附件二

出國報告審核表

出國報告名稱：出席 IIPF Annual Congress 2017 國際研討會報告

出國人姓名 （2人以上，以1人為代表）	職稱	服務單位
姚名鴻	副教授	財富與稅務管理系

出國類別	□考察 □進修 □研究 □實習 ■其他___國際會議___（例如國際會議、國際比賽、業務接洽等）	

出國期間：106年8月15日至106年8月23日	報告繳交日期：106年9月1日

出國人員 自我檢核	計畫主辦 機關審核	審 核 項 目
■	☑	1.依限繳交出國報告
■	☑	2.格式完整（本文必須具備「目的」、「過程」、「心得及建議事項」）
■	☑	3.無抄襲相關資料
■	☑	4.內容充實完備
■	☑	5.建議具參考價值
■	□	6.送本機關參考或研辦
■	□	7.送上級機關參考
□	□	8.退回補正，原因：
□	□	（1）不符原核定出國計畫
□	□	（2）以外文撰寫或僅以所蒐集外文資料為內容
□	□	（3）內容空洞簡略或未涵蓋規定要項
□	□	（4）抄襲相關資料之全部或部分內容
□	□	（5）引用相關資料未註明資料來源
□	□	（6）電子檔案未依格式辦理
□	□	（7）未於資訊網登錄提要資料及傳送出國報告電子檔
□	□	9.本報告除上傳至出國報告資訊網外，將採行之公開發表：
□	□	（1）辦理本機關出國報告座談會（說明會），與同仁進行知識分享。
□	□	（2）於本機關業務會報提出報告
□	□	（3）其他_____
□	□	10.其他處理意見及方式：

約用組員 吳繹欣 2017.09.11

出國人簽章（2人以上，得以1人為代表）	計畫主辦機關審核人	一級單位主管簽章	機關首長或其授權人員簽章
姚名鴻 106.9.1		教授兼管理學院院長 李一民 副教授兼國際合作組組長 王志強 2017.09.12 教授兼國際事務長 黃義俊	校長 楊慶煜(乙) 106.9.1

說明：

一、各機關可依需要自行增列審核項目內容，出國報告審核完畢本表請自行保存。

二、審核作業應儘速完成，以不影響出國人員上傳出國報告至「公務出國報告資訊網」為原則。

1

國立高雄應用科技大學出國報告無抄襲聲明書

　　本人任職於本校**財富與稅務管理系**擔任**副教授**　於 106 年 8 月 15 日至 106 年 8 月 23 日依**本系碩專班業務費**出國至**日本**　現回國並繳交出國報告一份　報告名稱為　**出席 IIPF Annual Congress 2017 國際研討會報告**　並據此聲明所交之出國報告並無抄襲相關資料之全部或部分內容

　　此致

國立高雄應用科技大學

聲明人　**姚名鴻**

日期　**106 年 9 月 1 日**

出國報告（出國類別：國際會議）

出席 IIPF Annual Congress 2017
國際研討會報告

服務機關：國立高雄應用科技大學 財富與稅務管理系

姓名職稱：姚名鴻 副教授

派赴國家：日本

出國期間：106 年 8 月 15 日至 106 年 8 月 23 日

報告日期：106 年 9 月 1 日

摘要

本次出國目的在參加第 73 屆國際財政學會年會暨學術研討會（The 73rd Annual Congress of the International Institute of Public Finance, IIPF Annual Congress 2017），會議由國際財政學會主辦，日本財政學會（Japan Institute of Public Finance）、日本地方財政學會（Japan Association of Local Public Finance）和東京大學協辦，在日本東京大學的伊藤國際會議中心（Ito International Research Center）舉行，會議時間從 2017 年 8 月 17 日報到開始，論文發表 8 月 18 日至 20 日，總計 4 天。

報告撰寫人於本次研討會口頭發表一篇論文，於 8 月 19 日上午第 C09 場次進行，題目是 Impacts of Fiscal Policies on Taiwan's Economic Growth: An Application of Recursive Cointegration Approach。共同作者包括本校金融資訊系簡美瑟教授和國立中山大學財務管理學系李建強教授。論文利用台灣 1955 至 2015 年的時間序列資料，估計我國在樣本期間公共投資、有效稅率、直接稅占間接稅之租稅結構變數及經濟成長率的長期關係。由於實證期間逾 60 年，在此期間我國經濟結構產生重大改變，因此，上述變數間的長期關係也會改變。本論文利用遞移共整合的實證方法解決此一問題。實證結果顯示公共投資對經濟成長有正向顯著關係，租稅結構變數對經濟成長有負向顯

著關係。有效稅率對經濟成長無顯著關係。另外，遞移共整合的估計結果顯示財政政策對我國經濟成長的影響，在 2004 年發生改變，可能的原因是我國自 2003 年起，依「就業保險法」實施「失業給付」，給付金額為勞保退保前之 6 個月平均月投保薪資的 60%。由於給付金額及條件遠較之前的規定優渥，故對勞動市場產生重大影響，進而影響我國經濟結構。我國整體失業率在「就業保險法」實施前 10 年（1993-2002）的未加權平均為 2.85%，實施後 10 年（2003-2012）失業率的未加權平均躍升至 4.52%。

此一實證結果的政策意涵是在維持相同的租稅負擔水準下，提高公共投資及調整直接稅占間接稅比率將有助於經濟成長。目前我國政府提出提高營業稅以作為政府推動長期照護的財源。從本研究的分析結果來看，此一租稅改革政策對經濟成長應不致於產生負面影響。

此外，研討會主辦單位安排加拿大蒙特婁工程學院（Polytechnique Montréal）的 Marcelin Joanis 教授擔任本論文之評論人。Joanis 教授建議本文應加強說明我國歷年的租稅改革政策，特別是直接稅占間接稅比率長期趨勢的變化。出席此次國際研討會的最大收獲除聆聽大會安排的 4 場由資深財政學者主講的主題式演講外，能和各國學者討論最新的財政學研究議題，更讓報告撰寫人受益無窮。

目　　次

一、目的

本次出國目的在參加第 73 屆國際財政學會年會暨學術研討會
（The 73rd Annual Congress of the International Institute of Public
Finance, IIPF Annual Congress 2017），會議由國際財政學會主辦，日
本財政學會（Japan Institute of Public Finance）、日本地方財政學會
（Japan Association of Local Public Finance）和東京大學協辦，在日本
東京大學的伊藤國際會議中心（Ito International Research Center）舉
行，會議時間從 2017 年 8 月 17 日報到開始，論文發表 8 月 18 日至
20 日，總計 4 天。

國際財政學會（The International Institute of Public Finance, IIPF）
於 1937 年在法國巴黎設立，是歷史非常悠久的國際性財政專業領域
學術組織。目前總部位於德國的慕尼黑，有來自全球 50 個國家，超
過 800 位會員。由於是一年一度的年會，因此來自世界各國的學者相
當多。本次年會，光是投稿的論文就超過 500 篇，最後只接受 200 多
篇論文的發表，其中包含政府支出、租稅改革、經濟成長、法律經濟
分析、財政分權等財政學各領域的最新研究成果。本人能參與此一盛
會，深感榮幸。透過論文發表，與各國財政學者討論，充分達到國際
學術交流的目的。

二、過程

由於暑假期間且地緣關係，個人前往日本旅遊的人數很多。因為機位因素，報告撰寫人於台灣時間 8 月 15 日上午由高雄小港機場出發，搭乘國籍中華航空 CI102 班機出境，於日本當地時間上午 11 點抵達東京成田國際機場，隨即安排機場附近旅店住宿。8 月 17 日早上搭乘大眾運輸工具抵達東京大學本鄉校區的伊藤國際會議中心，完成註冊與報到，並領取大會議程手冊、名牌和出席證明等會議資料。18 日起隨即進行 3 天的議程。8 月 20 日會議結束後，由於暑假機位因素，報告撰寫人安排私人行程參觀東京大學等著名景點，並於 8 月 23 日搭乘國籍中華航空 CI103 班機回高雄小港機場，返抵國門。

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本論文利用遞移共整合的實證方法解決此一問題。實證結果顯示公共投資對經濟成長有正向顯著關係，租稅結構變數對經濟成長有負向顯著關係。有效稅率對經濟成長無顯著關係。另外，遞移共整合的估計結果顯示財政政策對我國經濟成長的影響，在 2004 年發生改變，可能的原因是我國自 2003 年起，依「就業保險法」實施「失業給付」，給付金額為勞保退保前之 6 個月平均月投保薪資的 60%。由於給付金額及條件遠較之前的規定優渥，故對勞動市場產生重大影響，進而影響我國經濟結構。我國整體失業率在「就業保險法」實施前 10 年（1993-2002）的未加權平均為 2.85%，實施後 10 年（2003-2012）失業率的未加權平均躍升至 4.52%。

此一實證結果的政策意涵是在維持相同的租稅負擔水準下，提高公共投資及調整直接稅占間接稅比率將有助於經濟成長。日前我國政府提出提高營業稅以作為政府推動長期照護的財源。從本研究的分析結果來看，此一租稅改革政策對經濟成長應不致於產生負面影響。此外，研討會主辦單位安排加拿大蒙特婁工程學院（Polytechnique Montréal）的 Marcelin Joanis 教授擔任本論文之評論人。Joanis 教授建議本文應加強說明我國歷年的租稅改革政策，特別是直接稅占間接稅比率長期趨勢的變化。

此次研討會，主辦單位指派報告撰寫人擔任同場次來自葡萄牙里斯本科技大學（Technical University of Lisbon）的 Afonso 教授所發表論文之評論人。該論文主要是討論政府支出波動性對物價波動的影響。Afonso 教授指出，物價波動高通常伴隨高物價膨脹率，不利經濟成長。以 54 個國家在 1980 到 2013 年度期間的資料作分析，並利用不同指標衡量物價的波動性。實證結果發現政府支出波動愈大的經濟體，其物價水準的波動程度愈大。傳統的貨幣經濟學家認為物價水準是由貨幣供給所決定，但 Afonso 教授的實證結果說明，物價的波動除受貨幣政策影響外，也受政府的支出政策影響。因此，要穩定一國之物價，除控制貨幣供給量外，行政部門也必須穩定其支出水準，不宜有波動過大的現象。

研討會照片一：出席證明
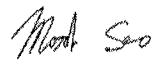
Certificate of Attendance
参加証明証

This is to certify that

National Kaohsiung University of Applied Sciences

Minghung Yao

Attended the 73rd Annual Congress of
the International Institute of Public Finance
August 18-20, 2017

Motohiro Sato
Chair
The 73rd Annual Congress of
the International Institute of Public Finance

研討會照片二：會議手冊

Fiscal Reform
August 18 - 20, 2017
Tokyo, Japan

Minghung Yao
National Kaohsiung University of
Applied Sciences
Taiwan
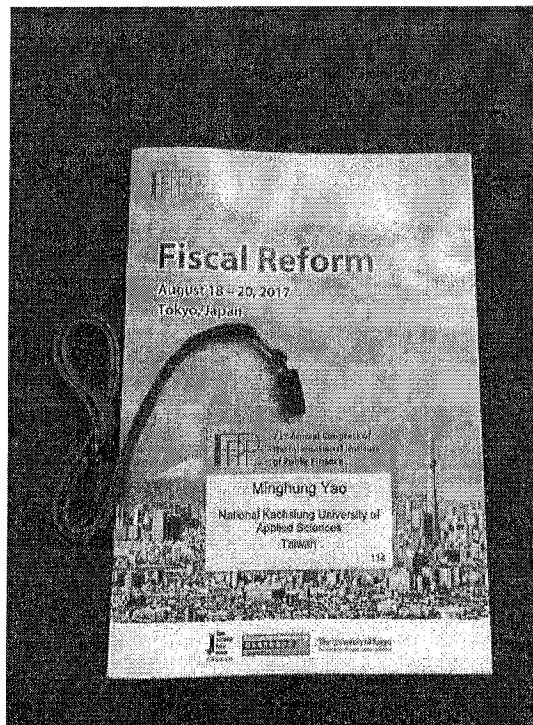
研討會照片三：研討會論文

Impacts of Fiscal Policies on Taiwan's Economic Growth:
An Application of Recursive Cointegration Approach

Ming-Hung Yao[†]

Mei-Se Chien[‡]

Chien-Chiang Lee[§]

Abstract

This paper discusses the effects of fiscal policies on economic growth in Taiwan from 1975 to 2015. Both taxes and public investment are considered as explanatory variables in the cointegration analyses. The recursive cointegration approach is employed to deal with the time-varying behavior of these linkages. The results indicate significant and strong long-run equilibrium relationships between public investment-to-GDP ratio, tax mix, defined as the ratio of direct to indirect taxes, average tax rate or tax burden, and economic growth rate in Taiwan. Public investment has positive effects while tax mix has negative effects on economic growth. Average tax rate has no significant effect on economic growth because the effects of direct and indirect taxation on economic growth may cancel each other out. The recursive cointegration estimation results confirm that the long-run equilibrium relationship changed around 2004, which might be caused by the implementation of Employment Insurance Act in 2004. The present results coincide with the argument of endogenous growth theory that given some tax burden, increasing public investment and reducing the ratio of direct to indirect taxes enhance economic growth.

Keywords: economic growth, public investment, tax burden, tax mix, recursive cointegration

JEL Classification: O11, R53, H20

1. Introduction

In the midst of the 2008 global economic recession, the government of Taiwan proposed cuts in motor vehicle excise tax, corporate income and personal income taxes. It also cut twelve public construction projects, including island-wide transportation network, flood control and river rectification, and sewer construction. These discretionary policies regained attention to the long-term effect of taxation and public investment on economic growth. The aim of this study is to investigate whether these expansionary policies are able to revive Taiwan's economy.

The effects of fiscal policies on economic growth have been widely discussed in the literature. Endogenous growth theory states that sustained economic growth can be explained by increasing returns to scale, human capital, research and development, and public investment (Romer, 1986; Lucas, 1988). Public investment, such as roadways, railways, ports, water systems and electricity mains to accumulate public capital. Provision of public infrastructure reduces private production cost, enhances production efficiency, and encourages private investment. Underinvestment in infrastructure may retard production activities and pose risks to a nation's productivity and standard of living.

Tax revenue is the main source of income for financing government expenditure. Taxes reallocate resources and affect capital formation. Endogenous growth economists state that public investment directly affects a country's long-term production capacity through public capital accumulation. Taxes also alter the returns of production factors and indirectly affect market activities. When it comes to economic growth, both taxation and public investment are important elements.

Unlike previous research which uses either taxes or public investment alone in estimation, this study considers both taxation and public investment when analyzing the impact of fiscal policies on economic growth in Taiwan during 1975-2015.

Moreover, little attention has been paid to the time-varying nature of the relationship between fiscal policies and economic growth in some papers. The economic growth puzzle is a long-run issue, and Taiwan has experienced a long-term structural transformation over the sample period. The linkages among these fiscal policies and economic growth might change over time. Hence, this study examines the time-varying impact of fiscal policies on economic growth in Taiwan to fill the gap in the literature. The recursive cointegration approach is used in this study to deal with the time-varying behavior of these linkages. The results indicate significant and strong long-run equilibrium relationships between public investment-to-GDP ratio, tax mix, defined as the ratio of direct to indirect taxes, the average tax rate or tax burden, and Taiwan's economic growth rate. Public investment has positive effects while tax mix has negative effects on economic growth. Average tax rate has no significant effect on economic growth because the effects of direct and indirect taxation on economic growth may cancel each other out. The recursive cointegration estimation results confirm that the long-run equilibrium relationship changed around 2004. The present results coincide with the argument of endogenous growth theory that given some tax burden, increasing public investment and reducing the ratio of direct to indirect taxes enhance economic growth.

The remainder of this paper is organized as follows. Section 2 provides a brief literature review. Section 3 introduces the theoretical model and econometric methods for this study. Section 4 describes Taiwan's economic and fiscal data. Section 5 presents an empirical analysis and section 6 concludes.

2. Literature Review

Numerous studies have discussed the relationship between public investment and economic growth. Aschauer (1989) indicates that nonmilitary public capital stock has

substantial influence on economic growth. Insufficient public investment accounted for the slow economic growth in U.S. during the 1970s and 1980s. Kocherlakota and Yi (1996) further propose that a 1% increase in the ratio of nonmilitary equipment capital to GNP will permanently raise GDP per capita by 2%. Finn et al. (1993) show that when public capital stock increases by 1 percentage point, equilibrium output level in Spain will grow by 2.8 percentage points. However, Albertog et al. (2011) suggest that the link between public investment and growth has weakened over time. According to these cross-sectional and time-series regressions, public investment in high-income countries is more likely to have a negative effect on economic growth. Ramos and Roca-Sagales (2003) use a vector autoregression approach to examine the effect of fiscal policies on GDP. They find that increase in public spending has a negative impact on long-term output growth. Ma (2007) decomposes the effect of government expenditure on real GDP growth rate and concludes that 1 percentage point increase in the share of government investment expenditure raises the equilibrium GDP growth rate by 0.162 percentage point. Yet, government consumption expenditure have negative marginal effects on economic growth.

The impact of tax policies on economic growth remains unresolved (Myles, 2009). Supernuetrality conjecture proposed by Harberger (1964) argues that tax policies have limited impact on labor supply, private savings, investment and economic growth. Kocherlakota and Yi (1996, 1997) present that the highest and effective personal income tax rates have no significant effects on long-term economic development of U.S. and U.K. respectively. Mendoza et al. (1997) estimate the effective rates of consumption tax, labor income tax, and capital income tax for 18 OECD countries. Their results indicate that these effective tax rates have small and insignificant impact on the average growth rate of GDP per capita.

Other empirical studies provide evidence that tax policies may affect economic

growth. Auerbach and Kotlikoff (1987) evaluate fiscal policies with a dynamic simulation model and find that consumption tax tends to encourage savings and capital formation. Skinner (1987) estimates data of 31 African countries during 1965-1982 and concludes that given same tax revenue, increased consumption tax rates associated with decreased import duty, personal income, and corporate income tax rates help boost economic growth. Wang and Yip (1992) find that consumption tax has a positive effect while income tax has a negative effect on economic growth. The opposing effects of these two taxes result in an insignificant impact on output. They suggest that individual rather than aggregate tax rates should be employed to examine the effect of taxation on economic growth. Branson and Lovell (2001) estimate the combination of tax burden and tax mix that maximizes New Zealand's economic growth rates. Their results show that during the sample period, the actual tax burden and tax mix exceed the growth-maximizing levels. If the government reduces the tax burden, real GDP will increase and people will obtain more purchasing power. Gray et al. (2007) discuss the impact of fiscal policy on economic growth in Europe and Central Asia (ECA). ECA countries are pioneers in adopting flat income tax. However, even though income tax rates have been dramatically lowered, payroll taxes remain high. They suggest reforming the social security system to reduce the labor tax burden and its effect on employment. Lower income and payroll tax rates can spur investment and employment.

The economic growth puzzle is a longterm issue, and the linkages among economic growth and its determinants might change over time. For example, Auerbach and Gorodnichenko (2012) apply regime-switching models and find large differences in the size of spending multipliers in recessions and expansions, with fiscal policy being considerably more effective in recessions than in expansions. Nakamura and Steinsson (2014) exploit regional variation in military spending in the United

States to estimate the effect of government spending on output. They find that when aggregate military spending in the United States rises by 1% of GDP, military spending in California on average rises by about 3% of California GDP, while military spending in Illinois rises by only about 0.5% of Illinois GDP. It is clear that fiscal policy might have different impacts on growth in recessions or in expansions, in high-income or low-income economies, and in open-or-closed economy. Taiwan has experienced a longterm structural transformation over the sample period, 1955-2018. For example, Taiwan adopted an expansion export trade policy in the 1960s, and then encouraged exporting and expanding into the international market, which established the foundations for its economic development to take off. The two oil crises in the 1970s caused international raw materials and the price of petroleum to soar, which hurt Taiwan's economy. Taiwan then began to enforce financial liberalization and an internationalization policy in the 1980s. The military crisis across the Taiwan Strait due to the threat from China, the Asian financial crisis (1997-1999), and the agreement of the OPEC to drop their production to increase oil prices are important economic incidents in the 1990s. Taiwan has had negative economic growth rates in the 2000s due to the technology bubble burst in 2001 and the financial crisis between 2008 and 2009. The government of Taiwan proposed tax cuts and had out twelve public construction projects to stimulate the economy in 2009. With the sample period being over half a century, the linkages among these fiscal policies and economic growth might change over time. Without considering the domestic process, the conclusions of the traditional time-series analysis might be far from convincing. To fill this gap in the literature for dealing with the time-varying behavior of these linkages, the recursive cointegration approach is used in this study.

3. Theoretical Model and Econometric Methods

Suppose a representative agent maximizes her utility defined as equation (1):

$$U(C_t) = E_0 \sum_{t=0}^{\infty} \beta^t \ln(C_t) \qquad (1)$$

where C_t denotes the consumption level at time t, and β is the discount factor. The production function is assumed as equation (2):

$$Y_t = f(A_t, G_t)K_t^\alpha S_t^\beta \qquad (2)$$

where Y_t is the output level, A_t represents the technology shock, S_t is the ratio of direct to indirect tax, K_t is the private capital stock, and G_t is the public capital stock at time t. Equation (2) implies that tax policies affect not only the accumulation of private capital through the changes of tax burden, but the output level with varying ratios of direct to indirect tax. Equation (3) defines the law of motion for private capital accumulation:

$$K_t + K_b - K_{t-1} - \theta K_{t-1}\left(\frac{I_{t-1}}{K_{t-1}}\right)^\delta \qquad (3)$$

where θ represents the rate of depreciation and $0 < \delta < 1$. I_{t-1} is the private investment at time $t-1$. Assume that τ_t is the effective tax rate. After-tax output level will be allocated between consumption and investment. The relationship between consumption, investment and output level can be expressed as

$$C_t + I_t = (1 - \tau_t)Y_t \qquad (4)$$

The representative agent maximizes her utility with respect to equations (2), (3) and (4). Consumption and investment can be obtained as

$$C_t = (1 - S)(1 - \tau_t)Y_t \qquad (5)$$

and

$$I_t = S(1 - \tau_t)Y_t \qquad (6)$$

where $S = \alpha \rho \delta/[1 - \rho(1 - \delta)]$.

According to Kriachnikova and Yi (1997), the growth rate of output level can be

expressed in structural form as [1]

$$\Delta y_t + \beta \Omega_t - \Delta n k_{t+1} - F(G_t, s_t, B_t) \qquad (7)$$

To reveal the dynamics of the relationships between fiscal policy variables and economic growth, the recursive cointegration rank tests of Johansen (1988) and Johansen (1991) are employed to examine the degree of cointegration during different subsample periods of the full sample. The Johansen tests are developed from the following vector autoregressive (VAR) system:

$$\Delta W_t = \sum_{i=1}^{k-1} \Gamma_i \Delta W_{t-i} + \Pi W_{t-k} + \varepsilon_t, \quad t = 1, \dots, T, i = 1, \dots, k-1,$$
$$E_t - I + \Pi_1 + \dots + \Pi_k, \Pi = -(I - \Pi_1 - \dots - \Pi_k) \qquad (8)$$

where W_t is a vector covering economic growth rates and fiscal policy variables. The matrix Π could be decomposed as $\alpha\beta'$, and α is the matrix of the short-run adjustment coefficients in the cointegrating vectors (β matrix). The relevant hypotheses are as regard to Π: if the rank of Π is r, where $0 \leq r \leq 1$, then r is called the cointegration rank. There are two test statistics for the rank of Π as follows:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n}\ln(1 - \lambda_i) \qquad (9)$$

$$\lambda_{max}(r, r+1) = -T\sum_{i=r+1}^{n}\ln(1 - \lambda_{r+1}) \qquad (10)$$

where λ_i are the eigenvalues of the estimated Π matrix and T is the number of observations. The statistic of equation (9) is called trace statistic, and the statistic of equation (10) is called maximum eigenvalue statistic.

4. Economic and Fiscal Data in Taiwan

During the sample period (1955-2018), the unweighted average economic growth rate in Taiwan was 7.51% (Figure 1). Except for the periods of technology bubble burst in 2001 and financial crises between 2008 and 2009, Taiwan has had

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[1] See Appendix 1 in Kriachnikova and Yi (1997) for details.

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[1] See Appendix 2 in Kriachnikova and Yi (1997) for details.

growth. Auerbach and Kotlikoff (1987) evaluate fiscal policies with a dynamic simulation model and find that consumption tax tends to encourage savings and capital formation. Skinner (1987) examines data of 31 African countries during 1965-1982 and concludes that given same tax revenue, increased consumption tax rates associated with decreased import duty, personal income, and corporate income tax rates help boost economic growth. Wang and Yip (1992) find that consumption tax has a positive effect while income tax has a negative effect on economic growth. The opposite effects of these two taxes result in an insignificant impact on output. They suggest that individual rather than aggregate tax rates should be employed to examine the effect of taxation on economic growth. Branson and Lovell (2001) examine the combination of tax burden and tax mix that maximizes New Zealand's economic growth rates. Their results show that during the sample period, the actual tax burden and tax mix exceed the growth-maximizing levels. If the government reduces the tax burden, real GDP will increase and people will obtain more purchasing power. Gray et al. (2007) discuss the impact of fiscal policy on economic growth in Europe and Central Asia (ECA). ECA economies are pressures in adopting the income tax, however, even though income tax rates have been dramatically lowered, payroll taxes remain high. They suggest reforming the social security system to reduce the labor tax burden and its effect on employment. Lower income and payroll tax rates can spur investment and employment.

The economic growth puzzle is a longterm issue, and the linkages among economic growth and its determinants might change over time. For example, Auerbach and Gorodnichenko (2012) apply regime-switching models, and find large differences in the size of spending multipliers in recessions and expansions with fiscal policy being considerably more effective in recessions than in expansions. Nakamura and Steinsson (2014) exploit regional variation in military spending in the United

States to estimate the effect of government spending on output. They find that when aggregate military spending in the United States rises by 1% of GDP, military spending in California on average rises by about 3% of California GDP, while military spending in Illinois rises by only about 0.5% of Illinois GDP. It is clear that fiscal policy might have different impacts on growth in recessions or in expansions, in high-income or in low-income economies, and in open or closed economies. Taiwan has experienced a long-term structural transformation over the sample period, 1953-2015. For example, Taiwan adopted an expansion export trade policy in the 1960s, and then encouraged exporting and expanding into the international market, which established the foundation for its economic development to take off. The two oil crises in the 1970s caused skyrocketing raw materials and the price of petroleum to soar, which hurt Taiwan's economy. Taiwan then began to enforce financial liberalization and an internationalization policy in the 1980s. The military cross across the Taiwan Strait due to the threat from China, the Asian financial crisis (1997-1999), and the agreement of the OPEC to drop their production to increase oil prices are important economic incidents in the 1990s. Taiwan has had negative economic growth rates in the 2000s due to the technology bubble burst in 2001 and the financial crisis between 2008 and 2009. The government of Taiwan proposed tax cuts and laid out smaller public construction projects to stimulate the economy in 2008. With the sample period being over half a century, the linkages among these fiscal policies and economic growth might change over time. Without considering the dynamic process, the conclusions of the traditional time-series analysis might be far from convincing. To fill this gap in the literature for dealing with the time-varying behavior of these linkages, the recursive cointegration approach is used in this study.

3. Theoretical Model and Econometric Methods

Suppose a representative agent maximizes his utility defined as equation (1):

$$U(C_t) = E_t \sum_{t=0}^{\infty} \rho^t \ln(C_t) \tag{1}$$

where C_t denotes the consumption level at time t, and ρ is the discount factor. The production function is assumed as equation (2):

$$Y_t = (A_t D_t) K_t^{\alpha} G_t^{\beta} \tag{2}$$

where Y_t is the output level, A_t represents the technology shock, D_t is the ratio of direct to indirect tax, K_t is the private capital stock, and G_t is the public capital stock at time t. Equation (2) implies that tax policies affect not only the accumulation of private capital through the changes of tax burden, but the output level with varying ratios of direct tax, indirect tax. Equation (3) defines the law of motion for private capital accumulation:

$$k_t = K_t - K_{t-1} = \delta K_{t-1} \left(\frac{I_{t-1}}{\delta K_{t-1}} \right)^{\phi} \tag{3}$$

where δ represents the rate of depreciation and $0 < \phi < 1$. I_{t-1} is the private investment at time $t-1$. Assume that τ_t is the effective tax rate. After-tax output level will be allocated between consumption and investment. The relationship between consumption, investment and output level can be expressed as

$$C_t + I_t = (1 - \tau_t) Y_t \tag{4}$$

The representative agent maximizes his utility with respect to equations (2), (3) and (4). Consumption and investment can be obtained as[1]

$$C_t = (1 - \delta \beta)(1 - \tau_t) Y_t \tag{5}$$

and

$$I_t = \delta (1 - \tau_t) Y_t \tag{6}$$

where $\delta = \alpha \rho \phi / [1 - \rho(1 - \delta)]$

According to Kocherlakota and Yi (1997), the growth rate of output level can be

expressed in structural form as[2]

$$\Delta y_t = \theta_0 Y_t - \theta_1 Y_{t-1} + F(G_t, \tau_t, D_t) \tag{7}$$

To reveal the dynamics of the relationship between fiscal policy variables and economic growth, the recursive cointegration (rank) tests of Johansen (1988) and Johansen (1991) are employed to examine the degree of cointegration during different sub-sample periods of the full sample. The Johansen tests are developed from the following vector autoregressive (VAR) system:

$$\Delta X_t = \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \varepsilon_t, \quad t = 1, \dots, T, \; i = 1, \dots, k-1,$$
$$\Gamma_i = -(I + \Pi_1 + \dots + \Pi_i), \quad \Pi = -(I - \Pi_1 - \dots - \Pi_k) \tag{8}$$

where ΔX_t is a vector covering economic growth rates and fiscal policy variables. The impact matrix Π could be decomposed as $\alpha \beta'$ and α is the matrix of the short-run adjustment coefficients to the cointegrating vectors β matrix. The relevant hypotheses are in regard to Π. If the rank of Π is r where $r \leq n - 1$, then r is called the cointegration rank. There are two test statistics for the rank of Π as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \tag{9}$$

$$\lambda_{max}(r, r+1) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_{r+1}) \tag{10}$$

where $\hat{\lambda}_i$ are the eigenvalues of the estimated Π matrix and T is the number of observations. The statistic of equation (9) is called trace statistic, and the statistic of equation (10) is called maximum eigenvalue statistic.

4. Economic and Fiscal Data in Taiwan

During the sample period (1953-2015), the unweighted average economic growth rate in Taiwan was 7.52% (Figure 1). Except for the periods of technology bubble burst in 2001 and financial crisis between 2008 and 2009, Taiwan has had

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[1] See Appendix 1 in Kocherlakota and Yi (1997) for details.

[2] See Appendix 2 in Kocherlakota and Yi (1997) for details.

positive economic growth rates. However, they gradually declined from 10.66% in the 1970s, 8.48% in the 1980s, 6.63% in the 1990s, to 3.87% in the 2000s. Nevertheless, when using 2011 as the base year, real GDP per capita increased from $1,494 in 1960 to $22,384 in 2015. Taiwan has turned into an advanced economy according to the IMF World Economic Outlook, September 2011.
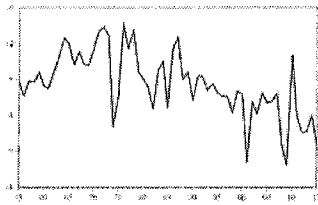

Figure 1 Taiwan's economic growth rate, 1955-2015

In this study, public investment is defined as the gross fixed capital formation of the government sector. Figure 2 shows the public investment-GDP ratios between 1955 and 2015. During the oil crisis in the 1970s, the government of Taiwan expanded the construction of ironworks and shipyards. The unweighted average ratio of public investment to GDP is 4.07% in the 1970s, and 4.41 in the 1980s. In the late 1980s and early 1990s, the government of Taiwan started the transport infrastructure investment projects. However, the ratio has continuously dropped since then due to substantial budget deficits. In the midst of the 2008 global economic recession, the government of Taiwan had ten twelve public construction projects, including

island-wide transportation network, flood control and river rectification, and sewer construction. Accordingly, the public investment-GDP ratio increased temporarily for 2008 and 2009.

Figure 2 Ratio of public investment to GDP, 1955-2015

Figure 3 represents the ratios of tax burden between 1955 and 2015. The tax burden during this period was between 11.4% and 19.9%. In 2003, the ratio dropped to its lowest level around 11.4%. In the midst of the 2008 global economic recession, the government of Taiwan proposed cuts in motor vehicle excise tax, corporate income and personal income taxes. The ratio of tax burden almost dropped to its lowest level again in 2010.
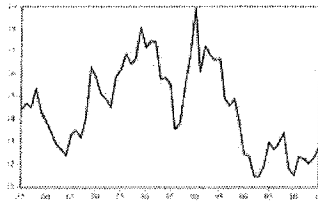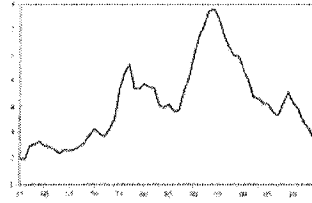

Figure 3 Tax burden (ratio of tax revenue to GDP), 1955-2015

Figure 3 shows the ratios of tax max between 1955 and 2015. According to the Ministry of Finance, Taiwan, direct tax includes income tax (individual and profit-seeking enterprises), estate and gift tax, securities and futures transaction tax, land tax, house tax, deed tax and education surtax. Indirect tax includes customs duties, commodity tax, tobacco and alcohol tax, business tax, vehicle license tax, stamp tax and amusement tax. The ratio of direct to indirect taxes has constantly risen except for several years in the early 1990s and 2000s. Taiwan's economy soared in the 1970s, which increased personal income and broadened the tax base. Income taxes hence became the main source of tax revenue. From the 1980s, Taiwan has reduced its tariff barriers to promote trade with the U.S. The share of customs duties in total tax revenue gradually declined. Taiwan stock market has rapidly developed since 1988. Before the Asian financial crisis in 1997, the share of securities transaction taxes in total tax revenue increased and raised slightly the ratio of direct to indirect taxes. In general, before 1989, the tax max was less than 1, implying that indirect taxes accounted for a larger share of total tax revenue. After 1989, direct tax revenue

gradually exceeded indirect tax revenue. In 2015, the tax max was 1.63. Direct taxes contributed about 62.1% to total tax revenue.
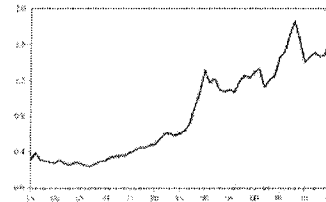

Figure 4 Tax max (ratio of direct to indirect taxes), 1955-2015

5. Empirical Analysis

This study follows Chen et al. (2013) in applying Johansen cointegration analysis to annual data of Taiwan from 1955 to 2015. The data of all empirical variables are obtained from the AREMOS economic-statistic data banks, created jointly by the Ministry of Education in Taiwan and National Taiwan University. [ ] GR, $PINT$, TB and TX denote real GDP growth rate, public investment-to-GDP ratio, tax burden, and tax max, respectively. Table 1 summarizes the descriptive statistics of these variables. Table 2 shows correlation coefficients of variables; the economic growth rate is negatively correlated to public investment and tax max, but positively correlated to tax burden.

Table 1 Descriptive statistics

	Mean	Maximum	Minimum	Std. Dev.	Observations
EGR(%)	7.807	13.289	-1.476	3.640	61
PINV(%)	4.154	7.838	1.862	1.546	61
TB(%)	14.513	18.921	11.424	3.984	61
TX	0.825	1.962	0.245	0.309	61

Note: The sample period is from 1955 to 2015

Table 2 Correlation coefficients of variables

	EGR	*PINV*	*TB*	*TX*
EGR	1.000			
PINV	-0.168	1.000		
TB	0.283**	0.448***	1.000	
TX	-0.668***	0.583***	-0.348***	1.000

Note: ** and *** indicate significance at 5% and 1% level respectively

5.1 Unit root tests

Prior to conducting cointegration analysis, three unit root tests, the augmented Dickey and Fuller (1979, 1981, ADF), Elliot, Rothenberg, and Stock's(Dickey-Fuller GLS detrended (1996, DF-GLS) and Kwiatkowski, Phillips, Schmidt, and Shin (1992, KPSS), have been employed to verify the stationarity of each time series. As shown in Table 3, all the first-difference series are stationary at the 1% significance level.

Table 4 Johansen's cointegration test results

	λ_{max}		λ_{trace}	
	statistics	5% critical value	statistics	5% critical value
$r = 0$	34.56**	28.58	65.54**	54.07
$r \leq 1$	17.69	22.29	35.09	35.19
$r \leq 2$	14.48	15.89	14.38	20.26
$r \leq 3$	2.95	9.16	2.95	9.16

Note: ** denotes significance at 5% level. The 5% critical values are computed from the response surface value obtained by Osterwald-Lenum (1992) using the method of Cheung and Lai (1993). r represents for cointegration rank.

$$EGR_t = 0.1944 + 0.8215 \cdot PINV_t - 0.0171 \cdot TB_t - 5.2519 \cdot TX_t \quad (11)$$

Table 5 Cointegration vector coefficient significance test

	PINV	*TB*	*TX*
Statistic	3.4793*	0.0082	7.4406***
p-value	[0.0642]	[0.9362]	[0.0064]

Note: TB test statistics are obtained by means of the $\chi^2(1)$ test. The numbers in the parentheses represent p-values. For superscripts * and *** denote significance at 10% and 1% level respectively.

5.3 Recursive cointegration test

(1) Explanation of recursive trace test

To discuss the importance of time-varying linkages in the long run, recursive cointegration is employed to test the dynamic convergence of *EGR*, *PINV*, *TB* and *TX*. The recursive cointegration analysis of Hansen and Johansen (1999) is executed to examine for the stability of the cointegrating rank and coefficients. This study first

Table 3 Results of unit root tests

Variable	ADF	DF-GLS	KPSS
Levels			
EGR	-0.733*(4)	-0.8793 (4)	0.9332**(6)
PINV	-1.9250 (1)	-1.4964 (1)	0.3174**(6)
TB	-1.6318 (0)	-1.6731 (0)	0.5564**(2)
TX	-0.1114 (0)	0.5567 (0)	0.9186**(6)
First differences			
EGR	-10.6405**(0)	-9.8387**(0)	0.1601 (6)
PINV	-4.1890**(0)	-4.2065**(0)	0.2518 (1)
TB	-7.9823**(0)	-3.9597**(2)	0.0879(0)
TX	-5.2169**(0)	-5.7957**(0)	0.0990(2)

Notes: Three unit root tests, the augmented Dickey and Fuller (1979, ADF), Elliot, Rothenberg, and Stock's Dickey-Fuller GLS detrended (1996, DF-GLS), and Kwiatkowski, Phillips, Schmidt, and Shin (1992, KPSS) are applied. The numbers in parentheses indicate the selected lag order. The superscripts include an intercept. The lag lengths are determined via the Modified AIC and are in parentheses. ** indicates significance at 5% level. The null hypothesis for all tests except for the KPSS test are unit roots.

5.2 Johansen cointegration

The trace and maximum eigenvalue statistics in Table 4 indicate that the null hypothesis of no cointegration, which is a test of $r = 0$, is significantly rejected at the 5% level, implying the existence of a long-run equilibrium among *EGR*, *PINV*, *TB* and *TX*. Equation (11) presents results of the cointegration coefficients of the long-run relationship variables, which has been normalized for *EGR* just to get meanings from the coefficients. The cointegration vector coefficient significance test results shown in Table 5 indicate that 1 percentage point increase in the public investment-to-GDP ratio is associated with 0.822 percentage point increase in Taiwan's economic growth rate at 10% significance level, and 1 percentage point increase in the ratio of direct to indirect taxes is associated with 0.08 percentage point decrease in Taiwan's economic growth rate at 1% significance level. But average tax rate has no significant effect on economic growth because the effects of direct and indirect taxation on

economic growth have cancel each other out. The present results coincide with the argument of endogenous growth theory that given wide tax burden, increasing public investment and reducing the ratio of direct to indirect taxes enhance economic growth.

estimates the trace statistics of recursive cointegration by applying the sample from 1955 to 1994, followed by adding one observation to the end so time increases. The estimated results of recursive trace statistics are displayed as a continuous graph of trace statistics, which can describe the time-varying number of cointegrating vectors.

Figure 5 shows the scaled trace statistics for the null hypothesis $r \leq i$, $i = 0, 1, 2, 3$. If the value of the recursive trace statistic is above 1, the 5% critical value, it means that the corresponding null hypothesis of $r \leq i$, $i = 0, 1, 2, 3$ should be rejected at the 5% significant level.

As seen in Figure 5, the dual line showing the path of tests for $H(r \leq 0|r = 0)$ is lower than the 5% critical value over much of the period before 2004, and higher than the 5% critical value after that. That is, there is a cointegration vector among *EGR*, *PINV*, *TB*, and *TX* after 2004. The change of the long-run equilibrium might be caused by Taiwan enforcing new unemployment insurance benefit policy in 2003. Taiwan began to provide unemployment insurance with the implementation of the Unemployment Benefit Regulations in 1999, adding a new provision for unemployment payments under labor insurance, but these were merely passive payments to assure the basic livelihoods of workers who had lost their jobs. To provide a more comprehensive employment security system, the Employment Insurance Act was passed in 2002, and implemented since 2003. The impact of unemployment insurance benefits on employment and labor market condition has been addressed in the literature. For example, Chodorow-Reich and Karabarbounis (2016) find that unemployment benefit extensions have an influence on unemployment outcomes. The increase in duration of benefits affects the labor market condition and raises the unemployment rate. The 10-year unweighted average unemployment rate in Taiwan in the period of 1993-2002 (before the implementation of Employment Insurance Act) was 2.85%, and then jumped to 4.53% in the period of

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2000-2012. Such a dramatic change in labor market would affect the influence process of the impact of fiscal policy on economic growth after 2004. This result also means that three stochastic trends drive EGR, $PINV$, TB, and TX after 2003. The present findings show a significant and strong a long-run equilibrium among these four variables after 2004.
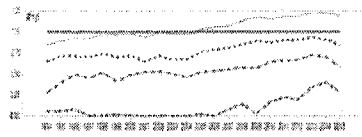

Figure 3 Recursive standardized trace test

(2) Estimation of recursive coefficients of cointegration vector β

The estimation of recursive coefficients of the cointegration vector, matrix β, can show how much the three dependent variables, $PINV$, TB, and TX, can affect EGR in the long run. The recursive coefficient matrix for the cointegrating vectors, matrix β, are estimated as Figure 6(a)-(c), showing the estimating recursive coefficients of $PINV$, TB and TX respectively. Moreover, the cointegration vectors are normalized around EGR.

First, in light of the recursive coefficient of $PINV$, shown in Figure 6(a), the coefficient was positive over the period, meaning that higher $PINV$ will increase EGR over much of the period. Moreover, the coefficient of $PINV$ increased rapidly and then became stable around 0.8 after 1995, which implies that public investment has exerted

increasingly larger impact on economic growth after 1995.

Figure 6(a) Recursive coefficient of $PINV$ of cointegration vector

As to the recursive coefficient of TB, shown in Figure 6(b), the sign of the coefficient changes all the time during the sample period. Moreover, it was close to zero and insignificant, indicating that tax burden is a factor of little impact on economic growth in Taiwan.

Figure 6(b) Recursive coefficient of TB of cointegration vector

The recursive coefficient of TX, shown in Figure 6(c), was significantly negative

over much of the period, which means that increasing TX would decrease EGR over much of the period. The absolute value of the coefficient of TX increased after 1995, implying that the power of decreasing TX to raise EGR became bigger after 1995. Notably, the coefficient of TX shows a substantial change from 2008 to 2011, from -5.47 in 2008 to -6.98 then to -4.5° in 2011, and remains stable around -5.00 after 2012.
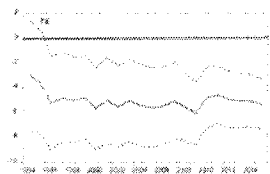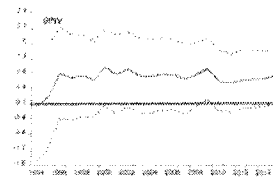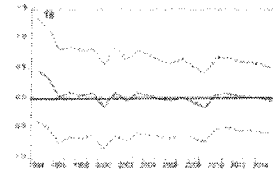

Figure 6(c) Recursive coefficient of TX of cointegration vector

6. Conclusion

This paper discusses the effects of fiscal policies on economic growth in Taiwan from 1955 to 2014. Both taxes and public investment are considered as explanatory variables in the cointegration analysis. The recursive cointegration approach is employed to deal with the time-varying behavior of these linkages. The results indicate significant and strong long-run equilibrium relationships between public investment-to-GDP ratio, tax mix, defined as the ratio of direct to indirect taxes, average tax rate or tax burden, and economic growth rate in Taiwan. Public investment

has positive effects while tax mix has negative effects on economic growth. Average tax rate has no significant effect on economic growth because the effects of direct and indirect taxation on economic growth may cancel each other out. The recursive cointegration estimation results confirm that the long-run equilibrium relationship changed around 2004, which might be caused by the implementation of Employment Insurance Act in 2003.

The present results do not coincide with Harberger's supermorbidity conjecture. Instead, they support the argument of endogenous growth theory that given same tax burden, expanding public investment and reducing the ratio of direct to indirect taxation would enhance economic growth. The public investment to GDP ratio dropped annually from 4.39 in 2002 to 2.03 in 2015, which is the lowest level since 1950s. The long period of underinvestment in infrastructure may retard private investment, and pose risks to a nation's productivity and standard of living. On the other hand, some direct taxes are thought to be more distorting than indirect taxes. For example, income tax creates a barrier between the value of a person's labor and what they actually receive, which causes people to work less and pursue more leisure activities, thus posing a negative force on the economy. A well-designed consumption tax is more neutral and does not affect the allocation of resources as dramatically as income tax. Thus, in order to promote long-term economic growth, the government of Taiwan should focus on prudentially increasing effectiveness of public infrastructure investment and increasing its magnitude, as well as adjusting tax structure, such as lowering the ratio of direct to indirect taxation.

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三、心得及建議

  報告撰寫人於本次國際財政學會年會及研討會發表一篇有關我國財政政策與經濟成長的論文。與會學者對我國的低租稅負擔水準、租稅結構和歷年的租稅改革議題感到相當有興趣。論文發表後也向本人提出有關台灣目前租稅政策以及論文研究方法的相關問題。與國外學者交換研究意見，對報告撰寫人後續研究規劃及研究方向獲益良多，最重要的是可瞭解目前世界各國的租稅改革政策及其它總體經濟政策的最新進展。參加國際性研討會有助於提高學術視野，因此期望國內專家學者能多加前往與會，以便提高國內財政學者在國際上之知名度。對於個人之研究可吸收最新研究方法，將有極豐富的啟發及研究助益。此外，經由與國外學者的意見交流，可得知國外總體經濟政策的影響。雖然由國際性的財經媒體可得知這些政策措施，但從學者的研究才能發現這些政策的影響。

  出席此次國際研討會的最大收獲除聆聽大會安排的 4 場由資深財政學者主講的主題式演講外，能和各國學者討論最新的財政學研究議題，更讓報告撰寫人受益無窮。國際學術交流對於相關領域的從業人員是必要的活動，其中，又以國際型學術研討會最為重要。因為國際性研討會提供一個平台，讓學術人員及業界人士，充分交流。本次

參與第 73 屆國際財政學會年會暨學術研討會，成果豐碩，除和各國與會之專家學者交換研究心得外，也吸取很多寶貴經驗與想法，建議國內之專家學者多能在參與多國舉辦之國際研討會後，貢獻經驗提供國內的國際研討會籌備參考。有感於研究不能閉門造車，應多與各國之研究學者專家交流，才能以獲裨益，使國內有志從事財政學領域之年輕後輩，除學校課程與參加研討會外，能進一步在研討會中學習理論基礎及實務之機會。