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臺灣的教育選擇與九年國民義務教育之評估
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摘要

本文以「華人家庭動態資料庫」(PSFD) 資料，分析台灣地區家庭環境因素與個人特質對教育成就的影響，並探討九年國民義務教育政策的施行對性別、城鄉與省籍間教育成就差異的影響效果。實證的結果顯示，個人特質與家庭環境因素對教育成就有顯著影響，而忽略個人特質將高估家庭環境因素的影響。在控制個人特質與家庭環境因素下，本文的研究結果發現，九年國民義務教育的實施，實有助於各別改善台灣地區不同性別、城鄉或省籍間教育成就的差異。但若進一步控制性別、城鄉與省籍間彼此的交互影響下，進行政策對各組教育成就差異的影響效果之多重比較，結果發現台灣地區九年國民義務教育政策的施行，主要的影響效果乃在改善台灣地區之省籍間教育成就差異，約可改善 1.21-1.94 年，而透過縮減省籍間教育成就的差異，局部改善性別及城鄉間教育成就的差異。

關鍵字: 國民義務教育、教育成就、政策評估。

一、 緒論

　　教育的根本在培養人才。從個人角度來看，教育可提升個人的品格涵養，在現實生活中教育程度的高低除代表個人工作能力高低的指標外，更關係著個人的薪資所得收入與社會地位；另一方面，就整個國家而言，教育亦是影響經濟是否能持續成長及社會安定的原動力。[1]

　　有鑒於此，與教育的相關議題特別受各國政府及學者的關注。如Shultz (1961)和Becker (1964) 認為教育是一種人力資本(human capital)投資；Becker and Tomes (1986) 指出家庭是人力資本投資的重要決策單位，而Bowles (1972) 亦認為經由跨代對子女的教育投資，將影響著下一代的所得分配與社會階級流動。因此，教育投資深受家庭因素如家庭背景與家庭結構的影響。近一、二十年來，歐美國家由於許多家庭及教育追蹤資料的建立與發展，研究學者得以更詳細地了解在不同成長階段的家庭環境中子女人力資本累積的狀況，得以運用更合適的實證計量模型來分析家庭因素、環境變數與自我的選擇等對教育成就的影響。[2]

　　在政府政策方面，為了有效提升國民的教育程度與勞動生產力，國民義務教育也普遍被許多國家政府所推動採用。我國政府亦於 1968 年開始施行九年國民義務教育。然則國民義務教育政策究竟對個人的教育成就有多大影響？其政策效果為何？則是另一個頗值得研究的政策議題。

　　過去台灣地區的調查資料通常以「戶」為單位，例如主計處的「人力運用調查」或「家庭收支調查」。以戶為單位的個人調查，在受訪者不一定與父母與兄弟姐妹同住之下，較不容易掌握父母的教育程度、兄弟姐妹的正確人數或個人就學期間時的資訊等。除此之外，另一影響教育成就的個人特質因素，在這些資料中亦沒有相關的選項，因而使得相關研究經常

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[1]有關教育對一國長期經濟成長的影響可參考Lucas (1988), Barro and Lee (1993), Benhabib and Speigel (1994)；有關教育可促進社會階級流動與社會安定可參考Prior and Mellor (2002) and Hauser et al. (1996)。

[2] 對這些因素的一系列研究可參考Haveman and Wolfe(1995)的整理與討論。

因資料的問題而受到限制。[3]

　　有別於過去的研究，本文使用「華人家庭動態資料庫」，分析台灣地區影響子女的教育成就因素，除了家庭背景因素（包括父母親教育、家庭社經地位、子女個數、生長環境等）外，尚考慮家庭教育資源與個人特質（如能力、性格、價值觀等）的影響，以更完整探討影響個人教育成就的決定因素。[4]控制家庭因素和個人特質下，再進一步分析九年國民義務教育的政策效果，即九年國民義務教育的實行是否會影響城鄉、性別與省籍間個人教育成就的差異。

　　本文共分為六節。第二節為文獻回顧。第三節為實證模型的建構與估計方法的說明。第四節為變數說明與資料分析。第五節為估計結果。第六節則為結論。

二、 文獻回顧

　　一般而言，影響個人教育成就的家庭背景因素除了包括家庭社經地位(socioeconomic status)如父母本身的教育程度、職業、省籍與族群之外，亦涵蓋家庭結構諸如子女的性別、出生排序、兄弟姐妹人數與生長環境等因素（如 Butcher and Case (1994)；Greenhalgh (1985)；Hauser and Kuo (1998)；Haveman and Wofe (1995)；Lillard and Willis (1994)；Huang (2000)），而其中尤以家庭的社經地位特別受到重視，而家庭的社經地位則常用父母親的教育程度、父母親的職業及家庭所得等變數來衡量。

　　父母親的教育程度對個人教育成就的影響方面，國外的文獻中大部分均發現父母親的教育程度對子女之教育成就有顯著正向的影響，但影響程度大小卻不一。Behrman(1999)、Maitra(2003)等研究指出母親的教育程度

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[3] 陳婉琪(2005)另採用「台灣社會變遷基本調查」的資料分析教育成就的省籍差異，雖然發現教育成就存在省籍差異，但受限於資料之故僅能控制部分家庭背景因素而無法控制個人的特質。
[4] Chu, Tsay and Yu(2005)與Chu, Xie and Yu(2005)雖然亦採用「華人家庭動態資料庫」，但只著重在家庭背景與家庭結構因素分析。

對子女教育成就的影響效果大於父親。而Chu, Tsay and Yu(2005)、Chu, Xie and Yu(2005)研究台灣資料則發現父親教育程度對子女教育成就的影響較母親的大。Card (1999) 的綜合文獻分析結果發現父、母親教育程度對子女教育成就的影響大致相同。Heltberg and Johannesen(2002)則進一步研究發現，母親的教育程度對女兒有較大的影響，而父親的教育程度則對兒子有較大的影響。[5]

至於子女出生排序對教育成就的影響，文獻上並無一致的結論。主張愈早出生者愈有利，即教育成就與出生排序之間呈「負」向的關係，如Leibowitz(1974)認為父母對子女的照顧有時間限制，且因為時間無法儲蓄或跨時移轉，若子女愈多，則愈晚出生的子女，所能分配到的照顧教養時間也愈短，所以長子(女)最為有利，而愈晚出生的子女則愈不利。Birdsall (1991)也認為小孩的表現與父母親投入的時間有關，特別是母親投入的時間，第一個出生的小孩不論男女，都較受父母重視，且在幼年時期，並無其他子女與其競爭父母的時間，父母一般會投入較多時間教導與相處，因此長子（女）的教育成就表現較佳。

主張愈晚出生者愈有利，即教育成就與出生排序呈「正」向的關係，則可從家庭所得生命週期 (life cycle) 的角度來解釋。較早出生的子女，因為父母早期所得較低，因此長子(女)通常面臨家庭資源較為不足的情況，父母對長子(女)的教育資源投入相對較少，因此在教育成就上亦較可能受到不利的影響。除此之外，Behrman and Wolfe (1984)亦提出另一種觀點，他們認為較晚出生的子女，其父母在養育子女上較有經驗，因此較晚出生的子女能得到父母較佳的照顧與教養，教育成就的表現亦可能相對較佳。

另外，亦有認為教育成就與出生排序呈曲線型的關係，則可以從資源

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[5] Plug and Vijverberg (2003)進一步探討父母的教育程度愈高，其子女受教年數也會愈多的原因，是因為父母遺傳其能力給子女，或是教育程度高的父母對子女提供了較好環境的關係。研究結果發現父母智商對子女的教育成就影響顯著為正,但若將其影響分解為父母的遺傳因素和家庭的環境因素則會發現有 70-75%是由遺傳因素所造成。但父母智商並非唯一決定子女教育成就的因素，在控制其他因素之下，遺傳因素對子女教育成就的重要性則下降為 55-60%。

分配的角度來看,在子女數目愈多的家庭,最早出生的子女,於初就學階段時,並無任何兄弟姐妹與其分享家庭資源,而出生序在中間的子女,於初就學階段時,其兄(姐)亦可能同時處於就學的階段,則勢必將與兄(姐)共同分享家庭資源,而最後出生的子女,在初就學時,家中的較年長的子女可能已經完成求學過程,且隨著么子(女)的就學過程的時間經過,其他較年長的兄姐亦將分別完成就學的過程,因此家中的么子(女)所分配的資源將會愈來愈多。由此可知出生序在中間的子女,剛好面臨最多的手足競爭分配家庭資源,也最為不利,特別是排 2、3、4、的子女,而這種情況較容易發生在家庭中子女人數眾多時。Blake (1989)和 Steelman and Powell (1991)以美國資料研究都發現類似的曲線型結果。

個人的生長與受教育環境亦會影響教育成就。 如 De-Fraja and Landeras(2006)認為個人的教育成就取決於學校的教學品質,他們認為學校的聲譽會影響該校的招生,進而使就學學生的能力因選擇而被區分,造成教育成就的差異。Lillard and Willis(1994)亦發現家庭環境,例如家居的品質 (housing quality)、學校的易取得性(school availability)與城市的居住 (urban residence)等,對教育成就都有顯著正向的影響。

過去研究台灣地區子女教育成就的文獻中, Greenhalgh (1985)曾使用 1978-1980 年台灣北部 80 個家庭的重複樣本調查 (longitudinal study)資料,深入探討台灣家庭中子女性別和家庭教育投資決策之間的關係;他發現在經濟發展過程中,家庭中女兒接受教育的機會逐漸和兒子均等,但這是因為快速的經濟成長下技術密集的勞動需求增加,使得對女兒的人力資本投資得以在其未出嫁前回收所致。

其後Parish and Wills (1993)曾使用 1989 年內政部、台灣大學與美國芝加哥大學合作之「台灣地區婦女生活狀況調查」的資料,探討家庭中出生排序、兄弟姊妹、性別、組成人數等因素對個人教育成就的影響,其探討的對象為 1929-1963 年出生的婦女及其子女與兄弟姊妹,研究在不同的經

濟發展階段，出生排序對女性的教育成就是否有不同影響，並獲得與
Greenhalgh(1985)類似的結論,他們發現在經濟發展早期兄弟姊妹眾多的家
庭的女性，較晚出生者較具有優勢，可以得到較多的教育與較好的結婚對
象。而由於家庭預算限制，較早出生的女兒，常需犧牲自己的婚姻與教育
機會，提早離家結婚或工作，以減輕家中負擔，將家中資源留給弟妹使用，
因此有助於弟妹個人的教育成就。[6]

國內有關省籍差異對教育成就之影響的文獻，Tsai, Gates, and
Chiu(1994)認為在升學過程的初段時，族群效果愈明顯，而在升學過程中
段時，雖然亦有明顯的族群效果，但相對上效果較小。Wang(2001)的研究
則發現，在控制父母親教育程式與父親職業之下，外省族群並無明顯的優
勢。陳婉琪(2005)則進一步發現省籍效果在低教育家庭背景中效果相當顯
著，而在高教育家庭背景下效果則不明顯，但在控制其他家庭背景因素
時，省籍效果會隨時間縮小而至消失。

惟相關的台灣研究對個人教育成就多偏向於家庭結構與家庭社經地
位因素的探討，本文除了多方面考慮家庭社經地位、家庭結構與成長環境
因素外，亦強調家庭教育資源(family educational resources)與個人特質
(personal trait)因素對教育成就的影響，一起納入控制並做更完整和深入討
論。

有關義務教育政策施行的效果方面，國內外文獻上的研究主要在兩個
方向，一方面主要探討義務教育的施行是否有助於教育報酬率的提升，如
Wei *et. al* (1999)研究中國中央與西南鄉村的收入與教育的關係，發現教育
與收入有相當程度的關係，他們認為義務教育的投資對中國貧窮農村地區
而言是相當有利的,且勞動者教育程度愈高,其教育報酬率也愈大。Patrinos
and Sakellariou (2005)採用委內瑞拉的家計單位資料估計義務教育施行對
教育報酬的影響， 以教育市場上供給面干預的工具變數(instrument

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[6] 有關國內研究子女的排序對教育成就的影響，亦可參閱陳建良(2002)。

variables)估計教育報酬，發現義務教育對頭生兒子的教育報酬相對較其他出生序子女平均的教育報酬為高。[7]國內文獻方面，黃芳玫(2001)採用「人力資源運用調查」資料分析台灣地區九年國民義務教育是否影響教育資源的投資，結果發現九年國民教育後教育的投資報酬率明顯地高於九年國民教育實施之前，九年國教之後的世代，其平均人力資本相對較高，邊際生產力亦相對較高。

另一方面則在探討義務教育政策的施行對教育成就的選擇，即義務教育政策的施行是否有助於教育成就的提升。Mclntosh (2001)以英國、荷蘭、德國與瑞典四個國家的資料，研究男女在國民義務教育結束後對進入較高等教育的需求，發現實施義務教育有助於人們選擇較高等的教育，且對女性而言效果較大。Lleras-Muney (2003)則以美國 1960 人口普查資料檢測義務教育的施行（或義務教育年數的增加）是否為 1915-1939 年間次級教育程度比例大幅成長的影響因素，實證的結果顯示若經由法律規定，每提高義務教育年數一年，會使個人的教育年數增加 5%，且對白人男性和白人女性上，影響結果皆相似，但對黑人而言則義務教育的施行效果則並不明顯。除此之外，Angrist and Krueger (1991, 1992)研究在就學年齡限制下義務教育法令對就學的影響，以出生日期為工具變數的估計方法分析發現義務教育將可增加 10%的就學人數。

三、 實證模型與估計方法

本文的目的，一方面探討個人特質與家庭及環境因素對子女教育成就的影響，另一方面則探討九年義務教育政策的施行對性別、城鄉及省籍間教育成就差異的影響。如一般文獻，個人教育成就的基本實證模型設定如(1)式所示，

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[7] 有關義務教育對教育報酬率之影響效果的文獻，亦可參閱Angrist and Krueger (1991)、Cruz and Moreira (2005)與Sakellariou(2006)等。

$$Y_i = \alpha_0 + \alpha_1 \text{FAM}_i + \alpha_2 \text{CHR}_i + \alpha_3 \text{GEN}_i + \alpha_4 \text{UBN}_i + \alpha_5 \text{ETH}_i + \alpha_6 COH_i + \varepsilon_i \quad (1)$$

其中 i 表示個人，Y 為受教育的年數，FAM 為家庭背景的變數，CHR 為個人特質變數，GEN 為性別虛擬變數（1 表示女性，0 表示男性），UBN 為就學時城鄉虛擬變數（1 表示鄉村，0 表示城市），ETH 為省籍的虛擬變數（1 表示父親為本省籍，0 表示父親為外省籍），COH 為世代或出生年變數，ε 為隨機干擾項。

其次，教育政策的評估為比較九年國民義務教育政策施行前後對教育成就的影響，考量依政策可能影響的不同組間(如性別、城鄉與省籍間)的處置效果(treatment effect)，故分別設定模型如下列(2)、(3)、(4)式所示[8]：

$$Y_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 \text{GEN}_i + \alpha_3 \text{UBN}_i + \alpha_4 \text{ETH}_i + \alpha_5 \text{POL}_i + \alpha_6 \text{POL}_i \times \text{GEN}_i + \varepsilon_i \quad (2)$$

$$Y_i = \beta_0 + \beta_1 Z_i + \beta_2 \text{GEN}_i + \beta_3 \text{UBN}_i + \beta_4 \text{ETH}_i + \beta_5 \text{POL}_i + \beta_6 \text{POL}_i \times \text{UBN}_i + \omega_i \quad (3)$$

$$Y_i = \gamma_0 + \gamma_1 Z_i + \gamma_2 \text{GEN}_i + \gamma_3 \text{UBN}_i + \gamma_4 \text{ETH}_i + \gamma_5 \text{POL}_i + \gamma_6 \text{POL}_i \times \text{ETH}_i + \upsilon_i \quad (4)$$

其中 Z 表示家庭背景、個人特質與世代變數，POL 表教育政策虛擬變數（1 表示受九年國民教育實施之影響， 0 表示未受九年國民教育實施之影響）。模型(2)中教育政策與性別交叉項的係數 α_6 代表義務教育政策的施行對性別上教育年數差異的影響，若係數為正，表示教育政策有助於縮減女性相對於男性的差異，反之若係數為負，則教育政策將擴大男女間教育年數的差異。同理模型(3)與(4)的交叉項係數分別表示政策施行對城鄉及省籍上教育年數差異的政策影響。透過模型(2)、(3)、(4)的估計結果，我們可以比較義務教育政策分別對性別、城鄉或省籍間教育成就差異的政策影響效果。

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[8] 因九年義務教育政策一體適用於男與女、城市與鄉村或不同省籍間，故本模型的設定不同於一般政策評估所採用之Difference-in-Differences估計法中實驗組(treatment group)與控制組(control group)的觀點，而此處不同政策與群組間之交叉項乃為檢測政策在不同群組中是否具不同的效果。

由於以上分析假設在九年義務教育政策施行前後，政策對性別、城鄉或省籍等各組間的影響均互相獨立，但因為性別、城鄉與省籍之間可能存在交互影響，尤其是對政策的反應，如本省籍女性相對於外省籍男性、居住鄉村女性相對於居住都市男性或居住鄉村本省人相對於居住都市外省人的政策反應可能極不相同。如此則以上述方法所估計的結果將可能會產生偏誤，為了解決這個問題，同時允許政策可作用在特定的組群，本文進一步將教育政策的施行對性別、城鄉與省籍間的教育成就差異影響進行組群間多重比較 (multiple comparison)，模型的設定如下式所示：[9]

$$Y_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 GEN_i + \alpha_3 UBN_i + \alpha_4 ETH_i + \alpha_5 POL_i$$

$$+ \alpha_6 POL_i \times GEN_i + \alpha_7 POL_i \times UNB_i + \alpha_8 POL_i \times ETH_i + \alpha_9 GEN_i \times UBN_i$$

$$+ \alpha_{10} GEN_i \times ETH_i + \alpha_{11} UBN_i \times ETH_i + \alpha_{12} POL_i \times GEN_i \times UBN_i$$

$$+ \alpha_{13} POL_i \times GEN_i \times ETH_i + \alpha_{14} POL_i \times UBN_i \times ETH_i$$

$$+ \alpha_{15} GEN_i \times UBN_i \times ETH_i + \alpha_{16} POL_i \times GEN_i \times UBN_i \times ETH_i + \mu_t \quad (5)$$

經由(5)式的估計結果與上述(2)-(4)式之結果相比較，將有助於進一步釐清九年國民義務教育政策在性別、城鄉與省籍間的政策效果。

四、 變數說明與資料分析

　　如同本文在第一節指出，過去台灣地區對教育成就分析通常以「人力運用調查」或「家庭收支調查」的資料進行分析，但若以這些資料處理子女教育成就的研究，不僅容易發生衡量偏誤(measurement error)的問題，[10]亦無法涵蓋樣本的個人特質。因此，本文採取「華人家庭動態資料庫」(Panel

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[9] 有關政策效果評估的多重比較方法可參考Meyer(1995)。
[10] 舉例來說，父親的職業為影響子女教育成就的重要因素，若採用「人力運用調查」或「家庭收支調查」所獲得的父親職業，為該年度父親的職業，而非子女在就學階段時的職業，然而影響子女教育成就者應為父親在子女就學階段時的職業，因此若採用「人力運用調查」或「家庭收支調查」的資料，容易產生衡量偏誤的問題。

Study of Family Dynamics，以下簡稱為PSFD)資料庫進行分析。

PSFD 由 1999 年開始調查，此一調查利用內政部所提供的戶籍資料，以家庭為一基本單位持續追蹤，規畫以成年人口為主樣本。由主樣本延伸，再將其父母、子女、兄弟姐妹納入訪問樣本，藉以建構追蹤資料庫。本文所使用的部分，是 PSFD 的三個主樣本的合併樣本，分別為 1999 年針對 1953-1964 年出生的主樣本所進行訪問（問卷編號 RI1999，1999 年的年齡為 35-46 歲），樣本數為 999；2000 年針對 1935-1954 年出生者進行訪問（問卷編號 RI2000，2000 年的年齡為 46-65 歲），樣本數為 1959；以及 2003 年針對 1964-1976 年出生者所進行訪問（問卷編號為 RI2003，2003 年的年齡為 27-39 歲），樣本數為 1152，三個主樣本之合併樣本總數為 4110。

PSFD 的主樣本問卷內容的架構大致相同，除了包括主樣本的基本資料、教育經驗、工作經驗、婚姻與配偶、父母及兄弟姐妹等相關資料外，還包括家庭價值與態度、居住安排、家庭決策與支出、家庭關係與和諧以及子女生育與教養等社會學與家庭經濟學關心的資料。

值得說明的是，文獻上通常以父母親教育程度、父母親的職業及家庭所得等變數來衡量家庭社經地位，但其中家庭所得雖可反應家庭資源的多寡與家庭的經濟狀況，但因為一般人較不願意透露其實際所得，甚至可能誇大（隱瞞）個人所得，而造成此一變數較難以正確地取得，即使問卷調查中有包含家庭所得的問項，其衡量誤差亦將比較大，且遺漏值也會比較多，而相反地，一般樣本問卷中有關職業的問項，所得到的答案可信度則較高。[11]另一方面，由於職業與所得之間有相當高的相關程度，且職業亦具長期穩定性，可於單一時點得到較佳的觀察值。除此之外，若選擇以家庭所得來做為子女教育成就的解釋變數，一般較合理方式是採用子女於就

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[11] 文獻上探討父母親所得或家庭所得對子女教育成就之影響皆為正，但並無一致性地顯著水準，例如Duncan(1994)、Hill and Duncan(1987)、Huang(2000)等發現家庭所得對子女教育成就無顯著影響；而Datcher(1982)則認為有顯著正的影響。Aughinbaugh and Gittleman(2003)進一步則發現英、美兩國中父母所得對子女發展有正向而顯著的影響，但所得之影響力比其他家庭背景的影響力相對較小。

學階段時的家庭所得來作為解釋變數，但此類的資料在取得上甚為不易，因此本文採用子女就學階段時父親的職業來代表該家庭的社會經濟地位。[12]

　　表一為本文實證模型所採用之變數說明。個人特質變數包括能力(學業表現)及價值觀念；家庭背景變數包括父母親教育年數、父親職業、母親是否就業、單親家庭、手足結構與家庭教育資源等。除了省籍與城鄉變數外，並加入世代虛擬變數以控制不同世代的可能環境影響。本文所使用的 PSID 三個主樣本合併資料個數為 4110，扣除各變數之遺漏值與不適用的樣本後，共得到 3636 個樣本資料。有關本文所採用之各變數的樣本個數、平均數及變異數請參考表二。

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[12]本文採用職業而不採用所得的另一原因是教育成就受家庭恆常所得的影響遠大於家庭臨時所得的影響，而恆常所得的資料也較不易取得，參見Aakvikk, lvanes, and Vaage (2005) 。

變數名稱	說明
教育程度	區分為不識字與自修、國小、國中、高中職、專科、大學、碩士及博士八種不同教育層級
教育年數	以教育程度推算其教育年數,自國小、國中、高中職、專科、大學、碩士至博士分別為 6 年、9 年、12 年、14 年、16 年、18 年、22 年。
個人特質:	
性別	以虛擬變數表示,女性為 1,男性為 0。
工讀	求學期間是否有打工賺自己或家庭的生活費,以虛擬變數表示,有為 1,沒有為 0。
學業優異獎學金	讀書過程中是否有領取學業成績優異獎學金,以虛擬變數表示,有為 1,沒有為 0。
清寒獎學金	讀書過程中是否有領取清寒獎學金,以虛擬變數表示,有為 1,沒有為 0。
孝道觀念	子女對「放棄個人的志向,達成父母的心願」觀念的看法,1=不重要,2,3,4,5=絕對重要
光耀門楣觀念	子女對「做些讓家族感到光彩的事」觀念的看法,1=不重要,2,3,4,5=絕對重要
家庭教育資源	
才藝訓練	在求學期間是否參加才藝訓練(例如學習彈鋼琴、畫畫、書法、跳芭蕾舞等),以虛擬變數設定,有為 1,沒有為 0。
課外補習輔導	求學期間是否參加校內課業輔導、校外補習班或家教,以虛擬變數設定,有為 1,沒有為 0。
學業獎勵	父母因成績好而獎勵,0=沒有、1=很少、2=有時、3=經常。
家庭遷移	16 歲之前,父母是否曾經為了幫子女遷至較好的學區或為了子女就學方便而搬家。以虛擬變數設定,有為 1,沒有為 0。
家庭背景因素:	
父親教育年數	以父親教育程度推算其教育年數,例如國小、國中、高中職、專科、大學、碩士與博士分別為 6 年、9 年、12 年、14 年、16 年、18 年、22 年。
母親教育年數	以母親教育程度推算其教育年數,例如國小、國中、高中職、專科、大學、碩士與博士分別為 6 年、9 年、12 年、14 年、16 年、18 年、22 年。
父親職業別	子女於 16 歲時父親所從事的職業,區分為專門技術人員、行政及主管人員、監督及佐理人員、銷售工作者、服務工作人員、農林漁牧狩獵人員及生產操作體力工。以農林漁牧狩獵人員為基準組,設定 6 個虛擬變數。
父親從事公職	子女於 16 歲時父親是否在公家機關工作,以虛擬變數設定,有為 1,沒有為 0。
母親就業	主樣本的母親亦在外工作,是為 1,不是為 0
單親家庭	主樣本於 16 歲時,雙親其中之一亡故或不在身邊,是為 1,不是為 0
城鄉	16 歲以前居住地,以虛擬變數設定之,鄉村為 1,城市為 0。城市與鄉村的區別按內政部戶政司資料區分之。
省籍	父親的省籍,區分為本省人（包含原住民、本省閩南人與本省客家人）與外省人,以虛擬變數表示,本省人為 1,外省人為 0。
手足因素:	
子女個數	家庭中子女的個數。
排序	家中之出生的排序
兄弟姐妹個數	家中兄、弟、姐、妹的個數。
世代:	
老年	出生時間在 1950 以前
中壯年	出生時間在 1951 年至 1960 年
青年	出生時間在 1961 年以後
	以 1950 年以前出生為基準組,設定 2 個虛擬變數。
政策變數	是否有接受九年國民義務教育。以虛擬變數表示之,有為 1,沒有為 0。

資料來源：華人家庭動態資料庫(Panel Study of Family Dynamics)。

表二、變數資料基本統計特性

變數名稱	樣本數	平均數	變異數
教育程度：			
不識字與自修	3636	0.0842	0.2781
國小	3636	0.2770	0.4476
國中	3636	0.1337	0.3403
高中職	3636	0.2643	0.4410
專科	3636	0.1194	0.3243
大學	3636	0.1004	0.3006
碩士	3636	0.0182	0.1335
博士	3636	0.0028	0.0524
教育年數	3636	9.7063	4.6054
個人特質：			
性別	3636	0.5149	0.4998
工讀	3636	0.2808	0.4495
學業優異獎學金	3633	0.1214	0.3266
清寒獎學金	3633	0.0190	0.1365
孝道觀念	3634	3.4188	1.1953
光耀門楣觀念	3635	3.8135	1.1483
家庭教育資源			
才藝訓練	3635	0.1356	0.3424
課外補習輔導	3633	0.2188	0.4135
學業獎勵	3635	0.0646	0.2459
家庭遷移	3628	0.0510	0.2200
家庭背景因素：			
父親教育年數	3623	4.9095	4.8118
母親教育年數	3630	2.9645	3.8363
父親職業別			
專門技術人員	3598	0.0439	0.2049
行政及主管人員	3598	0.0503	0.2186
監督及佐理人員	3598	0.0675	0.2510
銷售工作者	3598	0.1226	0.3280
服務工作人員	3598	0.0584	0.2345
農林漁牧狩獵人員	3598	0.4341	0.4957
生產操作體力工	3598	0.2232	0.4164
父親從事公職	3633	0.1610	0.3676
母親就業	3636	0.4588	0.4984
單親家庭	3636	0.0784	0.2688
城鄉	3633	0.4646	0.4988
省籍			
原住民	3629	0.0215	0.1450
本省閩南	3629	0.7812	0.4135
本省客家	3629	0.1144	0.3183
外省	3629	0.0829	0.2758
手足因素			
子女個數	3634	5.2930	2.2238
排序	3635	3.0564	2.0023
兄個數	3635	1.0094	1.2149
弟個數	3635	1.1568	1.1575
姐個數	3635	1.0470	1.2680
妹個數	3635	1.0798	1.2510
世代：			
老年	3636	0.3650	0.4815
中壯年	3636	0.2998	0.4582
青年	3636	0.3353	0.4721
政策變數	3636	0.4450	0.4970

資料來源：華人家庭動態資料庫(Panel Study of Family Dynamics)，RI1999、 RI2000 與 RI2003 合併資料。

由表二的基本統計資料可知，在個人特質方面，有 28%的比例在就學期間曾經打工賺取自己或家庭的生活費，而曾經獲取獎學金（包括成績優異獎學金或清寒獎學金）則占 14%。男性樣本比例占 0.4851，樣本數為 1764，而女性的樣本數則為 1872。在孝道觀念與光耀家門觀念方面，以重視的程度區分(由最低 1 至最高 5)，平均數分別高達 3.42 與 3.81，除了顯示華人社會對孝道與光耀家門觀念的重視外，亦反應華人社會對此類觀念的普遍價值。

家庭因素方面，在父母的教育年數上，父親教育的平均年數約為 4.91 年，而母親的教育年數則在 3 年左右，這是由於主樣本的父母年紀大多在 45 歲以上，因此父母的教育程度偏低並不令人意外。至於父親的職業別方面，最大的比例為從事農林漁牧狩獵工作，約占 43.41%，其次為生產操作體力工，占 22.32%。這是因為過去台灣地區主要是農業社會，再加上父親的教育程度較低，所以大多從事農業工作或需較少技能的生產體力工。除此之外，父親的從業身分方面，父親在公家機關工作的比例，約為 16.1%。主樣本為單親家庭者的比例為 7.84%，而主樣本的母親為工作者，則占 45.88%。

至於父親的省籍方面，以本省閩南人最多，占 78.12%，其次為本省客家人，占 11.44%，外省人占 8.29%，原住民則僅占 2.15%。

在家庭教育資源方面，有接受才藝訓練或課外補習輔導分別占 13.56% 和 21.88%；父母提供學業獎勵或為了較好學區而遷移者之比例則較少，分別占 6.46%和 5.10%。

本文所使用樣本的出生年代涵蓋自 1934 年至 1976 年，但不同年代出生者，可能因為經濟發展程度或教育普及的因素，以致其教育成就有顯著不同，為了控制不同出生年世代(birth cohort)的效果，本文將樣本依照其出生年代，區分為 1950 年以前出生、1951-1960 年出生及 1961 年之後出生等三個世代。三個世代所占的樣本比例分別為 36.5%、30%及 33.5%。

至於家庭中子女個數與兄弟姐妹數則相當平均，家中子女個數的平均數為 4.77 人，而兄弟姐妹數分別為 0.89、1.00、0.96 及 0.92，其中樣本為長子（女）的比例為 25.25%，而身為老么的比例則為 19.53%。

表三、教育成就特性分析

| | 教育年數 | 教育成就 | | | | | | |
		國小	國中	高中職	專科	大學	碩士	博士
性別								
男性	10.620 (4.050)	0.233	0.169	0.292	0.133	0.110	0.026	0.005
女性	8.834 (4.890)	0.318	0.100	0.238	0.107	0.091	0.011	0.001
父親教育程度								
低教育程度	8.682 (4.435)	0.340	0.153	0.249	0.088	0.054	0.007	0.002
中教育程度	12.877 (3.142)	0.069	0.083	0.335	0.237	0.229	0.036	0.003
高教育程度	14.144 (3.074)	0.038	0.019	0.260	0.202	0.351	0.115	0.005
省籍								
原住民	7.376 (3.622)	0.482	0.176	0.200	0.035	0.000	0.000	0.000
本省閩南人	9.265 (4.653)	0.298	0.141	0.249	0.108	0.086	0.016	0.003
本省客家人	10.576 (3.891)	0.277	0.130	0.299	0.152	0.097	0.024	0.002
外省人	13.003 (3.161)	0.049	0.081	0.357	0.198	0.263	0.036	0.003
世代								
老年	6.590 (4.452)	0.486	0.108	0.114	0.035	0.050	0.002	0.001
中壯年	10.047 (3.934)	0.306	0.157	0.294	0.104	0.095	0.012	0.004
青年	12.778 (2.705)	0.023	0.141	0.402	0.226	0.160	0.041	0.004
父親從事公職								
公家機關	12.502 (3.776)	0.109	0.080	0.308	0.192	0.236	0.049	0.003
私人部門	9.155 (4.537)	0.310	0.144	0.256	0.105	0.074	0.012	0.003
父親職業別								
專門技術人員	11.520 (4.783)	0.189	0.051	0.214	0.209	0.219	0.051	0.000
行政及主管人員	12.297 (4.399)	0.146	0.059	0.274	0.210	0.164	0.096	0.014
監督及佐理人員	11.548 (4.351)	0.167	0.103	0.267	0.160	0.221	0.036	0.000
銷售工作者	10.735 (4.148)	0.217	0.125	0.322	0.136	0.140	0.015	0.002
服務工作人員	10.782 (4.399)	0.222	0.129	0.238	0.173	0.165	0.020	0.000
農林漁牧狩獵人員	7.311 (4.342)	0.427	0.150	0.180	0.049	0.029	0.002	0.003
生產操作體力工	10.568 (3.887)	0.222	0.143	0.344	0.151	0.090	0.012	0.002
城鄉								
城市	10.797 (4.340)	0.225	0.114	0.293	0.149	0.139	0.027	0.005
鄉村	8.428 (4.546)	0.337	0.156	0.231	0.085	0.056	0.008	0.001
教育政策								
政策前	7.568	0.453	0.114	0.167	0.051	0.062	0.004	0.001

	(4.510)							
政策後	12.361	0.057	0.158	0.385	0.205	0.148	0.035	0.004
	(3.036)							

　　為進一步觀察個人特質及家庭因素與子女教育成就的關係，本文另將不同個人特質與家庭因素下之子女的教育成就列於表三。由表三中可發現性別在教育成就上，男性平均教育年數為 10.62 年，高於女性平均教育年數的 8.83 年，且男性樣本受高等教育（大專以上）的比例也都大於女性受高等教育的比例。

　　以父親教育程度區分，父親的教育程為低教育程度(國小程度以下（含不識字與自修）)、中教育程度（國中或高中職畢業者）及高教育程度（為專科以上（含專科、大學、碩士及博士））時，子女的平均教育年數分別為 8.68 年、12.88 年及 14.14 年，顯示父親的教育程度愈高，其子女的平均教育年數也愈大，且受高等教育的比例也愈大。

　　在省籍方面，父親若為外省人，子女的平均教育年數最大，約為 13 年，其次是父親為本省客家人，子女教育年數為 10.58 年，再其次是父親為本省閩南人，子女教育年數為 9.27 年，若父親為原住民，則子女的平均教育年數最小，僅 7.38 年。除此之外，若父親為外省人，其子女受高等教育程度的比例也大於本省客家人、本省閩南人及原住民。

　　在不同世代下，教育成就亦有所不同。平均教育成就隨不同世代的年輕化而增加，即愈年輕世代的平均教育年數愈大，而愈年長世代的平均教育年數則愈小，三個不同世代之平均教育年數分別為 6.59 年、10.05 年及 12.78 年，且愈年輕世代的子女，受高等教育程度的比例也愈大。[13]

　　父親的職業身份方面，若父親為公家機關工作者，子女的平均教育年數為 12.5 年，遠大於父親在私人部門工作之子女平均教育年數 9.16 年。

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[13] 此項世代差異，若進一步區分性別、省籍與城鄉之教育程度差異，則亦可以發現愈年長的世代，在不同性別、城鄉與省籍間之教育成就差異愈大，而在愈年輕的世代，在不同性別、城鄉與省籍間教育成就差異愈小。

此外，在父親的職業分類上，若父親為行政及主管人員，子女的平均教育年數最高，達 12.3 年，而父親為農林漁牧狩獵人員，子女的平均教育年數僅 7.31 年，明顯低於父親從事其他不同職業的子女之平均教育年數。除父親為農林漁牧狩獵人員外，若父親從事其他職業，子女的平均教育年數並沒有太大的差異。但在子女之不同教育程度的比例上，則有明顯的差別，其中以父親為行政主管人員或專門技術人員，其子女受高等教育程度的比例相對較高，將近五成的子女有大專以上的學歷。

除此之外，我們由表三的資料亦發現台灣地區城市與鄉村間子女教育成就亦有相當明顯的差異，居住在城市的子女平均教育年數為 10.8 年，而居住在鄉村的子女教育平均年數則只有 8.4 年。至於九年國民義務教育的採行，我們發現在九年國民義務教育實施之前，子女的平均教育年數為 7.6 年，而在義務教育實施之後子女的平均教育年數則提升為 12.4 年。義務教育明顯提升國民的平均教育水準。

表四為國民義務教育政策的實行前後，對省籍、城鄉與性別間的平均教育年數變化的交叉分析。由表中我們可以發現在義務教育政策施行之前，城市與鄉村間平均教育年數的差異為 2.13 年，在性別上的差距為 4.44 年，而在省籍上的平均教育年數的差異為最大，達 5.1 年。在義務教育政策施行之後，平均教育年數在城鄉、性別與省籍上的差異，則分別縮減為 1.45 年、0.4 年與 1.36 年。基本上，國民義務教育政策的實行有助於普遍縮減城鄉、性別與省籍上的教育成就差異，尤其是性別上的教育成就差異。其中本省人在城市與鄉村間平均教育年數差距由 1.73 年縮小為 1.29 年（其中以本省閩南人城鄉差距縮小的程度最高，本省客家人反而有擴大的現象），而外省人在城市與鄉村間平均教育年數差距則由 3.27 年縮小為 1.68 年，顯示教育政策對縮減城鄉之間教育成就的差異上，對外省人的效果相對較對本省人的效果為高；另一方面，城市中省籍間平均教育年數的差距由 4.94 年縮小為 0.99 年，而鄉村中的省籍間平均教育年數的差距則

由 2.40 年縮小為 0.60 年，顯示教育政策有助於縮減省籍之間教育成就的差異，由其對城市的效果相對較鄉村的效果為大。

在性別差異方面，不論男女義務教育均有助於縮減城鄉教育成就差異。惟縮減的效果外省籍中不論男女均優於本省籍，且外省籍男性的效果相對上又優於外省籍女性。另一方面，義務教育對縮減省籍教育成就的差異上，不論男女，在城市中義務教育的施行效果亦均優於在鄉村中施行的效果，但義務教育的施行對教育成就的提升則以鄉村的女性最為顯著(7.75 年)。

表四、政策前後城鄉及省籍的平均教育年數

政策前	城市	鄉村	總合	政策後	城市	鄉村	總合
本省人	8.23	6.50	7.29	本省人	12.78	11.49	12.22
原住民	5.88	6.55	6.35	原住民	9.33	10.33	9.71
本省閩南人	8.18	6.09	7.08	本省閩南人	12.76	11.39	12.16
本省客家人	8.99	8.95	8.97	本省客家人	13.43	12.29	12.93
外省人	13.17	8.90	12.39	外省人	13.77	12.09	13.58
總合	8.68	6.55	7.57	總合	12.95	11.50	12.38

表四、政策前後城鄉及省籍的平均教育年數(男性)(續)

政策前	城市	鄉村	總合	政策後	城市	鄉村	總合
本省人	9.17	8.16	8.64	本省人	12.84	11.88	12.40
原住民	2.00	7.80	6.83	原住民	10.22	12.00	10.55
本省閩南人	9.21	7.81	8.51	本省閩南人	12.80	11.72	12.30
本省客家人	9.27	9.99	9.68	本省客家人	13.59	13.13	13.39
外省人	13.36	9.00	12.81	外省人	14.20	12.43	13.94
總合	9.55	8.17	8.86	總合	13.05	11.88	12.57

表四、政策前後城鄉及省籍的平均教育年數(女性)(續)

政策前	城市	鄉村	總合	政策後	城市	鄉村	總合
本省人	4.58	3.99	4.25	本省人	12.72	11.01	12.01
原住民	6.77	5.22	5.78	原住民	8.00	9.86	9.00
本省閩南人	4.29	3.67	3.95	本省閩南人	12.73	10.97	12.01
本省客家人	6.42	5.77	6.03	本省客家人	13.27	11.46	12.47
外省人	8.17	4.14	7.26	外省人	13.38	11.50	13.23
總合	4.93	3.98	4.42	總合	12.85	11.02	12.17

五、 估計結果

本節分別討論個人特質、家庭因素與環境變數對教育成就的估計結果，並進一步做教育成就的敏感性分析，以及探討九年義務教育之政策效果與多重比較評估。

教育成就影響分析

表五為教育成就迴歸結果。如欄(1)所示，和大部份的文獻結果相同，父母教育年數對子女教育成就均有顯著的正面影響。[14]可能是因為子女得到父母基因的遺傳或是教育程度高的父母對子女提供了較好學習環境所致。除此之外，從父母教育年數的估計參數，可以發現父親教育年數的估計參數大於母親，表示對子女教育成就的影響，來自父親的效果大於來自母親的效果。[15]這是因為一個家庭之生計的來源，主要是來自於父親，且另一方面父親的教育程度也反應了該家庭的社會地位，因此相較於母親，父親的教育程度對子女教育成就的影響也較大（Chu, Xie and Yu(2005)）。

父親的職業方面，相對於父親從事農林漁牧工作者，其他職業估計結果均顯著為正，其中以父親的職業為行政主管人員，子女教育年數的效果最大，較父親從事農林漁牧工作者子女教育年數高 2.12 年，其次為銷售工作者，估計效果為 1.63 年。且若父親為從事公職的身分，估計結果亦顯著為正，表示父親從事公職，在子女的教育成就上相對較有利。主要的原因為從事公職，可獲得教育補助，降低子女教育投資成本，因此其子女教育成就相對也較高。

但是若母親也在工作，則其對子女的教育成就估計結果顯著為負，這是因為若母親亦在外工作，對子女在照顧與教養上的時間，相對亦會較

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[14] 相關的文獻可參見如Haveman and Wolfe (1995)和Card (1999)的綜合討論。

[15] Liu, Hammitt and Lin(2000)研究台灣資料亦發現對個人教育報酬的影響，父親教育年數的效果大於母親的教育年數效果。Chu, Tsay and Yu(2005)、Chu, Xie and Yu(2005)以PSFD的資料估計父母親的教育程度對個人教育成就的影響，也獲致相同的結果。

少，導致對子女的教育成就會有不利的影響。[16]此外，單親家庭對子女的教育成就估計結果亦為負，但不顯著。此負向結果和國外的文獻相同，單親家庭所得偏低且容易受到財務信用限制，不利於人力資本投資。[17]而本文估計不顯著原因大致有二，一是因為台灣地區單親家庭的比例相對較歐美的單親家庭比例小，另一個原因則是因為若控制其他家庭經濟資源或父母親教育水準等因素後，則單親家庭對子女教育成就的影響，相對較不顯著。[18]

在手足效果方面，子女個數的效果為顯著負值。表示在其他條件不變下，若兄弟姐妹的人數愈多，對教育年數也有顯著負的影響，這是因為家中分享資源的子女數目愈多，對於子女教育投資愈不利。出生排序一次項顯著為正，出生排序平方的估計係數亦是正值，但並不顯著，代表在子女個數固定下，愈晚出生的子女，在教育成就上的表現也愈佳，可能原因為愈晚出生的小孩此時家境相對也較為富裕，因此可以獲得的教育資源也相對較高。

另外，在個人性別、城鄉與省籍間教育成就的差異上，由表五第 1 欄的結果亦可發現，在控制其他家庭背景因素之下，女性的教育年數相對較男性低 1.30 年，而外省籍者的教育年數亦較本省籍者的教育年數高 0.61 年，居住在城市者的教育年數則較居住在鄉村者的教育年數高 0.53 年。此結果顯示鄉村本省籍尤其是女性的教育成就顯著居於劣勢。居住鄉村地區因為教育資源相對較為缺乏，故教育程度相對亦較低。外省族群因為過去大陸逃難經驗，相對較重視可以移動的人力資本投資，故其子女教育成就相對也較高。另外，由於傳統家庭重男輕女觀念，因此女孩相對於男孩的

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[16] 參見如Chin and Newman, (2002)和McLanahan and Sandefur (1994)探討母親工作對子女教育的負面影響。

[17] 參見如Elliott and Richards (1991)、Mclanahan and Sandefur (1994)、Haveman and Wolfe (1995)與Ermisch and Francesconi (2001)。

[18] Gregg and Machin (1998)亦發現當控制家庭財務因素下，單親家庭變數變為不顯著。

受教育機會也較少，教育成就也因此較低。

由於總體環境的改變或教育的普及化，不同世代的教育成就亦應有所不同，因此本文以世代(cohort)效果來控制總體環境的改變對教育成就的影響。由表五的估計結果我們發現，在其他情況不變之下，個人教育成就會因世代的年輕化而提高，亦即愈年輕的世代，教育成就愈高。與老年世代相比，中壯年世代的教育年數相對較老年世代高出 2.28 年，而青年世代的教育年數亦比老年世代高將近 3.56 年。

家庭背景中另外一項重要因素為教育資源的提供。[19]若考慮家庭教育資源對教育成就的影響，如表五第 2 欄所示，本文發現才藝訓練對子女的教育年數的影響，估計結果顯著為正，子女在求學期間有參加過才藝訓練者，其教育年數相對未參加才藝訓練者高 1.21 年，顯示學習是多元面相的。才藝訓練往往可以啟發和增加個人潛在能力有助於正規教育的學習。除此之外，補習教育對子女的教育年數的影響亦顯著為正，較未受補習教育的子女之教育年數高 1.44 年[20]，這個結果亦顯示台灣地區一切以考試為升學管道的制度造就了補習教育的盛行，而補習的結果確實對考試有效。[21]

在加入家庭教育資源的變數後，與表 5 第 1 欄的結果相比較，可發現家庭背景因素對個人教育成就的估計參數都變得較小，表示在未加入家庭教育資源的因素時，家庭背景因素對教育成就的影響，有過度估計(overestimate)的現象。因加入家庭教育資源變數可以抽離家庭背景因素中(如父母教育程度、家庭社經地位)隱含的資源效果。此外，分析家庭教育

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[19] Teachman (1987)發現處除了家庭社經地位外，教育資源提供，如自己有獨立的書房、家中有參考書籍或百科全書，亦顯著影響子女的教育成就。

[20] 黃芳玫、賴慧穎與吳齊殷(2005)研究補習教育對國中升學的影響發現補習對學生在國中繼續升學高中有顯著正的影響，但不必然補習要愈多才考得上較佳的高中。

[21] 若將迴歸模型中的補習教育區分為校內輔導，校外補習及家教，則三者的估計係數均為正，除家教不顯著外，校內輔導與校外補習均顯著為正，而其中又以參與校外補習對子女的教育年數之影響效果最大。

資源與家庭背景因素的解釋能力,可發現家庭教育資源的解釋能力占7%,而其他家庭背景因素的解釋能力則占 93%。

　　除了家庭背景和教育資源變數外,根據人力資本理論個人特質也是一項影響教育成就的重要因素。若再加入個人特質變數對教育成就的影響效果,如表五第 3 欄所示,在個人特質方面,於就學期間曾經工讀者或就學期間曾經獲得獎學金(包括學業優異獎學金與清寒獎學金),其估計係數均為顯著正值。表示個性較為獨立或求學成績較為優秀者,能力相對較強,教育成就相對亦較高,符合人力資本理論的預期結果。另外在孝道觀念及光耀家門觀念的個人價值觀念上,估計結果顯著為負,表示較重視此兩種傳統觀念者之教育成就反而較低,較可能的原因是因為重視這兩種觀念者,在個人的特質上相對較具服從性的心態,為父母或家族願意犧牲自己,而非選擇自己真正的興趣與性向發展,因此在求學與教育上的成就相對較易居劣勢。

　　在分別加入家庭教育資源與個人特質因素後,家庭背景變數仍然維持相同的顯著性,且所加入的家庭教育資源與個人特質變數亦均顯著,一方面表示家庭背景、家庭教育資源與個人特質均為影響個人教育成就的重要變數,另一方面表示此三種變數之間並無共線性的疑慮。[22]

　　另外,考慮男、女教育成就影響的因素效果可能不同,故進一步區分男、女兩組樣本。比較男性與女性樣本在個人特質、家庭教育資源與家庭背景因素上對個人教育成就的影響,由表五第 4 與第 5 欄的結果發現不論男性或女性樣本,解釋變數的顯著性均大致相同,惟其效果有大小之別。在個人特質方面,求學期間曾經工讀與曾經獲得學業優異獎學金,對女性

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[22] 若變數間存在共線性,則可能造成變數估計的不顯著。另外,經由相關係數的檢測,發現除了父親教育年數與母親教育年數,子女個數與排序,其相關係數為 0.6 外,其餘各變數間相關係數均小於 0.3,表示並不存在變數高度相關性的問題。

的教育成就效果較大。[23]在家庭教育資源方面，對女性教育成就的影響效果亦均大於男性。在傳統重男輕女觀念下，女姓教育資源的取得相對少於男性，故在其他情況不變下，增加對女性的家庭教育資源將有較大效果。在家庭背景方面，父母親的教育程度不論對兒子或女兒，均顯著為正，但相對而言，兒子的教育成就受父親教育程度高低的影響較大，而女兒的教育成就則受母親教育程度高低的影響較大，這個結果亦與Heltberg and Johannesen (2002)的研究相似，父親通常是兒子模仿的模範(role model)，而母親則是女兒模仿的模範。另外，父親的職業對女兒教育成就的影響大於對兒子教育成就的影響，但父親從事公職則對兒子的影響效果較大，母親若在外工作，對兒子或女兒的教育成就均有不利影響，但對女兒的效果則大於兒子。

在手足效果方面，家庭中子女個數愈多，對子女的教育成就會有不利的影響，但對女兒教育成就的負面效果略大於對兒子的效果。在排序方面，對兒子而言，愈晚出生，其教育成就也愈高，但對女兒而言，則效果並不顯著。[24]除此之外，在省籍與城鄉方面，由表五的結果發現，在控制其他變數之下男性在省籍間的教育成就差異高於女性，而女性在城鄉間的教育成就差異則高於男性。代表傳統重男輕女觀念不因省籍有不同，而鄉村則有過之。

比較表五的結果可以發現,若未考量家庭教育資源與個人特質將高估家庭教育背景因素對個人教育成就的影響及其解釋能力。表五的估計結果發現，對個人教育成就的解釋能力，個人特質占 10.81%，家庭教育資源占 6.99%，而家庭背景因素則占 82.1%。

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[23] Dynarski (2005)、Angrist and Lavy (2002)與Angrist, Lang, and Oreopoulos (2006)均發現學業的獎勵或優惠制度，女性比男性有更顯著的效果。
[24] 此結果亦印證一句台灣民間諺語:么兒較有奶喝。

表五、教育成就迴歸估計結果

變數名稱	全體樣本	全體樣本	全體樣本	男性樣本	女性樣本
個人特質因素：					
工讀			1.199***	0.921***	1.370***
			(0.115)	(0.160)	(0.165)
學業優異獎學金			2.164***	1.983***	2.258***
			(0.154)	(0.223)	(0.210)
清寒獎學金			1.824***	2.207***	1.299***
			(0.357)	(0.521)	(0.483)
孝道觀念			-0.213***	-0.158***	-0.244***
			(0.044)	(0.061)	(0.062)
光耀家門觀念			-0.089**	-0.070	-0.083
			(0.044)	(0.063)	(0.061)
家庭教育資源					
才藝訓練		1.210***	0.875***	0.584**	0.910***
		(0.162)	(0.155)	(0.238)	(0.202)
補習輔導		1.439***	1.300***	1.271***	1.332***
		(0.132)	(0.126)	(0.169)	(0.185)
學業獎勵		1.236***	1.203***	0.842***	1.355***
		(0.217)	(0.206)	(0.306)	(0.276)
家庭遷移		-0.111	-0.116	-0.035	-0.132
		(0.240)	(0.227)	(0.310)	(0.328)
家庭背景因素：					
父親教育年數	0.236***	0.202***	0.176***	0.183***	0.163***
	(0.017)	(0.017)	(0.016)	(0.023)	(0.021)
母親教育年數	0.159***	0.122***	0.115***	0.093***	0.145***
	(0.020)	(0.019)	(0.018)	(0.026)	(0.025)
父親職業					
專門技術人員	0.637**	0.384	0.355	-0.144	0.951**
	(0.304)	(0.295)	(0.281)	(0.400)	(0.389)
行政及主管人員	2.117***	1.873***	1.864***	1.732***	2.058***
	(0.271)	(0.263)	(0.250)	(0.346)	(0.356)
監督及佐理人員	0.955***	0.802***	0.936***	0.664*	1.306***
	(0.282)	(0.273)	(0.259)	(0.372)	(0.356)
銷售工作者	1.630***	1.416***	1.446***	1.239***	1.628***
	(0.182)	(0.177)	(0.168)	(0.242)	(0.230)
服務工作人員	0.579**	0.542**	0.479*	-0.170	1.026***
	(0.276)	(0.268)	(0.254)	(0.370)	(0.344)
生產操作體力工	0.847***	0.772***	0.705***	0.506**	0.886***
	(0.155)	(0.150)	(0.142)	(0.203)	(0.196)
父親從事公職	0.596***	0.566***	0.485***	0.920***	0.079
	(0.196)	(0.190)	(0.180)	(0.255)	(0.252)
母親就業	-0.258**	-0.242**	-0.225**	-0.171**	-0.279*
	(0.106)	(0.105)	(0.105)	(0.085)	(0.144)
單親家庭	-0.154	-0.123	-0.104	-0.275	-0.089
	(0.184)	(0.155)	(0.168)	(0.242)	(0.263)
手足因素					
子女個數	-0.136***	-0.109***	-0.110***	-0.094**	-0.119***
	(0.034)	(0.033)	(0.032)	(0.049)	(0.041)
排序	0.217***	0.142*	0.163**	0.182**	0.121
	(0.083)	(0.080)	(0.076)	(0.08)	(0.111)
排序平方	-0.007***	-0.001	-0.000	-0.006	-0.009
	(0.000)	(0.000)	(0.000)	(0.011)	(0.013)
性別	-1.297***	-1.341***	-1.338***		
	(0.107)	(0.104)	(0.099)		
省籍	-0.609***	-0.511**	-0.494**	-0.580**	-0.430
	(0.219)	(0.212)	(0.201)	(0.291)	(0.274)
城鄉	-0.529***	-0.402***	-0.372***	-0.034	-0.643***
	(0.116)	(0.113)	(0.107)	(0.155)	(0.146)
世代效果					
中壯年	2.275***	2.140***	1.870***	1.409***	2.238***
	(0.137)	(0.133)	(0.127)	(0.188)	(0.170)
青年	3.558***	3.441***	2.828***	2.184***	3.486***
	(0.158)	(0.154)	(0.151)	(0.215)	(0.210)
常數	7.254***	6.870***	7.754***	8.017***	6.135***
	(0.330)	(0.321)	(0.363)	(0.523)	(0.491)
樣本數	3585	3575	3570	1725	1845
Adj-F²	0.5277	0.5584	0.6033	0.5003	0.6626
F 值	236.54	215.79	209.75	70.03	145.87
解釋能力					
個人特質因素			10.81%	8.53%	11.71%
家庭教育資源		6.99%	6.99%	4.37%	9.25%
家庭背景因素		93.01%	82.10%	87.10%	79.04%

註：括號中為標準差，*表示 10%、**表示 5%、***表示 1%統計檢定顯著水準。

表六、敏感性分析估計結果

變數名稱	基本模型 估計結果	父親職業別細分類 估計結果	依出生年 估計結果
父親教育年數	0.364***	0.354***	0.332***
	(0.029)	(0.029)	(0.029)
父親教育年數平方	-0.014***	-0.014***	-0.013***
	(0.002)	(0.002)	(0.002)
母親教育年數	0.145***	0.137***	0.134***
	(0.038)	(0.038)	(0.038)
母親教育年數平方	-0.003	-0.003	-0.003
	(0.004)	(0.004)	(0.003)
父親教育層級			
國小	1.689***	1.637***	1.526***
	(0.135)	(0.136)	(0.135)
國中	2.118***	2.006***	1.967***
	(0.213)	(0.215)	(0.212)
高中職	2.127***	2.013***	1.877***
	(0.237)	(0.243)	(0.236)
專科	2.364***	2.272***	2.183***
	(0.427)	(0.441)	(0.424)
大學以上	1.863***	1.698***	1.750***
	(0.350)	(0.363)	(0.348)
母親教育層級			
國小	0.788***	0.745***	0.715***
	(0.136)	(0.137)	(0.135)
國中	0.891***	0.810***	0.884***
	(0.258)	(0.262)	(0.257)
高中職	1.396***	1.358***	1.228***
	(0.309)	(0.313)	(0.309)
專科	1.241**	1.039	1.040
	(0.654)	(0.665)	(0.651)
大學以上	2.032***	1.914***	1.753**
	(0.711)	(0.717)	(0.706)
子女個數	-0.049	-0.049	-0.045
	(0.031)	(0.031)	(0.031)
兄(有=1)	0.109	0.104	0.094
	(0.114)	(0.114)	(0.113)
弟(有=1)	0.000	-0.006	-0.001
	(0.117)	(0.117)	(0.116)
姐(有=1)	0.424***	0.420***	0.358***
	(0.113)	(0.114)	(0.112)
妹(有=1)	-0.107	-0.092	-0.100
	(0.114)	(0.115)	(0.113)
兄個數	-0.021	-0.013	-0.027
	(0.045)	(0.045)	(0.045)
弟個數	-0.105**	-0.096**	-0.098**
	(0.048)	(0.048)	(0.047)
姐個數	0.120***	0.110***	0.102**
	(0.042)	(0.042)	(0.041)
妹個數	-0.126***	-0.128***	-0.109**
	(0.043)	(0.043)	(0.043)

註：括號中為標準差，*表示 10%、**表示 5%、***表示 1%統計檢定顯著水準。

教育成就的敏感性分析

　　為了進一步確認實證結果的頑強性，我們考慮幾個不同的方向進行敏感性分析，首先考慮父母親教育年數的影響可能為非線性，故加入父母親教育年數的平方項，由表六第 1 欄的結果發現父親教育年數對其子女教育成就的影響，一次項仍顯著為正、但平方項則顯著為負，表示隨著父親的教育年數增加，子女的教育年數也增加，但是這個效果並非固定而是隨著父親的教育年數增加而遞減，而母親的教育年數對子女教育年數的影響亦顯著為正，而平方項雖仍為負，但並不顯著。另除教育年數外，父母教育階層的影響效果亦可能不同，我們另考慮以父母的教育階層取代教育年數，所得的結果亦大致相同，即父母親的教育程度愈高，對子女教育成就的影響愈大。

　　在教育成就的手足效果方面，如表五所示的結果教育成就與子女排序呈正向關係，表示愈晚出生的子女，教育成就相對較佳，但若僅以排序與排序平方估計教育成就的手足效果，只能看出子女在家中的排行對其教育成就的影響而無法確知不同性別排序組合是否亦有不同影響，因此本文另外採用是否有兄、弟、姐、妹的虛擬變數或擁有兄、弟、姐、妹個數為變數以估計手足結構對教育成就的影響。由表六第 1 欄的估計結果發現有姐姐時，估計參數顯著為正(0.42)，且每增加一個姐姐，教育年數則增加 0.12 年。表示有姐姐者，其教育成就會相對較高，這是因為過去台灣地區在家庭預算限制下，出生排序較前面的女性，常需犧牲自己的婚姻與教育機會，提早工作或延後結婚，以減輕家中負擔，將家中資源留給弟妹使用，因此有助於弟妹個人的教育成就，此結果和 Parish and Wills (1993)的研究發現相同。而有哥哥時，估計參數雖仍為正，但並不顯著，這個似乎也顯示了台灣地區早期父母對子女人力資本的投資有重男輕女現象，特別是長男。

　　除此之外，父親職業原依一位數分類區分為 7 項，所反映的社會經濟

地位可能並不夠明確，因此本文亦考慮以二位數職業分類將父親的職業加以細分為 76 項，所得結果如表六第 2 欄所示。另一方面，考慮個人出生的年代不同，可能的外部總體效果亦有差異，因此本文將世代的大分類改為依樣本的出生年為虛擬變數，估計結果如表六第 3 欄所示。由表六的第 2、3 欄的結果發現，不論是父親職業的細分類或是樣本出生年的細分類，父母教育程度與手足因素對教育成就的影響，顯著性均相同，且效果大小並無太大的差異。[25]

由本小節的敏感性分析結果支持家庭背景、家庭教育資源、個人特質為影響個人教育成就的重要解釋變數，而忽略個人特質將高估家庭背景對個人教育成就的影響。

表七、義務教育政策評估

	模型(1)	模型(1')	模型(2)	模型(3)	模型(4)	模型(5)
性別	-1.337***	-1.336***	-1.913***	-1.318***	-1.343***	-0.782
	(0.099)	(0.099)	(0.132)	(0.099)	(0.099)	(0.606)
城鄉	-0.371***	-0.373***	-0.351***	-0.772***	-0.387***	-1.325
	(0.107)	(0.107)	(0.106)	(0.137)	(0.107)	(1.249)
省籍	-0.471***	-0.473***	-0.484***	-0.516***	-1.695***	-1.399***
	(0.200)	(0.200)	(0.199)	(0.200)	(0.304)	(0.477)
政策	0.747***	0.001***	0.074	0.329	-0.961***	-1.169**
	(0.188)	(0.000)	(0.213)	(0.208)	(0.371)	(0.559)
政策*性別			1.292***			0.036
			(0.196)			(0.749)
政策*城鄉				0.931***		1.075
				(0.199)		(1.498)
政策*省籍					1.943***	1.211**
					(0.365)	(0.5830
性別*城鄉						-0.391
						(1.522)
性別*省籍						-0.639
						(0.637)
城鄉*省籍						1.225
						(1.264)
政策*性別*城鄉						-0.513
						(2.029)
政策*性別*省籍						1.053
						(0.800)
政策*城鄉*省籍						-0.607
						(1.525)
性別*城鄉*省籍						-0.645
						(1.545)
政策*性別*城鄉*省籍						1.007
						(2.071)

註：每個模型均包含表六中的個人特質、家庭教育資源與家庭背景變數。
　　括號中為標準差，*表示 10%、**表示 5%、***表示 1%統計檢定顯著水準。

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[25] 其他家庭背景、家庭教育資源與個人特質變數估計結果亦類似，因限於篇幅未予列出，有興趣讀者可向作者索取。

除模型(1') 政策變數為全台當年國中學校數量外，其餘模型均為政策虛擬變數。

九年義務教育政策評析

在控制個人特質、家庭教育資源與家庭背景因素後，教育成就於性別、省籍、城鄉與政策的差異，如表五的估計結果均為顯著負值，顯示男性的教育成就比女性高出 1.34 年，表示在台灣地區家庭中對子女的教育成就上明顯存在性別差異；在省籍方面，由估計結果顯示外省籍者，其教育成就相對比本省籍高出 0.49 年；而至於在城鄉方面，居住在城市者則較居住在鄉村者的教育成就高出 0.37 年。

表七中模型(1)為控制個人特質、家庭教育資源與家庭背景因素後，考慮九年國民義務教育政策的施行前後的政策影響，估計結果為顯著正值。其他控制變數估計結果和表六估計結果相似，因限於篇幅故未予列出。施行九年國民義務教育可增加教育年數 0.75 年。由於九年國民義務教育的施行，除了法令上要求國小畢業的學童必須就讀國中之外，在 1967 年至 1970 年間，政府於全台興建多所國中，國中數目增加 70%，為考慮政策密集度(policy intensity)，本文另以全台當年國中學校數取代政策虛擬變數進行估計，如表七模型(1')所示，所得的結果政策變數依然顯著為正。

表七中模型(2)、(3)與(4)分別為九年國民義務教育政策的施行對性別、城鄉或省籍間教育成就差異的影響。在個人特質、家庭教育資源與家庭背景的變數方面，模型(2)、(3)與(4)的估計結果與模型(1)之基本模型亦無明顯的差異，且估計的顯著情況也均相同。由模型(2)、(3)、(4)的估計結果發現，義務教育政策的施行對性別、城鄉或省籍間教育成就差異的各別影響均非常顯著。

在義務教育政策施行前，教育成就於性別上的差異女性比男性少 1.913 年，而在義務教育政策施行後，性別間教育成就的差異則縮減為 0.621 年，模型(2)的結果顯示台灣地區男女間教育成就的差異，會因義務教育的施行而改善 67.54%。

在縮減城市與鄉村的差異方面，由模型(3)的估計結果可發現，城鄉間教育成就的估計參數，在義務教育施行前為鄉村較城市少 0.772，而在義務教育施行後，估計參數為 0.159，經檢測後未顯著異於零。表示台灣地區城市與鄉村間教育成就的差異，在九年國民義務教育施行後，兩者之間的教育成就幾無差距。

在省籍之教育成就方面，如模型(4)估計結果顯示，義務教育施行前，本省人的教育成就相對較外省人低 1.695 年，而在義務教育施行後，本省人與外省人的教育成就差異則縮減為 0.713（-1.695-0.961+1.943）年，省籍間教育成就的差異因義務教育的施行而改善57.94%。換言之，九年國民義務教育的施行使本省籍與外省籍的教育成就差異縮減將近一年。經由模型(2)、(3)與(4)的政策評估估計結果，我們可以發現，九年國民義務教育的施行似有助於各別改善台灣地區性別或城鄉或省籍間教育成就的差異。

為了確實比較義務教育政策的施行對城鄉、性別與省籍間的共同影響，有必要進一步控制性別、城鄉與省籍間的交互影響及義務教育政策對特定群體的影響效果，故本文另採用政策效果多重比較的方法進行估計，所得結果如表七模型(5)所示。

由表七模型(5)的結果發現，若考慮政策的施行同時作用在性別、城鄉與省籍之下，除省籍、政策與政策*省籍變數的估計結果為顯著之外，其餘皆不顯著。表示控制可能的交互作用和政策對省籍的影響後，政策的施行對性別與城鄉之影響效果均不顯著。換言之，在控制政策對省籍的影響下，不論男女、居住在鄉村或都市，政策的施行均無顯著改善其教育成就的差異。九年國民義務教育政策的主要效果是在改善省籍之間的教育成就差異，且政策對縮減省籍教育成就差異的效果為 1.21-1.94 年。[26]

將模型(5)與模型(2)、(3)與(4)的結果相比較，我們發現對單一特定

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[26] 為了進一步控制世代的總體環境，我們另外選擇 1951 至 1960 年出生的樣本（即包含未受九年義務教育影響之前 5 年出生者與受九年義務教育影響之後 5 年出生者）進行迴歸估計，亦得到相似的估計結果。有興趣讀者可向作者索取。

組群(性別、城鄉或省籍)，九年國民義務教育的施行均有助於教育成就的改善。若考慮同時作用在不同群體的交互作用時，則九年國民義務教育政策僅對省籍的教育成就有改善的效果。此結果表示台灣地區性別與城鄉間教育成就差異的改善，並不是因為義務教育政策施行的效果，而是因為義務教育政策的施行，有效的降低了省籍間教育成就的差異，進而使性別與城鄉間教育成就的差異亦局部獲得改善。另外，性別教育成就的差異也可能受到傳統重男輕女觀念的改變和子女個數減少而改善；城鄉間的教育成就差異也可能受到經濟發展與所得提高而獲得改善。

六、 結論

本文採用「華人家庭動態資料庫」 (PSFD)研究台灣地區個人特質與家庭因素對教育成就的影響，並進一步探討九年國民義務教育的施行對性別、城鄉與省籍間教育成就差異的影響效果。

實證的結果顯示，個人特質與家庭環境因素對教育成就具有顯著的影響效果。總合而言，在個人特質方面，求學期間曾經半工半讀或曾獲取獎學金者，其教育成就相對較高，而重視孝道與光耀門楣觀念者，其教育成就則相對較低。在家庭環境因素方面：(1) 父母的教育程度愈高，則子女教育成就相對亦愈高，且來自父親的效果大於來自母親的效果。(2) 父親的職業身份，亦影響子女的教育成就，其中又以父親為行政及主管人員，子女的教育成就相對最高，若父親從事公職，其子女的教育成就亦較高。(3)母親在外工作對子女的教育成就有顯著的負面影響。(4) 才藝訓練，補習教育及對子女學業的獎勵，對子女的教育成就亦有正面的影響效果。(5)家庭中子女的人數愈多，因個人在教育資源上的分配也愈少，故教育成就也愈低，且手足結構效果顯示排序較前的姐姐通常會犧牲自己成全弟、妹的教育成就。(6) 控制其他因素不變下，台灣地區仍存在顯著的性別、省籍、城鄉間的教育成就差異，女性、本省籍、居住鄉村者的教育成就較低。

(7)個人的教育成就隨世代的年輕化而提升，愈年輕的世代，其教育成就也愈高。

　　除此之外，本文的另一個重點在探討九年國民義務教育政策的施行對性別、城鄉與省籍間教育成就差異的影響效果。實證的結果發現，義務教育政策的施行對各別改善性別、城鄉或省籍間教育成就差異均有顯著正面影響。然而在考量並控制性別、城鄉與省籍間之交互影響下，進一步發現義務教育政策的施行效果主要是體現在省籍的教育成就改善上。換言之，台灣地區性別與城鄉間教育成就差異的改善，主要並不是因為義務教育政策施行的效果，而是因為義務教育政策的施行，有效的降低了省籍間教育成就的差異，進而使性別與城鄉間教育成就的差異亦獲得局部改善。之所以有這樣的結果，我們認為在早期外省居民孤身來台，歷經戰亂的洗禮，因此較重視移動性較高的人力資本，對子女的教育投入相對亦較為重視，而本省居民在台灣早期農業社會時期，子女必須幫忙家中農務，對子女的教育成就相對較不重視，因而造成在義務教育政策施行前，省籍間教育成就存在相當大的差異。資料顯示(參見表四) 義務教育政策施行前省籍間教育成就的差異最大(5.1 年),其次為性別 (4.44 年)、城鄉(2.13 年)。九年國民義務教育政策的施行，乃是普遍性並未針對特定群體而設計，對及齡學童一律強制必須就讀小學與國中，使省籍間的教育成就差異因而獲致改善。另外，男女和城鄉間教育成就差異也會受經濟發展、所得普遍提高、生育率下降與傳統重男輕女觀念的改變而獲得改善，故純粹因義務教育政策的影響也會較為有限。

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出席國際學術會議心得報告

計畫編號	95-2413-H-004-007-
計畫名稱	臺灣的教育選擇與九年國民義務教育之評估
出國人員姓名 服務機關及職稱	莊奕琦 國立政治大學經濟學系教授
會議時間地點	Madrid, Spain, 14-18 March, 2007
會議名稱	63rd International Atlantic Economic Conference
發表論文題目	Educational Achievement and the Evaluation of the Nine-year Compulsory Education Policy: The Case of Taiwan

一、參加會議經過

　　This 63rd International Atlantic Economic Conference was held in Madrid, Spain, one of the most active capitals in Europe and the fourth most-visited European city in terms of tourists.　In this five days conference, scholars from all over the world meet and discuss their research interest, findings, and policy implications during the sessions or breaks and share with each other their relevant country-specific experiences, which provide fruitful chances for cultural exchange.　This conference covers various topics in terms of Symposium, concurrent sessions, and distinguished address.　Topics of the conference includes: Globalization, Economic growth and development, International stability, market structure and performance, European Union issues, Current issues in trade and finance, Economics of Education, Global warning and environmental management, Labor force and supply, and international finance market and institutions, etc.

二、與會心得

　　This is indeed a great opportunity for me to be able to attend this meaningful international conference and to exchange research results and share the experiences with distinguished scholars from different cultures and societies.　The 2007 R. A. Mundell distinguished address by Jean Pisani-Ferry, currently director of the Brussels European and Global Economy Laboratory, on "The economic governance of a monetary union: The experience of the Euro Area" is illuminated.　He explained carefully the development of Euro, its influences on the European countries from a policy perspective, and the importance of economic governance of a monetary union, which provided an insightful view on the issue. There are several topics and presentations that are dealing with current issues seriously, such as globalization and global warning and environmental management, which stimulate prolific discussion. My paper on "Educational Achievement and the Evaluation of the Nine-year Compulsory Education Policy: The Case of Taiwan" provided evidence and addressed the remarkable achievement of nine-year compulsory education in closing the educational gap between Taiwanese and Chinese Mainlander in Taiwan, which received a warm discussion from the

discussant and conference participants.

Based on my personal experience, I strongly recommend domestic scholars to actively joint international conferences like this IAES conference to share and learn more multicultural experience and at the mean time to enhance Taiwan's visibility on the international arena. Forming a research team and organizing a panel with especial research interests may be an effective way to show Taiwan's research comparative advantage.

Educational Achievement and the Evaluation of the Nine-year Compulsory Education Policy: The Case of Taiwan

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Abstract

Using data from Taiwan's Panel Study of Family Dynamics (PSFD), this paper investigates the effect of personal characteristics and family background factors on educational achievement and evaluates the Nine-year Compulsory Education policy implemented in 1968. We find that family background and personal characteristics are important factors that affect an individual's educational achievement. Without controlling for personal characteristics the estimated effect of family background on educational achievement will bias upwards. After controlling for personal characteristics and family background, we also find that the implementation of the Nine-year Compulsory Education policy significantly closed the educational gap across gender, region and ethnic groups, respectively. However, careful examination of multiple comparisons by allowing for interactions between different groups shows that the effect of the Nine-year Compulsory Education policy has mainly closed the educational gap between Taiwanese and mainland Chinese.

Key Words: Nine-year Compulsory Education; educational achievement; policy evaluation

JEL: I21, I28, C23

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I. Introduction

The aim of education is to cultivate people's abilities. Individually, education enhances people's talents and productivity which in turns increases one's wages and social status. From a wider perspective, education is an important source of a country's enduring economic growth, and provides for social cohesion and mobility.[1] Therefore, education has long been an important subject for academic research and government policy formulation. Shultz (1961) and Becker (1964) consider education as a kind of human capital investment and Becker and Tomes (1986) show that family is an important decision unit for an individual's educational investment. Bowles (1972) states that intergenerational investment in education has a strong impact on income distribution and the social mobility of the next generation. Therefore, individual's educational achievement is deeply influenced by family background and family structure. Recent studies of developed countries using personal or family panel data have examined the effect of family background on educational achievement.[2]

From policy perspective, in order to increase educational achievement and labor productivity of a country, a compulsory education policy has been widely adopted by many countries. In 1968, the Taiwanese government adopted the Nine-year Compulsory Education Policy. The average years of schooling in Taiwan have improved significantly from 3.24 years in 1960 to 11.03 years in 2006. What are the likely effects of the Nine-year Compulsory Education Policy on educational achievement in Taiwan?

Using data from Taiwan's Panel Study of Family Dynamics (PSFD), the aim of this paper is to understand how family background and personal characteristics affect an individual's educational achievement in Taiwan. How does the educational policy affect the educational achievement across gender, region and ethnic groups?

In general, factors affecting an individual's educational achievement are linked to family

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[1] See, for example, Lucas (1988), Barro and Lee (1993), Benhabib and Speigel (1994) for the effects of education on a country's long run growth, and Prior and Mellor (2002) and Hauser *et al.* (1996) for education as an instrument for social cohesion and social mobility.

[2] See, for example, Haveman and Wolfe (1995) for a detailed discussion on a series of related studies.

background, including family socioeconomic status, such as the parents' level of education, occupations, ethnic identity, number of siblings, birth order, gender, and living environment. (see, for example, Butcher and Case (1994)；Greenhalgh (1985)；Hauser and Kuo (1998)；Haveman and Wolfe (1995)；Lillard and Willis (1994)；Huang (2000), among others.)

It is usually observed that the higher the parents' level of education, the higher the level of their children's education will be. Does this phenomenon come from genetic predisposition, or a better study environment provided by healthy parents, or both? Plug and Vijverberg (2003) find that parents' intelligence quotient has a significant positive effect on their children. Upon examination, regarding the parents' effect upon inherited and environmental factors, they found that inherited factors account for about 70-75%, but after further controlling for other influences, the effect of inherited factors drops to 55-60%.

As for the effects of the number of siblings and birth order, research results are inconclusive. For example, Leibowitz (1974) thinks under limited time constraints and believes it is not possible to compare time across generations; the parents' time spent taking care of their children declines throughout the birth order of their children. Thus, other factors being equal, birth order effect has a negative effect on education, i.e. the larger the birth order, the smaller the educational achievement will be. Birdsall (1991) also considers children's' education to be related to parents' time spent on them, especially the mother's time. Regardless of gender, if one is a first child without competition from one's siblings, one receives more time from one's parents and hence receives more education. From a biological perspective, the possibility of birth defects increases over time as a woman ages. Therefore, children born later in their parents' lives tend to encounter possible biological disadvantages in their mental development. Moreover, due to shared living environment with parents during their early career stages, first-born children also tend to imitate their parents and thus attain similar educational achievements as their parents.

As for the reasons behind the positive birth order effect, i.e., the larger the birth order, the higher the educational achievement, this may be due to shortcomings in resources as from a family life cycle viewpoint, during early stages the family's income is usually limited as parents are just

beginning their careers, so children during this early stage of family financial constraints tend to underinvest in their education. Behrman and Wolfe (1984) also point out that parents gain experience in childcare over time, thus children born later tend to have better childcare and educational achievement than their older siblings.

However, from a resource allocation point of view, the larger the number of siblings, the smaller the family resources received by each child. As the number of siblings increases, each child's educational resources diminish due to the constraints on the family budget. Moreover, children whose are in the middle of the birth order usually also encounter more keen competition among siblings for educational resources as the possibility is higher for all the siblings being of school age. Therefore, we may expect a U-shape relation to sibling effect, i.e., second, third, or fourth in the birth order may have the most disadvantages in educational achievement. Empirical studies in the U.S. find such an effect exists, see, for example, Blake (1989) and Steelman and Powell (1991).

A better living environment may also affect learning. Lillard and Willis (1994) find that housing quality, school availability, and urban residence have significant positive effect on individuals' educational achievement.

There are some Taiwanese studies on educational achievement. Using 1978-1980 longitudinal survey data from eighty families in Taiwan's northern regions, Greenhalgh (1985) found that as the economy developed the educational opportunities between son and daughter equalized because of the increase in demand for highly skilled labor enabled the parents to recoup their educational investment in their daughter before she married. Parish and Wills (1993) investigated data from Taiwanese women born from 1929-1963 and their siblings from the Survey of Women's Living Status conducted in Taiwan with the cooperation of the Ministry of Interior Affairs, National Taiwan University, and the University of Chicago in 1989 and found similar results as in Greenhalgh (1985): that for those families with large number of kids, children born later have the advantage of receiving a better education. Due to family budget constraints, female children born early tended to sacrifice their education and marriage by receiving less education and

entering the labor market early to support the family or their younger brothers' or sisters' education.

Using data from the 1990 Population and Housing Survey and comparing educational achievement between children born between 1935 and 1965, Luoh (2001) found in terms of educational achievement, mainland Chinese were more advanced than Taiwanese and men were also more advanced than women. After 1965, the gender differences in education disappear among all ethnic groups and educational differences between ethnic groups decline but significant differences remain. He also examined data from children born from 1960 to 1974 in the 1979-1992 Family Income Survey and concluded that the educational levels of mainland Chinese will likely remain higher than that of the Taiwanese in the future. Luoh (2001，2002) also asserts that noticeable differences exist in educational achievement between urban and rural regions. The major drawback of these Taiwan's study is that they do not control for personal characteristic, such as ability and altitude, which may bias the estimated effects of family background upwards.

As for the evaluation of compulsory education policy, there are two lines of research. One line looks at the impact of the education policy in influencing people's return to schooling. Patrinos and Sakellariou (2005) use household data from Venezuela and find that the effect of compulsory education on return to schooling is higher for the firstborn child than other children born later. Wei *et. al* (1999) examined the relation between earnings and education in the central and southeast regions in China and found compulsory education has had a strong influence upon rural Chinese villages as education has led to a significant increase in income. The higher the education, the greater the rate of people's return to schooling.[3]

The other line reviews the effect of policy on educational achievement, i.e., does a compulsory education policy increase the length of schooling? Using data from the U.K., the Netherlands, Germany, and Sweden, Mclntosh (2001) found compulsory education increased the demand for higher education, especially for women. Lleras-Muney (2003) used U.S. 1960 population survey data to examine if compulsory education affected the tremendous increase in secondary education between 1915 and 1939. He found that an increase in compulsory education by one year will

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[3] For research on the impact of compulsory education on the rate of people's return to schooling see, for example, Angrist and Krueger (1991), Cruz and Moreira (2005) and Sakellariou(2006).

increase an individual's educational attainment by 5%, and this effect was similar for white males and white females but insignificant for the black population. Using birth date as instrumental variable for educational policy, Angrist and Krueger (1991, 1992) found that compulsory education will increase student enrollment by 10%. However, the policy effect of Nine-year compulsory Education in Taiwan has never been examined.

For the relevant studies, the most widely used data in Taiwan are from the Manpower Utilization Survey or the Survey Family Income and Expenditure, which is based on household units in which parents' education and exact number of siblings may not be available, as the family may not live together and information on personal characteristics may also be unobtainable. In contrast, this paper adopts data from the Panel Study of Family Dynamics which contains personal characteristics, such as academic performance and the value of life, and family background variables, such as parents education, occupation, ethnicity, and family educational resources, to investigate factors that affect educational achievement in Taiwan and to evaluate the Nine-year Compulsory Education policy implemented in 1968.[4]

The rest of this paper is organized as follows: Section II describes the construction of the empirical models and estimation methods; Section III presents a description of the variables and basic data analysis; Section IV presents the results of the estimations; and concluding remarks follow in Section V.

II. The Empirical Model and Estimation Method

In the literature, family background and living environment are important factors affecting individual's educational attainment and thus they were widely examined in the empirical studies.[5] However, in their survey article Haveman and Wolfe (1995) propose that a more comprehensive framework for determining children's educational attainment should contain three primary factors,

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[4] Chu, Tsay and Yu(2005) and Chu, Xie and Yu(2005) also used PSFD data to investigate educational achievement, however, they do not include family educational resources and personal characteristics variables.

[5] See, for example, Datcher (1982), Hill and Duncan (1987), Teachman (1987), Graham, Beller, Hernandez (1994), Ermisch and Franceconi (2000), and Aakvik, Salvanes, and Vaage (2005), among others. Ashenfelter and Rouse (1998) show that in their twins sample up to 60% of the cross-sectional variation in educational attainment can be attributed to family factors.

the choices made by the government, the choices made by the parents, and the choices made by children themselves. The part of children's decisions such as ability, motivation, and values are mostly neglected in the literature.[6] In this study besides family background and living environment factors we also include personal characteristics to measure individual's heterogeneity. The empirical model for educational achievement is specified as:

$$Y_i = \alpha_0 + \alpha_1 \text{FAM}_i + \alpha_2 \text{CHR}_i + \alpha_3 \text{GEN}_i + \alpha_4 \text{UBN}_i + \alpha_5 \text{ETH}_i + \alpha_6 \text{COH}_i + \varepsilon_i, \quad (1)$$

Where Y is for the year of education, FAM is for family background variable, CHR is for variables of personal characteristics, GEN is a dummy variable for gender (1 for female and 0 for male), UBN is a dummy variable for region (1 for rural and 0 for urban), ETH is a dummy variable for father's ethnicity (1 for Taiwanese and 0 for mainland Chinese), COH is a variable controlling for cohort effect, and ε is the disturbance term.

In order to evaluate the impact of the Nine-year Compulsory Education policy, this paper first tests the policy impact on the educational achievement across gender, region, and ethnic groups, respectively. The empirical model for policy evaluation can be written as

$$Y_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 \text{GEN}_i + \alpha_3 \text{UBN}_i + \alpha_4 \text{ETH}_i + \alpha_5 \text{POL}_i + \nu_i, \quad (2)$$

$$Y_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 \text{GEN}_i + \alpha_3 \text{UBN}_i + \alpha_4 \text{ETH}_i + \alpha_5 \text{POL}_i + \alpha_6 \text{POL}_i \times \text{GEN}_i + \delta_i, \quad (3)$$

$$Y_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 \text{GEN}_i + \alpha_3 \text{UBN}_i + \alpha_4 \text{ETH}_i + \alpha_5 \text{POL}_i + \alpha_6 \text{POL}_i \times \text{UBN}_i + \mu_i, \quad (4)$$

$$Y_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 \text{GEN}_i + \alpha_3 \text{UBN}_i + \alpha_4 \text{ETH}_i + \alpha_5 \text{POL}_i + \alpha_6 \text{POL}_i \times \text{ETH}_i + \tau_i, \quad (5)$$

Where Z stands for variables of personal characteristics, family background, and Cohort year, POL is a dummy variable for compulsory education policy (1 for those receiving compulsory education and 0 for those not). The coefficient α_5 in equation (2) represents the policy effect of the compulsory education. In order to take policy intensity into account, we also multiply the policy dummy by the number of junior high school. The coefficient α_6 in equation (3) represents the policy impact on the differences of educational achievement between women and men. If α_6 is positive (negative), it implies that compulsory education reduces (enlarges) the educational gap between women and men. By the same token, the coefficients of interaction terms in equations (4)

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[6] Few exceptions include prior choices made by the child are religiosity in Hill and Duncan (1987) and school performance in Behrman, Beller, and Hernandez (1994).

and (5) represent the policy effects on the educational gap between regions and ethnic groups, respectively.

As the educational environment encountered by gender, region, and ethnicity groups might be different due to interactions between groups, estimations in equations (3)-(5) may be biased. To avoid the problem, we further perform multiple comparisons of policy effects on gender, region, and ethnic groups to differentiate the policy effects on particular groups (such as Taiwanese women, rural women, and rural Taiwanese) and also allow for the possible interactions between groups. The model for policy evaluation is further modified as[7]

$$Y_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 \text{GEN}_i + \alpha_3 \text{UBN}_i + \alpha_4 \text{ETH}_i + \alpha_5 \text{POL}_i$$

$$+ \alpha_6 POL_i \times GEN_i + \alpha_7 POL_i \times UNB_i + \alpha_8 POL_i \times ETH_i + \alpha_9 GEN_i \times UBN_i$$

$$+ \alpha_{10} GEN_i \times ETH_i + \alpha_{11} UBN_i \times ETH_i + \alpha_{12} POL_i \times GEN_i \times UBN_i ,$$

$$+ \alpha_{13} POL_i \times GEN_i \times ETH_i + \alpha_{14} POL_i \times UBN_i \times ETH_i$$

$$+ \alpha_{15} GEN_i \times UBN_i \times ETH_i + \alpha_{16} POL_i \times GEN_i \times UBN_i \times ETH_i + \eta_i \quad (6)$$

For example, the coefficient α_{16} in equation (6) evaluates the policy effect on the educational achievement of rural Taiwanese women, the group that tends to have least education.[8] The estimation results of equations (6) will enable us to verify the real effects of compulsory education policy on gender, region, and ethnicity.

III. Description of Variables and Data Analysis

In the previous analysis of Taiwan's educational achievement, the most widely used data are either from the Manpower Utilization Survey or the Survey of Family Income and Expenditure. However, due to the lack of information in kinship and personal characteristics, those studies fail to precisely estimate educational achievement (Loah (2001)). This paper adopts the Panel Study of Family Dynamics, which has been conducted yearly since 1999 by the Academia Sinica. PSFD collects extensive family information including spouse, parents, children, siblings of that individual,

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[7] Additional comparison groups will reduce the importance of biases or random variation in a single comparison group. See Meyer (1995) for a discussion of advantages using multiple comparison groups for policy evaluation.

[8] In the samples of PSFD, the average years of education for rural Taiwanese women are 3.99, whereas those for urban

and the parents/siblings of the individual's spouse.[9]   The 1999 pilot survey contained 1000 random samples aged from 36 to 45 (born between 1953-1964) in Taiwan, according to the household registration provided by the Ministry of the Interior.   This paper uses a mixed sample of 4,110 individuals from the 1999, 2000, and 2003 PSFD surveys ((RI1999, RI2000, and RI2003).   The 1999 survey contains 999 samples aged 35-46, 2000 contains 1959 samples aged 46-65, and 2003 survey contains 1152 samples aged 27-39.

In current literature, family background factors influencing an individual's educational achievements include socioeconomic status, numbers of siblings, birth order, and location of childhood (Butcher and Case (1994); Greenhalgh (1985); Hauser and Kuo (1998); Haveman and Wofe (1995); Lillard and Willis (1994) and Huang (2000), among others).   Among them, family socioeconomic status has been highly informative, and parents' education, parents' occupation, and family income have been used as proxies for family socioeconomic status.   Though family income reflects family resources and economic status, people are usually reluctant to report their true family income (it may be underreported or overreported).   Thus, the data on family income are either unavailable, especially during their children's years of study, or might be subject to bias or error.[10] In contrast, the parents' occupations are usually available and more credible in terms of stable occupational trend in observed worker's life cycle.   Moreover, PSFD contains data on father's occupation during their children schooling years.   Because women in the labor market consist a small proportion of the total female population during the early stages of Taiwan's economic development, we use the father's occupation to proxy the family socioeconomic status.

We also include variables like talent training, after-school supplementary education, family transfer to better school district, and incentive offer for academic performance by parents to capture extra educational resources provided by family.[11]   Another advantage to include family

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mainland Chinese men are 13.36.

[9] For a detailed description and the design of the PSFD, see the official website at http://psfd.sinica.edu.tw .

[10] Another problem of using family income is that the short-run aspect of family income may not reflect the truth permanent income of family.   Carneiro and Heckman (2003) indicate that long-term income effects are the most important.   Using data from Norway, Aakvik, Salvanes, and Vaage (2005) also find that permanent family income is much more important for educational attainment than is short-term credit constraint.

[11] Teachman (1987) finds evidence that parents use resources to create a home environment like having an individual studying room, reference books or encyclopedia at home, which has a positive effect on educational achievement of

educational resources is that family educational resources are more important than family income in determining children's educational achievement and the control of family educational resources will also abstract the possible resources effect contained in family socioeconomic variables such as parents' education and family income.

You can lead horses to river but you cannot force them to drink. Besides family background, individual's heterogeneity represented by personal characteristics, like ability, attitude, and values of life, are also considered to be important factors driving individual's educational achievement.[12] Our variables include scholarship for academic performance, doing part time job during schooling, and two influential traditional values for filial duty and glory for the family in Chinese society.

As the sample aged between 27 to 65 years old, additional cohort dummies are added to control for possible cohort effects derived from different macro environment.

Table 1 presents the description of all variables used in the paper, while Table 2 shows the summary of basic statistics of the variables.

Table1. Variable Description

Variable name	Description
Education level	Eight levels: Illiterate and self-study, primary school, junior high school, senior high and vocational school, Junior college, University, Master's degree, Ph.D. degree.
Years of education	Years of education for primary school, junior high school, senior high and vocational school, Junior college, University, master degree, Ph.D. degree are specified as 6, 9, 12, 14, 16, 18, 20, and 24 years.
Personal Characteristics:	
Gender	Dummy variable: 1 for female, 0 for male.
Part-time job	Dummy variable: 1 for having part-time job to earn money to support oneself or family during schooling years, 0 otherwise.
Scholarship for academic performance	Dummy variable: 1 for obtaining scholarships based on academic performance during school years, 0 otherwise.
Scholarship for poor family	Dummy variable: 1 for obtaining scholarships based on low family income with certain academic performance requirement during school years, 0 otherwise.
Filial duty	One's opinion on the idea "one must sacrifice personal interests in order to

their children. ? also find that easy access to college and university has a positive effect on educational achievement.

[12] Heckman (2001) finds that more able people also tend to be more efficient in schooling and learning. More independent and self-motivated individuals are also likely to have better educational achievement.

	accomplish one's parents' wishes": scale from 1 to 5, 1=not important, up to 5=absolutely important.
Glory for the family	Ones opinion on the idea "one must do something to glorify ones family": scale from 1 to 5, 1=not important, up to 5=absolutely important.
Family background:	
Ethnicity	Father's ethnicity: 1 for Taiwanese (which includes aborigines, Fujian, and Hakka), 0 for mainland Chinese.
Father's education	Years of education for primary school, junior high school, senior high and vocational school, Junior college, University, master degree, Ph.D. degree are specified as 6, 9, 12, 14, 16, 18, 20, and 24 years.
Mother's education	Same as above.
Father's occupation	Dummy variables: occupations including professionals, administrators and executives, clerks, sales workers, services workers, agriculture related workers, production operators and laborers, and agriculture related workers is the reference group.
Father works in Public sector	Dummy variable: 1 if the father works in the public sector, 0 otherwise.
Talent training	Dummy variable: 1 for attending talent training (such as studying piano, painting, calligraphy, dance, etc.) during school years, 0 otherwise.
Supplementary education	Dummy variable: 1 for having after-school remedial or supplementary education, 0 otherwise.
Reward for school performance	Reward offered by parents for academic performance, increasing scale from 0 to 3 (0=none, 1=seldom, 2=some times, 3=often)
Family transfer	Dummy variable: 1 for having the experience before age of 16 that parent deliberately moved family to a district with better education environment or easy access to school, 0 otherwise.
Number of siblings	Number of siblings in the family.
Birth order	Ranking in birth order.
Number of brothers or sisters	Number of older brothers, older sisters, younger brothers, and younger sisters in the family.
Region	Dummy variable: 1 for residency in an urban area before age 16, 0 otherwise.
Cohort:	
Old Middle-age Young	Dummy variable: Old = born before 1950, Middle-aged = born between 1951 and 1960, and Young = born after 1961 (Old is the reference group).
Education policy	Dummy variable: 1 for receiving nine years of compulsory education, 0 otherwise.

Table 2. Summery of Basic Statistics

Variable	Sample size	Mean	Variance
Educational attainment:			
Illiterate and self-study	3636	0.0842	0.2781
Primary school	3636	0.2770	0.4476
Junior high school	3636	0.1337	0.3403
Senior high or vocational school	3636	0.2643	0.4410
Junior college	3636	0.1194	0.3243
University	3636	0.1004	0.3006
Master's degree	3636	0.0182	0.1335
Ph.D. degree	3636	0.0028	0.0524
Years of education	3636	9.7063	4.6054
Personal Characteristics:			
Gender	3636	0.5149	0.4998
Part-time job	3636	0.2808	0.4495
Scholarship for academic performance	3633	0.1214	0.3266
Scholarship for poor family	3633	0.0190	0.1365
Filial duty	3634	3.4188	1.1953
Glory for the family	3635	3.8135	1.1483
Family background:			
Ethnicity			
Aborigine	3629	0.0215	0.1450
Fujian	3629	0.7812	0.4135
Hakka	3629	0.1144	0.3183
Mainland Chinese	3629	0.0829	0.2758
Father's education	3623	4.9095	4.8118
Mother's education	3630	2.9645	3.8363
Father's occupation			
Professionals	3598	0.0439	0.2049
Administrators and executives	3598	0.0503	0.2186
Clerks	3598	0.0675	0.2510
Sales workers	3598	0.1226	0.3280
Services workers	3598	0.0584	0.2345
Agriculture related workers	3598	0.4341	0.4957
Production operators and laborers	3598	0.2232	0.4164
Father in public sector	3633	0.1610	0.3676
Mother at work	3636	0.4588	0.4984
Single family	3636	0.0784	0.2688
Family educational resources			
Talent training	3635	0.1356	0.3424
Supplementary education	3633	0.2188	0.4135
Reward to school performance	3635	0.0646	0.2459
Family transfer	3628	0.0510	0.2200
Number of siblings	3634	5.2930	2.2238

Birth order	3635	3.0564	2.0023
Number of older brothers	3635	1.0094	1.2149
Number of young brothers	3635	1.1568	1.1575
Number of older sisters	3635	1.0470	1.2680
Number of younger sisters	3635	1.0798	1.2510
region	3633	0.4646	0.4988
Cohort:			
Old	3636	0.3650	0.4815
Middle-aged	3636	0.2998	0.4582
Young	3636	0.3353	0.4721
Policy variable	3636	0.4450	0.4970

Source: RI1999, RI2000, and RI2003 surveys, Panel Study of Family Dynamics, Academia Sinica.

From Table 2, regarding personal characteristics, 28% of people had part-time jobs to earn money to support oneself or one's family during their school years, 14% (0.485 for male and 0.515 for female) received scholarships for either school performance or financial need. The average scale value for the concept of filial duty and glory for the family are 3.42 and 3.81 (in a full scale of 5), respectively, implying that the two traditional values are widely rooted in Chinese society.

As for family background, on average the father's education is about 2 years higher than mother's (4.91 years for the father and 3 years for the mother). The relatively few years of parental education is expected as the age of the sample's parents is above 45. The majority of fathers' occupations are work in the agriculture sector, consisting of 43.41% of the sample, followed by production operators or laborers (22.32%). In the early agriculture-oriented economy, most people were engaging in agricultural activities or jobs with low skill content. About 16.1% had fathers working in public sector and 45.88% whose mothers are also working. About 7.84% children live in a single family house.

As for father's ethnicity, the majority ethnic group is Fujianese (78.12%), followed by Hakka (11.44%), mainland Chinese (8.29%), and aborigines (2.15%). This ethnicity composition of the sample is fairly representative to that of Taiwan total population. In this paper, following conventional classifications, we define the Taiwanese as the summation of Fujianese, Hakka, and aboriginal ethnic groups.

The average number of children in a family is 4.77 people and the number for older brothers, older sisters, younger brothers, and younger sisters are 0.89, 1.00, 0.96, and 0.92. Among them, the proportion of first-born children is 5.25% and that of last-born children is 19.53%.

About 13.56% and 21.88% received latent training and after school supplementary education, respectively; while 6.46% and 5.10% experienced rewards for academic performance offered by parents and family deliberately transfer to a better school district, respectively.

The sample used in this paper consists of people born between 1934 and 1976. During this period of more than forty years, the economic situation and educational environment have changed tremendously. Thus, we also include a cohort dummy variable to control for the effects of age.

According to birth year, we classify the sample into three cohorts: old (born before 1950), middle-aged (born 1951-1960), and young (born after 1961). The sizes of the samples are 36.5%, 30% and 33.5%, respectively. For robustness test, we also use birth year dummies to control for year effect.

Table 3 presents educational achievement by personal characteristics and family background. On average, the duration of men's' education is 10.62 years, while women's' is 8.83 years. Except for primary school, the proportion of men is higher than that of women at all educational levels.

Table 3. Basic Data Analysis

		Educational Achievement						
	Years of education	Primary school	Junior high school	Senior high and vocational school	Junior college	University	Master degree	Ph.D. degree
Gender								
Male	10.620 (4.050)	0.233	0.169	0.292	0.133	0.110	0.026	0.005
Female	8.834 (4.890)	0.318	0.100	0.238	0.107	0.091	0.011	0.001
Father's education								
Low education	8.682 (4.435)	0.340	0.153	0.249	0.088	0.054	0.007	0.002
Middle education	12.877 (3.142)	0.069	0.083	0.335	0.237	0.229	0.036	0.003
Higher education	14.144 (3.074)	0.038	0.019	0.260	0.202	0.351	0.115	0.005
Ethnicity								
Aborigine	7.376 (3.622)	0.482	0.176	0.200	0.035	0.000	0.000	0.000
Fujian	9.265 (4.653)	0.298	0.141	0.249	0.108	0.086	0.016	0.003
Hakka	10.576 (3.891)	0.277	0.130	0.299	0.152	0.097	0.024	0.002
Mainland Chinese	13.003 (3.161)	0.049	0.081	0.357	0.198	0.263	0.036	0.003
Age								
Old	6.590 (4.452)	0.486	0.108	0.114	0.035	0.050	0.002	0.001
Middle-age	10.047 (3.934)	0.306	0.157	0.294	0.104	0.095	0.012	0.004
Young	12.778 (2.705)	0.023	0.141	0.402	0.226	0.160	0.041	0.004
Father's workplace								
Public sector	12.502 (3.776)	0.109	0.080	0.308	0.192	0.236	0.049	0.003
Private sector	9.155 (4.537)	0.310	0.144	0.256	0.105	0.074	0.012	0.003
Father's occupation								
Professionals	11.520 (4.783)	0.189	0.051	0.214	0.209	0.219	0.051	0.000
Administrators and executives	12.297 (4.399)	0.146	0.059	0.274	0.210	0.164	0.096	0.014

Clerks	11.548 (4.351)	0.167	0.103	0.267	0.160	0.221	0.036	0.000
Sales workers	10.735 (4.148)	0.217	0.125	0.322	0.136	0.140	0.015	0.002
Services workers	10.782 (4.399)	0.222	0.129	0.238	0.173	0.165	0.020	0.000
Agriculture related workers	7.311 (4.342)	0.427	0.150	0.180	0.049	0.029	0.002	0.003
Production operators and laborers	10.568 (3.887)	0.222	0.143	0.344	0.151	0.090	0.012	0.002
Region								
Urban area	10.797 (4.340)	0.225	0.114	0.293	0.149	0.139	0.027	0.005
Rural area	8.428 (4.546)	0.337	0.156	0.231	0.085	0.056	0.008	0.001
Education policy								
Before	7.568 (4.510)	0.453	0.114	0.167	0.051	0.062	0.004	0.001
After	12.361 (3.036)	0.057	0.158	0.385	0.205	0.148	0.035	0.004

Years of education for children whose father's education is low (primary school and below), mid level (junior high school, senior high school, and vocational school), and high (junior college and above) are 8.68, 12.88, and 14.14 years, respectively. This implies that the higher the educational level of one's father is; the greater one's educational achievements will be.

As for ethnicity, if the father is mainland Chinese, his children's education attainment averages 13 years, the highest among all ethnic groups, compared with 10.58 years for children whose father is Hakka, 9.27 years for children whose father is Fujianese, and 7.38 years for children whose father is an aborigine. Furthermore, the proportion in higher education is also higher for those children whose father is mainland Chinese than those children whose father is Taiwanese. In Taiwan, educational achievement between ethnic groups is considered to be evident.

As the economy developed, the younger generations tended to receive more education than the older generation. The years of education for old, middle-age, and young people are 6.59, 10.05, and 12.78 years, respectively.[13]

If the father worked in public sector, his children received more education than those children whose father worked in private sector. The average years of education for the former are 12.5 and

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[13] Further examination of the years of education for each age by gender, region, and ethnicity shows that the educational gap between gender, region, and ethnicity is higher for old than for young people.

9.16 for the latter. This is mainly because people who worked in the public sector received education subsidies for their children and this thus reduced the cost of education.[14] The father's occupation, a proxy for family socioeconomic status, shows that when the father works as an administrator and executive, his children have the highest (12.3) years of education compared to the lowest (7.31) years for those children whose father worked in agricultural sector. However, the deviations of education achievement are moderate among children whose father worked in other occupations. The proportion of higher education is greater, above 50%, for children whose father is an administrator and executive or professional.

Difference in educational achievement between rural and urban areas is also apparent. Years of education in urban areas average 10.8 years, while rural areas average 8.4 years. As for the implementation of the Nine-year Compulsory Education policy, before the policy, average years of education were 7.6 years and after the policy the average years of education were 12.4. The Nine-year Compulsory Education policy seems to improve educational achievement in Taiwan.

Table 4 further classifies educational achievement by gender, region, ethnicity, and policy for cross-table analysis. Before the compulsory education policy, the educational gap was the largest (5.1 years) between ethnic groups, then 4.44 years between gender, and 2.13 years between rural and urban region. After the compulsory education policy, the corresponding figures for the educational gap are 1.36, 0.4, and 1.45 years, respectively. Looking at the data, basically, the implementation of the Nine-year Compulsory Education policy in 1968 seems to have in some ways reduced the educational gap between gender, region, and ethnicity, especially gender. Among them, the educational gap for Taiwanese (vs. mainland Chinese) between rural and urban areas dropped from 1.73 (3.27) to 1.29 (1.68), which implies that the policy in effect shrunk the educational gap between rural and urban areas and its magnitude was greater for mainland Chinese than for Taiwanese. Conversely, the educational gap between mainland Chinese and Taiwanese in urban (vs. rural) areas was reduced from 4.94 (2.40) to 0.99 (0.60) years, which implies that the policy effect reduces the educational gap between mainland Chinese and Taiwanese and its

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[14] The educational subsidies in public sector are actually progressive along the educational levels, thus it provides extra incentive to obtain higher educational level.

magnitude is greater for urban than for rural areas.

In term of gender differences in education, after the policy the reduction in the education gap between women and men was greater between mainland Chinese than between Taiwanese, and the scale was greater for mainland Chinese men than for mainland Chinese women. Regardless of gender, after the policy the reduction in the educational gap in urban areas was greater than that in rural areas. However, the largest increase in educational achievement before and after the compulsory education policy falls to women in rural areas, whose average years of education increased from 3.98 to 11.02 years.

Table 4. Average Years of Education by Region and Ethnicity:
Before and After Policy Analysis (Whole sample)

Before policy	Urban	Rural	Total	After policy	Urban	Rural	Total
Taiwanese	**8.23**	**6.50**	**7.29**	Taiwanese	**12.78**	**11.49**	**12.22**
Aborigine	5.88	6.55	6.35	Aborigine	9.33	10.33	9.71
Fujian	8.18	6.09	7.08	Fujian	12.76	11.39	12.16
Hakka	8.99	8.95	8.97	Hakka	13.43	12.29	12.93
Mainland Chinese	**13.17**	**8.90**	**12.39**	Mainland Chinese	**13.77**	**12.09**	**13.58**
Total	8.68	6.55	7.57	Total	12.95	11.50	12.38

Table 4. Average Years of Education by Region and Ethnicity:
Before and After Policy Analysis (Male)

Before policy	Urban	Rural	Total	After policy	Urban	Rural	Total
Taiwanese	**9.17**	**8.16**	**8.64**	Taiwanese	**12.84**	**11.88**	**12.40**
Aborigine	2.00	7.80	6.83	Aborigine	10.22	12.00	10.55
Fujian	9.21	7.81	8.51	Fujian	12.80	11.72	12.30
Hakka	9.27	9.99	9.68	Hakka	13.59	13.13	13.39
Mainland Chinese	**13.36**	**9.00**	**12.81**	Mainland Chinese	**14.20**	**12.43**	**13.94**
Total	9.55	8.17	8.86	Total	13.05	11.88	12.57

Table 4. Average Years of Education by Region and Ethnicity:
Before and After Policy Analysis (Female)

Before policy	Urban	Rural	Total	After policy	Urban	Rural	Total
Taiwanese	**4.58**	**3.99**	**4.25**	Taiwanese	**12.72**	**11.01**	**12.01**
Aborigine	6.77	5.22	5.78	Aborigine	8.00	9.86	9.00

Fujian	4.29	3.67	3.95	Fujian	12.73	10.97	12.01
Hakka	6.42	5.77	6.03	Hakka	13.27	11.46	12.47
Mainland Chinese	**8.17**	**4.14**	**7.26**	Mainland Chinese	**13.38**	**11.50**	**13.23**
Total	4.93	3.98	4.42	Total	12.85	11.02	12.17

Fujian	4.29	3.67	3.95	Fujian	12.73	10.97	12.01
Hakka	6.42	5.77	6.03	Hakka	13.27	11.46	12.47
Mainland Chinese	**8.17**	**4.14**	**7.26**	Mainland Chinese	**13.38**	**11.50**	**13.23**
Total	4.93	3.98	4.42	Total	12.85	11.02	12.17

IV. Estimation results

After controlling for various family background variables and personal characteristics, the policy effect of compulsory education has a positive and significant effect on educational achievement. Model I estimates the effect of personal characteristics and family background on educational achievement. Models II to IV analyze the impact of the compulsory education policy on gender, region, and ethnicity, respectively. Models V to VII further test the policy impact of compulsory education on particular groups, such as Taiwan women, rural women, and rural Taiwanese; and these allow us to perform the multiple comparisons of effects of policy on the groups in question.

Factors affecting educational achievement

Table 5 presents the results of the empirical models on educational attainment. All the regression models in Table 5 have a F value which passed the 99% statistical significance level and the adjusted F^2 is over 0.5, which implies excellent explanatory potential and that the models are appropriate.

As in the literature, family background variables have significant effects on individual's educational achievement.[15] The effect of the father's education has a significant positive effect, which implies that the higher the education level of a father is, the higher the education level of his children will be. The effect of the mother's education is also positive and significant. These results are consistent with the literature that suggests that genetic predisposition matters or that better-educated parents tend to offer better study environment for their children. It is worth pointing out that the estimated coefficient for the father's education is actually greater than that of the mother's, implying that its effect on educational achievement is greater from the father than from the mother.[16]

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[15] See, for example, Haveman and Wolfe (1995) and Card (1999) for detailed discussion and references therein.

[16] We also consider parents' educational attainment instead of years of education to measure the effect of the parents' education; the results are similar to what we report here. Using Taiwan's data, Liu, Hammitt and Lin (2000) also find that the father's education has a greater effect than the mother's education on their children's return to education. Aakvik, Salvanes, and Vaage (2005) also find robust result showing that father's education has a greater effect on children education than mother's in Norway. Card (1999, Table 2) show that each additional year of schooling of either parent raises completed schooling by about 0.2 years, and roughly 30% of the observed variation in schooling among US adults is explained by parental education.

The father's occupation also affects his children's' education. A father who works as an administrator has the largest effect. Children whose father's occupation was administrators or executives receive an additional 2.12 years of education over children whose father worked in the agricultural sector and additional 1.63 years for children whose father worked as a sales person. Children who father worked in public sector also receive additional 0.6 years of education mainly because of education subsidies provided by government.

However, if mother is also working, the effect is negative and significant implying the sacrifice of mother's home caring and nurturing due to time constraint has rendered an adverse effect on children's educational achievement.[17] Living in a single family also has a negative effect but significant. Single family usually belongs to low income family and tends to encounter financial difficulties, which has a unfavorable effect on human capital investment.[18] The possible reasons for the insignificance here may be due to the proportion of single family is relatively small (about 7.84% of our sample) and the effect may be abstracted after controlling for family socioeconomic status such as parents education and occupations.[19]

As for family structure, the number of siblings has a significant negative effect, implying that holding family resources constant, the larger the number of siblings, the lower the educational achievement, because family resources spent on additional children decline as the number of children increase.[20] The coefficient of birth order is positive and significant, while that of its square is also positive but insignificant. It implies that holding the number of siblings constant, the latter the birth order, the better the educational achievement. The may be due to the latter born children usually receive more family resources as the family income becomes more stable at the

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[17] See, for example, Chin and Newman (2002) and McLanahan and Sandefur (1994) for the discussion of working mother's negative effects on children's educational achievement.

[18] See, for example, Elliott and Rechirds 91991), Mclanahan and Sandefur (1994), Haveman and Wolfe (1995), and Ermisch and Francesconi (2001).

[19] Gregg and Machin (1998) also find that after controlling for family financial constraints the effect of single family variable becomes insignificant.

[20] For the sibling effect we also consider both the order and number of siblings, the estimated results show that children whose have older sisters tend to receive more education and those who have younger sisters or brothers tend to have less education. The main reason is that in Taiwan's early economy due to family budget constraints, older sisters, especially first born girls, usually sacrificed their education or marriage to go to work early and married later to support the family and save resources for the education of their younger sisters or brothers. Parish and Wills (1993) also find similar results.

later stage of their parents' career.

After controlling for family background, the estimated coefficients of dummy variables gender, region, and ethnicity are all positive and significant. Significant educational divergence exists between gender, region, and ethnic groups. On average, women had 1.30 years less than men; rural areas had 0.53 years less than urban areas; and Taiwanese had 0.61 year less than mainland Chinese. This implies that Taiwanese females who live in rural area are the least educated group. It is obvious that children lived in rural areas receive less education because of the lack of educational resources. Due to their experience of fleeing from the civil war in China, mainland Chinese values more on human capital, which is moveable, than physical capital; whereas Taiwan is a traditional agriculture-oriented economy where education is not so important for a family and thus Taiwanese tends to underestimate in education.[21] Affected by deep-rooted traditional family thinking that prefer male than female, hence females tend to be discriminated and underinvested in their education.

As the larger environment changes over time, children born at different times may have different educational achievements. The cohort dummies, proxies for the change of macro environment over time are positive, i.e., the more recently born the student, the higher their educational level. Compared to the older population, middle-aged people had an additional 2.28 years of education while young people had nearly 3.56 years more.

As some of family background variables may also contain resources effect, such as family socioeconomic status (parents' education and occupations), column 2 in Table 5 further includes variables family educational resources to single out the likely resources effect. The estimated coefficients for after-school talent or skill training and remedial or supplementary education are positive and significant. Attending talent or skill training shows a gain of 1.21 years on educational achievement, implying that talent training will enhance academic ability. Having after-school remedial or supplementary education will add an additional 1.44 years of education, implying that supplementary after-school education is very useful under the examination-oriented

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[21] Besides the army of the Nationalist retreated from China to Taiwan in 1949, majority of mainland Chinese immigrant in Taiwan are either intellectuals or businessmen.

educational system in Taiwan.[22]   Attending talent training and/or supplementary education may also signal that those children are more likely from wealthy families which tend to offer better resources and environments for academic development.

Personal character and motivation important factor driving individual's educational achievement.   According to human capital theory, other thing being equal, more able people should receive more education.   Therefore, the lack of controlling for personal characteristics may bias the estimated coefficients of family background upwards.   Column 3 in Table 5 further includes variables of personal characteristics.   The results show that having a part-time job or receiving scholarships or awards during the period of study had a positive and significant effect on educational achievement.   This result, as we expected, implies that people of more independent character or more capable people tend to have higher levels of education.   Variables of filial duty and glorifying one's family have a significant negative effect, implying that traditional values of family may actually be harmful for individual educational achievement.   Theoretically, traditional family values may be a driving force to push descendants to work hard and pursue a higher educational level, as having a high level of education is the most important channel to win one fame and wealth in traditional Chinese society.   However, obedience to traditional family values also implies a dependent character willing to sacrifice personal individuality and self-interest, which may jeopardize an individual's pursuit of higher education.   The results seem to support the latter especially holding family's socioeconomic status constant.

As the response for educational investment by gender may be different, we further divide the sample in to male and female subsamples and run the regressions respectively.   The results are shown in Columns 4 and 5 of Table 5.   The gender effects of family background, family educational resources, and personal characteristics on educational achievement are all significant and share same sign for the coefficients but they differ in magnitude.   On personal characteristics, female has a greater effect of gaining academic performance and having part-time job on

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[22] The effectiveness of cram schools (Busiban) for supplementary education is apparent in Taiwan as the number of cram schools had increased from 3772 in 1992 to 16012 in 2006.

educational achievement.[23]   Family educational resources also have stronger effect for female. As traditional values favor educational investment in male, shifting additional resources to female is likely to have greater effect as the marginal return is higher for female than for male.   As for family background, parents' education have significant positive effect on both son and daughter. However, father's education has a larger effect on son, while mother's education has a larger effect on daughter.   These results are consistent with the theory of observational learning that parents can be role models for their children.[24]   Furthermore, father's occupation has a stronger effect on daughter than on son, whereas, father worked in public sector has a stronger effect on son than on daughter.   Working mother has a significant negative effect on both son and daughter's educational achievement; however, the negative effect is greater on daughter than on son.

As for siblings effect, the number of siblings has a negative effect for both male and female, however, the effect is greater for female than for male.   The birth order effect is positive but significant for male and insignificant for female.   The latter born son tends to receive more education.   Other thing equal, educational gap between ethnic groups is greater for male than for female, while educational gap between rural and urban areas is greater for female than for male.

The results from Table 5 suggest that family background has an important effect on individual's educational achievement; however, without controlling for family educational resources and personal characteristics, the estimated effects of family background are likely bias upwards.   The overall explanatory power for family background, family educational resources, and personal characteristics are 82.1%, 6.99%, and 10.81%, respectively.

Table 5. Regression results for educational achievement

Dependent Variables	Whole sample	Whole sample	Whole sample	Male	Female
Personal Characteristics					
Part-time job			1.199***	0.921***	1.370***

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[23] Dynarski (2005), Angrist and Levy (2002), and Angrist, Lang, and Oreopoulos (2006) all find that female has a greater response and thus a significant effect to academic scholarship or educational subsidies schemes on school performance.

[24] See, for example, Bandura (1977).   Using household survey data from Mozambique, Heltberg and Johammesen (2002) also find similar result that mothers' schooling has a stronger effect on girls' education and fathers' schooling has a larger impact on the education of boys.

	(1)	(2)	(3)	(4)	(5)
			(0.115)	(0.160)	(0.165)
Scholarship for academic performance			2.164***	1.983***	2.258***
			(0.154)	(0.223)	(0.210)
Scholarship for poor family			1.824***	2.207***	1.299***
			(0.357)	(0.521)	(0.483)
Filial duty			-0.213***	-0.158***	-0.244***
			(0.044)	(0.061)	(0.062)
Glory for the family			-0.089**	-0.070	-0.083
			(0.044)	(0.063)	(0.061)
Family educational resources					
Talent training		1.210***	0.875***	0.584**	0.910***
		(0.162)	(0.155)	(0.238)	(0.202)
Supplementary education		1.439***	1.300***	1.271***	1.332***
		(0.132)	(0.126)	(0.169)	(0.185)
Rewards for academic performance		1.236***	1.203***	0.842***	1.355***
		(0.217)	(0.206)	(0.306)	(0.276)
Family transfer		-0.111	-0.116	-0.035	-0.132
		(0.240)	(0.227)	(0.310)	(0.328)
Family background					
Father's education	0.236***	0.202***	0.176***	0.183***	0.163***
	(0.017)	(0.017)	(0.016)	(0.023)	(0.021)
Mother's education	0.159***	0.122***	0.115***	0.093***	0.145***
	(0.020)	(0.019)	(0.018)	(0.026)	(0.025)
Father's occupation professionals	0.637**	0.384	0.355	-0.144	0.951**
	(0.304)	(0.295)	(0.281)	(0.400)	(0.389)
Administrators and executives	2.117***	1.873***	1.864***	1.732***	2.058***
	(0.271)	(0.263)	(0.250)	(0.346)	(0.356)
Clerks	0.955***	0.802***	0.936***	0.664*	1.306***
	(0.282)	(0.273)	(0.259)	(0.372)	(0.356)
Sales workers	1.630***	1.416***	1.446***	1.239***	1.628***
	(0.182)	(0.177)	(0.168)	(0.242)	(0.230)
Service workers	0.579**	0.542**	0.479**	-0.170	1.026***
	(0.276)	(0.268)	(0.254)	(0.370)	(0.344)
Production operators and laborers	0.847***	0.772***	0.705***	0.506**	0.886***
	(0.155)	(0.150)	(0.142)	(0.203)	(0.196)
Father in public sector	0.596***	0.566***	0.485***	0.920***	0.079
	(0.196)	(0.190)	(0.180)	(0.255)	(0.252)
Mother at work	-0.258**	-0.242**	-0.225**	-0.171**	-0.279***
	(0.106)	(0.105)	(0.105)	(0.085)	(0.144)
Single family	-0.154	-0.123	-0.104	-0.275	-0.089
	(0.184)	(0.155)	(0.168)	(0.242)	(0.263)
Siblings structure					
Number of siblings	-0.136***	-0.109***	-0.110***	-0.094**	-0.119***
	(0.034)	(0.033)	(0.032)	(0.049)	(0.041)
Birth order	0.217***	0.142**	0.163**	0.182**	0.121
	(0.083)	(0.080)	(0.076)	(0.08)	(0.111)
Birth order^2	-0.007***	-0.001	-0.000	-0.006	-0.009
	(0.000)	(0.000)	(0.000)	(0.011)	(0.013)
Gender	-1.297***	-1.341***	-1.338***		
	(0.107)	(0.104)	(0.099)		
Ethnicity	-0.609***	-0.511***	-0.494***	-0.580**	-0.430
	(0.219)	(0.212)	(0.201)	(0.291)	(0.274)
Region	-0.529***	-0.402***	-0.372***	-0.034	-0.643***
	(0.116)	(0.113)	(0.107)	(0.155)	(0.146)
Cohort					
Middle-age	2.275***	2.140***	1.870***	1.409***	2.238***
	(0.137)	(0.133)	(0.127)	(0.188)	(0.170)
Young	3.558***	3.441***	2.828***	2.184***	3.486***
	(0.158)	(0.154)	(0.151)	(0.215)	(0.210)
Constant	7.254***	6.870***	7.754***	8.017***	6.135***
	(0.330)	(0.321)	(0.363)	(0.523)	(0.491)
Observations	3585	3575	3570	1725	1845
Adj-F²	0.5277	0.5584	0.6033	0.5003	0.6626
F value	236.54	215.79	209.75	70.03	145.87
Explanatory power					

Personal factors		*10.81%*	*8.53%*	*11.71%*
Family educational resources	*6.99%*	*6.99%*	*4.37%*	*9.25%*
Other family background factor	*93.01%*	*82.10%*	*87.10%*	*79.04%*

Notes: Figures in the parenthesis are standard deviation. *, **, and *** stand for statistical significant level at 10%, 5%, and 1%, respectively.

Sensitivity analysis

In order to test for the robustness of estimation results for educational achievement, a sensitivity analysis is further conducted. We first consider the non-linearity effect of parents' education by adding a square term for parents' education. Column 1 of Table 6 shows that parents' education remains a positive and significant effect and its square terms are negative but significant for father and insignificant for mother. This implies that the effect of father's education is not constant but diminishing. Using parents' educational level instead of years of schooling, the results show that then higher the parents' educational level, the great the effect on children's educational achievement.[25]

For siblings' effect, in order to further examine the siblings structure and gender preference, we use dummies variables as well as the number for order brother, younger brother, old sister, and younger sister, the result shows that having older sister has a significant positive effect. Adding extra older sister will increase educational achievement by 0.12 years. This is consistent with the find of Parish and Wills (1993) that at early stage of Taiwan's economic development under limited family budget constraint early born females usually sacrifice their education and marriage by working early and postponing marriage to earn money to support their family and their younger brothers or sisters' education. Having old brother has a positive but insignificant effect, implying the preference for male (especially elder son) than female in traditional Chinese society.

In order to actually reflect the socioeconomic status we further expand father's occupations from one-digit seven classifications to two-digit seventy-six classifications. The results are shown

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[25] Using data from the Polish Labour Force Survey (PLFS) from 1992 to 2000, Beblo and Lauer (2002) also find similar result for Poland.

in column 2 of Table 6.　As the sample covers age from 30 to 62 years old, the macro environment may change drastically we thus use birth year dummies to replace cohort dummies, the results are shown in column 3 of Table 6.　Comparing columns 2 and 3 to column 1 in Table 6, we find that both the sign and significant level of the relevant explanatory variables are similar.[26]

　　　The sensitivity analysis strongly support that family background, family educational resources, and personal characteristics are important factors determining individuals' educational achievement and excluding family educational resources and personal characteristics will overestimate the effects of family background.

Table 6. Sensitivity analysis

Variable name	Bench mark model	Father's occupation by 2-digit classifications	Birth year dummy
Father's years of education	0.364***	0.354***	0.332***
	(0.029)	(0.029)	(0.029)
Father's years of education^2	-0.014***	-0.014***	-0.013***
	(0.002)	(0.002)	(0.002)
Mother's years of education	0.145***	0.137***	0.134***
	(0.038)	(0.038)	(0.038)
Mother's years of education^2	-0.003	-0.003	-0.003
	(0.004)	(0.004)	(0.003)
Father's educational level			
Primary	1.689***	1.637***	1.526***
	(0.135)	(0.136)	(0.135)
Junior high	2.118***	2.006***	1.967***
	(0.213)	(0.215)	(0.212)
Senior high	2.127***	2.013***	1.877***
	(0.237)	(0.243)	(0.236)
College	2.364***	2.272***	2.183***
	(0.427)	(0.441)	(0.424)
University and above	1.863***	1.698***	1.750***
	(0.350)	(0.363)	(0.348)
Mother's educational level			
Primary	0.788***	0.745***	0.715***
	(0.136)	(0.137)	(0.135)
Junior high	0.891***	0.810***	0.884***
	(0.258)	(0.262)	(0.257)
Senior high	1.396***	1.358***	1.228***
	(0.309)	(0.313)	(0.309)
College	1.241**	1.039	1.040
	(0.654)	(0.665)	(0.651)
University and above	2.032***	1.914***	1.753***
	(0.711)	(0.717)	(0.706)
Number of siblings	-0.049	-0.049	-0.045
	(0.031)	(0.031)	(0.031)
Older brother (Yes=1)	0.109	0.104	0.094
	(0.114)	(0.114)	(0.113)
Younger brother (Yes=1)	0.000	-0.006	-0.001
	(0.117)	(0.117)	(0.116)
Older sister (Yes=1)	0.424***	0.420***	0.358***
	(0.113)	(0.114)	(0.112)
Younger sister (Yes=1)	-0.107	-0.092	-0.100

[26] The results of other variables such as family background, family educational resources, and personal characteristics are similar too and thus do not being presented in Table 6.　They are available upon request from authors.

	(0.114)	(0.115)	(0.113)
Number of older brother	-0.021	-0.013	-0.027
	(0.045)**	(0.045)**	(0.045)**
Number of younger brother	-0.105**	-0.096**	-0.098**
	(0.048)***	(0.048)***	(0.047)**
Number of older sister	0.120***	0.110***	0.102**
	(0.042)***	(0.042)***	(0.041)**
Number of younger sister	-0.126***	-0.128***	-0.109**
	(0.043)	(0.043)	(0.043)

Note: See Table 5.

Evaluation of the Nine-year Compulsory Education Policy

From Table 6, after controlling for family background, family educational resources, and personal characteristics, significant educational gap still exists between gender, region, and ethnicity. What are the likely effect of the Nine-year Compulsory education policy implemented in 1968 on educational achievement between gender, region, and ethnicity?   Table 7 presents the results for the policy evaluation of the Nine-year Compulsory Education by holding various family background variables and personal characteristics constant.   As in Table 6, the estimated coefficients of all the personal characteristics and family background variables show similar results and significant levels.[27]   Other thing being equal, model (1) shows that the effect of the policy is positive and significant by increasing additional 0.75 years of education.   As the implementation of the Nine-year Compulsory Education requires children of the right age to attend primary and junior high school, between 1967 and 1970 Taiwanese government had constructed a large amount of new junior high school.   At the period, the number of junior high school increases by 70%.   In order to take policy intensity into account, we further use the number of junior high school to replace the policy dummy in model (1') and the estimated policy effect remains positive and

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[27] To save space, the results for family background and persona characteristics variables do not report here, however, it is available upon request to the authors.

significant.

Models (2), (3), and (4) estimate the policy effects of the Nine-year Compulsory Education on educational achievement between gender, region, and ethnicity, respectively.   From Model (2), the estimated effects of the compulsory education policy on gender is positive and significant.   Before the compulsory education policy, the educational gap between women and men is 1.913 years; after the compulsory education policy, it drops to 0.611 years, implying that compulsory education reduces the gender gap in education by 67.54%.   Model (3) shows that the effect of the compulsory education policy on rural and urban areas is also positive and significant, implying the policy reduces the education gap between rural and urban areas.   Before the policy, rural areas had 0.772 years less education than urban areas; after the policy, rural areas rose to 0.159 years more education than urban areas.   The compulsory education policy seems to have closed the educational gap between rural and urban areas.   The effect of the policy on ethnicity in Model (4) is also positive and significant, implying that the compulsory education policy improves the education gap between ethnic groups.   Before the policy, Taiwanese had 1.695 years less education than mainland Chinese; after the policy, Taiwanese had actually 0.248 years more education than mainland Chinese, completely closing the gap.   In sum, the compulsory education policy has virtually closed the education gap in urban vs. rural areas and ethnicity, and significantly reduced the education gap in gender.

Considering the possible interactions between gender, region, and ethnicity which may generate biases for the factors in models (2) to (4) and allowing for the multiple comparisons the

different policy effects on gender, region, and ethnicity, we further run the regressions as in Model

(5).

Table 7. Evaluation of Nine-year Compulsory Education Policy

	(1)	(1')	(2)	(3)	(4)	(5)
Gender	-1.337***	-1.336***	-1.913***	-1.318***	-1.343***	-0.782
	(0.099)	(0.099)	(0.132)	(0.099)	(0.099)	(0.606)
Region	-0.371***	-0.373***	-0.351***	-0.772***	-0.387***	-1.325
	(0.107)	(0.107)	(0.106)	(0.137)	(0.107)	(1.249)
Ethnicity	-0.471***	-0.473***	-0.484***	-0.516***	-1.695***	-1.399***
	(0.200)	(0.200)	(0.199)	(0.200)	(0.304)	(0.477)
Policy	0.747***	0.001***	0.074	0.329	-0.961***	-1.169**
	(0.188)	(0.000)	(0.213)	(0.208)	(0.371)	(0.559)
Policy*Gender			1.292***			0.036
			(0.196)			(0.749)
Policy*region				0.931***		1.075
				(0.199)		(1.498)
Policy*Ethnicity					1.943***	1.211**
					(0.365)	(0.5830
Gender*region						-0.391
						(1.522)
Gender*Ethnicity						-0.639
						(0.637)
Region*Ethnicity						1.225
						(1.264)
Policy*Gender*Region						-0.513
						(2.029)
Policy*Gender*Ethnicity						1.053
						(0.800)
Policy*Region*Ethnicity						-0.607
						(1.525)
Gender*Region*Ethnicity						-0.645
						(1.545)
Policy*Gender*Region* Ethnicity						1.007
						(2.071)

Notes: All the regressions include personal characteristics, family educational resources, and family background variables as in Table 5.   Figures in the parenthesis are standard deviation. *, **, and *** stand for statistical significant level at 10%, 5%, and 1%, respectively.   Except model (1') where policy variable is the number of junior high school, all other models use policy dummies variable.

From Model (5), after controlling for the interactions between gender, region, and ethnicity, all the estimated coefficients of the relevant terms are insignificant except for variables of ethnicity, policy dummy, and policy*ethnicity.   These results implies that the policy effect on gender and region turns out to be insignificant and the only policy effect remained is on ethnicity.   In other words, the policy effect of Nine-year Compulsory Education is mainly on improving the educational gap between Taiwanese and mainland Chinese, the estimated effect is the increase Taiwanese by 1.21-1.94 years of education.

Comparing the results in Model (5) to Models (2), (3), and (4), we find that the compulsory education policy helps to reduce the educational gap of gender and region indirectly through

reducing the educational gap upon ethnic groups.

V. Concluding Remarks

Using data from Taiwan's Panel Study of Family Dynamics, this paper investigates the effect of personal characteristics and family background factors on educational achievement and evaluates the Nine-year Compulsory Education policy implemented in 1968.   We find that personal characteristics and family background are important factors that affect an individual's educational achievement.

People with part-time jobs or receiving scholarships during their school years tend to receive more education, while people rooted in the traditional values of filial duty and family glory are inclined to receive less education.   This result may imply that people with a more independent or self-motivated personal character and more able people have an advantage in educational achievement.   Parents' education has a significant and positive effect on their children's educational achievements and the effect of the father's education is greater than that of mother's. The effect of the father's occupation is also significant.   A father who works as an administrator or executive has the highest effect on his children's educational achievements and the effect is also higher if one's father works in the public sector rather than in the private sector.   Working mother has an adverse effect on children education achievement as the mother spends fewer hours in child-raising and nurturing due to time constraint.   Talent training, after-school supplementary education, and parents' reward for academic performance also leads to greater educational achievements.

The results of family background factors suggest that family financial constraints influence children's education and more wealthy families usually provide more resources and a better study environment for their children, and hence children from wealthy family have better opportunities to gain higher education.   Furthermore, the effects of the number of siblings and birth order are positive and significant.   Constraints on the family budget show older siblings (especially girls) tend to sacrifice themselves to gain less education and go to work early to support the family and

the educational development of their younger siblings.   As the economy developed, we also find that, other factors being equal, younger people have received more education than older people. Other things equal, significant educational gap remains between gender, region, and ethnicity.

As for the evaluation of the Nine-year Compulsory Education policy implemented in 1968, after controlling for personal characteristics and family background, we find that the implementation of Nine-year Compulsory Education policy has significantly closed the education gap between genders, regions, and ethnic groups, respectively.   However, careful examination of multiple comparisons by allowing interactions between different groups shows that the effect of the Nine-year Compulsory Education policy has mainly been to close the educational gap between Taiwanese and mainland Chinese.   Most mainland Chinese are political refugees who followed the retreat of the KMT government from China to Taiwan during the civil war.   Therefore, they pay more attention to and value "human capital", which is embodied in people and can be easily transported in times of political turmoil.   This helps explain why mainland Chinese immigrants had higher overall educational achievements than native Taiwanese, who stressed agricultural production rather than education, especially during the early stages of development when Taiwan's economy was focused upon agriculture.

The data show that before the Nine-year Compulsory Education Policy was implemented, the education gap between mainland Chinese and Taiwanese was 5.1 years, following by gender (4.44 years) and region (2.13 years) (see Table 4).   As the Nine-year Compulsory Education Policy is a country-wide policy and did not target any specific group, children at age six must enroll in the primary school and enter junior high school right after they graduate from primary school.   Thus, the main effect of the Nine-year Compulsory Education Policy has been upon ethnicity, an identity which cannot be changed by external factors.   In contrast, the education gap between gender and region may be affected by the larger environment.   For example, economic development accompanied by an increase in income and a decline in the fertility rate will effectively close the educational gap between both gender and rural and urban areas.   These may explain why the effect of Nine-year Compulsory Education policy on gender and region's educational achievement is

relatively limited.

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