出國報告：（出國類別：會議、考察）

第 14 屆歐洲不動產年會暨研討會—歐洲都市步行環境整建之考察

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出國期間：2007/06/25~2007/07/13
報告日期：2006/10/08

摘要

第 14 屆歐洲不動產學會國際研討會於 2007.6.27～2007.6.30 於英國倫敦舉辦，本人此次亦親自參與該研討會並發表論文，與世界各國之研究者交換關於「通勤者出發時刻選擇之研究」與「住宅租買選擇之研究」的研究心得。同時，也順道至歐洲諸國之都市(包括英國倫敦、葡萄牙里斯本、西班牙馬德里及巴塞隆納、義大利羅馬等)考察市中心商業區活化與整建之現況，特別是將考察重點置於步行環境整建，蒐集相關之書面及研究資料，此將有助於台灣相關規劃單位在交通場站聯合開發與舊市區更新之規劃參考。

關鍵詞：通勤者、出發時刻選擇、住宅類型選擇、步行環境

Abstract

I had participated in the 14th ERES International Conference held in London during 2007.06.27～2007.06.30; had presented the research, and had interchanged the research ideas about the study of commuters' departure time choice and the study of housing tenure choice with scholars from every nation. Meanwhile, I had been to several cities of different countries in Europe (including London, U.K., Lisbon, Portugal, Madrid & Barcelona, Spain, Roma, Italy) to inspect the present condition of CBD’s regeneration and construction. We put emphasis on the construction of walking environment and the collection of related documents and research data. What we do will be referable for joint development of transit nodes and redevelopment of old city center.

Key words : commuter, departure time choice, housing tenure choice, walking environment

目次

一、目的

本人此次出國之目的係爲參加第 14 屆歐洲不動產學會國際研討會，並於研討會舉辦期間發表論文，與世界各國之研究者交換關於「通勤者出發時刻選擇之研究」與「住宅租買選擇之研究」的研究心得。同時，也順道至歐洲諸國之都市(包括英國倫敦、葡萄牙里斯本、西班牙馬德里及巴塞隆納、義大利羅馬等)考察市中心商業區活化與整建之現況，特別是將考察重點置於步行環境整建，蒐集相關之書面及研究資料，此將有助於台灣相關規劃單位在交通場站聯合開發與舊市區更新之規劃參考。

二、參加會議經過

第 14 屆歐洲不動產學會國際研討會(14th European Real Estate Society Conference)，於 2007 年 6 月 27 日到 6 月 30 日在英國倫敦舉行。本研討會是有關不動產開發、管理、都市經濟與公共政策等相關議題的研討會，議題與內容十分多樣、具體、踏實，同時亦有許多來自全世界各國的學者共襄盛舉。藉由參與「2007 歐洲不動產學會研討會(2007 European Real Estate Society annual Conference)」的機會，讓本人認識了許多世界各國的學者與業者。整個會議不管是在議程或內容的安排上，都充分地展現主辦單位的熱情與巧思。會議的舉辦地點在倫敦的 Cass business school，從第一天的登記開始，該校之接待人員以親切的招呼及詳盡的說明，來協助解決交通與相關事宜，讓我們很快地熟悉當地的情況，而減少摸索的時間。

本次大會第一天（6/27）安排了專業場次討論會，提供各方彼此學習與歷練之機會。6 月 28 到 30 日共 3 天的密集會議行程，共計 10 個大場次，每一大場次又分爲 6 至 8 個小場次供論文發表，各篇文章之內容均十分具有創見。同時，每天的中午午餐時間，也都安排 Key note address，演講者所講述之內容均十分具有前瞻性。

6 月 28 日上午 10:30 研討會場次正式展開，同時在 9 處不同場地進行論文發表與討論，由於本人此日在「Housing Tenure Choice」場次中發表「The Preliminary Study of the Relationship between Tenure Choice and Dwelling Type」一文，故須完整參與該場次之發

表與討論。該場次包含本人所發表的文章共有三篇，分別爲：Steven Bourassa & Martin Hoesli，其發表的文章爲「Why do Swiss rent ?」；另一篇則爲 Christian Hilber 所發表之「Why Are Homeownership Rates So Different Across Europe?」。此兩篇所關注的議題皆爲「住宅自有率」的問題，作者們嘗試用不同的方法來解釋，究竟何項因素會對人們之住宅自有率造成影響。

在 Bourassa & Hoesli 的文章裡指出，瑞士係爲西歐國家中住宅自有率最低的國家，其住宅自有率僅 34%。爲瞭解瑞士的住宅自有率爲何偏低，此研究便嘗試利用 1998 的瑞士家戶調查資料來進行探討。該研究之結論指出，相對於租屋成本及家戶收入、財富而言，過高的房屋價格是造成瑞士住宅自有率低落現象的原因。

而在 Hilber 的研究裡，則是著眼於「住宅自有率」的國際比較問題，其研究目的係在於探討爲何歐洲各國的「住宅自有率」會有如此大的差異。其研究指出，南歐國家、英國及愛爾蘭等地的住宅自有率均較高；而阿爾卑斯山週邊的國家，其住宅自有率則相對較低。該研究發現，「housing type(住宅形式)」及「課稅政策的差異」是造成不同國家(地區)有不同住宅自有率的主要原因。

而在本人以台南市所做的實證研究中發現(見附件一)，台南市的「住宅自有率」高達 89.7%，較歐洲諸國之情況要高出許多，此情況也讓歐洲諸學者感到興趣。除了房價、優惠房貸、收入等因素之外，更重要的原因可能爲：在國人「有土斯有財」之傳統觀念的影響下，「買房子」不僅是代表「住」與「投資」之意，更是證明一個家庭是否持有恆產的表現。而這一點，也是國際比較中所須特別注意的「文化差異」。

綜合上述三篇研究之特色，在此將研討心得簡述如下：

(1)除了本人之外，另外兩篇文章亦都以「住宅自有率」做爲探討對象，顯示該議題有其重要性。利用計量經濟模式(Bourassa & Hoesli 利用羅吉特模式進行分析；而 Hilber 則利用 log-logistic 模式來進行分析)來分析「住宅自有率」問題時，在求得模式變數的係數之後，便可將預先設定之政策內容代入模式之中，藉由觀察「住宅自有率」變化的狀態，來決定何種政策較爲適當。

(2)在歐洲地區的實證研究發現，房屋價格、住宅形式、課稅制度均爲顯著影響住宅

自有率的重要變數。未來在台灣進行類似研究時，可考慮將此變數納入考量。

(3)在進行住宅自有率的國際比較時，除了對可觀察的變數(如課稅制度、個人收入、當地房價)進行分析比較之外，亦須針對那些會影響住宅自有率之傳統文化、習俗等脈絡因素(context)進行探討。

6 月 29 日一整天眾多場次同步進行，本人參與了「Applied Housing Market Analysis」、「Methodological Issues in Valuation」、「Housing Policy」、「Housing and Land Use Models」等主題場次。同時，在「Housing policy」的場次中，本人也發表了「The preliminary study of effects of flexible time system on commuting time choice and scheduling evaluation：Study on Commuting Departure Time Choice and Expected Work-Starting Time of Commuters」一文；在短短 15 分鐘發表時間內，針對台南地區通勤者之時間運用行爲進行說明。雖然本研究被分類在「housing policy」的場次，但在實質上本研究較屬於 TDM 應用的範疇。在發表結束之後，一位英國的都市計劃學者則以倫敦之 Road Pricing 爲例，並提出爲何台南市不利用 Road Pricing 來做爲 TDM 策略。雖然 Road Pricing 對於抑制小汽車進入市中心有顯著的效果，但對於台南市而言，Road pricing 卻有其難以適用之處，其原因說明如下：(1)台南市之市中心範圍難以界定。由於台南市的土地使用方式屬於混合使用，較無一明顯的市中心存在，在設定市中心的收費範圍時，有其困難性存在。(2)缺乏適當的公共運具。Road Pricing 的本意在於促使小汽車使用者轉而使用公共運具或其它運具(如自行車或步行)，然而在現今台南市缺乏良好公共運輸系統做配合的情況之下，勢將難以推動此措施。相較之下，本研究提出之分散尖峰時刻之彈性上班制度，不須設定收費範圍，通勤者亦無需改變所使用的運具，故短期裡可能較具效果。會中所發表的文章可詳見附件二。

6 月 30 日只有將近半日的議程，但由於尚有後續之考察行程，故於上午便離開了倫敦。自 6 月 30 日起至 7 月 12 日則是前往葡萄牙里斯本、西班牙馬德里及巴塞隆納、義大利羅馬等都市進行考察。7 月 13 日返回台灣。

三、與會心得

本次研討會主題設定於：(1)不動產投資與財務。(2)財產投資組合管理。(3)市場分析與預測。(4)公司不動產發展與管理。(5)國際不動產市場。(6)不動產服務業市場。(7)不動產開發。(8)都市經濟與不動產。(9)都市政策與不動產。(10)不動產教育。(11)不動產證券化。(12)新經濟與不動產。(13)住宅經濟。主題豐富且多元，讓諸位參加者受益良多。

本人利用本次機會，親身參與多場論文發表會，並與發表人針對不動產與都市計畫等議題進行討論。在討論的過程中，由於與會學者之背景皆不相同，藉由不同觀點的激盪，亦產生許多新的研究方向。特別是，若欲進行某主題之國際比較時，參與國際研討會是必要的。以此次的經驗可知，歐洲諸國和台灣在「住宅自有率」上有很大的差異，而此差異除了受到一些可觀測因素的影響之外，還受到一些脈絡因素的影響，若不是透過研討會上彼此面對面的討論，對那些不是生活在當地的人而言，是較難得知的。

除了論文的發表之外，藉由參與國際研討會更可認識許多不同領域之國外研究者，透過以文會友之方式，讓更多的國外研究者能知道並瞭解台灣目前的研究現況。若說參與國際研討會便可以促成國際研究合作，可能是過份地誇大，但基本上仍是讓研究國際化踏出了必要的第一步。至目前爲止，本人已持續多年參與歐洲不動產年會暨研討會，亦已與多位歐洲學者熟識，希望後續能再利用此項補助之機會參與此國際研討會，讓此關係更爲深化。

除了參與國際研討會之外，本人亦利用此次難得的機會前往歐洲諸著名的都市參觀，以實際體會並瞭解歐洲都市市中心規劃之現況。此次參觀之都市如下：①英國倫敦、②英國劍橋、③葡萄牙里斯本、④西班牙馬德里、⑤西班牙巴塞隆納、⑥義大利羅馬。由於重點在於瞭解都市內步行環境、交通運輸場站設施與市中心商業區之整建現況，以下將針對此次之考察心得做簡單之說明：

(1) 步行與其它運具的結合爲一重要的發展趨勢

利用「步行」來認識一個都市可說是最方便亦最深入的方式，然而，受限於體力或其它外在條件的限制，步行亦有其侷限之處。是故，如何將「步行」與其它交通運具做適當的結合，便成爲規劃者必須面對的課題。

以英國倫敦爲例，分佈綿密的地下鐵系統搭配公車系統，形成了一個便捷的交通網，人們可利用此一公共交通網路到達其所欲前往的地方。而爲了使公共交通更具吸引力，用於支援公共交通的事業有：①以整建道路做支援，②以整建節（結）點做支援，③以軟體對策做支援三種。其中①的內容有：公車專用道、彩色鋪裝、單軌電車、新交通系統基礎設施、LRT、與鐵路之連續立體交叉事業、道路交通順暢化事業等的整建工作。②的內容有：站前廣場、P＆R 之停車場、機慢車停車場、與公車站牌相關等設施的整建工作。③的內容有：公車站牌資訊、運行資訊、提供使用者積極利用公共交通的資訊等。而歷史古都羅馬「X 型」的地鐵路線，則是最令人感到不便的路線規劃方式；然而，此可能是爲了保護地下之歷史古蹟，所做出的權宜性規劃。同時，在進行轉乘的規劃時也應將運輸場站週邊環境的規劃納入考量，此即涉及聯合開發的議題。以西班牙馬德里的太陽門廣場之規劃爲例，太陽門廣場鄰近主廣場(Mayor Plaza)，其週邊亦設有徒步商業區，係爲馬德里觀光與商業的主要中心節點，捷運路線在此交會，讓來自四面八方的遊客能夠方便地抵達此處，也直接地促進此地區的發展(可見照片 1 與 2)。

照片 1　西班牙馬德里太陽門廣場

照片 2　西班牙馬德里太陽門廣場週邊的徒步商店街

(2) 徒步街區的規劃

徒步街區的設置不僅有利於地區商業的發展，同時亦有助於歷史古蹟的保存。在商業區裡設置徒步街區，藉由阻擋小汽車進入特定街區的方式，讓遊逛的消費者感到安心，不必擔心和小汽車爭奪空間使用權的問題。此外，徒步街區的規劃亦可增加消費者的遊逛時間，亦可能間接促使消費者在此消費較多的商品(如照片 3)。

照片 3　西班牙巴塞隆納 Rambla 大街之徒步街區

在羅馬，亦發現有部份歷史街區是禁止車輛進入，阻止了小汽車的進入，讓觀光客更能盡情地欣賞古蹟風光，此將可確保觀光客之旅遊品質。除此之外，小汽車行駛中所排放出的廢氣，內含多種化合物，在與空氣中之水氣結合之後，所形成的酸性液體對石材將造成傷害。雖說小汽車係屬於「移動性」之空污排放源，但其仍屬於都市內較主要之空污排放源，若能減少其對古蹟的直接危害，對於古蹟維護將有所助益。

(3) 自行車的重要性

此次參觀歐洲諸都市，亦發現有許多人使用自行車做爲日常通勤或觀光運具。舉例而言，在英國倫敦的地鐵車箱內，便發現設有自行車使用者的專屬車箱，供使用自行車通勤的上班者使用。西班牙的巴塞隆納則是爲觀光客規劃了自行車遊覽路線，配合自行車租借系統，形成新型的都市遊逛方式，此系統的優點在於：①利用預先購買的點數卡至自行車停放處租借自行車。②可採「甲地租車、乙地還車」的方式，租借較具彈性(照片 4 與 5)。

在自行車車道的規劃方面，有兩種主要的方式：①於步道空間上將行人與自行車做區分；②在原有的道路空間上區隔出自行車道，以供自行車利用。此二方式亦各有其優缺點，①的優點爲，自行者騎士可免於受到小汽車或公車之干擾，而能安心地行駛於人行道上；其缺點則爲，壓縮行人的步行空間、自行車與行人易生衝突。②的優點爲，自行車有其專屬的走行空間；缺點則爲，由於鄰接小汽車車道，若無適當的分隔設施，小汽車易侵入自行車道，造成自行車騎士的危險；同時，此規劃方式在空間的使用上亦較不具效率性。

在環保、健康、能源節約的口號聲中，自行車的重要性日益提升，如何確保自行車騎士之安全，並營造出一個令其它運具使用者亦能感到安心的交通環境，是未來必須努力的一個方向。

照片 4　西班牙巴塞隆納自行車租借系統

照片 5　西班牙巴塞隆納自行車租借系統

四、建議

(1)建議日後可增加經費申請之彈性額度，讓申請者更可因應各地不同物價及機票費用。

五、攜回資料名稱及內容

1. ERES 2007 Programme.

2. ERES 2007 Abstract of Papers.

3. 與會研究學者聯絡名冊。

附件一

A study on the relationship between tenure choice and dwelling type choice --Tainan City

Authors: Kan-Chung Huang, Kuang-Yih Yeh, Hao-Ching Hsia

ABSTRACT

Tenure choice and dwelling type choice are two important parts in decision process of housing demand, and both of them are probably connected. Most of studies focused on tenure choice and ignored the relationship between it and dwelling type. The other few studies still can't completely explain decision process and meaning of housing demand of households due to inadequate and restricted model. This study uses the data obtained from the Family Income and Expenditure Survey to conduct statistics and analysis on the tenure and dwelling types of the households in Tainan City, aiming to preliminarily understand the relations between tenure and relevant effect variables, the relations between dwelling type and relevant effect variables and the relations between tenure and dwelling type. In addition, the study tries to express the possibility of the nest structure for tenure and dwelling type with icons and discusses the effect and setting method of the factors that possibly affect the above two, thus laying a theoretical foundation for follow-up empirical studies.

Keywords：Tenure Choice, Dwelling Type Choice, Process of Decision

1. Introduction

In early period, most of the studies on housing demand explored the behaviors of housing consumers based on hedonic price function, for example: Rosen, (1974), Linneman (1980), Butler (1982) and Megbolugbe (1991). Hedonic price function implies housing price varies with housing attribute and isn't affected by household income and preference. Later on, scholars strongly questioned this concept and put forth models which cover household income, preference and characteristics. The most popular one is the model of logit form, while the pioneer is Quigley (1976). Quigley (1976) established a joint choice model of residential location and dwelling type in Pittsburgh. The followers, such as: Lerman(1977) and Anas (1982) devoted attention to the establishment of the joint choice model of travel or commute mode and residential location. In the same period, researchers on housing demand made diverse attempts. For instance, Borsch-Supan and Pitkin (1998) concentrated on the choice between nine housing alternatives and explored the role of demographic and financial variables. Fischer and Aufhauser (1988) integrated several elements of the institutionalised and regulated the nature of housing market in an analysis of the relationship between household type and housing choice. The study revealed the significant impacts of demographic and income-based variables on housing choice. Kim (1992) focused on the estimation of the choice behavior of dwelling units in the rental housing market. The results of the study show that transitory or permanent income, family size and level of education

have strong effects on the Korean rental housing choice.

Ahmad (1994) established a joint model of tenure choice and housing demand. The result indicates that income, age and education of household heads are the significant determinants for housing rental or purchase. Tu and Goldfinch (1996) developed a two-stage discrete choice model of private owner-occupied housing. They separated the choice process into the choice of a sectoral housing sub-market and the choice of an individual dwelling unit from the sub-market. It is revealed that the former is influenced by budget constraint, dwelling price, neighborhood and sectoral dwelling components, preference and household's socioeconomic background, while the latter is influenced by non-key dwelling components, such as type of kitchen, and with/without central heating or private garden.

In the same period, many studies on dwelling extended to investigation of the effects of the public sector on the choice behavior of households. Friedman (1981) calibrated an economic model to forecast households' choice among residential communities. The findings of the study indicate that residential choice is not significantly related to local public services and community characteristics. It is rather determined by the consumption of housing services, which contradicts the studies that adopt Tiebout hypothesis (Kain and Quigley, 1970; Pollakowski, 1974). Some studies in same vein also focused on taxes and government subsidy policies, Westerlund and Wyzan(1995) for instance.

All of the studies mentioned above employ the logit technique to establish models. However, the setting methods of logit models adopted are diverse: the probit model (Ahmad, 1994); the discrete choice model (Friedman, 1981; Kim, 1992; Tu and Goldfinch, 1996); the multinomial logit model (Westerlund and Wyzan, 1995); and nested multinomial logit model (Quigley, 1976; Lerman, 1977; Anas, 1982; Borsch-Supan and Pitkin; 1988; Fischer and Aufhauser, 1988).

The biggest limitation of the multinomial logit model is IIA (independence of the irrelevant alternatives) assumption which is widely questioned (Daly, 1987). Conversely, the nested multinomial logit model, of which theoretical foundation was established by McFadden (1973) is free from the IIA assumption. This property constitutes a major reason for wide application of nested logit. However, the nested logit multinomial model is inefficient in two aspects: firstly, information is omitted in the estimation of the based level; secondly, the amount of calculation needed to pass information between the initial and subsequent estimates is excessive.

Cho (1997) established a joint choice model of tenure and dwelling type. In the model, there are two types of housings: multiple dwelling and detached dwelling, so there are four alternatives, i.e.: owner-occupied detached dwelling, Rented detached dwelling, Owner-occupied multiple dwelling, and Rented multiple dwelling. The results of estimation of multinomial logit model indicates that housing choice is still affected by the age, education and occupation of household heads, dummy variables of preschool children, and housing

price to household income ratio. The model establishment process and topic determination of this article bear great resemblance with this study. The difference is that this article only considers multinomial alternative and fails to establish nest alternative, so it is impossible to know whether the joint choice of tenure and dwelling type is common choice, nest choice or mutually independent. Moreover, the model is calibrated with logistic regression. As a result, the information in reference alternative is virtually ignored.

The past empirical studies in relation to tenure choice mostly established models with logistic regression, while model calibration still adopted a method of defining an alternative as reference alternative and the rest as optional alternatives. The odds ratio of the average or dummy variables of household attribute to the tenure-related alternative is used to evaluate the effect of economic variables and variables of household attribute on the choice of tenure-related alternative. This study uses the concept of average value, but ignores the discrepancy of individual utilities. Therefore, if economic utility theory is used as analysis basis, its reasonableness will be obviously inferior to discrete choice model. In addition, when making tenure choice, households will give simultaneous consideration to dwelling type, thus forming a joint choice model of tenure and dwelling type (refer to detached dwelling or multiple dwelling). To ascertain whether tenure and dwelling type have the relation of simultaneous choice or nest choice, or whether they are mutually independent, the multinomial logit model and nested logit model in discrete choice model must be compared.
The scope of this study is Tainan City. Firstly, the study makes preliminary analysis on demographic statistic attribute, income and expenditure of households, tenure and dwelling type in Tainan City by using the data obtained from the Household Income and Expenditure Survey. Secondly, it discusses the contingency analysis of tenure, dwelling type and relevant variables. Lastly, it tries to preliminarily establish a joint choice model of tenure and dwelling type.

2. Study objects and scope

This study uses the data obtained from the Family Income and Expenditure Survey 2003 in Taiwan and households in Tainan City are selected as study objects. The Family Income and Expenditure Survey adopt stratified two-section random sampling. Counties and cities are sub-matrices, villages are first-section sampling units and the households in villages are second-section sampling units. 0.2% of the total households in Taiwan were sampled as sample households and amount to about 14,000. This survey program includes: 1. family composition; 2. overview of family equipment and dwellings; 3. income and expenditure; 4. consumption expenditure; 5. capital gain and loss as well as transferred income and expenditure. Field investigation was carried out in the second year of the survey. The survey on family income and expenditure provides information about households' income and expenditure, population attribute and lifecycle, tenure and dwelling type. Fig. 1 is the

administrative map of Tainan City. The city has 175.6456km^2 of land and 756,859 of population, lies in the southwestern corner of Taiwan and is the fourth largest city in Taiwan.

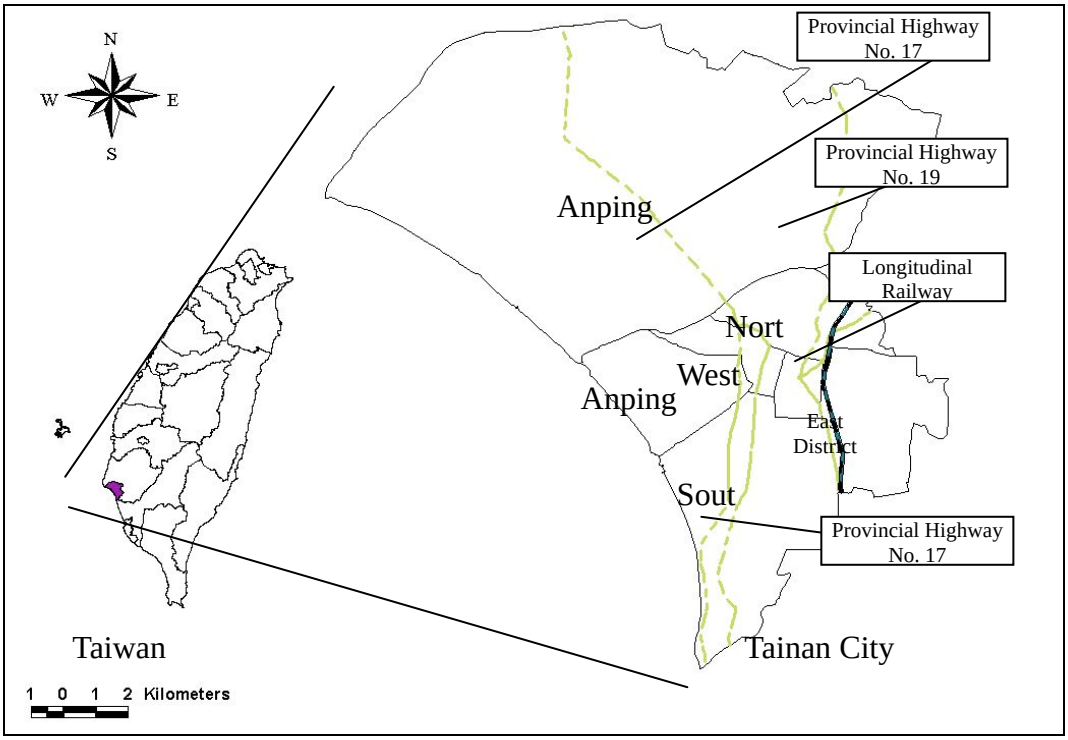

Fig. 1 Location relation and main traffic systems within the study scope

3. Basic statistical analysis of households

(1) Analysis on attribute of household population

Among the 508 interviewed households, 395 households are headed by male, accounting for 77.76% of the total; 113 households are headed by female, accounting for 22.24%, indicating paternity still dominates the households in Tainan City. The distribution is shown in Table 1.

Table 1 Sex of household heads

Sex	Qty	Percentage (%)
Male	395	77.76
Female	113	22.24
Sum	508	100.00

In terms of educational level, the household heads with an educational level of below junior high school are most, accounting for 40.77%, followed by those with an educational level of senior high school or vocational high school, accounting for 29.33%, those with an educational level of junior college or college, accounting for 28.74%, and those with an educational level of postgraduate, accounting for 2.17%. The sample distribution is shown in Table 2.

Table 2 Distribution of educational level

Educational level	Qty	Percentage (%)
Below junior high school	202	40.77
Senior or vocational high school	149	29.33
Junior college or college	146	28.74
Postgraduate	11	2.17
Total	508	100.00

In terms of marital status of household heads, the married household heads account for 71.85%, followed by the unmarried, accounting for 14.57%. The household heads with other marital statuses account for 13.58%. The sample distribution is shown in Table 3.

Table 3 Distribution of martial status

Marital status	Qty	Percentage (%)
Married	365	71.85
Unmarried	74	14.57
Divorced	28	5.51
Separated	8	1.57
Widowed	33	6.50
Sum	508	100

Table 4 is a table for age distribution of household heads. The highest age is 89 and the lowest is 21. Most of them are in 41~50 years old, accounting for 33.66%, followed by those aged 31~40 and 51~60, accounting for 23.03% and 20.08% respectively.

Table 4 Distribution of Age

Age	Qty	Percentage (%)
≤30	44	8.66
31-40	117	23.03
41-50	171	33.66
51-60	102	20.08
61-70	43	8.46
≥71	31	6.10
Sum	508	100.00

In terms of the quantity of preschool children, 84.65% of households have no child aged below 6 and 11.02% of households have only one child aged below 6. The distribution of the above data is shown in Table 5.

Table 5 Quantity of preschool children of a household

Qty of preschool children (aged below 6) of a household	Qty of households	Percentage (%)
0	430	84.65
1	56	11.02
2	22	4.33
Sum	508	100.00

Table 6 indicates the quantity of school-age children of a household. A majority of households don't have any school-age child aged 7~12, accounting for 76.97%; followed by households with one child aged 7~12, accounting for 16.34%; and households with two or more than two children aged 7~12, only accounting for 6.7%.

Table 6 Quantity of school-age children of a household

Qty of children of a household (aged 7~12)	Qty of households	Percentage (%)
0	391	76.97
1	83	16.34
2	33	6.50
3	1	0.20
Sum	508	100.00

(2)Household income and expenditure

Among the 508 households, the highest income is $0.347 million and the lowest is $900. From Fig. 2, it can be seen that the distribution of household income declines rightward, the predominant ratio is at $15,000 ~ 30,000.

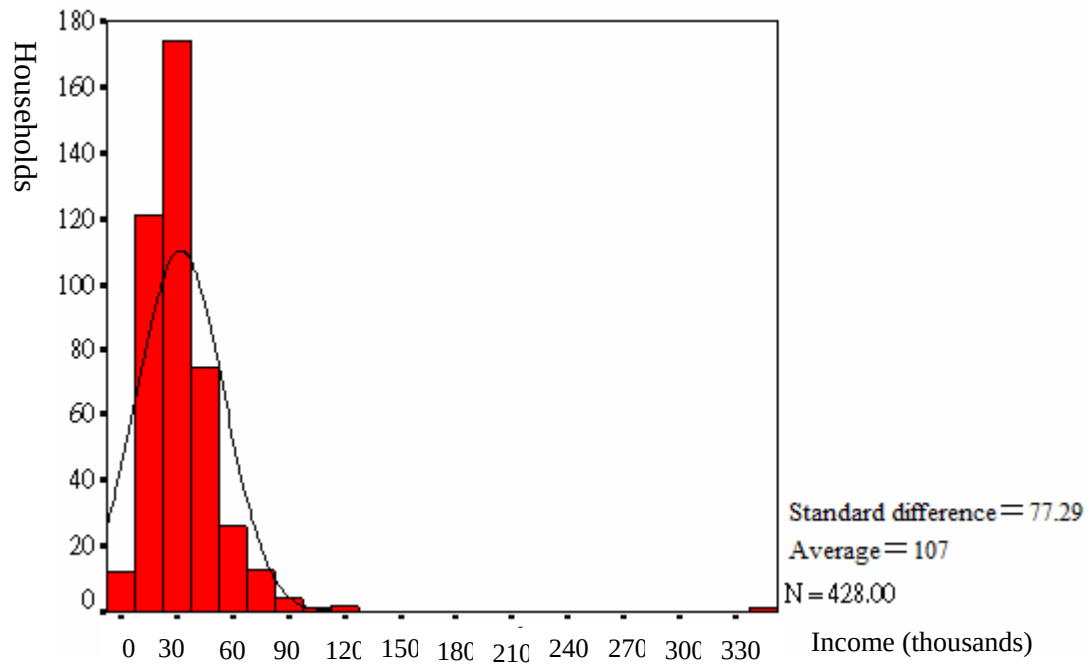

Fig. 2 Household income

Total current expenditure is the sum of total non-consumption expenditure and total consumption expenditure. The highest is $121,000 and the lowest is $3,000. From Fig. 3, it can be seen that the distribution of household expenditure declines rightward and is mainly concentrated on $12,000 ~ 30,000.

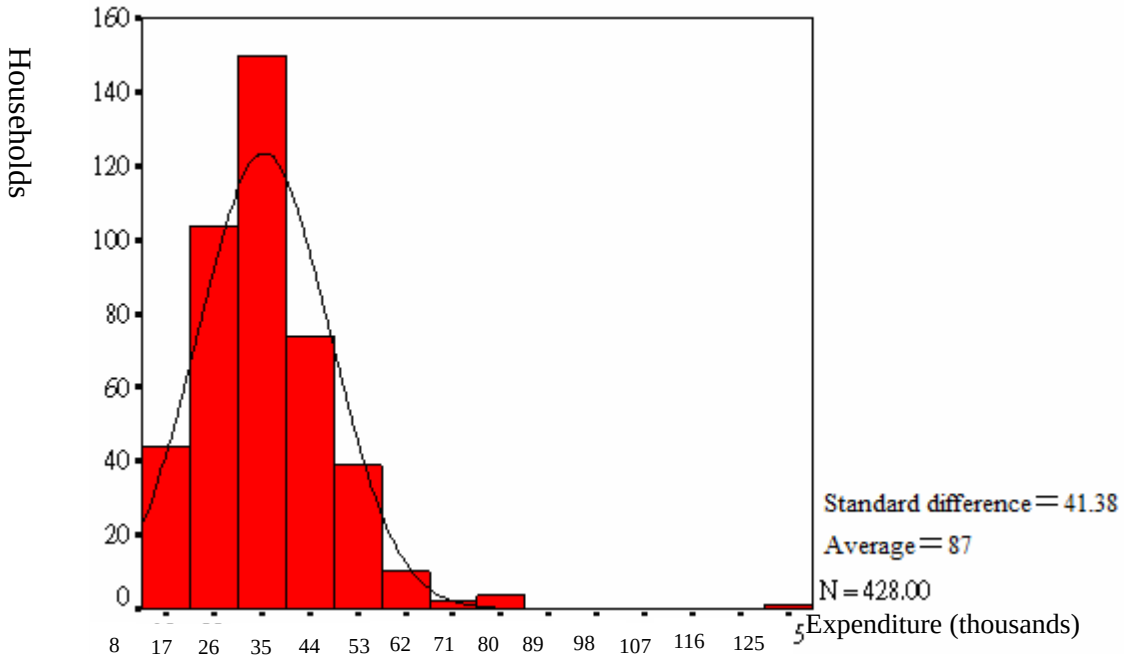

Fig. 3 Household's current expenditure

(3) Contingency analysis of household housing tenure, housing type and household attribute

Housing tenure is classified into: owner-occupied, rent, issued and others (including borrowed). This study only takes owner-occupied and rent into consideration. Therefore, 40

samples for “issued” and “other (including borrowed)” are deleted. Besides, in the classification of household head’s occupations, in order to enhance the effectiveness of relevant follow-up verification, occupations with little sample data are ignored, including 7 samples: farm, livestock and relevant laborers, forestry and relevant laborers, fishery and relevant laborers, in-service armymen and so on. In addition, technicians and assistant professional staff, affair staff, service staff and salespersons, technical workers and relevant staff, machine operators, assembly workers, non-technical workers and manual laborers are jointly called technicians and affair staff. People’s representatives, chief executives, corporate chief and managers are jointly called “chiefs”.

First of all, the relationship between tenure and dwelling type were discussed. From the discussion, Table 7 was obtained. From Table 7, it can be seen that in Tainan City, most houses are owner-occupied, accounting for 89.7%. Detached dwelling are dominant, accounting for 87.1%. For the lower land price than other big cities and the desire to own independent asset especially for southern Taiwaness, It comes out the not surprised result. Besides, the Chi-Square Test on tenure and dwelling type accepts null hypothesis, i.e. tenure and dwelling type are irrelevant.

Table 7 Cross table of tenure and dwelling type

Tenure / Dwelling type	Owner-occupied	Rent	Total
Detached dwelling	337 (90.3%)	36 (9.7%)	373 (100.0%)
Multiple dwelling	47 (85.5%)	8 (14.5%)	55 (100.0%)
Total	384 (89.7%)	44 (10.3%)	428 (100.0%)
H_0： Tenure and dwelling type are irrelevant. P=0.265 (accept null hypothesis)			

From Table 8, it can be seen that whether households are male or female, most of them live in detached dwelling, accounting for 87.2% and 86.6% respectively. The ratios are close. The Chi-Square Test on dwelling type and sex accepts null hypothesis, i.e. dwelling type and sex are irrelevant.

Table 8 Cross table of dwelling type and sex

Dwelling type / Sex	Detached dwelling	Multiple dwelling	Total
Male	295 (87.2%)	43 (12.7%)	338 (100.0%)
Female	78 (86.6%)	12 (13.33%)	90 (100.0%)
Total	373 (87.1%)	55 (12.85%)	428 (100.0%)
H_0： Dwelling type and sex are irrelevant. P=0.878 (accept null hypothesis)			

From Table 9, it can be seen that regardless of age range, detached dwelling are dominant. However, the ratio of detached dwelling among aged household heads (aged 51-60 and above 61) is slightly higher than that among those household heads in any of other age ranges. The Chi-Square Test rejects H_0 null hypothesis, i.e. dwelling type and age are relevant.

Table 9 Cross table of dwelling type and age

Age \ Dwelling type	Detached dwelling	Multiple dwelling	Total
⩽30	28 (80.0%)	7 (20.0%)	35 (100.0%)
31-40	80 (80.8%)	19 (19.2%)	99 (100.0%)
41-50	142 (88.2%)	19 (11.8%)	161 (100.0%)
51-60	74 (90.2%)	8 (9.8%)	82 (100.0%)
⩾61	49 (96.1%)	2 (3.9%)	51 (100.0%)
Total	373 (87.1%)	55 (12.9%)	428 (100.0%)
H_0： Dwelling type and age are relevant. P=0.047 (reject null hypothesis)			

From Table 10, it can be seen that regardless of occupation, detached dwelling are dominant. The ratio of detached dwelling among the jobless and manual laborers is higher than that among people with other occupations. The jobless may contain high ratio of retirees. This is the very reason for such special consequence. The Chi-Square Test accepts H_0 null hypothesis, i.e. dwelling type and occupation are irrelevant.

Table 10 Cross table of dwelling type and occupation

Occupation \ Dwelling type	Detached dwelling	Multiple dwelling	Total
Jobless	44 (91.7%)	4 (8.3%)	48 (100.0%)
Chiefs	35 (85.4%)	6 (14.6%)	41 (100.0%)
Professional staff	20 (76.9%)	6 (23.1%)	26 (100.0%)
Technicians and affair staff	249 (86.8%)	38 (13.2%)	287 (100.0%)
Non-technical workers and manual laborers	25 (96.2%)	1 (3.8%)	26 (100.0%)
Total	373 (87.1%)	55 (12.9%)	428 (100.0%)
H_0： Dwelling type and occupation are irrelevant. P=0.254 (accept null hypothesis)			

From Table 11, it can be seen that regardless of educational level, detached dwelling are dominant. The lower the educational level is, the higher the ratio of detached dwelling among household heads is Nevertheless, the Chi-Square Test accepts H_0 null hypothesis, i.e. dwelling

type and educational level are irrelevant.

Table 11 Cross table of dwelling type and educational level

Dwelling type / Educational level	Detached dwelling	Multiple dwelling	Total
Below junior high school	143 (89.4%)	17 (10.6%)	160 (100.0%)
Senior or vocational high school	110 (87.3%)	16 (12.7%)	126 (100.0%)
Junior college or college	113 (86.3%)	18 (13.7%)	131 (100.0%)
Postgraduate	7 (63.6%)	4 (36.4%)	11 (100.0%)
Total	373 (87.1%)	55 (12.9%)	428 (100.0%)
H_0 : Dwelling type and educational level are irrelevant. P=0.101(accept null hypothesis)			

From Table 12, it can be seen that regardless of marital status, the ratio of detached dwelling is higher than that of multiple dwelling. The ratio of detached dwelling among married household heads is higher than that among household heads with other marital statuses. The Chi-Square Test accepts H_0 null hypothesis, i.e. dwelling type and marital status are irrelevant.

Table 12 Cross table of dwelling type and marital status

Dwelling type / Marital status	Detached dwelling	Multiple dwelling	Total
Married	290 (87.9%)	40 (12.1%)	330 (100.0%)
Unmarried	46 (85.2%)	8 (14.8%)	54 (100.0%)
Divorced	17 (81.0%)	4 (19.0%)	21 (100.0%)
Widowed	20 (87.0%)	3 (13.0%)	23 (100.0%)
Total	373 (87.1%)	55 (12.9%)	428 (100.0%)
H_0 : Dwelling type and marital status are irrelevant. P=0.786(accept null hypothesis)			

In addition, the analysis of tenure and relevant variables are shown in Table 13. From Table 13, it can be seen that the income of households which rental or owner-occupied dwellings varies obviously with the number of school-age children. T-test reveal that the mean and standard deviation income of owner-occupied household are both higher than renters, while the former average number of school-age children and standard difference is lower that the latter's.

Table 13 Two-sample T-test of tenure and relevant variables

Variable \ Tenure	Rented	Owner-occupied	Two-sample T-test
Income	$\overline{X_1}$ =782883.95 S_1 =309423.76	$\overline{X_2}$ =1100419.07 S_2 =803006.17	H_0 : The average incomes of households with different forms of tenure are same P=0.010 (reject null hypothesis)**
Family size	$\overline{X_1}$ =3.66 S_1 =1.20	$\overline{X_2}$ =3.63 S_2 =1.41	H_0 : The average family sizes of households with different forms of tenure are same P=0.896 (accept null hypothesis)
Preschool children	$\overline{X_1}$ =0.23 S_1 =0.57	$\overline{X_2}$ =0.21 S_2 =0.51	H_0 : The average numbers of preschool children of households with different forms of tenure are same P=0.868 (accept null hypothesis)
School-age children	$\overline{X_1}$ =0.50 S_1 =0.70	$\overline{X_2}$ =0.31 S_2 =0.60	H_0 : The average numbers of school-age children of households with different forms of tenure are same P=0.053 (reject null hypothesis)*

**significant at α =0.01; * significant at α =0.05.

4. Model establishment and variables setting

With different settings of nest structure, tenure and dwelling type can be expressed with three models as shown in Fig. 4. Model 1 implies housing demand regards tenure as the upper nest layer and then decides dwelling type; Model 2 is the opposite of Model 1; Model 3 shows tenure and dwelling type are selected simultaneously (same layers). This study believes that Model 1 more tallies with common tenure behaviors of residential housing and Model 2 is the most impossible. Anyway, such view needs to be confirmed by the result of parameter estimation.

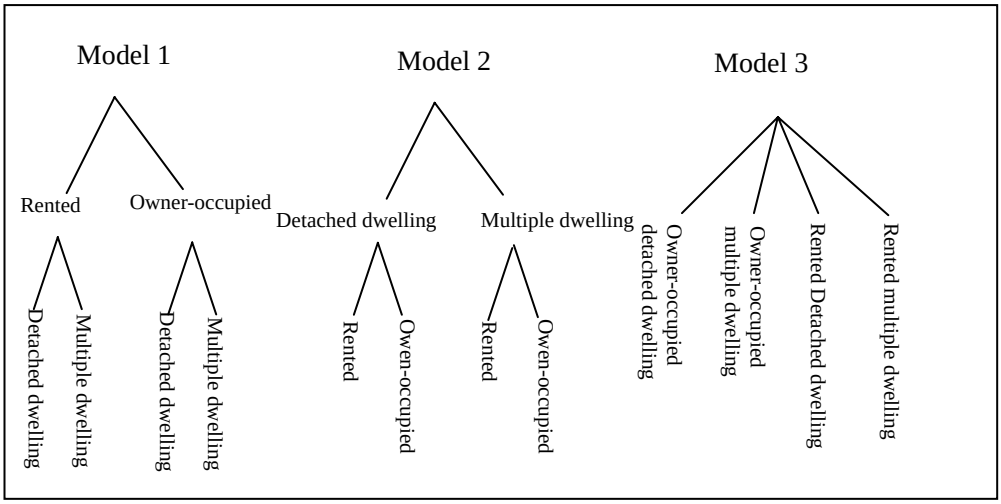

Fig. 4 Concept of model establishment

Subsequently, the setting method and the types of relercne variables which the tenure choice alternatives involve are expressed in Table 14.

Table 14 Setting method and types of variables

Variable	Definition	Type
Income	Annual income of household head	Common variable
Value-rent ratio	Ratio between value and rent	Common variable
Owner-renter ratio	Ratio between house purchase price and rent	Common variable
Family size	Family size	Common variable
No. of children of a household	No. of preschool and school-age children of a household	Common variable
Average age of a household	Average age of family members	Common variable
Government loan	Set to owner-occupied alternative if a household has financial loan from public sector	Alternative-specific dummy variable

The effect and degree of the above variables on tenure choice are explained below separately:

(1) Income

Income increase will raise the probability of owner-occupied housing. Most studies believe the consumption of durable goods depends on permanent income, while permanent income is the accumulation of current income over a period of time, so it won't be as changeable as current income which is affected by many temporary elements. So, permanent income has a better demonstration effect than current income does. Generally speaking, current income will underestimate the elasticity of housing demand (Mayo, 1981). However, it is difficult to know permanent income. Moreover, for same housing market, reasonable elasticity of housing demand can also be obtained through estimation with current income. The estimated value of permanent income and that of current income should be an issue of "relatively accurate". After counting the cost, this article adopts current income as explanatory variable.

(2) Value-rent ratio

Value-rent ratio can be used as an alternative variable for the possibility of household investment and consumption mix. The principle is to compare the subject house with other houses to reveal the asset value of rent-paid subject houses. High value-rent ratio implies the market expectation of capital gains, making the possibility of owner-occupied housing higher than that of rental housing.

(3) Owner-renter ratio

When the housing quality in sub-market is controlled, this variable can reveal households' consumption motivation. Moreover, when the quantity of houses is same, this variable can be considered as a price index of house owners relative to renters. The increase of owner-renter ratio has no good for owner-occupied housing, but is good for rental housing.

(4) Family size and number of children of a household

Family size and number of children of a household are believed to have positive effect on the probability of owner-occupied housing.

(5) Age and average age of a household

These two variables express the stages of family life circulation of a household as well as the effect of each stage on tenure decision. It is generally believed they have positive effect on owner-occupied housing.

(6) Government's low-interest-rate loan

It is unlikely for common people to pay house purchase price in a lump sum. Most of them will apply for government’s low-interest-rate loan through bank. Therefore, the ones who can obtain government’s subsidized low-interest-rate loan will more likely purchase houses.

The setting method and types of the effect variables which the alternatives of detached dwelling and multiple dwelling involve are shown in Table 15.

Table 15 Setting method of type of variables

Variable	Setting method	Type
Educational level	Household heads with college or above college education are set to multiple dwelling	Alternative-specific dummy variable
Occupation	White-collar household heads are set as to detached dwelling	Alternative-specific dummy variable
Sex	Male household heads are set to detached dwelling	Alternative-specific dummy variable
Marriage	Household heads of a DINK or nucleus family are set to detached dwelling	Alternative-specific dummy variable
Age	Household heads aged at or above 50 are set to detached dwelling	Alternative-specific dummy variable

The effect and degree of the above variables on residential types are explained below separately:

(1) Educational level

Here we suppose people with higher educational level should more likely live in multiple dwelling.

(2) Occupation

Here we suppose white-collar people should more likely live in detached dwelling.

(3) Sex

Here we suppose male household heads more likely live in detached dwelling.

(4) Marriage

Here we suppose DINK (Double Income No Kid) families or nucleus families more likely

live in detached dwelling.

(5) Age

Here we suppose the households of which heads are at or above 50 years old more likely live in detached dwelling.

5. Conclusions and Suggestions

This study uses the data obtained from the Family Income and Expenditure Survey to conduct statistics and analysis on the tenure and dwelling types of the households in Tainan City, aiming to preliminarily understand the relations between tenure and relevant variables, the relations between dwelling type and relevant variables and the relations between tenure and dwelling type. In addition, the study tries to express the possibility of the nest structure for tenure and dwelling type with icons and discusses the effect and setting method of the factors that possibly affect the above two, thus laying a theoretical foundation for follow-up empirical studies.

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附件二

The preliminary study of effects of flexible time system on commuting time choice and scheduling evaluation :

Study on Commuting Departure Time Choice and Expected Work-Starting Time of Commuters

Kuang-Yih Yeh[1] Hao-Ching Hsia[2] Kan-Chung Huang[3]

abstract

To meet their own demands on the food, clothing, shelter, travel, sports and recreation, people must exchange their labor for rewards, and then get the desired goods and/or services from markets with such rewards. Therefore, for most of people who have to earn their household livelihood, work has become the most important activity on the weekdays. If the work starting time is fixed, the commuting trips will be concentrated during peak hours, resulting in traffic congestion. Congestion will result in traffic accidents, air pollution, noise, and higher travel cost (time) and will make workers' quality of life worse. As the flexible working time system is executed, commuters are able to determine the most optimal commuting departure time and the expected work-starting time according to the allocation frame of living times (spaces of living)of individuals and other household members. Therefore, before the introduction of the flexible working time system, to examine the possible influences choices for commuting departure time and work-starting time which are resulted from the social and economic backgrounds of commuters and other constraints allows for the establishment of such a flexible working time system that satisfies the need of commuters. This is the major purpose of this study.

Keywords : flexible time system, commuting time choice, scheduling evaluation

1. Introduction

To meet their own demands on the food, clothing, shelter, travel, sports and recreation, people must exchange their labor for rewards, and then get the desired goods and/or services from markets with such rewards. Therefore, for most of people who have to earn their household livelihood, work has become the most important

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activity on the weekdays. However, in view of urban transportation, the implementation of fixed work starting time system causes commute trips centralized within some peak time-periods and leads to traffic congestion. The problems raising out of traffic congestion, such as traffic accidents, air pollution, noise, increase in travel cost (and time) all indirectly result in the failure of commuters get a high quality life. To resolve such problems, it is can be considered to carry out a flexible working time system to disperse traffic demands during peak time-periods, and further to mitigate traffic congestion in downtowns (Lan, Chen, 1998; Tsukai et al., 1999). It is known from previous studies that, in terms short-term traffic demands management, the flexible working time system is very effective. Generally, the introduction of flexible working time system has direct impacts commuters‘ decision of both the commuting departure time choice and the work starting time choice. Thus, in the aspects of time allocation and time use, the introduction of flexible working time system enables commuters to schedule their trips of each day effectively, and at the same time can produce a better result in terms of the living time evaluation.

Generally, under the fixing working time system, commuters must follow the office hours specified by firms, that is, they should not arrive at their working place late, nor leave there early. As a result, the fixed working hours is bound to exercise a great influence and many constraints on the choice for other activities. However, the commuters with different economic backgrounds will make different time allocations. For example, the commuters who have school or pre-school children, carting their children to nurseries (such as baby-sisters’ quarters or kindergartens) or schools is a mandatory task that must be accomplished before they go to work. In another hand, if the flexible working time system is carried out, commuters have more time to handle any tasks that must be performed in their daily lives properly. In addition, under such system, commuters have a wide time range to choose from for their go-to-work times that fit their paces of living. This will help commuters minimize the constraints on their timing of diary activities.

As the flexible working time system is executed, commuters are able to determine the most optimal commuting departure time and the expected work-starting time according to the allocation frame of living times (spaces of living)of individuals and other household members. Therefore, before the introduction of the flexible working time system, to examine the possible influences choices for commuting departure time and work-starting time which are resulted from the social and

economic backgrounds of commuters and other constraints allows for the establishment of such a flexible working time system that satisfies the need of commuters. This is the major purpose of this study.

In the Section 1 and 2 of this paper, we will review some relevant previous literatures regarding the commuting departure time choice and work starting time choice. In Section 3, a brief description is made about the execution methods and procedures of this study, and preliminary results are presented. In the last Section, some conclusions and recommendations are made.

2. Literature Review

2.1 Some studies related to commuting departure time choice

In the past, the majority of studies regarding the commuting departure time choice of commuters were conducted using the discrete choice model, which uses time-period as the alternative of patterns, allowing commuters to choose the most efficient time-periods as their commuting departure times. Cosslett, Abkowitz and Small et al. all used the multinomial logit model to construct the model of commuting departure time choice (Saleh & Farrell, 2005). Some scholars believed that there could be a sequential decision relationship between the commuting departure time choice and the commuting mode choice. Bhat (1998) constructed the combined choice model of departure time choice and the commuting mode choice through taking shopping trips as examples, and he believed that there was a nested relationship(sequential relationship)between the departure time choice and commuting mode choice, that is, the commuting mode choice was at upper nested level (decided first), while the departure time choice at lower one(decided later). Meanwhile, there were some scholars who believed that the relationship between the commuting departure time choice and route choice was sequential decision one too (Chang et al., 2003; Ziliaskopoulos & Rao, 1999). In the foresaid combined choice model, although the nested structural relationship between the commuting departure time choice and the commuting mode choice (or route choice) had been demonstrated through statistical verification, but the rationality of this relationship merely stopped at the one of logistic reasoning. Considering the actual actions of commuters on weekdays, the commuting mode and route used by them for commuting characterize steady and not easy to change, in another words, the commuters are not always making choices for the traffic/route due to the habit behavior formed from long-term influences proposed by individual habits, household

properties and other factors. In addition, the difference in the commuting mode will be reflected out by length of trip hours that will affect the commuting departure time choice behavior of commuters. So, in this study, the used commuting mode is considered as an exogenous variable which affects the commuting departure time choice. It is found from the results of various studies that the contributing factors affecting the decision of departure time by commuters include: ①trip hours, ②trip cost, ③marital status and household liabilities, ④income, ⑤occupation and ⑥flexibility of working time. Among them, the sixth factor has the greatest influence. Small (1982) observed that marital status, occupation and the used commuting mode were three major factors affecting the commuting departure time choice. de Palma(1997) demonstrated in his studies that compared with the commuters with fixed working hours, those with flexible working hours had highly flexible choices for their departure times . However, since time belongs to a continuous variable, when the discrete choice model is used to handle the decision of commuting departure time choice, the following problems occur: (if the discrete choice models are used to handle the issue of departure time choice, it is essential to divide the continuous time into many time-periods adjacent to each other. The problem is that different division patterns will produce different results. (In the discrete choice model, the time points on the time-period boundaries are randomly drawn into any time-period adjacent to it. But in practice, this is a very irrational hypothesis. (It is logically irrational to handle the time parameter because it is a continuous variable. Therefore, how to handle commuting departure time choice problems in continuous model becomes the research direction that a large number of scholars follow. Tsukai et al., (1999) found that the commuting departure time choice would affect the length of in-home time, so he decided to model the commuting departure time choice using duration model. Bhat and Steed(2002) conducted a study of the factors affecting the departure times for shopping trips, and finally stated that age, income, social and economic backgrounds , occupation and trip type all could bring influences on the departure time choice behavior of shopping trips of consumers.

2.2 Relevant Literatures concerning the allocation and evaluation of living times of commuters

Generally, the allocation of commuters' living times is subject to the interactive effects between the individual demands and the demands of other household members. In view of the influences by individual demands, Yamada et. al., (1999) noted that healthcare and work have different effects on the allocation of individual times. To be specific, young commuters would spend more time on their works; while elder commuters would spend more time on health

care. In his study, he also discovered that, in addition to individual properties, the cultural conventions also brought great impacts on the timing of individual times. Men in Japan whether employed or unemployed, for example, spend the same time on household works, which is caused by Japanese cultural conventions.

Besides individual demands, the demands of household members also have impacts on the allocation of commuters' living times. For instances, in households with both husbands and wives working, the task to cart their children to and from school will affect the allocation of husbands' or wives' times. For this reason, to understand the allocation of commuters' living times, it is essential to know first the mutual decision behavior of household members and the interactive effects of task allocation. To learn the interactive effects amongst household members, Algers et al.(1997) modeled the commuting modes and trips of household members using the nested logit model. Wen & Koppelman(1999) also used the nested logit model to analyze issues concerning the stopping location choice and tour formation choice of households . The studies foresaid more often than not focused on the analysis of activity-travel behavior, seldom involving the group decision of household members. The Albatross model system established by Arentze & Timmermans(2000) belongs to a heuristic simulation system. It assumes that the choice behavior of individuals belongs to a continuous decision behavior, based on different rules. Through interaction with environment and communication with other persons, individuals can acquire experiences and correct the existing rules with the acquired experiences, and form different decision behaviors. With this model, we can forecast what types of activities the individuals is going to do, when, where, with whom and what commuting mode will be used. This model analyzes the activity-travel behavior from multiple aspects, but it does not consider the group decision. Gliebe & Koppelman(2000) used the additive household utility function of household members to model the interactions among household members. In this model, it is assumed that the effectiveness of a household member is related to the effectiveness of the remaining household members and the effectiveness of his/her participation in activities with other household members. Then through this model, the contradiction effects of individual activities against the activities jointly participated by other household members . It can be concluded according to previous studies that the interactive effect between individual demands and the demands of other household members really impacts on the allocation of commuters' living times. Therefore, during the modeling of work starting time evaluation, it is necessary to take both types of variables into consideration.

3. Survey summary and Methods

This study mainly covers: ①modeling of commuting departure time choice. This study has also tried to model the commuting departure time choice behavior using continuous model (This study actually uses the hazard based duration model) to find out the factors affecting commuters to determine their commuting departure times; ②modeling of work starting time evaluation. In this Section, the ordered probit model is adopted to analyze and construct the living time evaluation model so that the influences of individual properties and household properties of commuters on work starting time evaluation.

In aspect of information collection, this study takes commuters in Tainan City as the study respondents. A questionnaire investigation was conducted with 50 commuters randomly sampled from office buildings over all Tainan City. Both consequential analysis and construction of related models are performed based on these 50 commuter samples.

3.1 Survey Summary

For the sake of easy accessibility of information, this study chose only six districts of Tainan City (East District, West Central District, South District, North District, Anping District and Annan District) and one adjacent city, Yongkang City, as its research areas where 50 commuters in total were sampled at random for this purpose through questionnaire and interview and all those 50 commuters had fixed work-starting times. This investigation was a prophase trial, so the number of sampled commuters was relatively small. In the consequential investigations, a quota sampling method was employed among the commuters in Tainan City and its adjacent administrative districts for precision and in-depth analysis.

The followings are the simple statistics on age, gender, used commuting mode, time use pattern of the respondents. From Figure 1, it is known that the respondents age 21~30(inclusive) amount for the majority, about 58%; the second largest age group is composed of age of 41~50 (inclusive) year old commuters, approximately 20%; and the next age group is 31~40 years (inclusive) of age, about 10%. The Commuters under age 40 totally amount for 78%, so what should be pointed out hereby is that in this study, the results have tendency toward the young commuters. In terms of gender distribution, as shown by Figure 2, the male make up 44%, and the female 56%.

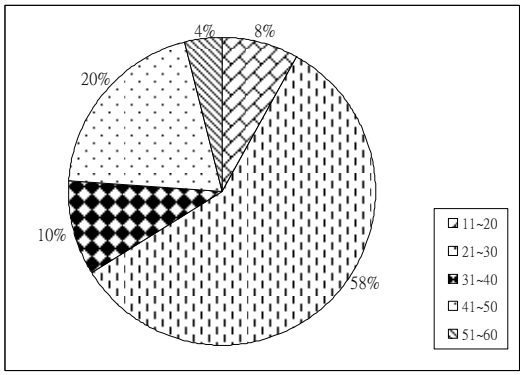

Fig. 1 Age Distribution Pie Chart

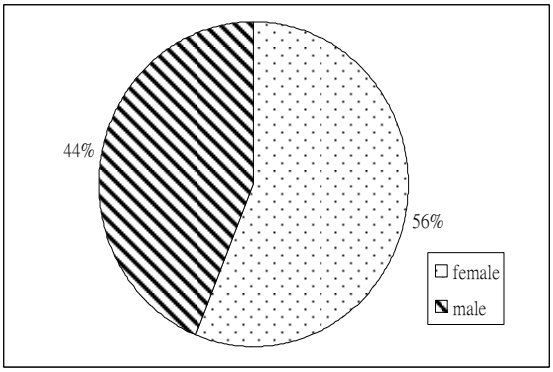

Fig. 2 Gender Distribution Pie Chart

As for the commuting mode for commuting, as shown by Figure 3, commuters who use Scooters make up the majority, about 80%; the next is car-using commuters, approximately 12%.

In view of the time use patterns of commuters, it is clear from Figure 4 that the average wake-up time among the respondents is at 7:28am; the average departure time for working places at 8:23am; and the average arrival time at 8:43am. It follows that after getting up commuters generally spend about one hour in handling their household works; and from departure from home, it takes them about 20 minutes to get their working places, which is the sum of non-work time and travel time. If 9:00am is considered as the standard work-starting time, it can be noted that a larger part of commuters still choose to arrive at their working places before the required work-starting time and use this time-period to make preparations for work starting.

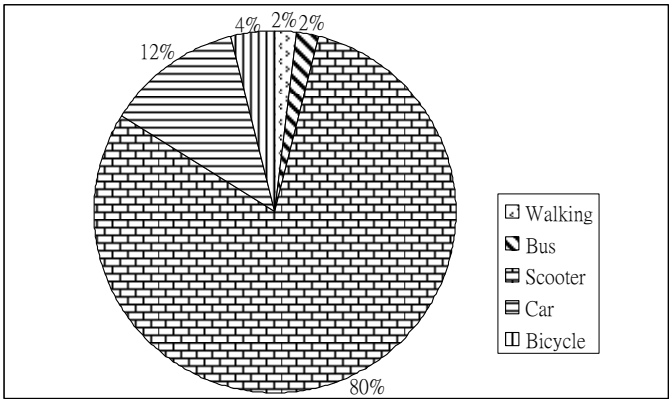

Fig. 3 Commuting mode Use Pattern Pie Chart

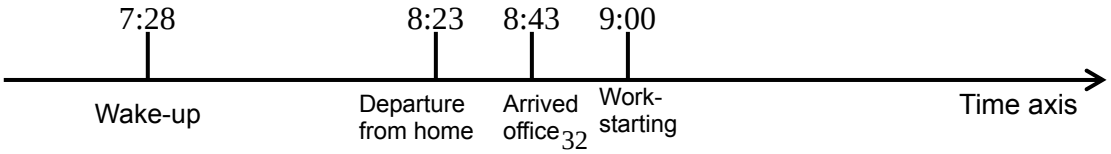

Fig. 4 Respondents' Average time use Pattern

3.2 Modeling and Analysis of Commuting Departure Time Choice

Table 1 shows the present status of commuting departure time distribution of commuters; the distribution profile appears a right skewness, that is, 18% of the respondents are free-time workers or other special workers, so they can depart home after 10:00am. But, regarding it as a whole, the peak of commuting departure time fall within the time-period from 7:00am to 7:59am; that is, up to 82% commuters choose to depart home before 9:00am.

Table 1 Present Home Departure Times

No.	Time period	Proportion
1	Before 6:00	2%
2	6:00-6:59	8%
3	7:00-7:59	42%
4	8:00-8:59	30%
5	9:00-9:59	0%
6	10:00-10:59	8%
7	11:00-11:59	4%
8	After 12:00	6%
Total		100%

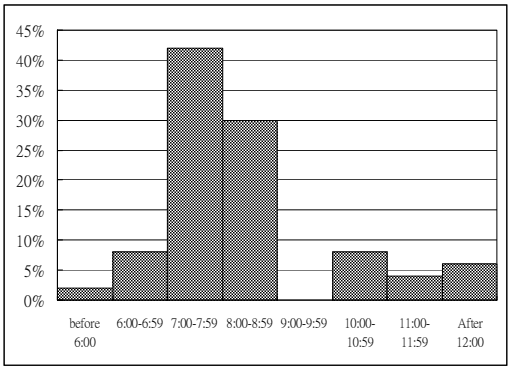

Fig. 5 Present Departure Time Distribution

In the past, the most of studies on commuting departure time choice behaviors used the discrete choice model to model the commuting departure time choice behavior; while this study tries to use the continuous model to for the same purpose. Since the in-home (dwell) times of commuters are prone to be affected by the commuting departure time choice, and characterize uncertain, so in this study, it is assumed that, on weekdays, the proportion of commuters who leave home continuously varies as time escapes. Thus , the duration model can be employed to describe the commuting departure time choice model, that is, the duration function is used to express the in-home time or the "time" variable before departure time (it means the time duration from wake-up to the departure from home). Before the estimation of model parameters, it must be assumed that the distribution of duration function is similar to the logistic distribution due to the probability distribution function of in-home dwell times of commuters. In this way, this study, through making

references to the existing study results, use logistic distribution as the distribution of the duration function for the estimation of model parameters.

With such assumptions on variables, and making references to the relevant literatures concerning the commuting departure time choice, it is determined to use the following four types of possible affecting factors: ①commuting habit; ②time use patterns; ③commuting mode; ④ household tasks. Different variables are assigned to each type of factors, which are defined in details in Table2. Table 3 shows the estimation results of this model.

Table 2 Variables of Departure Time Model

Category	Variable	Description
Commuting habit	Early	It represents an individual's habit to arrive workplace at least 5 min earlier than the official work starting time (It takes a value of 1 if a respondent answers yes, and 0 otherwise.)
	Late	It represents an individual's habit to arrive workplace at least 5 min later than the official work starting time (It takes a value of 1 if a respondent answers yes, and 0 otherwise.)
Time allocation behavior	Safety time	The core time ─ the usual arrival time(at workplace) (The core time is 10:00 A.M.)
	Activity time	The usual arrival time(at workplace) ─ the usual departure time(from home)
Commuting mode	Bus	It represents an individual's commuting mode. (It takes a value of 1 if a respondent uses a bus, and 0 otherwise.)
	Scooter	It represents an individual's commuting mode. (It takes a value of 1 if a respondent uses a scooter, and 0 otherwise.)
	Car	It represents an individual's commuting mode. (It takes a value of 1 if a respondent uses a car, and 0 otherwise.)
Household tasks	Child 1	It represents the number of children who are younger than 6 years old.
	Child 2	It represents the number of children who are younger than 12 years old and older than 7 years old.
	Child	It represents the household structure. (It takes a value of 1 if there is al least one child who is younger than 12 years old in respondent's household , and 0 otherwise.) It should be noted that it can not be involved in the model with Child1 and Child2 simultaneously.
	Duty	It represents that an individual's duty of taking household member to school or workplace. (It takes a value of 1 if a respondent has a duty, and 0 otherwise.)

In the commuting departure time choice model constructed by this study, the in-home time-period from the wake-up time to the departure time of commuters is considered as the dependent variable of this model. Therefore, this model can be considered as the model of the in-home dwell time prior to the departure for work. This study has tried many times to model using the different combinations of variables. And during modeling, the existing assumptions are followed. In the four types of

assumptions, different variables are singled out for modeling. After experiments of many times, it is found that the commuting habit exerts no significant impacts on the commuting departure time choice of commuters. So this variable is not taken into consideration during modeling.

From Table 3, it can be seen that the following variables: ample safety time(Safety time), use of Scooters(Scooter) and necessity of carting household members to work/school(Duty) greatly influence commuters' decision of commuting departure time choice. The ample safety time is equal to the core work-starting time minus the working-place arrival time. The more ample safety time commuters have, the later they always tend to depart from home. This is because that this time-period can be allotted and employed freely by commuters and may be transferred for handling household works or their own affairs before they depart from home. For the purpose of this study, making references to previous studies, the core work-starting time is taken as 10:00am.

Scooters characterize small size and not prone to influence of traffic congestion. Commuters who use scooters as their commuting mode have high mobility. They not only need no time to look for parking spaces, but also have higher certainty in commuting time control than cars or public traffic users certainty, especially during peak time-periods. So, commuters using Scooters as commuting mode will spend more in-home time and tend to leave home late.

Table 3 Commuting Departure Time Choice Model

Category	Variable	Model result
Commuting habit	Early	-
	Late	-
Time allocation behavior	Safety time	0.628E-02 (2.045)*
	Activity time	0.120E-01 (1.127)
Commuting mode	Bus	-
	Scooter	2.749 (8.107)*
	Car	-
Household tasks	Child 1	-
	Child 2	-
	Child	-
	Duty	1.649 (3.00)*
Loglikelihood		-89.347
Lamda(scalar parameter)		0.040
P(distribution parameter)		1.242

Note: (1) t-statistic is in parentheses.
(2) The number with star is significant at 0.95 confidence level

In terms of household tasks, if commuters have to cart other household members to work/school on their way to work, they tend to depart home later. This is possibly because: (they must fit the work/ school times of other household member; (in this model, the duration of in-home time is a dependant variable. It is also possible that commuters wake up early so that the duration of in-home time can be extended to enable themselves and the household members to be carted by them to make preparations for home departure.

3.3 Modeling and Analysis of Work Starting Time Evaluation

On ordinary weekdays, the whole behavior of commuters manifests itself as a certain routine which is the optimal result of repeated experience of trial-and-error and correction. Commuters usually spend each day according to such routine consciously and unconsciously. This makes them feel ease and quiet. When a system (flexible working time system) is carried out, commuters will try to change their existing lifestyle; however, before the lifestyle is changed, commuters have to reflect on each and all constraints facing them, and then make the optimal decisions. Therefore, the purpose of this Section is to learn: what impacts each type of constraints facing commuters (capability constraints, coupling constraints, authority constraints, etc.) will bring on their decision of expected work-starting time choice, and the preference to different work-starting time-periods of commuters with different social and economic backgrounds as well.

It is known from Table 4 that, provided the flexible working time system is introduced, a large portion of commuters (approximate 46%) want to choose their work-starting time from the time-periods from 8:00am to 8:59am, and 26% commuters wish start work within the time-periods from 9:00am to 9:59am. Again, when commuters have decided their work-starting time, they have also decided their work-closing time. That is, the later commuters start to work, the later they have to leave work. On the whole, above 86% commuters still wish they can start to work before 10:00am so that, based on normal working hours (8 hours per day), they can get off work for home at 18:00am at longest and have more night time to do other activities or simply get a good rest at home. That also means that commuters shall decide their own work-starting time according to the time use patterns of post-work time.

Table 4 Expected Work-Starting Times of Commuters with Flexible Working Hours

Time period	7:00-7:59	8:00-8:59	9:00-9:59	10:00-10:59	11:00-12:00	Total
Proportion	14%	46%	26%	10%	4%	100%

For the purpose of work-starting time evaluation, a five-point Likert scale is used,

and the respondents are asked to give their evaluation to each time-period as divided hereinafter through choosing one value from values -2, -1, 0, 1 and 2, indicating that the work-starting time within this time-period is very inappropriate, inappropriate, no problem, appropriate and very appropriate to them respectively. Table 5 shows the weighted average evaluation value of each time period.

As shown in Table 5, the work-starting time within time-period from 8:00am to 8:59am is also estimated by commuters appropriate; the overall evaluation curve appears a single-peak shape, going up as the advance of time first, and then gradually dropping from some time point. This can be verified with data shown in Table 6. It can be observed from Table 6 that the single-peak shaped work starting time evaluation shares the highest proportion, about 74%.Therefore, it is very clear that in the mind of each commuter, there is an optimal work-starting time which he/she is satisfied with.

In the course of investigation of work-starting time evaluation, only normal working hours is involved, no consideration given to the influences of overtimes. Meanwhile, only pre-work and post-work activities are taken into consideration. In this way, the requirements of evaluation basis are met. In addition, even if the flexible working hour system is introduced, but the working hours per day are still constant. This means that, while commuters have decided their work-starting time, they have also decided their work-closing time. Taking one hour as the time division unit, this study divides morning hours (6:00~12:00) into six time-periods: 6:00~6:59, 7:00~7:59, 8:00~8:59, 9:00~9:59, 10:00~10:59 and11:00~12:00. In the questionnaire, the respondents were asked about what time-period they most expect their work-starting time to fall within; and to give their evaluation on the degree of appropriateness of each “expected work-starting time” on a Likert scale that ranged from “very inappropriate” to “very appropriate”. In this study, the assumption that all respondents make their evaluation on each time-period on the same evaluation basis is employed. According to the evaluation given by each respondent, the optimal work-starting time satisfying his/her pace of living can be determined quickly and decidedly. To learn precisely the effect of interactive interferences between household members, both individual properties and household properties are incorporated into the model as variables. Individual properties include such variables as age, gender and so on; the variables of household properties include the numbers of children under age 6 and age from 7 to 12 in commuters’ households, whether, on their way to work,

commuters have to cart other household members to work/school. The variables of both individual properties and household properties, as the case may be, are introduced into the model as virtual variables or continuous variables. After the construction of model, it may be used to acquire the values of living time evaluation, household members of commuters, and further to find out the evaluation of commuters on the expected work starting time and the potential impacts of interactive influence effect between household members.

Table 5 Weighted Average Evaluation Value of Each Time Period

—	**6:00-6:59**	**7:00-7:59**	**8:00-8:59**	**9:00-9:59**	**10:00-10:59**	**11:00-12:00**
weighted average	**-1.36**	**-0.4**	**0.32**	**0**	**-0.56**	**-0.62**

(The values shown above are the weighted averages computed using ***-2 scores: very Inappropriate; -1 score: Inappropriate; 0 score: No problem; 1score: appropriate; 2 scores: very appropriate***)

Table 6 Distribution Shapes of Work Starting Time Evaluation

Definition	**Description**	**proportion**
Increase Type	The evaluation value on the departure time first increases with the escape of time,	12%
Decrease Type	The evaluation value on the departure time first decreases with the escape of time,	2%
Constant Type	The evaluation value on the departure time doesn't vary with the escape of time	2%
First increase then constant	The evaluation value on the departure time first increases with the escape of time, but remain constant after some time point.	4%
Single-peak shaped	The highest evaluation occurs at some time point	74%
Double-peak shaped	The highest evaluation occurs at more than two time points	6%

As for modeling, the ordered probit model is used by this study to construct the evaluation model of commuters living time. For the scoring of alternative scheme,

Likert scale and the “order” variable are used to obtain its score value that is also a dependent variable of the ordered probit model. Since the multinomial logit model is unable to handle order properties of this dependent variable, so it is unsuitable to be used as the modeling method of the willingness evaluation model. Although the linear regression model can be used to forecast the dependent variable with a variety of variables, the forecast is based on the assumption that the differences between various types of dependent variables are identical. Such assumption is inconsistent with the basic assumptions of “order” variable (the values of order variable merely indicate difference in degree, while the difference in order is meaningless). Thus, the regression model does not suit to address such problem. Therefore, to consider the fact that dependent variable is a question in the questionnaire which is used to measure the order (1 = very bad, 5= very good) and for the sake of ease to analysis, the ordered probit model is employed.

The ordered probit model was first proposed by Zavoina and McKelvey in 1975 based on binary probit model. Because this order choice model can be used to study preference order problems, in recent years it has found wide applications in a variety of research fields, such as public policy-making, commuters’ attitudes towards travel demands management strategy (Bhattacharjee et al., 1997; Abdel-Aty, 2001; Podgorski and Kockelman, 2006). Refer to Maddala(1989) for the detailed modeling of this model.

In this study, the degree of acceptance toward time-periods is classified into five rates (answer options): very unacceptable, unacceptable, no problem, acceptable, very acceptable, and expressed by 0, 1, 2, 3 and 4. The threshold parameters are denoted by μ_{-1}, μ_0, μ_1, μ_2, μ_3, μ_4, where, $\mu_{-1}=-\infty$, $\mu_0=0$, $\mu_4=\infty$. If all five options of acceptance are used, then only three threshold parameters are required. The major significance of threshold parameters lies in determining the relative value of each acceptance rate. To find out the variables affecting each time-period evaluation model, t-statistics shall be used for judgment. This study has addressed work-starting time evaluation models, whose results are listed in Table 7.

It is clear from Table 7 that, in the aspect of age, the commuters over age21 and under age 40 set a high value on the work-starting time-period after 8:00am; whereas the commuters age 41 to 50 prefer to the work-starting times within time-period from 7:00am to 7:59. In terms of gender, male commuters have high regard for the work-starting times within time-periods from 7:00am to 7:59am and from 8:00am to

8:59am.

In point of the effect of interactive interference between household members, the number of children under age 6 and the number of school children aged 7 ~ 12 bring distinguishable impacts on the evaluation on work starting time the commuters respectively. The more children under age 6 there are in a household, the higher value the household attach on the work-starting time within the time-period from 7:00 am to 7:59am. This result seems irrational, but in reality, amongst commuters with children under age 6, the greater part of them are very young and at low occupational positions. Therefore, even if the flexible working time system has been introduced in the firms that they are serving, they have to arrive at the working places earlier than their superiors do. Under such circumstances, the only choice to these commuters is to cart the children to the nurseries early as possible before they head for working places. To some extent, going to work early can yield more post-work time, as a result, commuters have more time to care for their children and have more rest. In another hand, if there are more schoolchildren age 7 ~ 12 in the households of commuters, the commuters don't prefer to the work-starting time within the range from 7:00am to 7:59am. This result is consistent with the actual conditions because children age 7~12 all are primary school children and the go-to-school time specified by most primary schools fall with the time-period from 7:00am to 7:59am. Therefore, commuters will decide to cart their children to school first, and then allot their go-to-work time-periods. Therefore, they do not show their preference to the work-starting times within this time-period.

In general, with the work starting time evaluation model, it can be found that both individual properties and household properties really have impacts on the evaluation on work starting times of commuters. This proven result provides planners a point claiming their attentions.

4. Conclusions and Suggestions

This study first examined the time use patterns of commuters using described statistic techniques, and then established the model of commuting departure time choice and the model of work starting time evaluation respectively through the hazard duration model and the ordered Probit model. Now, the following conclusions may be reached from this study:

Table 7 Work Starting Time Evaluation Model

No. of Model	1	2	3	4	5
Time Period / Variables	**7:00-7:59**	**8:00-8:59**	**9:00-9:59**	**10:00-10:59**	**11:00-12:00**
Age 21-30 dummy (1:Yes; 0:No)	0.567E-01 (.221)	0.951* (3.413)	0.892* (3.219)	0.582* (2.076)	.393 (1.418)
Age 31-40 dummy (1:Yes; 0:No)	0.8426 (1.444)	0.733* (2.990)	1.510* (5.981)	1.230* (4.867)	.898* (3.586)
Age 41-50 dummy (1:Yes; 0:No)	1.975* (4.758)	0.626 (1.102)	0.944 (1.739)	0.703 (1.280)	.869 (1.595)
Male (1:Male; 0:Female)	1.102* (3.857)	1.115* (2.851)	0.552 (.135)	0.278 (0.684)	.165 (.410)
The number of children under age 6	0.903* (3.285)	0.182 (.702)	0.349 (1.347)	-0.871 (-0.324)	-.123 (-.463)
The number of children age 7-12	-1.021* (-3.137)	-0.702 (-.240)	0.321 (1.101)	-0.173 (-0.577)	-.494 (-1.595)
Duty dummy (1:Yes; 0:No)	-0.526 (-1.063)	-0.176 (-.037)	0.542 (1.089)	0.555 (1.139)	-.119 (-.244)
Threshold 1	0.802* (4.399)	0.513* (3.428)	1.240* (6.227)	1.436* (7.516)	1.037* (5.945)
Threshold 2	1.975* (8.444)	1.221* (7.232)	2.465* (12.151)	2.294* (10.292)	1.670* (8.168)
Threshold 3	3.074* (9.141)	2.257* (9.881)	3.043* (12.431)	3.317* (7.506)	2.331* (7.924)
Log likelihood at zero	-75.71	-75.79	-69.31	-64.48	-72.77
Log likelihood at convergence	-62.19	-74.99	-65.61	-63.03	-70.34
No. of observations	50	50	50	50	50

Note: (1) t-statistic is in parentheses.
(2) The number with star is significant at 0.95 confidence level

(1) The mean wake-up time of commuters is at 7:28am, the average commuting departure time at 8:23am; the average work arrival time at 8:43am. In average, after getting up, commuters spend about one hour to handle household works or individual activities; after departure from home, commuters averagely spend approximate 20minutes in traveling to their working places. Overall, most commuters have arrived at their working places by 9:00am.

(2) In the commuting departure time choice model, it is clear that such variables as the ample safety time, the use of Scooters as commute mode, and carting household members to work/school significantly affect commuters' decision of commuting departure time.

(3) Generally, if commuters have more ample safety time, they tend to leave home late. It is because that the longer the ample safety time is, the more time commuters will have available before work starting time(assumed as 10:00am). In this way, their time use patterns will become flexible, and they may transfer part of

the ample safety time to household works or other activities.

(4) Commuters who use Scooters as commuting modes also tend to depart home late. It is because Scooters have a high mobility and are not prone to be affected by traffic congestion due to their small size and high speed.

(5) If on their way to work commuters have to cart their household members, they tend to depart home late. This is possibly because: ① they must fit the work/ school times of other household member; ②in this model, the duration of in-home time is a dependant variable. It is also possible that commuters get up early so that the duration of in-home time can be extended to enable themselves and the household members to be carted by them to finish preparations before home departure.

(6) Both individual properties and household properties really have influences on the evaluation of commuters' work-starting time evaluation. Especially in the aspect of household properties, the number of children under age 6 and the number of children age 7 to 12 influence the time allocation of commuters in different ways.

In the future research, the following recommendations should be considered:

(1) It is anticipated to ascertain, by means of stated preference method, the extent of acceptance by people to the flexible working time system and its potential effects, which are referenced by the policy-making; Furthermore, through introducing the various policy evaluation conditions (ex: road pricing), to find out the possible influences of various policy evaluation conditions on commuters.

(2) Commuters usually perform many activities on their way to work, such as buying breakfast, carting household members to work/school. So, if transport facilities are centralized to some areas or on significant commute routes through properly planning, commuters will save part of their travel time and use their time more effectively.

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