(curse of dimensionality)。前三點在最近的文獻發展上皆有一定程度的進展，惟獨最後一點幾乎尚未有人探討。但該議題會隨著追蹤資料累積更快速，而形尖銳。如何在這些大量資料中，形成簡易的統計量，而可以有效結合資料中的資訊，會越來越迫切。Prof. Reichlin 提到收縮估計式(shrinkage estimator)是可能的解決方案。收縮估計式係以適當的權數對不同估計式加以組合的非線性統計量。不同估計式可選擇的對象之一即是以追蹤資料估計而得的統計量，例如迴歸係數的估計值。該估計值由於已經總結橫斷面的資訊，若再與其他方式產生的估計值進行結合，新的估計式焉然而生。理論上，收縮估計式會具有良好的統計性質。但重要的是，在前述的計算中，其實已大幅度解決面對大量追蹤資料的維度問題。未來中，將會有許多研究落實這個研究方向。

三、建議

本次會議中，有若干澳洲博士班參與發表論文。其中有若干品質與程度皆屬上乘的論文。這些學生的台風亦十分穩健，令人耳目一新。澳洲距離台灣很近，若要培養我國本土博士生具有國際視野，可以思考鼓勵我國博士生踴躍投稿本會議。

四、攜回資料名稱與內容

會議議程與論文摘要。

出席國際學術會議心得報告

計畫編號	94-2415-H-004-001-
計畫名稱	高階近似下的最適消費行為:理論與實證(2/2)
出國人員姓名 服務機關及職稱	郭炳伸 政治大學國貿系
會議時間地點	2007.04.12~04.16, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong
會議名稱	Academic Program of SETA 2007
發表論文題目	Doing Justices to Fundamentals in Exchange Rate Forecasting: A Control over Estimation Risks

一、參加會議經過

SETA 係少數在國際上以計量理論與應用的論文或研究為主軸而召開的會議。該會議始於 2005 年台北，今年為第三屆，主辦單位為香港科技大學(HKUST)經濟學系。這是一次非常成功的會議，東道主科大經濟系的精心安排場次與會議各項服務，皆讓參與學者留下深刻印象。更重要的，參與者所發表的論文，由於論文主軸明確，大部分發表論文水準皆相當高。

二、與會心得

我的論文被安排在第一天下午第一場次，由於同時間有計量理論場次的論文發表，參與者未如預期地多。即使如此，我分別在發表後與會後獲得參與該場次多位學者的回應與評論，倒是令我印象深刻與驚訝。這些學者的意見相當具有參考性與前瞻性。我的論文實際關係現有計量學界所討論的組合預測式，但應用於滙率預測。由於預測結果遠比既有文獻所報導的來得精確與優異，我打算將論文投稿至頂級期刊。而此次參加會議，正可藉由其他學者的意見，進一步改善文章的呈現，或許得以提高獲刊的機率。由於這些學者的意見十分珍貴，且與文獻發展的思考方向一致，值得加以記錄。

（一）我的論文所提倡的估計式與文獻所討論的估計式有何不同？

這是一個很好的問題。文獻上所討論的估計式，建構在連結最小平方估計式與某「固定」限制常數。因為這一層原因，在傳統的組合預測中，其權重皆為該固定常數檢定量函數。但我所建構的估計式，則不以某固定常數為連接對象，而是來

自應用追蹤資料所得到的估計，因而在本質上是隨機的，而與固定常數性質截然不同。所以在最適權重選擇上，將與檢定量脫鈎，而產生截然不同的權重結構。但這一點值得在文章進一步說明，因為大部分學者仍然習於既有的組合估計式思考方式，為避免誤解，並給予更有趣的動機說明，這樣的意見應該在文中納入，並重做釐清。

（二）最適權數之選擇是否應限定介於０與１之間？

多位學者對論文中所估計的權重為負提出不同的觀點。在傳統的組合估計式中，最適權重必須介於０與１之間，以滿足理論上的要求。而我所推導的估計，則已無此限制，因此該權重實可以為任何實數值。而很重要的是，在我所報告的結果中，有二組資料所估計出的權重為負，但卻至今仍無法加以解釋。一位來自美國的資深學者，則舉出其研究亦有相似的權重選擇問題，且得到負的估計。他認為我所獲得的負權重估計，應該具有其應用估計式的性質。他引用財務理論選擇股票組合時，會對「贏者」(winner)股票加重權重(大於一)，但對「輸者」股票採取處罰(小於一)。因此，如果將股票之「報酬率」，改成為預測中之「偏誤」或「情報品質」，那麼權重產生負值，就有相對應的經濟解釋，當會為文章內容加分不少。

三、攜回資料名稱與內容

議程與論文簡介。