# 國科會八十八年度專題研究計畫成果報告

**1. 計畫名稱: 一個隨機的政府大小模型** (A Stochastic Time-Series Model of Government Size)
**2. 計畫編號:** NSC 88-2415-H-004-015
**3. 執行期限:** 1998年8月1日至1999年7月31日
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**7. 中文摘要: 本實證研究利用高等時間數列方法探討美國各級政府的長期 (實質) 支出趨勢，結果發現政府大小的變動是永久性的** (fluctuations in government size are permanent)。

**8. 英文摘要 (abstract):** This research employs advanced time-series techniques to investigate the long-run properties of the government size series. By applying the persistence measures developed by Campbell and Mankiw (1987) and Cochrane (1988), this study finds big long-term persistence in government size at all levels of the US government.

**9. 計畫緣由與目的 (Introduction and Background)**

One of the most challenging questions facing public finance economists in the past few decades and possibly for the next century is the appropriate size of government (see, for example, Feldstein, 1997).[1] In fact, the growing tendency of government has led to intense debate about the proper role of government across the Western European countries over recent years (see, for example, Borre and Scarbrough, 1995; Gemmell, 1993). In the United States, three government major spending programs, Medicare, Medicaid, and Social Security, have been under critical examination (see, for example, Auerbach, 1997; Burtless, 1997). It can be noted that, unlike the more conventional cross-sectional subjects, the present issues tend to evaluate the development of government activities over a relatively long period. An in-depth analysis of long-run data on government activities, indeed, has become fundamental. In the public finance literature, the investigation of government size can be traced at least as far back as the mid-nineteenth century in the work of Adolph Wagner. Based upon Wagner's hypothesis of "increasing state activity" (i.e., the so-called "Wagner's Law"), the size of government will become larger as the economy expands.[2] In essence, Wagner's Law is meant to describe the long-run relationships between government size (as generally denoted by government expenditures) and the economy (as conventionally denoted by output). From a statistical viewpoint, it is reasonable to infer that data on government expenditures and output behave similarly. In other words, they might possess similar long-run properties. In the macroeconomic literature, Nelson and Plosser (1982) and Campbell and Mankiw (1987), for example, have found large random walk components in output.[3] As emphasized above, a detailed analysis of long-term data on government size is essential for evaluating and understanding government activities. Furthermore, according to Wagner's Law, it is likely that the government size series and the output series behave similarly in the long run. As many studies have identified the long-run properties of output, it seems necessary to subsequently examine the government size series.

**10. 研究方法、結果與討論 (Methodology, Results, and Implications)**

To investigate the long-run properties of government size, this study uses the persistence measures proposed by Campbell and Mankiw (1987) and Cochrane (1988). According to Campbell and Mankiw (1987), the change in a time series can be modeled as a stationary ARMA process. That is,

$$\alpha(L)\Delta X_t = \theta(L)\varepsilon_t \qquad (1)$$

where $\alpha(L) = 1 - \alpha_1 L - \alpha_2 L^2 - \ldots - \alpha_p L^p$, and $\theta(L) = 1 + \theta_1 L + \theta_2 L^2 + \ldots + \theta_q L^q$.

Then, equation (1) can be rearranged into the moving average representation for $\Delta X_t$:

$$\Delta X_t = \alpha(L)^{-1}\beta(L)\varepsilon_t = A(L)\varepsilon_t \quad (2)$$

The moving average representation for the level of $X_t$ can be obtained by inverting $1-L$:

$$X_t = (1-L)^{-1}A(L)\varepsilon_t = B(L)\varepsilon_t \quad (3)$$

where $B_i = \sum_{j=0}^{i} A_j$.

The limit of $B_i$, in fact, is the infinite sum of $A_j$ coefficients, which can be denoted as $A(1)$. The $A(1)$ measure, infinite sum of moving average coefficients for the differenced process, is the measure of persistence developed by Campbell and Mankiw (1987). Cochrane's (1988) measure of persistence, which can be denoted as $V$, is related to that of Campbell and Mankiw (1987). Cochrane's technique is to measure the size of a random walk component in a time series from the variance of its long differences. According to Cochrane, a time series that follows a first-difference stationary linear process has a moving average representation of the following form:

$$\Delta X_t = (1-L)X_t = \alpha + C(L)\varepsilon_t = \alpha + \sum_{j=0}^{\infty} c_j \varepsilon_{t-j} \quad (4)$$

where $\varepsilon_t$ are i.i.d. error terms with variance $\sigma_\varepsilon^2$.

Given the representation (4), Cochrane derives several *facts*, including the innovation variance of the random walk component. Campbell and Mankiw (1987) show that the square root of Cochrane's persistence measure is a lower bound on their measure. Quarterly data for the period 1965:1-1999:2 are taken and adapted from the DRI Basic Economics database (formerly Citibase). The time period chosen is mainly considered from the viewpoint that two of the largest social spending programs in the United States, Medicare and Medicaid, enacted in 1965. To be consistent with the major investigation of real output, this study examines both the real expenditures and real expenditures per capita series for different levels of government.[4] Data are classified as follows. Total government expenditures (*TE*) are divided into two categories: government consumption expenditures and gross investment (*CE*; i.e., government purchases of final goods and services), and transfer payments (*TR*).[5] Consumption expenditures (*CE*) are converted into real terms with the implicit price deflator for government purchases of final goods and services with respect to different levels of government. Transfer payments are deflated by the price index for personal consumption expenditures.[6] The real total government expenditures, as a result, are arrived by summing the respective deflated amounts of the consumption and transfer components. The relative measures of real government size (i.e., the real expenditures per capita series) are obtained by dividing real expenditures into total population (*POP*). Eventually, six measures of government size, *TE*, *CE*, *TR*, *TE/POP*, *CE/POP*, and *TR/POP*, for the overall, the federal, and the state and local levels of government are sequentially investigated.[7]

The estimation strategies advanced by Campbell and Mankiw (1987) and Cochrane (1988) are applied and the results are reported from Table 1 to Table 6.[8] Table 1 to Table 3 report estimates of persistence in absolute measures of real government size. At the overall level, the values of $\hat{V}^k$ and $\hat{A}^k(1)$ for the *TE* series start out above unity (but fall very gradually) and are below unity for window sizes of 55 and above. For the *CE* series, the values of $\hat{V}^k$ and $\hat{A}^k(1)$ are well above unity for window sizes of 55 and below. The *TR* series appears to be less persistent. At the federal level, The $\hat{V}^k$ and $\hat{A}^k(1)$ values for the *TE* series are greater than 0.5 at all window sizes. Also, one can note that the level of persistence reported at the overall level is mainly attributable to the high level of persistence at the state and local level. Table 4 to Table 6 report estimates of persistence in the real expenditures per capita series. Basically, one obtains the conclusions similar to those for absolute measures of government size. At the overall level, the $\hat{V}^k$ and $\hat{A}^k(1)$ values for the *TE/POP* series are all well above unity at all window sizes. For the *CE/POP* series, the values of $\hat{V}^k$ and $\hat{A}^k(1)$ are well above unity for window sizes of 55 and below. For the *TR/POP*

series, the values of $\hat{V}^k$ and $\hat{A}^k(1)$ are all close to unity at all window sizes. One can also note that, at the federal level, the $\hat{V}^k$ and $\hat{A}^k(1)$ values for the *TE/POP* and *TR/POP* series rise gradually and are above unity for most window sizes. At the state and local level, the values for the *TR/POP* series fall gradually. Many studies have employed time-series techniques to examine the long-run properties of output. Some of the results show that output fluctuations are largely permanent. By applying the estimation techniques developed by Campbell and Mankiw (1987) and Cochrane (1988), this study also confirms that fluctuations in government size are permanent. The main results indicate that a 1 percent innovation in government size should change one's forecast of government size by over 1 percent over a long horizon. This finding, therefore, is consistent with the implication drawn from Wagner's Law. The stylized fact presented in this study is not only useful for evaluating theories of government size but also instrumental for designing and implementing government policies. The finding of this study, in a sense, indicates that the long-run government spending trend has become more random in nature. This tendency, in fact, partially explains the fact that the US and many other developed countries have gradually taken steps to control the size of government.

**Table 1. Nonparametric Estimates of Persistence in Absolute Measures of Real Government Size at the Overall Government Level, 1965:1-1999:2**

| Window size ($k$) | $\hat{V}^k$ | | | $\hat{A}^k$ | | |
|---|---|---|---|---|---|---|
| | *TE* | *CE* | *TR* | *TE* | *CE* | *TR* |
| 15 | 1.048 | 3.141 | 1.021 | 1.028 | 1.788 | 1.015 |
| | (0.414) | (1.239) | (0.403) | | | |
| 25 | 1.045 | 3.353 | 0.828 | 1.027 | 1.847 | 0.914 |
| | (0.526) | (1.687) | (0.417) | | | |
| 35 | 1.044 | 3.113 | 0.530 | 1.027 | 1.780 | 0.731 |
| | (0.618) | (1.843) | (0.314) | | | |
| 45 | 1.016 | 2.514 | 0.286 | 1.013 | 1.599 | 0.537 |
| | (0.680) | (1.682) | (0.191) | | | |
| 55 | 0.766 | 1.889 | 0.328 | 0.879 | 1.386 | 0.575 |
| | (0.565) | (1.395) | (0.242) | | | |
| 65 | 0.386 | 0.787 | 0.161 | 0.624 | 0.895 | 0.403 |
| | (0.309) | (0.631) | (0.129) | | | |

*Note*: Standard errors are in parentheses.

**Table 2. Nonparametric Estimates of Persistence in Absolute Measures of Real Government Size at the Federal Government Level, 1965:1-1999:2**

| Window size ($k$) | $\hat{V}^k$ | | | $\hat{A}^k$ | | |
|---|---|---|---|---|---|---|
| | *TE* | *CE* | *TR* | *TE* | *CE* | *TR* |
| 15 | 0.613 | 3.514 | 0.663 | 0.795 | 1.891 | 0.824 |
| | (0.242) | (1.387) | (0.262) | | | |
| 25 | 0.531 | 4.159 | 0.691 | 0.741 | 2.057 | 0.841 |
| | (0.267) | (2.092) | (0.347) | | | |
| 35 | 0.503 | 4.211 | 0.580 | 0.721 | 2.070 | 0.770 |
| | (0.298) | (2.492) | (0.343) | | | |
| 45 | 0.569 | 3.718 | 0.482 | 0.766 | 1.945 | 0.703 |
| | (0.380) | (2.488) | (0.323) | | | |
| 55 | 0.548 | 2.720 | 0.419 | 0.752 | 1.664 | 0.655 |
| | (0.404) | (2.008) | (0.310) | | | |
| 65 | 0.511 | 1.416 | 0.258 | 0.727 | 1.200 | 0.514 |
| | (0.410) | (1.135) | (0.207) | | | |

*Note*: Standard errors are in parentheses.

**Table 3. Nonparametric Estimates of Persistence in Absolute Measures of Real Government Size at the State and Local Government Level, 1965:1-1999:2**

| Window size ($k$) | $\hat{V}^k$ | | | $\hat{A}^k$ | | |
|---|---|---|---|---|---|---|
| | *TE* | *CE* | *TR* | *TE* | *CE* | *TR* |
| 15 | 8.817 | 3.032 | 2.283 | 3.812 | 1.761 | 1.547 |
| | (3.479) | (1.196) | (0.901) | | | |
| 25 | 12.042 | 3.677 | 2.042 | 4.455 | 1.939 | 1.463 |
| | (6.058) | (1.850) | (1.027) | | | |
| 35 | 13.938 | 3.940 | 1.622 | 4.793 | 2.007 | 1.304 |
| | (8.250) | (2.332) | (0.960) | | | |
| 45 | 13.793 | 4.034 | 1.147 | 4.768 | 2.031 | 1.096 |
| | (9.229) | (2.699) | (0.767) | | | |
| 55 | 11.648 | 4.286 | 0.729 | 4.381 | 2.093 | 0.874 |
| | (8.599) | (3.164) | (0.538) | | | |
| 65 | 9.149 | 4.109 | 0.233 | 3.883 | 2.050 | 0.494 |
| | (7.333) | (3.293) | (0.187) | | | |

*Note*: Standard errors are in parentheses.

**Table 4. Nonparametric Estimates of Persistence in Relative Measures of Real Government Size at the Overall Government Level, 1965:1-1999:2**

| Window size ($k$) | $\hat{V}^k$ | | | $\hat{A}^k$ | | |
|---|---|---|---|---|---|---|
| | *TE/POP* | *CE/POP* | *TR/POP* | *TE/POP* | *CE/POP* | *TR/POP* |
| 15 | 1.420 | 3.530 | 1.142 | 1.193 | 1.913 | 1.073 |
| | (0.560) | (1.393) | (0.451) | | | |
| 25 | 1.482 | 3.601 | 1.059 | 1.219 | 1.932 | 1.033 |
| | (0.746) | (1.811) | (0.533) | | | |
| 35 | 1.564 | 3.236 | 0.914 | 1.252 | 1.832 | 0.960 |
| | (0.926) | (1.915) | (0.541) | | | |
| 45 | 1.661 | 2.576 | 0.810 | 1.290 | 1.634 | 0.903 |
| | (1.112) | (1.723) | (0.542) | | | |
| 55 | 1.508 | 1.913 | 0.983 | 1.229 | 1.409 | 0.995 |
| | (1.113) | (1.412) | (0.726) | | | |
| 65 | 1.332 | 0.743 | 0.952 | 1.155 | 0.878 | 0.979 |
| | (1.068) | (0.596) | (0.763) | | | |

*Note*: Standard errors are in parentheses.

**Table 5. Nonparametric Estimates of Persistence in Relative Measures of Real Government Size at the Federal Government Level, 1965:1-1999:2**

| Window size ($k$) | $\hat{V}^k$ | | | $\hat{A}^k$ | | |
|---|---|---|---|---|---|---|
| | *TE/POP* | *CE/POP* | *TR/POP* | *TE/POP* | *CE/POP* | *TR/POP* |
| 15 | 0.899 | 3.790 | 0.861 | 0.960 | 1.977 | 0.939 |
| | (0.355) | (1.496) | (0.340) | | | |
| 25 | 0.923 | 4.261 | 1.063 | 0.973 | 2.097 | 1.044 |
| | (0.464) | (2.143) | (0.535) | | | |
| 35 | 1.034 | 4.151 | 1.152 | 1.030 | 2.069 | 1.087 |
| | (0.612) | (2.457) | (0.682) | | | |
| 45 | 1.273 | 3.559 | 1.256 | 1.143 | 1.916 | 1.135 |
| | (0.852) | (2.381) | (0.840) | | | |
| 55 | 1.412 | 2.500 | 1.376 | 1.203 | 1.606 | 1.188 |
| | (1.042) | (1.845) | (1.016) | | | |
| 65 | 1.579 | 1.158 | 1.397 | 1.272 | 1.093 | 1.196 |
| | (1.266) | (0.928) | (1.119) | | | |

*Note*: Standard errors are in parentheses.

**Table 6. Nonparametric Estimates of Persistence in Relative Measures of Real Government Size at the State and Local Government Level, 1965:1-1999:2**

| Window size ( $k$ ) | $\hat{V}^k$ | | | $\hat{A}^k$ | | |
|---|---|---|---|---|---|---|
| | *TE/POP* | *CE/POP* | *TR/POP* | *TE/POP* | *CE/POP* | *TR/POP* |
| 15 | 8.384 | 2.894 | 2.085 | 3.617 | 1.724 | 1.478 |
| | (3.308) | (1.142) | (0.823) | | | |
| 25 | 11.084 | 3.291 | 1.850 | 4.159 | 1.838 | 1.392 |
| | (5.576) | (1.656) | (0.931) | | | |
| 35 | 12.092 | 3.214 | 1.482 | 4.344 | 1.817 | 1.246 |
| | (7.158) | (1.903) | (0.877) | | | |
| 45 | 10.975 | 2.893 | 1.030 | 4.139 | 1.723 | 1.039 |
| | (7.344) | (1.936) | (0.689) | | | |
| 55 | 7.769 | 2.714 | 0.616 | 3.482 | 1.669 | 0.803 |
| | (5.735) | (2.003) | (0.454) | | | |
| 65 | 4.309 | 2.107 | 0.138 | 2.593 | 1.471 | 0.380 |
| | (3.453) | (1.689) | (0.110) | | | |

*Note*: Standard errors are in parentheses.

## 11. 計畫成果自評 (Self-Evaluation)

**(1) 本實證研究利用高等的時間數列方法分析美國各級政府的長期支出趨勢，符合原申請計畫內容。文獻上衡量政府大小的指標極多，本研究均一一探討。**

**(2) 本實證研究的成果基本上超過原計畫預期目標。本研究使用之時間數列方法雖與原申請計畫擬用之方法不完全相同，但同樣達到分析政府之長期支出趨勢的目標，且更適合進一步用來分析政府大小之長期變動的過程。**

**(3) 本實證研究的結果深具學術意義與發表價值，已在九月份時投稿至國外的第一級經濟期刊。**

## 12. 參考文獻 (References)


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**13. 附註（Notes)**

1. The government size here refers to the measures of government spending activity. Structural explanations of the size (and growth) of government in the literature can be broadly divided into two strands. The first strand posits that government activities fully reflect the preferences of citizens. Classic studies along this line of research include, at least, Wagner's hypothesis of "increasing state activity" (see, for example, Bird, 1970, 1971), Baumol (1967) "cost disease" model, works rely on the "median voter" theorem (see, for example, Borcherding and Deacon, 1972; Bergstrom and Goodman, 1973), and the influence of interest groups (Becker, 1983,1985). The second strand presumes that government activities reflect the preferences of bureaucrats who run the government. Major studies along this line include, for example, the Peacock-Wiseman (1961, 1979) "displacement effect," Niskanen's (1971, 1975) model of bureaucracy, and the "Leviathan hypothesis," advanced by Brennan and Buchanan (1977, 1978, 1980) and further extended by Oates (1985, 1989).
2. As Wagner's Law stands in its basic form without explicit formulation, many empirical versions exist in
   the literature. For different versions of Wagner's Law, see Lin (1995, p. 276) for example.
3. Using US long historical data, Nelson and Plosser (1982) investigate three output series: real GNP, nominal GNP, and real per capita GNP. Campbell and Mankiw (1987) use the postwar quarterly real GNP data and annual real GNP data since 1869.
4. Actually, the nominal government size series are also examined and appear to be more persistent. The results seem to indicate a *stronger* version of Wagner's Law and are available upon request. Due to data availability and reliability, this study does not report the results for Taiwan and the rest of the other G-7 countries. The preliminary results for Taiwan, however, are available upon request.
5. Unlike consumption expenditures, transfer payment expenditures are not included in national income accounting. In the US, transfer payments include social security and welfare benefits, unemployment compensation, interest payments on debt, and other transfers.
6. The implicit price deflator for transfer payments is unavailable. Since transfer payments do not involve direct use of resources by government, it is more appropriate to use the implicit price deflator for personal consumption expenditures to deflate transfer payments (see, for example, Beck, 1981). This study also uses the implicit price deflator for government purchases of final goods and services to deflate transfer payments and the key conclusions remain unchanged.
7. In fact, *TE/GDP*, *CE/GDP*, and *TR/GDP* are also examined. The key results remain the same and are available upon request.
8. In practice, it is essential to check whether the government size series are stationary or not. Thus, this study first applies the Phillips-Perron unit root test (Phillips, 1987 and Phillips and Perron, 1988). Overall, the government size series appear to be nonstationary. (Also, it has been confirmed that all the series are integrated of order one by performing the unit root test on first differences.) The results for the unit root test are available upon request.