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Determinants of Remittances: Recent Evidence Using Data on Internal Migrants in Vietnam*

Yoko Niimi, Thai Hung Pham and Barry Reilly

The present paper examines the determinants of remittance behavior for Vietnam using data from the 2004 Vietnam Migration Survey on internal migrants. It considers how, among other things, the vulnerability of a migrant's life at the destination, their link to relatives back home, and the time spent at the destination affect remittances. The paper finds that migrants act as risk-averse economic agents and send remittances back to the household of origin as part of an insurance exercise in the face of economic uncertainty. Remittances are also found to be driven by a migrant's labor market earnings level. The paper highlights the important role of remittances in providing an effective means of risk-coping and mutual support within the family.

I.   Introduction

Migration flows in Vietnam in the past were strictly controlled by a combination of government migration policies and the household registration system (*ho khau*). To redress imbalances in population density across the country, urban to rural and intra–rural migration were explicitly encouraged (Dang et al., 2003). Until

the early 1990s, officially organized migration was the most common form of internal movement observed in Vietnam (Guest, 1998; Dang et al., 2003). Since the middle of the 1990s, however, organized migration has been replaced increasingly by a more spontaneous migration phenomenon (Hardy, 2000).

The *doi moi* (renovation) program has been the main driving force behind the apparent shift from organized to spontaneous migration in Vietnam. Dang et al. (2003), for example, argue that the *doi moi* policy has affected internal migration in three distinct ways: (i) de-collectivization in the agricultural sector has rendered farmers less tied to the land (see Fforde and Huan, 2001); (ii) the marketization of the economy has allowed people, particularly those in the urban sector, to be considerably less dependent on government subsidies and rationing for their daily necessities; and (iii) the increased flow of foreign direct investment (FDI) into Vietnam has attracted migrant workers to certain regions that have been the main recipients of these investment flows (e.g. the Southeast region). This in turn has created regional disparities in labor market earnings that have provided incentives for internal migrants. Pham and Reilly (2007), for example, report that the average hourly wage rate in the Southeast region is approximately 50 percent higher than the national average.

More generally, the observed increase in internal migration over the past decade may also be attributable in part to the emergence of a young and growing population in Vietnam that enjoys greater freedom and a larger array of economic opportunities than earlier generations. As of 2004, over one-fifth of the population was aged less than 15 years, and the 4–19 year age group grew by over 10 percent between 1989 and 1999. This yielded annually approximately 1.5 million new entrants to the labor force over this period. During the 1990s, agriculture was central to job creation for the growing labor force. The set of policy initiatives associated with land reform, trade liberalization, and the promotion of the household sector were crucial in providing conditions for robust growth in the agricultural sector, and the resultant improvement in the living standards of rural households (World Bank, 1998; Benjamin and Brandt, 2004). However, the gains from correcting these distortions were not sustainable given the agricultural sector's inability to absorb the growing labor force and sustain the type of poverty reduction witnessed in the early 1990s (Van de Walle and Cratty, 2004; World Bank, 2006). The share of agriculture in total employment declined from more than two-thirds in 1990 to approximately 58 percent in 2004. The underemployment rate has also shown a tendency to increase in rural areas, with the General Statistics Office (GSO) of Vietnam recording an average rate of 25 percent in recent years (GSO, 2006).

In contrast, the emergence of a vibrant private sector, which was given impetus by the introduction of the Enterprise Law of 2000, created new wage employment opportunities in urban areas.[1] During the period 1993–2002, the average

1.   Approximately 20 000 new establishments were formed per annum after the introduction of the Enterprise Law in 2000 (see World Bank, 2005).

real wage rate grew rapidly by an average rate of 12 percent per annum, with the strongest growth observed in urban areas, especially in the Southeast region (Pham and Reilly, 2007).

The foregoing factors resulted in a widening of the urban–rural gap in household living standards over time (Nguyen et al., 2007). Although the absolute poverty rate has declined substantially since the introduction of the *doi moi*, poverty continues to be far more pervasive in rural than in urban areas. The incidence of household poverty in urban areas reduced from 25 percent in 1993 to well under 10 percent by 2004. Although the rural headcount poverty rate has halved over the same period, it remains stubbornly high and was recorded at 25 percent in 2004.[2] The increasing disparity in urban–rural welfare provides important incentives that stimulate the rural–urban migration flows in Vietnam.

According to the 1999 Population and Housing Census data, 6.5 percent of the population over five years of age (approximately 4.5 million people) changed their place of residence between 1994 and 1999.[3] It is not surprising that provinces with the highest population density (in the Red River Delta) and those with low household incomes in the central regions (the North and South Central Coast) had the highest rates of net outward migration. The country's three largest cities, Hanoi, Da Nang and Ho Chin Minh City, were the main destinations for migrants. For instance, out of a total of nearly 1 million inward migrants to the Southeast, Ho Chin Minh City received nearly half of them.[4]

An important implication of the increased internal population movement is the significant amount of remittances repatriated by migrants. Le and Nguyen (1999), using the Vietnam Living Standards Surveys (VLSS) data from 1992/1993, report that approximately one-fifth of households received remittances during the 12 months prior to the survey interview date and these were equivalent to, on average, approximately 38 percent of their household expenditure. Despite the great volume of remittance flows, there has been little empirical work investigating remittance-related issues in Vietnam, presumably because of the limited availability of data. The data constraint is particularly acute for the analysis of remittance behavior among migrants because detailed data on migrants themselves are often absent in conventional Vietnamese household surveys (e.g. the VLSS or the Vietnam Household Living Standards Survey).

Fortunately for our purposes, data from the 2004 Vietnam Migration Survey have recently become available. This survey collected detailed information on migrants within Vietnam. The main research aim of the present paper is to use this data to examine the key factors that influence the remittance behavior of

2. These are based on the authors' calculations using the Vietnam Living Standards Survey 1992/1993 and the Vietnam Household Living Standards Survey 2004.
3. This does not include short-term, unregistered movement or movement in the six months preceding the census date.
4. Authors' calculations based on the 1999 Population and Housing Census.

internal migrants in Vietnam. Given the absence of data on recipients, our focus will be on the remitters. We specifically examine, among other things, how the circumstances of migrants at the destination, their link to relatives left behind, and the time spent at the destination influence their remittance behavior. According to the 2004 Vietnam Migration Survey, more than half of migrants sent money/goods home to their relatives during the 12 months prior to the interview. Among those who remitted, the total value amounted to, on average, approximately 17 percent of migrants' earnings, reflecting the potential importance of remittances to the origin households.

The remainder of the paper is structured as follows. The next section provides a review of the existing theoretical literature on remittance motives and frames some of the research questions of primary interest to this study. A description of the migration survey data used for the empirical analysis is provided in Section III. Section IV outlines and justifies the variables used in our empirical model, and Section V discusses some econometric issues related to the estimation of the empirical relationship of interest. Section VI presents the empirical results and Section VII offers some concluding remarks.

II.   Literature Review

A variety of theoretical models have been suggested to explain the motives underlying remittance behavior, including altruism, exchange or self-interest, and insurance. The altruistic behavior is modeled by allowing the utility of a remitter to be derived from the well-being or consumption level of those recipients left behind (Becker, 1974). This basically implies a negative relationship between the income of the recipient and the amount of remittances. Aggarwal and Horowitz (2002), in contrast, examine the effect of multiple migrants (as opposed to a single migrant) on the level of remittances. They argue that under pure insurance (or self-interest) motives, the number of other migrants in the family should not affect the amount of per-migrant remittances. However, under altruism, the presence of other remitting migrants will reduce the average size of remittances. Using data for Guyana, Aggarwal and Horowitz (2002) find some support for the presence of altruism.

The exchange motive implies a complex relationship between the recipient's income and the size of remittances. Cox (1987) formalizes a model where private transfers represent payments for services rendered. Under this model, an increase in the remitter's income will be associated with a higher probability of transfers as well as larger payments because the remitter is willing to pay more for the services provided by the recipient. However, if the recipient's income rises, the opportunity cost of providing the service will rise, and the recipient is, therefore, likely to require a higher price for the service provided. As a result, an increase in the recipient's income will reduce the probability of transfer. If the transfer does take place, then the amount of the transfer could rise, fall, or stay the same depending on the remitter's elasticity of demand for the services of the recipient.

The empirical findings of Cox (1987), Cox and Rank (1992) and Cox et al. (1998) suggest a positive relationship between the size of transfers and the recipient's pre-transfer income, rejecting the altruistic behavior of remitters. It is perhaps questionable whether the Cox (1987) theoretical framework has as much relevance to the Vietnamese context as it does for the case of the USA. However, it is worth noting that Secondi (1997), using data for China, also finds that altruism alone cannot explain the observed transfers and that exchange may indeed be involved. In the context of China, where much of the financial flows appear to be transfers from adult children to their elderly parents, childcare is found to be one of the main services that parents render to their adult children in exchange for money (Secondi, 1997).

The above motives are certainly not mutually exclusive and an individual migrant might have more than one motivation for remitting home at any given point in time. Lucas and Stark (1985), for instance, propose 'tempered altruism' or 'enlightened self-interest' to refer to transfers motivated by a combination of altruism and self-interest. This is based on the view that remittances are part of a self-enforcing contractual arrangement between a migrant and his or her family that is of mutual benefit. The migrant adheres to the arrangement as long as it is in his or her interest to do so (Lucas and Stark, 1985). For example, using data drawn from the National Migration Study of Botswana, Lucas and Stark's analysis suggests that transfers are made as a repayment for the cost of the migrant's education and transportation.

In a similar context to the contractual arrangement, Stark (1991) suggests a model incorporating risk-sharing motives. In this model, remittances allow risk-averse households to diversify their income sources and, therefore, minimize the adverse effects of income shocks (Stark, 1991; Gubert, 2002). Amuedo-Dorantes and Pozo (2006) also argue that migrants are likely to behave as risk-averse economic agents and purchase insurance in the face of economic uncertainty. In this way, remittances can be considered as a payment to insure against risky income outcomes in the destination region or country. Based on data for Mexican migrants in the USA, Amuedo-Dorantes and Pozo (2006) find that income risk proxies (e.g. being an undocumented immigrant or not having social networks within the USA) are associated with a higher propensity to remit and with a higher level of remittances.

Quinn (2005), in contrast, suggests another model of remittance behavior whereby remittances are treated as both a consumption transfer to households and as an alternative saving mechanism for migrants. The model predicts that the migrant's remittance/saving behavior is affected by the relative rate of return on their savings and on the savings of the remittance-receiving household. Using data on Mexican workers in the USA, the author finds that migrants remit more and save less when the remittance-receiving household's rate of return on savings increases (or the migrant's return falls). His findings imply that an improved access to savings and investment mechanisms for recipient households in the home country might increase remittance inflows from migrants.

It is useful to now review the relevance of the existing theories to the current Vietnamese context. As noted in the previous section, one of the main factors contributing to the increased internal migration over the past decade is the growing urban–rural gap in living standards. One of the research questions of interest in this paper is whether the migrant's remittance behavior is driven by altruism (i.e. to support his/her family members left behind, presumably, in a poorer area with limited economic opportunities). Unfortunately, our data do not allow for the inclusion of the income/consumption level of the recipient household in the estimated remittance equation, which is often used to examine the altruistic motive in the published literature. Instead, we use the information on the presence of the migrant's immediate family members at the destination to indirectly inform this issue.

The data does not permit an explicit examination of the exchange motive proposed by Cox (1987). However, it is intended to shed some light on the relevance of the self-enforcing contractual arrangement theory, as popularized by Lucas and Stark (1985), to the case of Vietnam. This will be undertaken through an empirical examination of the relationship between the education level of migrants and their remittance behavior.

Another theory, and one perhaps most relevant to the case of Vietnam, relates to the Stark (1991) model of risk-sharing motives. Internal migrants within Vietnam generally face less risk/uncertainty at the destination than international migrants, such as Mexican migrants in the USA (Amuedo-Dorantes and Pozo, 2006). Nevertheless, given the existence of the complex household registration system, described in more detail below, internal migrants in Vietnam have to cope with various problems, including their access to basic public services, which is curtailed in the absence of appropriate registration. It would be interesting, therefore, to investigate whether migrants send money home as an insurance against the vulnerable nature of their position at the destination location.

III.   Data

The empirical analysis reported in this paper is based on data from the 2004 Vietnam Migration Survey. The survey was undertaken by the GSO of Vietnam with the aim to provide detailed information on internal migration in the post *doi moi* era (GSO, 2005). It was conducted in areas identified with high immigration rates based on the 1999 Population and Housing Census, and the sample was selected using the sampling frame of the Population Census (see GSO, 2005). They included some enumeration areas of Hanoi, the Northeast Economic Zone (Hai Phong, Hai Duong and Quang Ninh), the Central Highlands (Gia Lai, Dac Lac, Dak Nong and Lam Dong), Ho Chi Minh City, and the Southeast Industrial Zone (Bing Duong and Dong Nai).

The survey interviewed both migrants and non-migrants in the destination areas, who were in the 15–59 year age-group category. We restrict our analysis

to migrants, and these are defined as those who had moved from one district to another in the five years prior to interview but not more recently than a month before the interview date. The survey covered a wide range of topics, including information on the migration process, socioeconomic characteristics of migrants, demographic composition of household members (at the destination), housing conditions, access to public services, and personal history (e.g. migration and employment activity) of migrants.

The survey data are not without their limitations. For example, the survey does not contain any information on the household from which the migrant originated. This implies that we have no information on the potential recipients of migrant remittances or for what purpose the remittances were used. It is also unfortunate that non-migrants are those found in the destination areas only and this essentially prevents any analysis of the process governing the migration decision. Nevertheless, the data do contain detailed information on migrants themselves, and this allows for an investigation of the effects of various factors on migrant remittance behavior.

IV. Empirical Variables

The empirical model specified in the present study is eclectic in nature and guided by some of the theoretical considerations outlined above, but also strongly reflects the Vietnamese context within which the analysis is situated. Table 1 reports the dependent variable and the explanatory variables used in our analysis, and contains selected summary statistics.

The key dependent variable is expressed in millions of dong and is defined as the total value of money/goods a migrant sent back home to relatives in the 12-month period prior to the interview date.[5] Among those who remit, the average amount of remittances is approximately two million dong. However, for a large number of individuals in the sample the variable is censored at zero, requiring use of a specific econometric approach for the empirical analysis, which is discussed in the next section. A variety of explanatory variables are used and these are now described in turn in the following subsections.[6]

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5. It should be noted that in this paper we define a remitter as a migrant who sent any money/goods home to their relatives and/or gave any money/goods to the relatives during their visits. The data do not allow a distinction between the two types of activity. Hence, the value of remittances is the total value of the money/goods that the migrant sent/gave to his or her relatives during the 12 months prior to the interview.

6. We investigated the magnitude of the correlations between the explanatory variables as a prelude to our regression analysis. In general, the correlations were modest in nature, with the average correlation coefficient being approximately 0.09 in magnitude. The overwhelming majority of estimated correlation coefficients were found to be less than 0.3. Therefore, we do not believe that multicollinearity represents a serious issue for the econometric analysis undertaken here. In addition, the role of this particular phenomenon is likely to be attenuated by the large sample size used in estimation.

Table 1   Description of variables

	Description	*Mean*
Remittances (millon dong)	Total value of money/goods a migrant sent back to relatives in the 12-month period prior to the survey interview date	1.078
Age	Age expressed in years	28.659
Household head	Dummy variable for being household head	0.541
Kinh (majority ethnic group in Vietnam)	Dummy variable for being Kinh	0.900
Female	Dummy variable for being female	0.557
Married	Dummy variable for being married	0.574
Presence of spouse	Dummy variable for spouse living with migrant	0.412
Presence of school age children	Dummy variable for school age (5–18 years) children living with migrant	0.244
Presence of parents	Dummy variable for parent(s) living with migrant	0.136
Household size	Total number of household members living with migrant (at the destination)	3.546
Education		
Illiterate	Dummy variable for being illiterate	0.029
Primary	Dummy variable for having primary education	0.104
Lower secondary	Dummy variable for having lower secondary education	0.487
Upper secondary	Dummy variable for having upper secondary education	0.309
College+	Dummy variable for having a college degree or higher	0.072
Earnings (million dong)	Monthly labor market earnings	0.908
Receive bonus	Dummy variable for receiving any bonus at work	0.351
Receive housing benefits	Dummy variable for receiving any housing benefits at work	0.011
Sector of organization		
Government	Dummy variable for working for government organization	0.131
Private	Dummy variable for working for private organization	0.653
Foreign invested	Dummy variable for working for foreign invested organization	0.208
Others	Dummy variable for working for other type of organization	0.008
Reside in a large city	Dummy variable for living in a large city	0.386
Coming from the countryside	Dummy variable for originating from a rural area	0.785
Live in own house	Dummy variable for living in a house that migrant owns	0.317
Live in permanent dwelling	Dummy variable for living in a dwelling of a permanent type	0.159
Registration status:		
Not registered	Dummy variable for not being registered at the destination	0.041
K1 (permanent)	Dummy variable for having K1 registration status	0.116
K2 (permanent)	Dummy variable for having K2 registration status	0.063
K3 (temporary)	Dummy variable for having K3 registration status	0.316
K4 (temporary)	Dummy variable for having K4 registration status	0.464
Duration in destination		
12 months or less	Spline for 1–12 months	10.785
13–24 months	Spline for 13–24 months	7.395
25–48 months	Spline for 25–48 months	8.314
Had relatives at destination on arrival	Dummy variable for having had some relatives at the destination at arrival	0.599

Table 1   (*continued*)

	Description	*Mean*
Had friends at destination on arrival	Dummy variable for having had some friends/countrymen at the destination at arrival	0.330
Faced difficulty at arrival	Dummy variable for having faced some difficulty at arrival	0.461
Have a health insurance card	Dummy variable for having an insurance card	0.369
Loans		
No loans	Dummy variable for having no loans	0.776
Loans from relatives	Dummy variable for having loans from relatives	0.084
Loans from financial inst.	Dummy variable for having loans from financial institution	0.040
Loans from others	Dummy variable for having loans from others	0.100
Number of visits to relatives	Number of visits paid to relatives during the last 12 months prior to the interview	2.548
Province (current place of residence):		
Hanoi	Dummy variable for living in Hanoi	0.193
Hai Phong	Dummy variable for living in Hai Phong	0.044
Hai Duong	Dummy variable for living in Hai Duong	0.052
Quang Ninh	Dummy variable for living in Quang Ninh	0.095
Gia Lai	Dummy variable for living in Gia Lai	0.053
Dac Lac	Dummy variable for living in Dac Lac	0.054
Dak Nong	Dummy variable for living in Dak Nong	0.054
Lam Dong	Dummy variable for living in Lam Dong	0.050
Ho Chi Minh City	Dummy variable for living in Ho Chi Minh City	0.199
Bing Duong	Dummy variable for living in Bing Duong	0.098
Dong Nai	Dummy variable for living in Dong Nai	0.108
Month of interview		
January, February, March, April	Dummy variable for being interviewed between January and April 2004	0.009
September	Dummy variable for being interviewed in September 2004	0.165
October	Dummy variable for being interviewed in October 2004	0.498
November	Dummy variable for being interviewed in November 2004	0.229
December	Dummy variable for being interviewed in December 2004	0.100

Source: The 2004 Vietnam Migration Survey.

IV.1   Characteristics of individual migrants

A set of individual characteristics capturing the migrant's age, gender and marital status, whether the migrant is the head of the household, and whether the migrant belongs to the Kinh ethnic group, which is the majority ethnic group in Vietnam, are included in the regression analysis. Variables capturing the education level of migrants are also included to inform the theory of contractual arrangement (Lucas and Stark, 1985). We would expect a positive relationship between the amount of remittances and the education level as the migrant's education can be considered as reflecting an earlier household investment requiring future repayment in the form of remittances.

IV.2 Household-level characteristics

Variables relating to the structure of the migrant's household at the destination are also included in the analysis. These variables include measures that indicate whether the spouse, school-age children (those aged 5–18 years) or parent(s) are present at the destination, as well as a variable for the total number of household members. The presence of immediate family members at the destination would imply potentially weaker ties to the place of origin and, if altruistic behavior is present, negative effects for these variables are anticipated (see Markova and Reilly, 2007). In addition, variables representing the housing tenure status of a migrant (e.g. whether the migrant owns the accommodation and/or whether it is of a permanent type) are also included. The expected signs for the estimated effects of these variables are again assumed negative. If the migrant owns the housing and/or lives in a permanent-built dwelling, it might imply that the migrant has a less transient connection with the destination or that the migrant's living condition at the destination is relatively more secure. In either case, the migrant is likely to remit less.

IV.3 Employment status of migrants

We also include a set of variables that capture the labor market earnings of the migrant as well as controls for whether the migrant receives any bonus or housing benefits relating to the job held. We would expect a positive coefficient on both the level of earnings and the dummy variable for receiving a bonus. However, receiving some housing benefits is likely to reduce the insecurity of the migrant at the destination and, therefore, a lower level of remittances might be needed for insurance purposes. A mutually exclusive set of variables designed to capture the type of enterprise in which the migrant works (e.g. government, domestic private sector, foreign invested sector and others) are also included and are taken to reflect the security of the migrant's job in the destination labor market.[7] For instance, if the migrant works for a government organization, their job is likely to be relatively stable in nature and, as a result, the migrant might be less likely, *ceteris paribus*, to remit money home for insurance purposes.

IV. 4 Migrant's registration status

This study also investigates the influence of the Vietnamese migrant registration system on remittance behavior. Vietnam has a complex household registration system delineated across four levels of registration: KT1 (the migrant is registered in the district where the person resides); KT2 (the migrant is not registered in

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7. Unfortunately, the data do not allow us to distinguish whether the migrant works for the government or in a manufacturing state-owned enterprise.

the district where the person resides, but registered at another district or in the same province); KT3 (the migrant has temporary registration for a period of 6 months or more); and KT4 (the migrant has temporary registration for a period of less than 6 months).

These four categories can be broadly allocated into two groups: permanent registration (KT1 and KT2) and temporary status (KT3 and KT4) at the destination. Given that the migrant's registration status potentially captures whether the move is temporary or permanent, we would expect a positive relationship between the migrant's temporary status and the level of remittances compared to a more permanent registration status. However, if the motive for remittances is altruistic, whether the migrant's move is permanent or temporary should not affect the size of transfer remitted. However, not having a permanent registration status could also be taken to reflect the vulnerability of the migrant's position at the destination. According to Deshingkar et al. (2006), for instance, migrants with KT3 or KT4 status have to secure the most basic services at prices well above average, and some public services might be inaccessible to them. Hence, if we observe a positive coefficient on the variables for KT3 or KT4 (with KT1 providing the base category in estimation), this could be interpreted as evidence supportive of an insurance motive for remittances. It is also worth noting that a relatively small number of migrants (4 percent) report having no registration at all.

IV.5   Duration of stay at the destination

To examine the relevance of the remittance decay hypothesis for Vietnam (see Liu and Reilly, 2004), we also include the time spent at the destination. Unfortunately, in the survey, migrants are defined as those who had moved from one district to another in the 5-year period prior to the interview date. Therefore, we are unable to fully explore the issue of remittance decay hypothesis for the case of Vietnam. Nonetheless, the duration variables should proxy some general tendencies in this regard. The duration variables are splined using the number of months spent at the destination (see Table 1 for the nodes used).

IV.6   Ease of migration process

To examine how the security/stability of the migrant's position at the destination affects remittance behavior, several other potentially informative variables are also included. One is a dummy variable for whether the migrant faced any difficulty on arrival in the host destination.[8] If the insurance theory of remittances is valid, a positive sign for the coefficient corresponding to this variable is likely as it captures the vulnerability of the migrant. We also include a variable designed to capture whether the migrant had any relatives in the

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8.   Among those migrants who faced some difficulties, the main ones are reported (in rank order) to be housing problems, having no income source, and, related to this, not being able to find a job.

destination location on arrival to determine whether or not network effects are important. We also include a similar variable for the presence of friends and/or other individuals from their location of origin. Finally, a dummy variable representing whether the migrant has any health insurance at the destination is also included, as this could be taken to capture the migrant's degree of integration at the destination. The coefficients on the network and insurance variables are anticipated to be negative because if the migrant has a social network and/or any insurance at the destination, reliance on relatives for any assistance is likely to be less, as is the value of repatriated money and/or goods.

IV.7   Other variables

There are several other variables contained in our empirical specification. These include the number of visits to relatives that migrants undertook within the 12-month period prior to the interview. The sign of this coefficient is anticipated to be positive as the greater number of visits captures a closer relationship with the relatives left behind and provides a greater opportunity to directly remit money and/or goods. The survey also asked questions relating to migrants' loans, and we therefore include variables capturing the migrant's borrowing behavior. More specifically, we include a set of mutually exclusive dummy variables for: (i) if the migrant has no loans; (ii) if the migrant secured loans from relatives; (iii) if the migrant secured loans from a financial institution; and (iv) if the migrant secured loans from others. The first provides the base category in estimation. These variables are designed to capture, among other things, whether there is any financial mechanism or capital market operating within the family, and the estimated coefficients will reflect how these variables affect the amount of remittances.

We also include a set of variables that indicate the geographical characteristics of the origin and destination places. The set includes a dummy variable for whether the destination is a large city and for whether or not the migrant comes from a rural area. We are likely to observe a positive relationship between the former of these variables and the level of remittances as such locations are more likely to be characterized by a better financial infrastructure (e.g. banks and post-offices) that facilitates the transfer of goods and money, and better transportation links to the area of origin. In addition, provincial dummies (based on the destination) and seasonal dummies (based on the interview month) are also included. The former are designed to capture spatial differences that might be important to remittance behavior, and the latter are included to capture potential seasonal effects in this type of activity.

V.   Econometric Methodology

One of the key issues affecting the estimation of a migrant remittance function is the censored nature of the dependent variable. This occurs because

not all migrants remit money in a given year. The application of OLS will generate biased estimates in such a context, with the magnitude of the bias linked to the proportion of non-censored observations in the sample. Therefore, conventional linear regression methods are inappropriate for the censored dependent variable as they fail to account for the qualitative difference between censored (zero) observations and uncensored (continuous) observations. When data are censored, an approach that incorporates a discrete component (to generate the zero observations) and a continuous component (to generate the positive observations) is required (Greene, 2003). The most commonly used censored regression model in this context is the tobit model (Tobin, 1958).

This method has been used in various studies in the migrant remittance literature, including those by Brown (1997), Ahlburg and Brown (1998), Liu and Reilly (2004), Amuedo-Dorantes and Pozo (2006) and Markova and Reilly (2007). The tobit model offers a simple way of estimating the determinants of remittances and is used for the empirical analysis reported in the present paper.

The underlying structure of the remittance equation is defined as follows:

$$
\begin{aligned}
R_i &= R_i^* \quad \text{if } R_i^* > 0 \\
R_i &= 0 \quad \text{otherwise,}
\end{aligned} \tag{1}
$$

where R_i is the amount of money that the ith individual remits, which is observed if R_i^* is positive. The latter is an unobservable latent dependent variable that captures the ith individual's propensity to remit. It is defined as follows:

$$
R_i^* = X_i \beta + u_i, \quad \text{where } u_i \sim N(0, \sigma^2), \tag{2}
$$

where X_i is a $1 \times k$ vector of independent variables where k is the number of variables including a constant term, β is a $k \times 1$ vector of unknown parameters, and u_i is an independently and normally distributed error term with mean zero and constant variance σ^2. This model is regarded as a censored regression model because observations of R_i^* at or below zero are censored. In other words, R_i is either positive ($R_i > 0$) or zero ($R_i = 0$). Based on this information, the likelihood function can be expressed as:

$$
L = \prod_{R_i | R_i = 0} \left[1 - \Phi\left(\frac{X_i \beta}{\sigma} \right) \right] \cdot \prod_{R_i | R_i > 0} \left[\frac{\phi((R_i - X_i \beta)/\sigma)}{\sigma} \right], \tag{3}
$$

where $\Phi(\cdot)$ and $\phi(\cdot)$ denote the operators for the cumulative distribution and probability density functions of the standard normal, respectively. The first part resembles the likelihood function for a probit model for the event of zero, while the second part is similar to the likelihood function for the conventional OLS model for the sample observations that are continuous (i.e. not censored). It is convenient to log this likelihood function to facilitate estimation, and the

inverse of the regression model's information matrix provides the asymptotic variance–covariance matrix for the parameter estimates.[9]

VI.   Empirical Results

We restrict our sample to working migrants, as the number not working is negligible, and only includes those who report labor market earnings.[10] This yields a total sample size of 4388 migrants. More than half (55 percent) are reported to have sent some money/goods to their relatives within the 12-month period prior to the interview date. Among those who remit, the average share of remittances in migrant earnings is approximately 17 percent. This is comparable to the findings for urban migrants reported in a recent study for China (see Knight et al., 1999). Table 2 reports the tobit estimates for the remittance model, translated into marginal and impact effects for the continuous and dummy variables, respectively.

In general, the individual-level characteristics of migrants, such as their age, gender and ethnicity, do not appear to affect remittance behavior. In contrast, the education level of migrants has a well-defined positive effect on remittances. For instance, if the migrant has primary education, the amount of remittances sent home increases by 1 million dong compared to a migrant who is illiterate, on average and *ceteris paribus*. The marginal effect rises to 1.2 million dong for those with a college education or better. Given that we are controlling for labor market earnings, the positive coefficients on the education variables appear consistent with the theory suggested by Lucas and Stark (1985), which suggests that remittances can be considered as a repayment for the resources that the migrant's family originally invested in the migrant's education.

The empirical results show that the presence of a migrant's immediate family members at the destination reduces remittances. Markova and Reilly (2007) provide comparable evidence for a sample of Bulgarian migrants in Spain. The effect for Vietnamese migrants is particularly pronounced for those with school-age children and parents present. The amount of their remittances is lower compared to those without such dependents, by 0.2 and 0.6 million dong, respectively, on average and *ceteris paribus*. The closer the ties that the migrant has with those left behind, captured by the number of his or her return visits to

9.   The estimation of the migrant remittance function using cross-sectional data, as in this study, may be affected by the presence of heteroscedasticity. In the context of the tobit model, this has implications for both parameter consistency and efficiency. As the estimated tobit model is not the subject of rigorous diagnostic testing in this respect, a degree of caution is perhaps required. Unfortunately, sandwich estimators for the variance–covariance matrix, conventionally used for limited dependent variable models to correct for the presence of heteroscedasticity and other model assumption violations, are not feasible for the censored tobit model.

10.   We have also excluded from our analysis a small number of observations with implausibly large remittance and labor market earnings values.

Table 2   Maximum likelihood estimates for tobit model

	Marginal and impact effects	Asymptotic standard errors
Age	0.025	[0.018]
Age squared	−3.16E-04	[2.61E-4]
Household head	0.079*	[0.047]
Female	0.055	[0.046]
Kinh (majority ethnic group in Vietnam)	0.115	[0.104]
Married	0.065	[0.065]
Presence of spouse	−0.001	[0.062]
Presence of school age children	−0.167**	[0.067]
Presence of parents	−0.556***	[0.076]
Household size	0.021*	[0.012]
Education		
Illiterate[a]		
Primary	1.002***	[0.244]
Lower secondary	1.033***	[0.239]
Upper secondary	1.040***	[0.241]
College+	1.248***	[0.257]
Earnings	0.624***	[0.043]
Received bonus	0.146***	[0.054]
Received housing benefits	0.097	[0.188]
Sector of organization		
Government	−0.221***	[0.076]
Private[a]		
Foreign invested	0.194***	[0.068]
Others	0.113	[0.215]
Reside in a large city	0.210*	[0.114]
Coming from rural area	0.123**	[0.052]
Live in self-owned housing	−0.157**	[0.071]
Live in a dwelling of permanent type	−0.113*	[0.063]
Registration status		
Not registered	0.260**	[0.132]
K1 (permanent)[a]		
K2 (permanent)	−0.059	[0.127]
K3 (temporary)	0.224***	[0.084]
K4 (temporary)	0.580***	[0.098]
Splines for duration in destination		
12 months or less	0.058***	[0.009]
13–24 months	0.010**	[0.005]
25–48 months	−0.005*	[0.003]
Had relatives at destination on arrival	0.209***	[0.043]
Had friends at destination on arrival	0.005	[0.044]
Faced difficulty at arrival	−0.115**	[0.045]
Have a health insurance card	0.043	[0.060]
Loans		
No loans[a]		
Loans with relatives	−0.143*	[0.078]
Loans with financial institution	0.286**	[0.116]
Loans with others	0.031	[0.082]

Table 2   (*continued*)

	Marginal and impact effects	Asymptotic standard errors
Number of visits home to relatives	0.096***	[0.006]
Province (current place of residence)		
Hanoi[a]		
Hai Phong	−0.237**	[0.116]
Hai Duong	0.167	[0.150]
Quang Ninh	0.751***	[0.127]
Gia Lai	−0.279	[0.178]
Dac Lac	−0.038	[0.181]
Dak Nong	0.011	[0.165]
Lam Dong	0.160	[0.157]
Ho Chi Minh City	0.206**	[0.097]
Bing Duong	0.089	[0.130]
Dong Nai	−0.074	[0.129]
Number of observations	4388	
Number of censored observations	1987	
σ	2.387 [0.036]	
Pseudo adjusted-R^2	0.311	
Log-likelihood value	−6549.12	

Notes: The exogeneity of earnings was investigated using the test of Smith and Blundell (1986) and supported by the data. Dummies capturing the months when the interview occurred were also included in the regression model. The marginal effects are evaluated at the means of the independent variables for the unconditional expected values of the dependent variable. For the binary variables, we report the discrete change from 0 to 1.
[a]Category omitted in estimation. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.
Source: Calculations based on the 2004 Vietnam Migration Survey data.

the location of origin, the greater the level of remittances sent home.[11] These findings seem to render some support for an altruistic motive with respect to remittance behavior, but are also potentially consistent with migrants retaining links to ensure favorable treatment in the context of family inheritance.

The labor market earnings of migrants exert an expected positive effect on remittances. According to the marginal effect, if monthly earnings increase by 1 million dong, this raises annual remittances by 0.6 million dong. The remittance–earnings elasticity, computed at the overall sample means, is estimated to be 0.53, which is on the low side when compared to the existing published literature.[12] However, a direct comparison with the literature is

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11. We do not have sufficient information to control explicitly for the distance of the origin from the destination location. This might influence the number of trips and visits a migrant makes home in any 12-month period.
12. See Liu and Reilly (2004) for a survey of estimates.

fraught with difficulty given differences in both empirical specifications used and geographical contexts. Nevertheless, this finding suggests that the flow of remittances in Vietnam is fairly insensitive to labor market conditions, as captured by earnings, in the destination location. Bonus payments on the job also impact positively on remittances, with those in receipt of such a job-related benefit remitting 0.15 million more dong, on average, than those who are not.

As for the sector of the enterprise where migrants work, compared with working in a private domestically-owned enterprise, which could be situated within the informal sector, a migrant who works for the government is likely to repatriate less money home. The opposite is the case for those working in the foreign-invested sector. This might reflect the stability of jobs in a particular sector, which possibly influences the degree of a migrant's reliance on their family in the originating household and, therefore, reduces the co-insurance motive for remitting. For instance, jobs in the government sector are likely to be more stable and more permanent, and migrants working in this sector thus rely less on their family at home to insure against labor market risk. Moreover, the positive coefficient on the foreign-sector dummy seems to indicate that the benefits of FDI might not be restricted to urban workers, with trickle-down effects to rural areas through the process of remittances evident in these estimates.

In regard to registration, a migrant possessing the most temporary form of registration status (K4), on average and *ceteris paribus*, sends a greater volume of remittances home than a comparable migrant with permanent residential status (K1). Hence, the fragile nature of the migrant's residential status appears to matter in Vietnam and is resonant of the finding reported by Liu and Reilly (2004) for rural migrants in Jinan (China). The temporary and uncertain nature of the status encourages migrants to retain strong links with the origin household to insure against the risk of forced expulsion from the host destination. Similarly, if migrants own their housing, or if they live in permanent accommodation, they are found to remit less. This again supports the view that if the nature of the migration is permanent and/or stable, migrants tend to send less money home, providing some support for the co-insurance theory.

We find a positive relationship between the number of months at the destination and the level of remittances. This is particularly the case for the initial year. However, after the third year the relationship becomes negative and consistent with the remittance decay hypothesis. This seems to suggest that over time migrants acquire a greater level of location-specific human capital in the destination, thus reducing the risk of failure and, assuming a co-insurance motive underlying remittances, require less support from home. This manifests itself in a tendency to reduce the amount of money and goods remitted home by the migrant.

As far as network effects are concerned, having relatives at the destination on arrival exerts a positive effect on the level of remittances, suggesting that such networks assist migrants to settle in more smoothly at the new location, thus reducing settlement costs. We found no significant effect for the network based

around non-relatives. In contrast, if the migrant encountered any difficulty on arrival, less money is sent back. However, whether the migrant possesses a health insurance card does not seem to exert a significant impact on remittance behavior.

Having a loan from relatives negatively impacts on the level of remittances. We could interpret the negative sign as reflecting the fact that relatives might be more relaxed about the time profile for loan repayment. In contrast, it is revealing that those who obtained loans from financial institutions, presumably in their location of origin, do remit more than those without loans. This might reflect the fact that they are required to service such loans in a more timely fashion and within a shorter time frame than that tolerated by relatives.

Finally, compared to those migrants located in Hanoi, those residing in Quang Ninh (in the Northeast Economic Zone) and Ho Chi Minh City remit a larger amount of transfers. This could be taken to suggest that migrants are selectively choosing destinations with a view to servicing the requirements of their origin household. The greater the requirements, the more likely migrants are to re-locate to the more buoyant labor markets in Vietnam. Finally, migrants who reside in a large urban city remit relatively more than those who do not, and this might simply reflect the fact that the large cities possess the financial and other infrastructure that more easily allow and facilitate the transfer of money and goods.

VII.   Concluding Remarks

This paper has empirically examined the key determinants of migrant remittances at the individual level using a recently conducted survey on internal migration within Vietnam. Our empirical model incorporated, in an eclectic manner, variables assumed to capture some of the underlying motives for remitting suggested by existing theories. The paper also tried to uncover some factors unique to Vietnam that determine remittance behavior in that country.

The empirical analysis yielded a number of key findings and suggests that no one theory is likely to be sufficient to explain the remittance phenomenon in Vietnam. The study found that the education of migrants has a well-defined positive effect on the level of remittances. This seems to provide some support for the theory of contractual arrangement (Lucas and Stark, 1985), where remittances are seen as a repayment for the money and resources that the migrant's family originally invested in the migrant's education. The negative coefficient on the variable for the presence of the migrant's parents at the destination also provides some support for this notion. However, the negative coefficient can also be seen as supportive of altruistic motives (Becker, 1974). Unfortunately, given the absence of any information regarding the recipient household, such as the origin household's income or assets, we are unable to examine empirically this issue in a more systematic fashion. The observed negative coefficient relating to the presence of school age children at the

destination suggests that remittances can also be seen as an investment in the education of the migrant's family.

The empirical estimates also provide support for the co-insurance theory (Stark, 1991; Amuedo-Dorantes and Pozo, 2006). For instance, we have found that having a family network at the destination increases the level of remittances. Moreover, the sector of the enterprise where the migrant works, which we take to reflect the security of the migrant's job, also impacts migrant remittance behavior. Given that these variables capture the vulnerability of the migrant's position at the destination and/or the ease of the process of settling into a new location, our findings appear consistent with the insurance motive where the migrant sends remittances as a payment to insure against labor market uncertainty at the destination.

Another key finding of this paper is that temporary migrants tend to remit more as revealed by the significant positive effect corresponding to the variable for temporary registration status (K4). This can be interpreted as evidence for the co-insurance motive as this registration status indicates the relatively insecure position of migrants in the destination area. However, the coefficients for the time spent at the destination provide support for the remittance decay hypothesis. A significant positive relationship between the number of months and the level of remittances is found for the initial year, but the estimated relationship becomes negative by the third year.

The negative coefficients on the variables for the presence of the migrant's immediate family members at the destination provide evidence for the altruistic behavior of migrants. However, given data constraints, we could not examine the validity of the altruism hypothesis in a more direct way. Our findings reveal that altruism is unlikely to provide a sufficient explanation for the motivation to remit.[13] On balance, our econometric findings are not inconsistent with migrants acting as risk-averse economic agents sending remittances as part of an insurance strategy in the face of economic uncertainty.

We believe that our analysis sheds some important light on the role remittances perform in terms of risk-coping and mutual support within the family. However, the fact that we are unable to control explicitly for origin household characteristics in our analysis suggests the need for some interpretational caution. It may be the case that the introduction of controls capturing the socioeconomic status of families at the place of origin, if they were available to us, could weaken some of the estimated relationships uncovered. In addition, it should be borne in mind that if such omitted variables were highly correlated with key variables included in the estimated regression model, this could introduce bias in some of the estimated effects reported. Unfortunately, neither of these are issues for which the current data allow further investigation. Nevertheless, we do believe that the empirical evidence presented emphasizes the need for policy-makers,

13. It should be stressed that this is somewhat speculative given that we have not formally tested the predictions of altruism theory in this study.

when formulating migration-related policies, to be sensitive to the fact that many migrants retain strong economic links to those left behind. A more thorough investigation of how migrant remittances are actually used in the origin household is required before definitive conclusions can be offered on the effect such remittances exert on vulnerability and poverty within the origin households in Vietnam. This analysis should clearly comprise part of an important agenda for future research for Vietnam.

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Efficiency, Cointegration and Contagion in Equity Markets: Evidence from China, Japan and South Korea*

A.S.M. Sohel Azad

This paper empirically examines whether three East Asian stock markets, namely, those of China, Japan and South Korea, are individually and/or jointly efficient, and whether contagion exists between the cointegrated markets. While individual market efficiency is examined through testing for the random walk hypothesis, joint market efficiency is examined through testing for cointegration and contagion. The present study finds that the hypothesis of individual market efficiency is strongly rejected for the Chinese stock market, but not for the Japanese and the South Korean stock markets. However, when testing for cointegration, market efficiency is strongly rejected for all these markets. We take a simple case of contagion and find that although there is a long-term relationship among the three markets, the contagion hypothesis cannot be rejected only between Japanese and South Korean stock markets, indicating short-run portfolio diversification benefits from these two markets.

Keywords: market efficiency; unit root; variance ratio; cointegration; contagion; simulation.

JEL classification codes: C14; C32; G14; G15.

doi: 10.1111/j.1467-8381.2009.02002.x

I. Introduction

The concept of market efficiency dates back to the theoretical contribution by Bachelier in 1900 and the pioneering empirical research by Cowles in 1933 (Campbell et al., 1997). However, Bernstein (1992) points out that the modern literature of efficiency starts with Samuelson's (1965) contribution 'Proof that properly anticipated prices fluctuate randomly,' in which he has neatly introduced

the concept of the random walk hypothesis to economics and finance. Fama (1970) has also captured this idea in his work. He points out that, in an informationally efficient market, prices fully reflect all available information. It is worthwhile noting that an investor behaves aggressively upon any informational advantage at his or her disposal and, therefore, he or she allows prices to incorporate new information, which generates returns from his or her investment. An investor responds to the new information before the profits from trading on the assets quickly disappear. In the age of rapid growth of information technology and economic globalization this happens instantaneously. Therefore, information-based trading is always risky; and in an efficient market, price changes are random and unpredictable. In general, the developed markets are found to be informationally efficient: price changes are unpredictable and excessive returns are unlikely because both the prices are properly set and the risks are appropriately measured.

The study of individual market efficiency helps us to understand the behavior of that specific market. Such a study is important if the investor focuses on one market only. However, the increasing levels of trade interaction and the easing of regulatory rules governing the movement of capital have allowed investors to look for international portfolio diversification among the many markets. Consequently, investors are encouraged to know the investment behavior of other markets to exploit arbitrage opportunities. Tai (2001) also argues that in the age of economic globalization and regional integration, the study of individual market efficiency has limited implications, particularly when investors look for time-varying risk premia in different markets.

The study of the behavior of several stock markets has encouraged academics, policy-makers and international fund managers to ascertain whether these markets are truly interlinked, interdependent, cointegrated and, therefore, contagious to each other. The general notion is that if there is strong evidence of cointegration, the markets are susceptible to shocks in other markets and, hence, the volatility in one market does spill over to other.[1] There are two major assumptions that the empirical literature uses to clarify the relationship between market efficiency and cointegration. One of these assumptions is that if asset prices in two different markets are efficient, then these prices cannot be cointegrated (see also Granger, 1986). The second assumption is related to market integration and statistical cointegration. If asset prices in two different markets are integrated of the same order (i.e. $I(1)$), then these prices are, by and large, cointegrated. This rule applies if the two markets considered are geographically close and, of course, their financial markets are highly integrated. However, to further investigate whether the long-term relationship exists at all among these markets, we have to look at their statistical significance,

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1. The literature on market contagion typically uses the ARCH/GARCH approach to look at volatility spillover. Because we focus more on the interrelationships, here we use the long-run equilibrium relationship and the causal relationship to analyze volatility spillover.

which we can do using the cointegration test procedures. The two assumptions of market integration and statistical cointegration lead to the contradictory conclusion that the integrated financial markets cannot be efficient markets. Lence and Falk (2005) raise these issues and clarify the relationships among market efficiency, market integration and statistical cointegration more clearly from theoretical perspectives. They show four possible combinations (concerning market efficiency and market integration) to demonstrate that the concept of cointegration is unrelated to market integration or to market efficiency and that the equity prices may be either cointegrated or not in all four possible combinations. Therefore, it is practically difficult to prove or refute a direct link among cointegration, market efficiency and market integration.

This paper focuses on three East Asian equity markets, namely, China, Japan and South Korea, to examine whether these markets are individually efficient and/or jointly efficient and contagious to each other. Questions may arise regarding why we confine our study to these three markets, even though there are many emerging and rapidly developing markets in the region. Janakiramanan and Lamba (1998) argue that markets that are geographically and economically close exert significant influence over each other. Masih and Masih (1999) also advocate the intraregional impact of fluctuations in the Asian stock markets. These three markets, China, Japan and South Korea, are both geographically and economically close, so it is expected that they would exert significant influence over each other.

Three major purposes are identified for this study: to examine (i) individual market efficiency; (ii) interdependence (or joint market efficiency); and (iii) contagion. Three hypotheses are used in the analysis: the efficiency hypothesis, the cointegration hypothesis and the contagion hypothesis. Each of these hypotheses is tested using different methodologies. Individual market efficiency is examined through studying the univariate properties of the markets concerned and the joint efficiency is examined through multivariate tests of cointegration and causality. The multivariate tests elucidate whether the markets are interdependent and interlinked to each other. Although the presence of both individual and joint market efficiencies indicates that the returns from the markets are unpredictable, the absence of the same implies that the return from a market can be predicted by its or other's past values. On the one hand, the unpredictability of returns from the financial market is commonly interpreted as evidence of efficiency. On the other hand, the predictability of returns is interpreted as evidence against efficiency. The ability to forecast the returns from a market depends on several factors: for instance, investors' ability to gather superior information, economic integration, the extent of speculation in the market, the extent of policy intervention by the regulators and entry of foreign investors.

Three hypotheses are tested in three phases. First, individual market efficiency is examined using the Zivot and Andrews (1992) unit root test and the variance ratio tests of Lo–MacKinlay (1988) and Wright (2000). Second, joint

efficiency is examined using the Engle–Granger (1987) and the Gregory–Hansen (1996) cointegration tests. Third, the contagion hypothesis is examined using Toda–Yamamoto (1995) tests of Granger causality.

All the above procedures are applied to the daily closing prices of the three stock exchanges: Shanghai Stock Exchange (SSE, China), Tokyo Stock Exchange (TSE, Japan) and Korea Stock Exchange (KSE, South Korea). The test statistics indicate that the Chinese stock market is characterized by inter-temporal inefficiency under the hypothesis of individual as well as joint market efficiency. Not surprisingly, even though the Japanese and South Korean markets are found to exhibit market efficiency under the hypothesis of individual market efficiency, these two markets along with the Chinese markets are found to be jointly inefficient. Because our analysis implies that the three equity markets are cointegrated, which is indicative of a long-term relationship, a different approach is used to test causality (proposed by Toda and Yamamoto, 1995), to detect whether there is much evidence of contagion.[2] In this regard, we also follow Tsutsui and Hirayama (2004) to examine the causality from the TSE and the KSE to the SSE because the closing stock prices are observed at different hours of the day in these markets due to time differences. The SSE is the last of the three exchanges to close on a given day, and closing prices for Tokyo and Seoul for the same day are already available to investors in Shanghai. Therefore, in a regression equation with the SSE price as a dependent variable, we include prices in the other two markets on the same day (along with past prices) as regressors. Notwithstanding, the results from both the previous day and the same day closing prices have not altered the conclusion. The test statistics indicate that even though the markets are cointegrated, there is not much evidence of contagion between the markets, with the exception of bi-directional causality/contagion between Japan and South Korea.

The rest of the paper is organized as follows. Section II provides a brief review of the published literature. Section III describes the background of the markets. The methodology is explained in Section IV, and in Section V the data, summary statistics and empirical results are discussed. The paper ends with some concluding remarks in Section VI.

II. Review of Literature

The literature review can be divided in two: there are studies that consider methodological issues and others that focus on Asian equity markets. Different kinds of econometric methodologies are used in the existing body of published

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2. There is widespread disagreement on the definition and application of the term contagion (for more details see Forbes and Rigobon, 2002; Billio and Pelizzon, 2003). We take a simple case to define the term and indicate that if the cointegrated markets provide evidence of causality, then there is some evidence of contagion. Phengpis (2006) euphemistically put forward that in most cases we ignore the simple analytical techniques (e.g. statistical correlation) to explain the linkages and interdependencies among the markets.

literature, including univariate, bivariate and multivariate tests, to examine whether financial markets are informationally efficient. Univariate tests indicate whether a financial market is individually efficient. Bivariate and multivariate tests indicate whether one financial market incorporates sufficient information for creating forecasts of another and to explain the efficiency of the other financial market(s).

The most frequently used univariate tests are the unit root tests, the autocorrelation tests, the fractional integration/long memory tests and the variance ratio tests. Lo and MacKinlay (1988, 1989), Cecchetti and Lam (1994) and Gilmore and McManus (2003) argue that the variance ratio test is more reliable than the other univariate tests, like traditional unit root tests and autocorrelation tests. Also, the variance ratio tests of Lo and MacKinlay (1988) and Wright (2000) applied in this paper take into account both the conditions of homoscedasticity and heteroskedasticity in the relevant time series. The most frequently used bivariate and multivariate tests are cointegration tests, causality tests, panel unit root tests, panel cointegration tests and multivariate generalized autoregressive conditional heteroskedasticity (MGARCH). Of the several cointegration tests available, we apply the Gregory–Hansen (1996) cointegration test, which takes into consideration the endogenous breaks in the series.[3] There are three alternative procedures that can be applied when the variables are cointegrated. These are the error correction model (ECM)-based Granger (1969) causality test, the likelihood ratio (LR) test, suggested by Mosconi and Giannini (1992), and the multivariate generalizations of Wald (MWALD) test (of Granger causality) suggested by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996). The Monte Carlo experiment, in Zapata and Rambaldi (1997), shows that the MWALD test has comparable performance in size and power to that of ECM-based and LR tests if there are 50 or more observations. The major motivation for the use of the Toda–Yamamoto (1995) approach is attributed to its practical implication in explaining the long-term relationship while at the same time examining Granger causality.

When contemplating individual market efficiency, the study by Hoque et al. (2007) is a good starting point because it uses the variance ratio methodology to examine the Asian stock market efficiency.[4] Hoque et al. use weekly data, focusing on eight emerging markets in Asia, including South Korea (but not Japan and China), and find that South Korea's market is efficient. Kim and Shamsuddin (2008) report similar results. They apply the variance ratio methodology to daily and weekly data and find that the Japanese and the South Korean markets are also efficient. In earlier studies, Ayadi and Pyun (1994) and Ryoo and Smith (2002), among others, fail to reject the random walk

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3. Phengpis (2006) summarizes the advantages and limitations of some of the cointegration procedures with an application to the study of foreign exchange market efficiency.
4. For a survey of the existing published literature on individual market efficiency, see Hoque et al. (2007), and for literature on Asian equity price linkages, see Worthington et al. (2004).

hypothesis for South Korea. In contrast, Huang (1995) rejects the random walk hypothesis for South Korea. There are, of course, innumerable studies on the Chinese and the Japanese stock markets, and there are no significant disagreements among the researchers on the results, albeit, the common wisdom applies to these markets: the former providing the evidence against market efficiency and the latter supporting the evidence of market efficiency.

Chan et al. (1992, 1997) study the interlinkages among international equity markets and interpret their findings of no cointegration among these markets as evidence of joint market efficiency. The term 'joint efficiency' is documented in other studies too. Mishra et al. (2002) use the cointegration test and the associated error-correction model to examine the joint efficiency in forward and futures markets for foreign currencies. Hassapis et al. (1999) also use the cointegration test to investigate joint efficiency in the international commodity markets for four industrialized countries. Lence and Falk (2005) list some studies that apply the cointegration procedures to test for market efficiency in equity markets, security markets, foreign exchange markets, commodity markets and banking product markets. However, Lence and Falk (2005) themselves argue that cointegration of asset prices may not be used for assessing market integration and/or market efficiency but may be used to draw inferences about preferences and endowment processes. Dwyer and Wallace (1992) also argue that cointegration is neither a necessary nor a sufficient condition for market efficiency. Kühl (2007) does not explicitly use the term 'joint market efficiency,' but applies the cointegration procedures to test informational efficiency in foreign exchange markets. Worthington and Higgs (2004) and Olienyk et al. (1999) interpret the evidence of Granger causal relationships between cointegrated markets as a violation of (joint) market efficiency. Lim et al. (1998) also argue that investors can devise trading strategies to exploit any inherent inefficiencies between markets. In contrast to others, Roca (1999) identifies the evidence of finding no cointegration (between equity markets of Australia, the UK, the USA and other Asian countries) as good for long-term portfolio diversification. Using three financial market variables; namely, exchange rates, stock price indices and interest rates, Khalid and Kawai (2003) test the contagion hypothesis in the East Asian financial markets. They apply Granger causality to nine East Asian countries, including Japan and South Korea, and do not find strong support for contagion. Baig and Goldfijn (1998), Masih and Masih (1999), Reside and Gochoco-Bautista (1999), Jang and Sul (2004) and Pan et al. (2007), among others, apply VAR, associated ECM techniques and the Granger causality tests to study the contagion in the East Asian stock markets. Jang and Sul (2002) use co-movements in markets to measure contagion, whereas Pan et al. (2007) use the linkages between exchange rates and stock prices to analyze contagion. Tai (2007) applies the asymmetric multivariate GARCH, which provides evidence of contagion from the stock markets to the foreign exchange markets in the Asian emerging markets, including South Korea.

III. Market Backgrounds

III.1 China

China's equity market has been in existence since 1990, when both the SSE and the Shenzhen Stock Exchange (SHSE) were created. China's equity market is characterized as less developed compared to Japan and South Korea's equity markets. Two types of shares are traded in the Chinese stock markets: A shares for domestic investors and B shares for foreign investors. The stock market experienced its first peak in the early 1990s, led by intense speculative activity, and returned to more moderate levels in the mid-1990s. Wong (2006) argues that China's stock market development during this period was driven primarily by rent-seeking and speculative activities, not by value-driven transactions between investors and fund seekers. Throughout the 1990s, the market was characterized by frequent price movements (see panel 'a' of Figure 1). The market experienced an upward trend from the late 1990s to 2000. In 2000, the market capitalization, the liquidity and the trading volumes doubled from the previous year.

III.2 Japan

Japan's equity market is the second largest in the world and the largest in Asia Pacific in terms of market capitalization. The history of Japan's equity trading dates back to the late 1800s when the TSE and Osaka Stock Exchange were set up. At present, equity trading features in six exchanges in Japan: Tokyo, Osaka, Nagoya, Fukuoka, Sapporo and JASDAQ. The TSE accounts for approximately 80 percent of market volume and capitalization, followed by the Osaka Stock Exchange (15 percent) and the remaining regional stock exchanges (approximately 1 percent each). Japan's equity market experienced both bubble and burst in the late 1980s, and, for a brief period from 1989 to 1990, market capitalization exceeded that of the US market.

III. 3 South Korea

South Korea's equity market has been in existence since 1956, when the country's first exchange the "Daehan Stock Exchange (DSE)" was set up. The DSE was reorganized in 1962 as a joint-stock company. In 1963, the DSE became a non-profit government entity and was renamed the Korea Stock Exchange (KSE) (also known as the Korea Exchange (KE)). South Korea's equity market is substantial in size but is very tightly regulated. Unlike other Asia-Pacific stock markets, the KSE has managed to sustain steady growth in listings, trading volume and market capitalization.

  As demonstrated in Figures 1 through 3, compared to the Japanese and Korean stock markets, the Chinese stock markets have experienced extremely

Figure 1   Shanghai stock exchange (a) price and (b) return indices (expressed in logarithms)
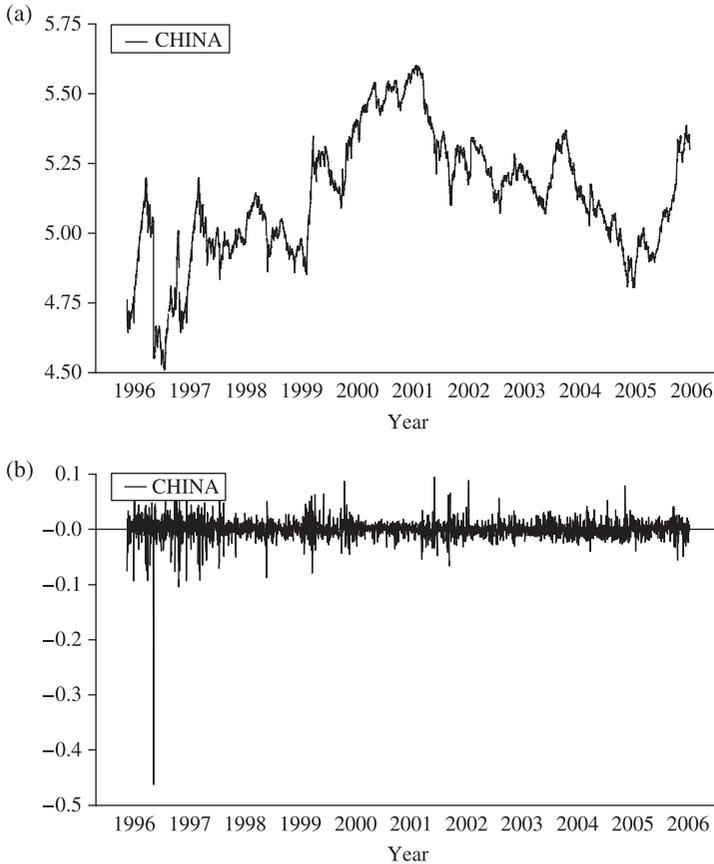
large price movements, indicating deviations from the market fundamentals. Such price movement or volatility is attributed to excessive speculation. Wong (2006) argues that the rapid but vulnerable price movement/development in China's equity market is attributed to three major factors. First, the government has used the stock market as a vehicle to raise funds for state-owned enterprises. Second, the repressed financial regime has not allowed free flow of capital (especially capital flight) and competition among financial assets (e.g. bank deposits, stocks, corporate bonds and government bonds). Third, the legal framework has been too weak to offer shareholders sufficient protection.

Table 1 shows a correlation matrix as a rough measure of stock price linkages. The matrix shows the correlation between the price and returns between the three markets. As the correlation matrix demonstrates, the East Asian stock markets react both positively and negatively to the other markets.

Figure 2   Nikkei 225 (a) price and (b) return indices (expressed in logarithms)
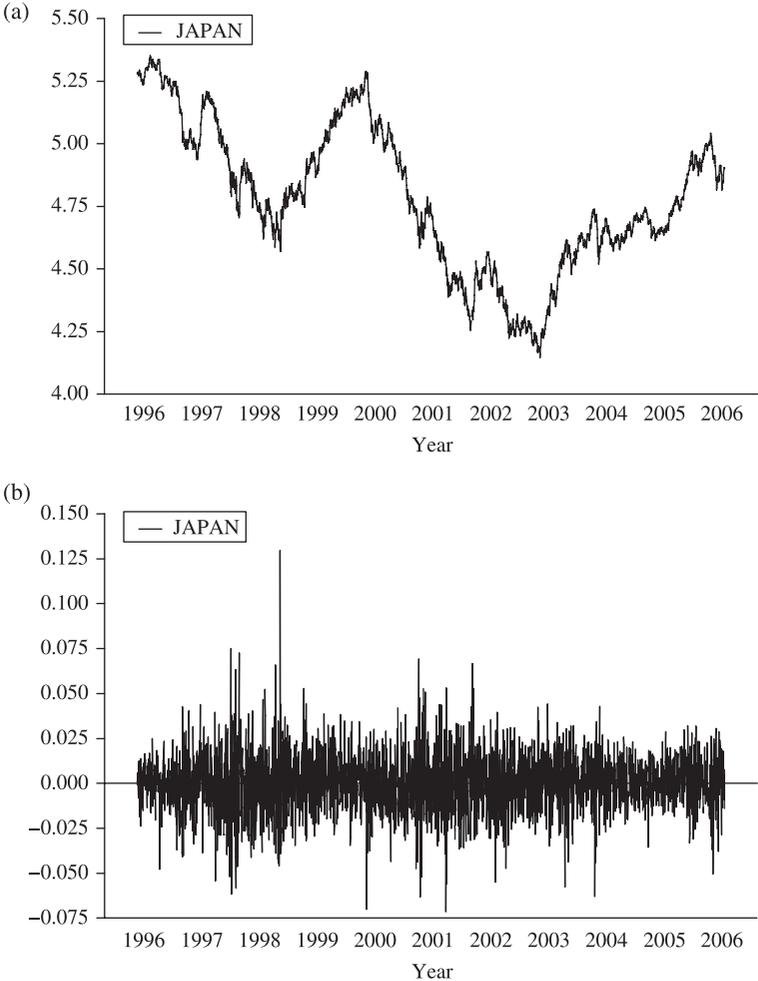
The correlation between Japanese stock returns and Korean stock returns is strongly positive, whereas the correlations between Chinese stock returns and those of the Japanese and Korean stock returns are strongly negative.

IV.   Econometric Methodology

IV.1   Unit root test

We apply the Zivot–Andrews (1992) test, which allows for a structural break in a series to mitigate the bias towards non-rejection of the unit root null hypothesis

Figure 3 Korea Stock Exchange (a) price and (b) return indices (expressed in logarithms)
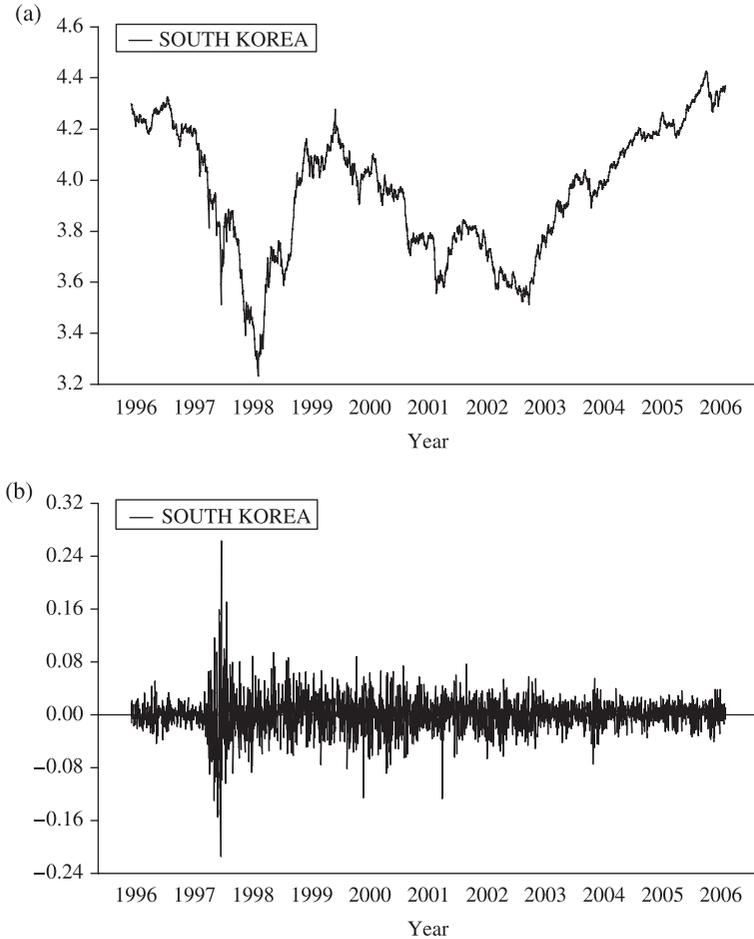
while the series is in fact stationary but subject to a structural break date. The Zivot–Andrews test allows the break date to be determined endogenously by the test equation. For a possible break date, T_{SB}, which ranges from the observation $0.15T$ to the observation $0.85T$, where T is the sample size, the unit root test equation can be estimated for each stock price/return series, y_i, as follows:

$$\Delta y_{it} = \mu_i + \theta DU_{it} + \alpha y_{it-1} + \sum_{j=1}^{k} \phi_i \Delta y_{it-j} + \varepsilon_{it}, \qquad (1)$$

Table 1   Correlation matrix

	China prices	Japan prices	Korea prices	China returns	Japan returns	Korea returns
China prices	1	0.017	0.006	−0.040*	0.039*	0.024
Japan prices		1	0.017	−0.031	−0.038	0.030
Korea prices			1	−0.020	−0.046*	0.018
China returns				1	−0.317**	−0.259**
Japan returns					1	0.575**
Korea returns						1

* and ** represent significance at the 0.05% (2-tailed) and 0.01% (2-tailed) level, respectively.

where the dummy variable (modeling for a structural change), $DU_t = 1$ for $t > T_{SB}$, and 0 otherwise, and k is the number of augmented lags. The *t*-statistic for testing $á = 0$ or t_α is computed for each T_{SB} iteration. The smallest value of $t_á$ computed for all T_{SB} iterations becomes the Zivot–Andrews test statistic under the null hypothesis that the stock price/return series, y_{it}, is $I(1)$ against the alternative hypothesis that it is $I(0)$ with one structural break point. If the null hypothesis is rejected, the T_{SB} associated with the Zivot–Andrews statistic becomes T_B or the date at which a structural break date in a series transpires.

IV.2   Variance ratio tests and the calculation of critical values for the variance ratio tests

IV.2.1   Lo and MacKinlay variance ratio

According to Lo and MacKinlay (1988), if y_t is a time series of stock returns with a sample of size T, the variance ratio to test the hypothesis that y_t is independent and identically distributed (*iid*) or that it is a martingale difference sequence (*mds*) is defined as:

$$VR = \left\{ \frac{1}{Tk} \sum_{t=k+1}^{T} (y_t + y_{t-1} \ldots + y_{t-k} - k\hat{\mu})^2 \right\} \div \left\{ \frac{1}{T} \sum_{t=1}^{T} (y_t - \hat{\mu})^2 \right\}, \qquad (2)$$

where $\hat{\mu} = T^{-1} \sum_{t=1}^{T} y_t$. The numerator of VR (the variance ratio) is $1/k$ times the variance of y_t after aggregation by a factor of investment horizon, k. This statistic should be close to 1 if y_t is *iid/mds* but not if it is serially correlated. Lo and MacKinlay (1988) show that if y_t is *iid* then

$$T^{1/2}(VR - 1) \to_d N\left(0, \frac{2(2k-1)(k-1)}{3k}\right). \qquad (3)$$

Therefore, the test statistic

$$M_1 = (VR - 1)\left(\frac{2(2k-1)(k-1)}{3kT}\right)^{-1/2} \qquad (4)$$

follows the standard normal asymptotically under the *iid* null (homoscedasticity). To accommodate for conditional heteroskedasticity in y_t, Lo and MacKinlay (1988) propose the following robustified test statistic:

$$M_2 = (VR - 1)\left(\sum_{j=1}^{k-1}\left[\frac{2(k-j)}{k}\right]^2 \delta_j\right)^{-1/2}, \qquad (5)$$

where

$$\delta_j = \left\{\sum_{t=j+1}^{T}(y_t - \hat{\mu})^2(y_{t-j} - \hat{\mu})^2\right\} \div \left\{\left[\sum_{t=1}^{T}(y_t - \hat{\mu})^2\right]^2\right\}. \qquad (6)$$

Lo and MacKinlay (1988) show that if y_t is *iid/mds*, then M_2 is asymptotically normally distributed with mean 0 and standard deviation 1. The usual decision rule for the standard normal distribution applies to both M_1 and M_2.

IV.2.2 Wright's alternative variance ratio

Wright (2000) proposes ranks (R_1 and R_2) and signs (S_1 and S_2) as alternatives to M_1 and M_2 of Lo and MacKinlay (1988):

$$R_1 = \left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(r_{1t} + r_{1t-1}\cdots + r_{1t-k})^2}{\frac{1}{T}\sum_{t=1}^{T}r_{1t}^2} - 1\right) \times \left(\frac{2(2k-1)(k-1)}{3kT}\right)^{-1/2} \qquad (7)$$

and

$$R_2 = \left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(r_{2t} + r_{2t-1}\cdots + r_{2t-k})^2}{\frac{1}{T}\sum_{t=1}^{T}r_{2t}^2} - 1\right) \times \left(\frac{2(2k-1)(k-1)}{3kT}\right)^{-1/2}, \qquad (8)$$

where

$$r_{1t} = r(y_t) - \frac{T+1}{2}\bigg/\sqrt{\frac{(T-1)(T+1)}{12}} \text{ and } r_{2t} = \Phi^{-1}(r(y_t)/(T+1)), \qquad (9)$$

where $r(y_t)$ is the rank of y_t among $y_1, y_2, \ldots,$ and y_T. Φ is the standard normal cumulative distribution function. The sign based tests are defined as follows:

$$S_1 = \left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(s_t + s_{t-1} \cdots + s_{t-k})^2}{\frac{1}{T}\sum_{t=1}^{T}s_t^2} - 1 \right) \times \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2}. \quad (10)$$

Under the assumptions that the time series of stock return is *mds*, if $\mu = 0$, then S_1 has the same distribution as:

$$\left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(s_t^* + s_{t-1}^* \cdots + s_{t-k}^*)^2}{\frac{1}{T}\sum_{t=1}^{T}s_t^{*2}} - 1 \right) \times \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2}, \quad (11)$$

where $\{s_t^*\}_{t=1}^{T}$ is an *iid* sequence, each element of which is 1 with probability 0.5 and -1 otherwise. The test S_2, which is related to the conservative test that a series is a random walk with drift (see Campbell and Dufour, 1997), controls for the probability of Type I errors in finite samples and is robust to conditional heteroskedasticity. Wright (2000) shows that both R_1 and R_2 have better power than either of the M_1 and M_2 tests. He also shows that even though the sign-based tests generally have less power than the rank-based tests, they still have more power than the Lo–MacKinlay tests.

We obtain the critical values for Wright's (2000) R_1, R_2 and S_1 tests by simulating their exact sampling distributions. Wright's (2000) S_2 is not considered, because in Monte Carlo simulation, Wright (2000) finds that the size and power properties of S_2 are inferior to those of S_1. Table 2 shows the critical values for R_1, R_2 and S_1 test statistics associated with the sample sizes and holding periods.

IV.3   Engle–Granger and Gregory–Hansen Cointegration Tests

The Engle–Granger (1987) cointegration test with no structural change (i.e. with the cointegrating relationship being time-invariant) can be estimated as follows:

$$Y_{it} = \mu_i + \beta X_t + \varepsilon_{it} \quad t = 1, \ldots, n, \quad (12)$$

where X_t are the explanatory variables all with $I(1)$, and ε_{it} is the equilibrium error if cointegration exists and, hence, $I(0)$. Parameters μ_i (intercept) and β (slope) are the m-dimensional hyperplanes towards which the vector process Y_{it} tends over time. This test presumes that the parameters μ_i and β are time-invariant. Nevertheless, these parameters may be time-invariant over fairly long periods of time and then form a new 'long-run' relationship at some unknown point, which requires a change/shift in either the intercept μ_i or the slope β or both intercept and slope. Gregory and Hansen (1996) consider three types of such (structural) shifts in the cointegrating relationship: (i) a level shift or a level break denoted by C; (ii) a level break with a trend denoted by C/T; and (iii) a

Table 2   Critical values for Wright's (2000) R_1, R_2 and S_1 tests

k	T = 2500		T = 3000	
R_1				
2	−1.970	1.915	−1.973	1.964
5	−1.997	1.919	−1.971	1.971
10	−1.950	1.928	−1.948	1.957
20	−1.979	1.888	−1.974	1.916
30	−1.972	1.837	−1.974	1.967
40	−1.975	1.807	−1.885	1.935
R_2				
2	−1.965	1.919	−1.985	1.971
5	−2.025	1.933	−1.933	1.973
10	−1.965	1.913	−1.922	1.944
20	−1.974	1.852	−1.949	1.934
30	−1.975	1.848	−1.968	1.972
40	−1.950	1.828	−1.981	1.961
S_1				
2	−1.920	1.960	−2.010	1.972
5	−1.950	1.980	−1.953	1.953
10	−1.910	1.995	−1.932	1.923
20	−1.883	2.015	−1.922	1.899
30	−1.876	1.999	−1.913	1.908
40	−1.866	2.011	−1.885	1.935

Notes: The critical values were simulated with 10 000 replications in each case. For each entry, the numbers in columns 2 and 4 give the 2.5 percentile of the distribution of the test statistics (for specified value of T and k) and the numbers in columns 3 and 5 give 97.5 percentile of that distribution. The critical values for other percentiles of the distribution can be obtained from the author on request.

regime shift/full break denoted by C/S. In the case of a level shift, a structural change/break is allowed in the intercept u_i, while the slope coefficients (β) are considered to be constant. In the second case, the structural change allows a time trend, α_t, in the level shift model. In the third case, the structural change allows the slope vector to shift as well. Therefore, the Gregory and Hansen procedure determines the breakpoint by finding the minimum value for the augmented Dickey–Fuller (ADF) statistic. The three cases are as follows:

(i) Level shift (C)

$$Y_{it} = \mu_{i1} + \mu_{i2}\varphi_{r\tau} + \beta^T X_t + \varepsilon_{it} \quad t = 1, \ldots, n; \tag{13}$$

(ii) Level shift with trend (C/T)

$$Y_{it} = \mu_{i1} + \mu_{i2}\varphi_{r\tau} + \alpha_t + \beta^T X_t + \varepsilon_{it} \quad t = 1, \ldots, n; \text{ and} \tag{14}$$

(iii) Regime shift (C/S)

$$Y_{it} = \mu_{i1} + \mu_{i2}\varphi_{r\tau} + \beta_1^T X_t + \beta_2^T X_t \varphi_{r\tau} + \varepsilon_{it} \quad t = 1, \ldots, n. \tag{15}$$

Although the null hypothesis is the same in both the tests, the alternative hypothesis of the Gregory–Hansen (1996) test takes the Engle–Granger (1987) test as a special subclass when the cointegrating vector shifts at one unknown break point.

IV.4 *The MWALD test for Granger causality in cointegrated systems*

The contagion hypothesis is tested using one of several alternative procedures available when the variables in the system are cointegrated. We adopt the Toda and Yamamoto (1995) tests for Granger causality to examine the contagion hypothesis in these three equity markets. We follow Rambaldi and Doran (1996) to simplify the Toda and Yamamoto procedure.

Let us assume that d_{max} is the maximum order of integration in the system (i.e. return series in our case). In cointegrated systems, the Wald test for linear restrictions on the parameters of a VAR(k) has an asymptotic χ^2-distribution when a VAR($k + d_{max}$) is estimated. Preliminary tests are performed to determine the lag length, k $(= 3)$, in the vector autoregression (VAR) using Akaike Information Criteria. Let China, Japan and South Korea be denoted by y, z and w, respectively. Because $d_{max} = 1$, we need to estimate a VAR (4) using the following system of equations:

$$
\begin{bmatrix} y_t \\ z_t \\ w_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} y_{t-1} \\ z_{t-1} \\ w_{t-1} \end{bmatrix} + A_2 \begin{bmatrix} y_{t-2} \\ z_{t-2} \\ w_{t-2} \end{bmatrix} + A_3 \begin{bmatrix} y_{t-3} \\ z_{t-3} \\ w_{t-3} \end{bmatrix} + A_4 \begin{bmatrix} y_{t-4} \\ w_{t-4} \\ z_{t-4} \end{bmatrix} + \begin{bmatrix} e_y \\ e_z \\ e_w \end{bmatrix}. \quad (16)
$$

The above system of equations is estimated using the method of seemingly unrelated regression. If we want to test that Granger causality does not exist between Japan and China, the null hypothesis becomes H_0: $a_{12}^{(1)} = a_{12}^{(2)} = a_{12}^{(3)} = 0$, where $a_{12}^{(i)}$ are the coefficients of z_{t-i}, $i = 1, 2, 3$ in the first equation of the system. The other null hypothesis can be defined similarly.

V. **Data, Summary Statistics and Empirical Results**

The study covers the daily closing price indices; namely, the SSE Composite (China), the Nikkei 225 Stock Average (Japan) and the KSE Stock Price Index (South Korea), from 2 July 1996 to 24 December 2006, providing a total of 2650 observations. All data are collected from Global Financial Data.

The Shanghai Stock Price Index that we use is a capitalization-weighted index. This index tracks the daily price performance of all A-shares and B-shares listed on the SSE. The index was developed on 19 December 1990, with a base value of 100. The Global Financial Data series ID of this index is _SSECD. For the Japanese stock market, the Nikkei 225 stock average is taken. The Global Financial Data series ID of this index is _N225D. The index was developed on 4 January 1968, with a base value of 100. For the South Korean stock market,

Table 3   Summary statistics (*N* = 2650)

	SSE	*Nikkei 225*	*KOSPI*
Sample mean	0.00039	−0.000114	0.00021
Variance	0.000358	0.000270	0.000642
Skewness	−5.72	0.18	0.022
	(0.000)	(0.00016)	(0.64)
Kurtosis (excess)	137.20	2.68	10.93
	(0.000)	(0.000)	(0.000)
Jarque–Bera	2092958.96	807.56	13194.169
	(0.000)	(0.000)	(0.000)
Ljung–Box Q-statistics (lag = 12)	22.58	23.73	137.63
	(0.032)	(0.022)	(0.024)
LM	3.459	1.315	5.507
	(0.000)	(0.000)	(0.000)

KOSPI, Korea Stock Exchange Stock Price Index; LM, Lagrange multiplier; SSE, Shanghai Stock Exchange.

the Korea SE Stock Price Index (KOSPI) is taken. The Global Financial Data series ID of this index is _KS11D. The relevant series of the Global Financial Data can be consulted for further details. Table 3 shows the descriptive statistics for these three markets.

The mean return in SSE is positive. However, the negative skewness reveals the fact that the Chinese stock return is non-symmetric, non-normal and has a long tail to the left. The large excess kurtosis indicates that the underlying data is leptokurtic and the Chinese stock market is speculative in nature. The Jarque–Bera (JB) test indicates that the return from the Chinese stock market is non-normal and the Q statistics indicate that there is evidence of autocorrelation in the stock return series. Unlike the SSE return, the mean return from the Japanese stock market is negative, whereas the skewness is positive, indicating that the return series is symmetric and normally distributed. However, the JB and Q statistics are significant at 1 and 5-percent levels of significance, respectively. The kurtosis is less than 3, which means that there is not much evidence of speculation in the Japanese stock market. For the KOSPI, we find that both the mean and the skewness of the return series are positive. Nonetheless, the kurtosis tends to have a distinct peak near the mean, declines rather rapidly, and has heavy tails. This indicates that the Korean stock market is speculative in nature. Both the JB and Q statistics are statistically significant at the 1-percent level of significance. LM represents the Lagrange multiplier test for the presence of the autoregressive conditional heteroskedasticity (ARCH) effect with up to 30 lags. The LM statistics for all three markets are significant at the 1-percent level.

Other univariate statistics, namely, the unit root test statistics and the variance ratio test results, are shown in Tables 4 and 5, respectively. The unit root test

Table 4   The Zivot–Andrew unit root test statistics on daily stock prices and returns

Markets	Price series		Return series	
	Zivot–Andrew test statistics	T_{SB}	Zivot–Andrew test statistics	T_{SB}
China	−4.17959	1999:09:22	−15.803**	2000:12:06
Japan	−2.40775	2000:10:27	−16.451**	2000:06:06
South Korea	−1.93358	2003:04:07	−16.856**	1998:07:29

Notes: Figures in parentheses indicate the '*p*-value.' Critical values are −5.34 and −4.80 at the 1% and 5% level, respectively. ** indicates that the test statistics are significant at 1% level.

statistics indicate that the three equity markets examined identify a unit root component in the price series but not the return series. The results for the return series are significant at the 1-percent level, indicating the stationarity of the stock price returns from these markets. The Zivot–Andrews statistics also give the structural break date T_{SB}. Because the Chinese markets are characterized by high price movements, the Zivot–Andrews test statistics indicate a structural shift in Chinese markets long before the structural shift in other markets. However, as the price series features a unit root component in all series, the return series should be taken to explain the structural break date more meaningfully. As evidenced from Table 4, South Korea underwent a structural break on 29 July 29 1998, followed by Japan on 6 June 2000, and China on 6 December 2000. This indicates that South Korea might have led the regulatory reforms in relation to the equity markets in East Asia. The KSE systematically introduced the reforms before it fully lifted the foreign ownership restrictions in 1998. In the process, the order-routing system in KSE was automated in 1983, enabling member firms to electronically transmit orders to the trading floor. The trading system was fully automated in 1997, allowing the market to operate without the trading floor. Since the early 1980s, the Korean stock market has been gradually opened to foreign investors, particularly since the introduction of international investment trusts and country funds (e.g. the Korea Fund). In 1992, the Korean stock market was opened to foreign investors with certain restrictions, and the foreign share ownership restrictions were gradually lifted and were fully eliminated in 1998.[5] This major reform can be linked to the structural break date identified for the KSE in 1998. In the SSE's case, some major reforms can be connected to the break period identified. In early 2000, the Chinese Government undertook a series of reforms to privatize listed enterprises, to remove the restrictive barriers in the financial sector, and to improve the legal protection of shareholders. The Chinese stock market responded very well to these reforms.

5.   Related to the reforms in the Korean stock markets, see the KSE homepage.

Table 5   Variance ratio test statistics on daily stock returns

k	M_1	M_2	R_1	R_2	S_1
China					
2	2.62**	1.57	2.78**	2.87**	1.18
5	2.69**	1.67	2.76**	2.71**	0.91
10	1.15	0.74	2.82**	2.15**	1.01
20	0.90	0.61	4.11**	2.86**	2.18**
30	0.86	0.60	4.44**	2.99**	2.55**
40	0.75	0.54	4.75**	3.12**	2.89**
Japan					
2	−2.10**	−1.82	−2.61**	−2.40**	−2.46**
5	−2.24**	−1.95	−2.34**	−2.32**	−2.24**
10	−1.50	−1.31	−1.80	−1.62	−1.70
20	−1.30	−1.15	−1.17	−1.25	−0.98
30	−1.16	−1.03	−0.89	−1.06	−0.70
40	−1.04	−0.93	−0.50	−0.82	−0.26
South Korea					
2	4.50**	2.58**	4.04**	4.48**	2.51**
5	−1.25	−0.60	1.32	0.90	0.94
10	−0.38	−0.18	0.77	0.62	0.92
20	0.62	0.30	1.04	1.14	1.74
30	0.79	0.39	0.85	1.04	1.77
40	0.88	0.45	0.87	1.05	2.07*

Notes: M_1 and M_2 are asymptotically distributed standard normal, while M_1 is under the conditions of homoskedasticity and M_2 is under the conditions of heteroskedasticity. ** and * represent significance of rejections at the 1% and 5% level, respectively.

By the end of 2000, stock market capitalization in Chinese stock markets rose to more than US$507bn, making China's markets the second largest in Asia, after Japan's. The trading volume almost doubled in 2000, before it continued to slump again after 2001. Interestingly, during this period of rapid growth in liquidity and market capitalization in China, the opposite was occurring in other transitional economies, which were rather plagued by low market capitalization and low liquidity.[6]

On 1 March 2000, Hiroshima and Niigata stock exchanges merged into the TSE. However, the effect of this merger was only apparent on 10 March of the same year, when the trading volume was two times higher than that of the previous day. Nonetheless, the break date identified by the Zivot–Andrews test differs from that of the actual change in the relevant time series. We argue that this difference originates from the data mining problem.

Let's look at the variance ratio test statistics of these stock markets. The variance ratio tests are examined for several values of k (holding period of

6.   See Wong (2006) for more details on the reforms in Chinese stock markets.

investment). Although the random walk hypothesis can be strongly rejected when the test statistics are rejected for all k, the hypothesis can also be soundly rejected if there are more than two rejections (Hoque et al. 2007). The inferences from the Lo and MacKinlay (1988) variance ratio tests are different from those of the Wright tests. The results from these tests for the three equity markets are shown in Table 5. The hypothesis that the Chinese stock markets exhibit *iid/mds* null cannot be rejected under the Lo and MacKinlay tests but can be strongly rejected according to Wright's tests. Yet, the analysis of Class A and Class B shares in the Chinese equity markets might provide different results. Lima and Tabak (2004) report such findings. Lima and Tabak (2004) also use the variance ratio tests and find that Class A shares are weak-form efficient but Class B shares do not follow the random walk hypothesis. In such a case, liquidity and market capitalization may play an important role in explaining the inter-temporal efficiency of the developing and emerging equity markets. The empirical result on the random-walk process of the SSE is consistent with earlier studies. Darrat and Zhong (2000), Ma and Barnes (2001) and Seddighi and Nian (2004), among others, demonstrate similar results (that the Chinese stock markets do not follow a random walk).

For the Japanese and Korean markets, both the conventional and rank and sign-based variance ratio tests give fairly consistent results, rejecting the *iid/mds* null at some (e.g. for Japan, at $k < 10$ and, for Korea at $k = 2$ and 40), but not all, k. Therefore, the variance ratio tests reveal that the Japanese and South Korean markets are efficient, indicating the evidence of random walk behavior. Finding the Japanese market efficient is not in disagreement with the general notion that the developed markets, by and large, possess strong random walk behavior. However, the empirical literature on the efficiency of the South Korean market is divided. The results from this paper relating to the South Korean market are in agreement with Hoque et al. (2007), but differ with Mun and Kee (1994),[7] Huang (1995) and Chaudhury and Wu (2003). Hoque et al. (2007) find that the South Korean market appears on balance unaffected even by further opening of its equity market following the Asian financial crisis. The timing and intensity of the Asian crisis is not considered in the present study because there is a vast literature on this and it is not expected to add significant contributions to the literature. Malliaropulos and Priestley (1999) relate the failure to reject the random walk hypothesis (for the South East Asian markets including Japan and South Korea) to mean-reversion of expected returns rather than market inefficiency.

Based on the findings from the univariate tests, the hypothesis of (individual) market efficiency can be strongly rejected for the Chinese stock markets and, we firmly state, the returns from the Chinese stock markets are predictable. However, the hypothesis (of individual market efficiency) could not be rejected

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7.   Mun and Kee (1994) apply Lo and MacKinlay (1988) variance ratio tests along with other tests.

Table 6   Cointegration tests: Engle–Granger versus Gregory–Hansen

Equation	Engle–Granger (ADF test statistics)	Gregory–Hansen (level break)		Gregory–Hansen (full break)	
		ADF test statistics	T_{SS}	*ADF test statistics*	T_{SS}
China	−14.013**	−14.060**	2001:09:12	−14.063**	2001:03:13
Japan	−16.667**	−16.760**	2003:06:19	−16.751**	1998:03:16
South Korea	−16.257**	−18.448**	1998:01:14	−16.493**	1998:08:04

Notes: Seven lags are selected automatically. Critical values for the augmented Dickey–Fuller (ADF) test statistics obtained from MacKinnon (1996) are −4.68 and −4.12 at the 1% and 5% levels, respectively. Critical values for the Gregory and Hansen (1996) cointegration test are −5.44 and −4.92 at 1% and 5% level of significance for the level break, respectively, and −5.97 and −5.50 at 1% and 5% level of significance at full break, respectively.

for the Japanese and South Korean stock markets and, hence, returns from these markets are unpredictable.

Now we report the results of the cointegration tests to see whether the Chinese markets are jointly efficient with those of Japanese and Korean markets. To facilitate this, both the Engle and Granger (1987) and the Gregory and Hansen (1996) cointegration tests are considered. Table 6 shows the test statistics of the Engle and Granger cointegration test that does not consider the structural break and the Gregory and Hansen cointegration tests that do consider the structural break in the cointegration space. Although a cointegrating relation is evident in both cases, Gregory and Hansen tests imply that this cointegrating relation is time-variant and has shifted at some break point.

In Table 6, column 1 indicates the cointegration test equation in which the country listed is a dependent variable. Column 2 shows the ADF test statistics under the null hypothesis of no cointegration based on the Engle–Granger cointegration procedure in which a possible shift in a cointegration relation is not considered. For the Gregory–Hansen test, the cointegration equation is allowed to have an endogenous shift in its intercept (level break) and a shift in the slope vector (full break). The ADF test statistics in the case of Gregory–Hansen cointegration is under the null hypothesis of no cointegration against the alternative hypothesis of a cointegrating relation with a structural shift. It is the smallest value of the ADF statistics calculated for all possible dates for a structural shift. T_{SS} is the possible structural shift associated with the ADF. Both the Engle–Granger and the Gregory–Hansen tests strongly reject the null hypothesis of no cointegration between the markets. Noted earlier, multivariate tests like the cointegration tests elucidate whether one financial market incorporates sufficient information useful for creating forecasts of another, and explain the efficiency of the other financial market(s). Evidence of a cointegrating

relationship indicates that there are common stochastic trends shared by the three markets and that returns from one are predictable in terms of information in another.

The cointegration tests confirm that there is a long-term equilibrium relationship between the three markets but the relationship is not time-invariant: rather it is subject to some structural shifts. Worthington et al. (2004) and Worthington and Higgs (2004) find similar results in terms of the long-run relationship between these markets. Although Worthington et al. (2004) find a significant relationship among three developed and six emerging markets in the Asia Pacific, Worthington and Higgs (2004) find a causal relationship between China and Japan, and a unidirectional causality running from Japan to Korea. According to them, these causal relationships suggest that opportunities for international portfolio diversification in Asian equity markets still exist. Pan et al. (1999) use a modified cointegration test with the GARCH effect to demonstrate that the six Asia Pacific stock markets along with the USA are integrated through the second moments of stock returns but not the first moments. The evidence of a cointegrating relationship is characterized as joint market inefficiency and implies that at least one of the markets within the VAR is inefficient even though the rest of the markets may be individually efficient (see Hasapis et al., 1999). Not surprisingly, even though Japanese and South Korean stock markets are found to be individually efficient (from the unit root and variance ratio tests) they are found to violate market efficiency under the system of cointegration. This is because of the individual market inefficiency of the Chinese market. The evidence of joint market inefficiency suggests the potential for short-term arbitrage opportunities and the potential for international portfolio diversification. However, Allen and MacDonald (1995), Richards (1995) and DeFusco et al. (1996), among others, argue that if the equity markets are cointegrated, long-run international diversification potential is limited and, hence, diversifying between the integrated markets over a long period of time is not likely to generate large benefits through risk reduction.

Responding to the last (contagion) hypothesis of the present paper, because the cointegration tests identify a long-term relationship among the markets, we proceed to the application of the Toda–Yamamoto procedure of Granger causality to identify whether these markets are contagious to the other markets during any volatility shock. The test statistics identify bivariate causality between South Korea and Japan. Therefore, these two markets are interdependent and at the same time contagious to the volatility shocks in its counterpart. Even though the Chinese market is cointegrated with the Japanese and the South Korean markets, the volatility shocks in other markets are not contagious to the Chinese market. The null hypothesis and the results from Toda–Yamamoto tests of Granger causality are shown in Table 7.

Our results in relation to causality are consistent with the findings of Baig and Goldfijn (1998), who also demonstrate less supportive evidence for stock market contagion in the region. However, our results are not in agreement with

Table 7   Toda–Yamamoto tests of Granger causality

Null hypothesis	Test statistics (χ^2)	p value
China does not Granger cause Japan	0.984	0.805
Japan does not Granger cause China [taking no effect of same day's closing prices of the TSE on SSE: up to VAR(4)]	0.609	0.894
Japan does not Granger cause China [taking the effect of same day's closing prices of the TSE on SSE: up to VAR(4)]	1.493	0.684
Japan does not Granger cause China [taking the effect of same day's closing prices of the TSE on SSE: up to VAR(5)]	1.551	0.671
China does not Granger cause South Korea	1.508	0.680
South Korea does not Granger cause China [taking no effect of same day's closing prices of the KSE on SSE: up to VAR(4)]	0.156	0.984
South Korea does not Granger cause China [taking the effect of same day's closing prices of the KSE on SSE: up to VAR(4)]	0.261	0.967
South Korea does not Granger cause China [taking the effect of same day's closing prices of the KSE on SSE: up to VAR(5)]	0.669	0.955
South Korea does not Granger cause Japan	17.855	0.0005
Japan does not Granger cause South Korea	11.391	0.0098

KSE, Korea Stock Exchange; SSE, Shanghai Stock Exchange; TSE, Tokyo Stock Exchange.

those of Masih and Masih (1999), who confirm a contagion within Asian stock markets. The trading hours of the Japanese and the South Korean stock markets are one hour ahead of those of the Chinese stock markets (SSE). Because the SSE closes one hour after the closing of the TSE and the KSE and, therefore, today's closing prices in Tokyo/Seoul are already known to investors in Shanghai when the SSE closes, we examine whether the inference is altered due to time differences. Even after taking the effect of the same day's closing prices of the TSE/KSE on the SSE, we do not find significant causality running from the TSE/KSE to the SSE. A similar result is reported by Jang and Sul (2002). Adjusting for the time difference in consideration of the closing hours, Jang and Sul (2002) find no significant causality in the East Asian markets. The evidence of non-causality (no contagion) indicates that knowledge of past return behavior in one market is unlikely to improve forecasts of returns in another, except for some causality running from South Korea to Japan and Japan to South Korea.

Related to the above findings on individual and joint market efficiency, the investors in these markets might try to exploit the market inefficiency to generate market returns. However they are advised to be much cautious in forecasting returns, because other investors might also try to exploit the opportunity of informational inefficiency, as has been observed in these markets. Although an identification of the short-term relationship through ECM-based Granger causality might result in some profits for the investors, the (long-term) causal relationship (identified through Toda–Yamamoto level VAR) between Japan and South Korea indicates that there would be no long-range benefits from

pair-wise portfolio diversification between these two markets. For other non-causal relationships, for example, China–Japan and China–Korea, where both long-run and short-run differences may exist, the knowledge of one of these markets would seldom help forecast the return from other market(s) and, therefore, the gain from the portfolio diversification is generally limited.

VI. Concluding Remarks

This paper explains market efficiency, interdependences and contagion among the three East Asian stock markets using both univariate and multivariate tests. The study indicates that the Chinese stock market is (informationally) inefficient, whereas the Japanese and the South Korean stock markets are efficient. However, the three markets are jointly inefficient in the cointegrating sense. Therefore, even though the Japanese and the South Korean stock markets are individually efficient, these markets are not jointly efficient under the system of cointegration due to inefficiency of the Chinese stock market. Furthermore, although these three markets are cointegrated, the contagion effect exists only between Japanese and South Korean stock markets. The market inefficiencies, both in an individual and cointegration sense, give speculators the chance to manipulate prices. Any short-term price movements might persuade weak market players to wrongfully estimate the returns from their stocks. Therefore, we suggest that regulators control unrealistic price movements in order to protect the interests of weak market players and to facilitate the potential development of capital markets. At the same time, investors need to be cautious about information flows and noise, and to have a clear/overall understanding of the markets they are interested in. The results in this study are not against the general wisdom that the developed and emerging markets, by and large, are efficient, whereas the underdeveloped markets are not. Because we find that the long-term relationships between the East Asian equity markets are not stable over time, it is not possible that the identification and use of an error correction model will indicate short-term arbitrage opportunities. Although the causal relationship between Japan and South Korea is suggestive of market inefficiencies and possible short-term arbitrage opportunities, the evidence of non-causality (no contagion) for other pairs, namely, China–Korea and China–Japan, indicates that knowledge of past return behavior in one market is unlikely to improve forecasts of returns in another. Future research could use more high frequency data to explore the underlying reasons why some East Asian markets provide evidence of market efficiency and others do not, using a univariate and/or a multivariate framework.

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Impact of the National Pension Fund on the Suitability of Elderly Pensions in Thailand*

Wade D. Pfau and Vararat Atisophon

This study combines a traditional hypothetical worker approach with the techniques of stochastic forecasting to provide a better sense about the suitability of the pension system for formal sector private workers in Thailand. With regard to the proposed defined-contribution pension, we find that workers with a 40-year career can only expect a median replacement rate of approximately 13–14 percent of their final 5 years of income. Most of the pension benefits will still likely come from the unsustainable defined-benefit pension system and further reforms will be needed to maintain suitable pensions.

Keywords: defined-contribution pension, pension suitability, stochastic forecast, Thailand.

JEL classification code: H55.

doi: 10.1111/j.1467-8381.2009.02003.x

I. Introduction

In Thailand, policy-makers are strongly considering proposals to introduce a mandatory defined-contribution pension system, the National Pension Fund (NPF), for private workers to commence as soon as 2009 as a supplement to the existing defined-benefit pension system.[1] The goal is to improve the suitability

1.   The NPF was originally intended to begin on 1 January 2007 (Chaiyasoot, 2005; Chantanusornsiri, 2006a). The proposal is mainly waiting for parliamentary approval, but the turbulent political situation in Thailand has led to its delay. Currently, the Ministry of Finance plans to introduce the NPF in 2009 once parliamentary approval can be obtained (Chaitrong, 2008). For this paper, we will assume a start date of 1 January 2009, although this might yet prove to be too soon, depending on political circumstances.

of Thai pensions without further jeopardizing the sustainability of the existing system. Thailand is just one of many countries in the process of reforming the pension system to better cope with the challenges of an aging population. Reform is needed to ensure that the pension system will be suitable, in terms of providing the elderly with adequate pensions, and sustainable, in terms of ensuring that enough funds flow into the pension system to cover benefit payments and other expenses. In the present paper, we focus on the issue of suitability for the Thai pension system with regard to Thailand's formal sector workers.

Now is a particularly important time to focus on pension reform in Thailand. The existing system is still quite new, coverage remains low, and there is still time to make reforms in response to important demographic and economic adjustments without being overburdened by existing unfunded liabilities. Declining fertility and mortality rates are leading to an increasingly aging population in Thailand, which will place further pressure on the pension system. According to the United Nations Population Division (2004), in the 1950s and 1960s, a woman in Thailand could expect to bear at least 6 children during her lifetime. Since the 1970s, the fertility rate has dramatically declined. By the late 1990s it had settled below the population replacement rate of around 2.1. Nonetheless, the Thai population will continue to grow on account of the improvements in mortality rates brought about by advances in medicine, nutrition and hygiene. According to the United Nations, men and women in the 1950s and 1960s could expect to live to ages 49.8 and 54.3 years, respectively. Already, by around 2000, these numbers had increased to approximately 66 years for men and 73 years for women, and the United Nations projects further increases in the coming years. The old-age dependency ratio, which shows the number of people aged 65 years and older to people aged 15–64 years, quantifies how the population is aging. At present, the old-age dependency ratio is approximately 10 percent, meaning that there are 10 people of working age for every elderly person. However, by 2025, United Nations demographers expect the elderly dependency ratio to increase to 20 percent, and by 2050, the dependency ratio could be as high as 35 percent. In this case, there will only be three people of working age for every elderly person.

Beyond these demographic trends, an additional concern for elderly well-being relates to changes in elderly living arrangements. Traditionally, Thai families were extended families, in which family members helped to take care of one another. Elderly family members could typically rely on their extended family for housing, financial support, and other care. The importance of this support is such that the World Bank revised their pension framework to include it as the fourth pillar (see Holzmann and Hinz, 2005). However, rapid economic development in Thailand is changing the structure of families, and elderly people may increasingly find few relatives living close by, as is explained in Ryansakul (2000). The elderly are expected to become increasingly self-reliant, but maintaining a suitable living standard will become difficult without access

to a decent pension. These issues raise concerns about the ability of elderly people to maintain an appropriate standard of living and also the ability of the government to arrange appropriate support.

Thailand is not alone in experiencing challenges in financing the pensions of rapidly aging populations. Changing demographic conditions have been playing havoc on the public pension systems of countries both rich and poor. Traditionally, countries have tended to rely on defined-benefit pay-as-you-go pension systems that allow them to provide pensions to their current elderly using the contributions of the current workforce. These systems tend to work so long as the growth rates of contributors and their productivity exceed the growth of pensioners. Worldwide, however, reduced fertility rates and increasing longevity are making such systems unsustainable in the sense that promised pension payments to the increasing elderly populations will exceed worker contributions. In response, a number of countries are increasingly shifting their public pension systems toward defined-contribution pensions, in which the pension provider does not make a promise about benefit levels, but rather the pension amount is determined by the performance of the assets accumulated in the pension account. Whitehouse (2007) indicates that defined-contribution pensions have become very common in Latin America, the Caribbean, Eastern Europe and Central Asia. It is in this direction that Thailand is moving with the proposed NPF.

Although some savings will be moved from existing voluntary pension funds to the NPF, the establishment of the NPF should still result in increased savings for the Thai economy. Chaiyasoot (2005) indicates that the need for increased savings to support various large-scale investment projects is an important justification for introducing the NPF.

We must also consider the economics of pension reform and pension suitability. With the proposed defined-contribution pension system, Thai workers will potentially be investing their savings in risky financial assets, which will be subject to capital gains or capital losses from year to year. Therefore, determining pension suitability requires long-term forecasts of economic and financial performance. Traditionally, pension forecasts have been created using a deterministic, scenario-based forecasting approach. This often involves three alternative scenarios: a low-cost (optimistic) alternative, an intermediate-cost (best guess) alternative, and a high-cost (pessimistic) alternative (as in the Asian Development Bank Consultant's Report (2000) for Thailand). Each of these scenarios combines a set of assumptions about the future course of the economy, but this type of deterministic approach does not provide the reader with any sense of the likelihood with which these future scenarios might occur. It combines the assumptions in overly rigid ways, and, hence, does not provide a sense of the future risks.

The expansion of defined-contribution pension systems that include investments in equities and fixed income securities makes reliance on the deterministic approach all the more troubling. This is because the volatility of actual

investment returns might not be represented very well by a deterministic approach, and a proper investigation of investment returns must take into consideration more than just the expected value of the outcome to properly account for the risks. Unlike deterministic forecasts, stochastic forecasts can be used to estimate a probability distribution for outcome measures, which can be used to determine the likelihood of various outcomes and to better capture the extent of volatility in the performance measures. As such, we will create stochastic forecasts for the Thai economy to obtain a probability distribution for the future pension benefits available to Thai workers. Our research approach is motivated by the work of Ronald Lee and others, particularly Lee and Tuljapurkar (1998) and Lee et al. (2003). Other examples of this stochastic forecasting approach include Feldstein and Ranguelova (2001) and Harris et al. (2005).

Regarding for whom we will simulate these future pensions, we will use hypothetical Thai workers retiring between 2014 and 2060 who earn some fraction of the economy-wide average wages throughout their working careers. These dates are chosen because although accumulated savings will still be small in 2014, this is the first year in which workers will be eligible for annuities from Thailand's existing defined-benefit pension, and by 2060 we will have reached a steady state in which workers are able to contribute to their defined-contribution pension at the maximum contribution rate for their full career. We will define their years of birth, age that work begins, age of retirement, and lifetime earnings level and pattern. Naturally, such workers are not representative of everyone, but they will provide a framework for comparing how pension reform could affect the suitability of pensions. This approach is often used in analyses of social security reform issues, including whether participants will get their 'money's worth' from their contributions to defined-benefit systems, how much benefits participants can expect from defined-contribution pensions, and how a defined-benefit pension system redistributes income between participants, both within a cohort and across cohorts. Recent studies using hypothetical workers in this way include Steurle and Bakija (1994), Nichols et al. (2001), Burtless (2002), Pfau (2003) and Shiller (2005).

The present study combines the traditional hypothetical worker approach with the techniques of stochastic forecasting, to provide a better indication of the suitability of the pension system for formal sector private workers in Thailand. Although this technique is relatively new, it can provide important insights regarding pension reforms that include volatile investment choices. The use of hypothetical workers to study pension reform has been used a great deal in other studies, because although such workers might not represent the specific situation of any particular person, they can provide reasonable examples to clarify how the pension system will function in practice for representative individuals. However, the use of hypothetical workers to study pension reform is usually undertaken using deterministic forecasts for the future course of the economy, often with several different scenarios considered. This approach is particularly hazardous for considering pension reforms that include investment

in equities and fixed-income securities because the average historical returns for various investments do not directly reflect their underlying risk. Burtless (2002) and Shiller (2005) respond to this problem by using successive historical periods, and by bootstrapping the historical data so that it represents the potential variability in outcomes. Our paper contributes to this literature by extending the use of stochastic forecasts for the economy to obtain a probability distribution for the likely effects of pension reform.

With the creation of the NPF, defined-contribution benefits will play a large and important role in shifting demographic and economic risks from the government to individuals. This creates some concern about the potential performance of the underlying investments. Historically, the Thai stock market has been very volatile, and even if savings in the stock market could produce higher benefits on average for retirees, there is no promise of higher benefits for any given individual. The question remains about how much risk Thai workers will face with the new NPF. We seek to examine this important issue, to determine what level of pension benefits can be expected from the defined-benefit and defined-contribution portions of the mandatory pensions. The combined pension is potentially suitable, but it is not sustainable in its current form. Most of the pension benefits will come from the defined-benefit portion of the pension system, and our results indicate that this part of the pension system is not sustainable, as contributions will fall short of promised benefits. Meanwhile, once the defined-contribution part of the pension matures, workers should only expect an average income replacement rate of 13–14 percent, which, although sustainable, is far from suitable. Therefore, although creating the NPF is a step in the right direction, further reforms will be needed to ensure that suitable and sustainable pensions are available for the Thai population. To obtain these results, the present paper will proceed as follows. In the next section, we consider the details of Thailand's pension system. In Section III we explain the methodology and application of our stochastic hypothetical worker model for the situation in Thailand. This is followed by our results in Section IV. We finish with some concluding observations and policy recommendations in Section V.

II.   The Pension System in Thailand

This paper focuses on the mandatory, contributory public pension system for formal sector private workers in Thailand, which includes the first and second pillars of the World Bank framework described in Holzmann and Hinz (2005).[2]

2.   Holzmann and Hinz (2005) update the World Bank framework to include five pillars. The pillars not addressed in this paper include Pillar 0, which is a non-contributory pension provided to elderly people by the government that may either be universal or means-tested; Pillar 3, which involves voluntary arrangements whereby workers save additional funds for retirement either by themselves or through an employer; and Pillar 4, which is the informal support provided to the elderly within their family. In Thailand, Pillar 3 includes the Provident Fund (established in 1987) and the Retirement Mutual Fund (established in 2001).

The first pillar is a mandatory contributory defined-benefit system linked to earnings, which seeks to replace some portion of a worker's income at retirement. In Thailand, this first pillar is the Old-Age Pension Fund (OAPF), which operates as part of the Social Security Fund. The second pillar of the World Bank approach is a mandatory defined-contribution system that acts as a savings account for participants. Workers place a portion of their income into the account, which is vested into a range of financial assets, and the total assets available at retirement will depend on the performance of the underlying portfolio. In Thailand, this is expected to be part of the reforms to create the NPF, which is expected to begin operations in 2009.[3]

With regard to Thailand's first pillar for private workers, the Social Security Fund began collecting contributions for the OAPF in 1999, and it will begin making annuity payments to retirees with at least 15 years of contributions in 2014.[4] Funding obligations for the Social Security Fund are split between employers, employees and general government revenues, and funds are allocated among three benefits categories. The combined total tax rate (since 2004) for the Social Security Fund is 12.75 percent, and the portion of this dedicated to old-age pensions and child allowances is 7 percent. This amount for the OAPF is split as 3 percent from employers, 3 percent from employees and 1 percent from general government revenues. The minimum earnings needed to contribute are 1650 baht per month, and the maximum taxable earnings are 15 000 baht per month. In addition, these contributions are tax deductible and the benefits received are tax exempt.[5]

The old-age benefits provided by the OAPF follow a defined-benefit formula. Contributors who retire with more than one year but less than 15 years of participation will receive a lump-sum payment equal to the contributions of the employee and the employer plus interest at the rate set by the Social Security Office in each year.[6] If someone contributes for less than 12 months, their employee contributions will be returned. The formula to calculate benefits for those with at least 15 years of contributions is:

$$BENEFIT = SALARY \times \frac{(1.5x - 2.5)}{100}, \qquad (1)$$

where *BENEFIT* is the total monthly benefit expressed as a percentage of *SALARY*, which is the average monthly salary from the last 60 months (5 years)

3. The NPF will likely encompass the various existing pensions in Thailand while incorporating a new mandatory defined-contribution pension as well. To simplify the language though, we will sometimes refer to the new defined-contribution pension as the NPF, even though it is only expected to be a part of the NPF.

4. Our discussion of the OAPF is based on a variety of sources, including the Social Security Office (2005), Asian Development Bank Consultant's Report (2000), Kanjanaphoomin (2004), Pai (2006), Ryansakul (2000) and Kesornsutjarit (2000).

5. The OAPF and the NPF will only cover Thailand's formal sector labor force, which is currently about one-third of the actual labor force.

6. From 1999 to 2005, the annual interest rates were 2.4%, 3.7%, 4.2%, 4.3%, 6.5%, 2.0% and 2.0%, respectively.

of employment. Additionally, *x* represents the number of years of contribution to the pension system. Therefore, someone with 15 years of contributions will have a replacement rate of 20 percent, whereas 30 years provides 42.5 percent, and 40 years provides a replacement rate of 57.5 percent.[7]

The OAPF is operated on a pay-as-you-go basis, although some pre-funding is currently being built up prior to the introduction of benefit payments. There is no guarantee that the fund will be sustainable, in terms of the contributions entering the fund being adequate to pay all of the promised benefits, particularly with the expected aging of the Thai population. With the defined-benefit approach, the government bears the risk of the future economic and demographic changes, as it will be obliged to pay benefits according to its formulas regardless of what happens to future contribution levels, or to the returns on its underlying assets. Thailand is just one of many countries now pursuing alternative funding strategies to relieve pressure on the government to provide pension benefits.

In Thailand, the second pillar, the mandatory defined-contribution pension system, is expected to begin operation in 2009 as a part of the NPF reforms. Because it does not yet formally exist and the Thai Government has not finalized the details of the reforms, we must speculate on how it is likely to operate based on press reports and interviews with government officials regarding their intentions. First, the fund could be centralized or decentralized. If centralized, it is likely that the NPF will be modeled after the Government Pension Fund (GPF), which is the existing second pillar pension fund for civil servants and military officers.[8] In this case, Thailand will essentially expand the GPF to apply to all formal sector workers. Otherwise, if the fund is decentralized, it will likely be modeled after the voluntary Provident Fund. These decentralized funds operate with many fund managers, with various investment choices available to participants. Because we directly test the implications of different asset allocations, the details of how they will be managed are not important for our results, and our findings are applicable for both of these possible systems.

The NPF will likely be operated on a defined-contribution basis from both employees and employers. Starting in 2009, we assume that the employee and the employer will each contribute 3 percent of the worker's wages to the defined-contribution pension. In 2012 and 2017, we increase these amounts to 4 percent and 6 percent, respectively. Chantanusornsiri (2006b) mentions that such contribution rate increases are likely. The formal retirement age for the NPF is proposed to be 60 years old. However, early retirement at 55 years of age might

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7. This benefit formula represents a recent legislative change to make more generous benefits. The formula is described in the Social Security Office's 2005 *Annual Report*. Previously, as is cited in most literature about the Thai pension system, the benefit formula was, *BENEFIT = SALARY * x*/100, with the terms defined the same as in the text and *x* must be at least 15 years.
8. Funke and Stadtmann (2004) provide an excellent overview of the GPF.

Table 1   Asset allocation of Thailand's government pension fund (as of 31 December)

	2001 (%)	*2002 (%)*	*2003 (%)*	*2004 (%)*	*2005 (%)*	*2006 (%)*
Thai fixed income	88.0	86.0	80.0	75.7	68.0	71.6
Thai equity	7.0	10.0	15.0	15.0	14.0	10.5
Thai property	4.0	3.0	3.0	3.4	3.0	4.3
Alternative investments	1.0	1.0	2.0	2.7	6.0	4.4
Global fixed income	0	0	0	0	8.0	5.1
Global equity	0	0	0	3.2	1.0	4.2
Net assets (billions of baht)	158.6	190.9	239.1	246.9	286.7	320.8

Source: Asset allocations are estimated by the authors using Government Pension Fund data (www.gpf.or.th). Total assets are provided by the Thailand Bureau of Savings and Investment Policy (2007).

be possible for workers in certain physically demanding industries. Formal sector workers will contribute to individual accounts that are vested in a variety of financial assets, which will be converted into a lump-sum payment consisting of contributions and capital gains (or losses) at the time of retirement. Then, rules will probably require the conversion of the lump-sum payment into a lifetime annuity, if such annuity markets are able to develop in the future. Unlike a defined-benefit system, a particular benefit level is not guaranteed, unless the government provides some minimum guarantee funded through general revenues in the event of unfortunate investment performance. Benefit amounts will largely depend on how successful the worker's portfolio investments have been.

As such, asset allocation decisions for the NPF are very important, and will certainly be the subject of continued debate in Thailand. We assume that the NPF's asset allocation will be modeled after the existing GPF. The trend in asset allocation for this fund is shown in Table 1. This fund has been undergoing rapid changes in asset allocation, including the recent introduction of foreign assets. The portion dedicated to Thai fixed-income assets has always been the highest, ranging from 88 percent of the allocation in 2001 to 68 percent in 2005. Thai equities provide the next largest category, and in 2003 and 2004 they represented 15 percent of the assets. Other categories include Thai property, alternative assets (mainly private equity), global fixed income assets, and global equities. Although the GPF is a single fund, it is possible that the NPF could introduce investment choices, in accordance with the Asian Development Bank (2000) recommendation of three choices for participants: aggressive, balanced and conservative. These possibilities will be illustrated with the range of scenarios we consider, although our baseline portfolio will include 15 percent equities

and 85 percent fixed income, which is an asset allocation similar to the GPF in 2002 and 2003.

III. Methodology for Stochastic Hypothetical Workers Model

Our methodology includes two steps: first, we develop long-term stochastic forecasts for the Thai economy; second, we apply these forecasts to the pre-defined career paths of a variety of hypothetical workers. We will discuss these matters in turn.

III.1 *Application of stochastic forecasts to study pension reform in Thailand*

To examine the suitability of pensions in Thailand, we will create stochastic forecasts for four key economic variables. These four variables include the Headline CPI (Headline CPI), the 1-year fixed bank deposit rate, the Stock Exchange Index (SET) for Thailand, and the average wage level. Data for the first three variables come from the Bank of Thailand, and wage data is from Thailand's General Statistics Office. The 1-year fixed deposit rate is our proxy for the returns to less risky fixed income securities available to Thai workers,[9] and the SET index is our proxy for the returns Thai workers can experience by investing in equities. For Thailand, historical data are available on an annualized basis for 1979–2005, although not for average wages. Average wages start from 1989 and annual average wages are calculated from monthly data provided by the National Statistical Office of Thailand (2007). For 1-year fixed deposit rates, in some years a range of rates is provided, and in these cases we select the middle value of the range.

For these variables, the nominal growth rates and real growth rates are computed and shown in Table 2. The analysis here will be conducted in real terms. Deserving of particular mention is the Thai stock market. Between 1979 and 2005, the average real return on the Thai SET index was 7.32 percent per year. However, the Thai stock index has shown remarkable volatility during this time period, declining by as much as 57.56 percent in 1997, and rising by as much as 112.77 percent in 2003, in real terms. The standard deviation of the returns during this time period was 44.54 percent, so that the geometric real return to the Thai stock index was actually −0.89 percent during these years, representing a loss of purchasing power. We make the stochastic forecasts using the historical returns and standard deviations in Table 2, under the assumption that these variables have growth factors that are lognormal and are independently and identically distributed in accordance with their historical characteristics. We create 1000 stochastic simulations of the four variables through 2060, based on this historical data.

9. We choose the 1-year fixed deposit rate for several reasons. Most importantly, it is used as the benchmark to compare returns from the GPF, and data for longer-term bonds, such as 3 or 10-year government bonds, are available only from 1996.

Table 2   Historical values for time-series economic data

	Time period	Arithmetic mean (%)	Standard deviation (%)	Geometric mean (%)
Inflation (headline CPI)	1979–2005	4.85	4.10	3.49
Interest rate (1-year fixed deposit)	1979–2005	8.15	4.09	6.60
Real interest rate	1979–2005	3.19	3.89	3.12
Average wage by industry	1989–2005	5437 baht	1570 baht	—
Growth rate of average wage	1990–2005	7.12	8.41	6.82
Real growth rate of average wage	1990–2005	3.06	7.44	2.82
Annual growth rate of SET index	1979–2005	11.85	45.07	3.84
Real growth rate of SET index	1979–2005	7.32	44.54	–0.89

Note: For the interest rate, the year-end value is used, and in some years a range of rates is
     provided in the data. For these cases, we use the middle value of the range. CPI, consumer
     price index; SET, Stock Exchange of Thailand index.
Sources: See Methodology section.

### III.2   Methodology for hypothetical workers and their pensions

We will apply these stochastic forecasts to hypothetical workers to study
pension suitability. Actually, defining hypothetical workers in Thailand is generally
easier than for other countries for two reasons: Thailand does not have a spousal
retirement benefit so it makes no difference whether a worker is married, and
there is no progressive benefit formula to redistribute wealth through the
pension system, such that the actual level of earnings (low, medium or high) has
little impact on measurements comparing pension benefits relative to income
and contributions. Therefore, we only consider average wage workers.[10] We appeal
to the hypothetical worker approach because of difficulties in obtaining data on
the lifetime earnings of Thai workers. We will indicate the direction of any bias
created by our assumptions.

We consider workers who retire in years ranging from 2014 to 2060. For each
worker, we assume that employment begins on their 20th birthday and lasts
continuously until retirement. We assume that retirement will occur on the 60th
birthday, and so each worker has a 40-year continuous work history.[11] We will
only use average wage workers, who are assumed to earn wages equal to the
average wage in Thailand for each year of their careers. This pattern will produce

10.   We ignore the issue of minimum and maximum salaries with which participants pay contributions,
because it is not clear how these will be adjusted in the future to account for price and/or wage
growth. For average wage workers, these constraints should not be binding, but this is the only
factor that could create differences in the ratios between benefits and salary for participants based
on their salary levels.
11.   Currently, the retirement age for the OAPF is 55 years, but it will probably be 60 years for the
NPF, and it is reasonable to expect that the OAPF retirement age will be increased to 60 years as
well to correspond with the NPF (Chantanusornsiri, 2006a, 2006b).

Figure 1   Scaled earnings: Mean wage by age as a percentage of Thailand's average wage
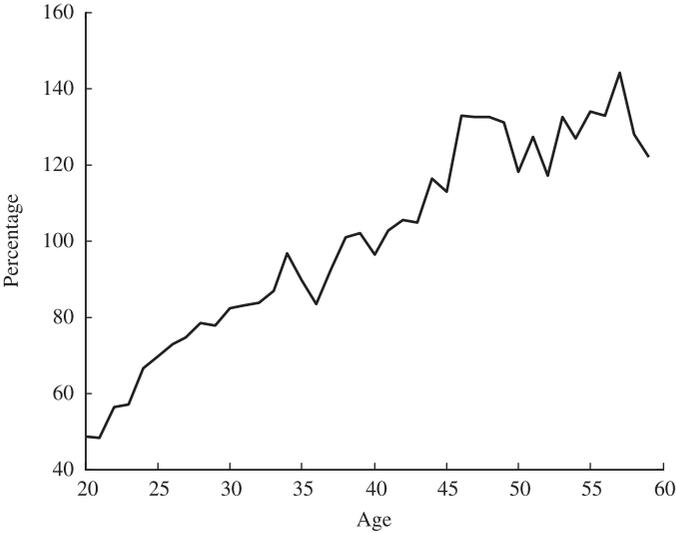
Source: Authors' calculations from the 2002 Socioeconomic Survey of Thailand.

a trend of increasing real wages throughout one's career on account of the upward trend of real wages over time.

Furthermore, we do not use a steady average earnings history, where wages at each age are defined as a constant proportion of average wages. This has been a deficiency of several previous studies. Instead, we use the 2002 Socioeconomic Survey of Thailand to analyze the pattern between age and earnings level at a given time, which is illustrated in Figure 1. In 2002, young workers tended to earn substantially lower wages, and it was at about age 40 that wages began to exceed the economy-wide average. We assume that this pattern extends into the future and apply it to obtain average wages by age. In comparing the scaled earnings history to the steady earnings counterpart, the assets accumulated in the defined-contribution account will tend to be less, because contributions are shifted from early to late in one's career, and it is contributions at young ages that would have experienced the most compounded growth before retirement. The scaled earnings history will also reduce our outcome measures, which compare pension benefits to the last 5 years of salary, in accordance with how benefits are calculated. This is because, as Figure 1 shows, salary between ages 55 and 59 years (the final 5 working years) is higher than the lifetime average.

We do not consider people retiring before 2014 because the SSF did not begin to collect contributions for old age pensions until 1999 and one must contribute for 180 months (15 years) before becoming eligible for an annuity. The range of retirement years ends in 2060, because by then (in 2057, to be

precise) workers have participated with the highest contribution rates for 40 years under both systems and so a steady state is reached.

We will calculate pensions coming from both of the mandatory parts of the Thai pension system: the OAPF and the NPF. For both pensions, we will allocate the entire payroll tax contribution to the worker, even though the legal incidence of the payroll tax is shared between the worker, the employer, and the government. Studies of wage elasticity in the USA justify this assumption: employers generally reduce wages by the amount of their payroll tax contribution. Also, it is not meaningful to say that the government contributes to the pension, because these contributions ultimately come from taxes, except that this design might lead to redistribution from those not covered by the pension system to those who are covered. As such, the combined tax rate for the OAPF is 3 percent for 1999, 5 percent from 2000 to 2002, and 7 percent in 2003 and later. For the defined-contribution pension, the combined tax rate is 6 percent from 2009 to 2011, 8 percent from 2012 to 2016, and 12 percent in 2017 and subsequent years. For the OAPF pension, the present study will calculate benefits using the new OAPF benefit rule in Equation (1). We do not consider any possible child or survivor benefits from the OAPF, only the retirement pension.

Regarding the defined-contribution portion of the NPF, the details of this program have not been finalized, and many important decisions are yet to be made. The returns expected to be obtained from the defined-contribution accounts are quite sensitive to the assumptions made about asset allocation, the nature of the annuitization process, whether there will be minimum benefit guarantees, and the treatment of account bequests upon death. Policy-makers must decide how much freedom Thai people will have to choose their investment portfolios, and whether there will be restrictions on asset classes, such as Thai equities, real estate, international assets, and other alternative assets.

First, we consider a worker's NPF account during the accumulation phase. We assume that workers will place their annual contributions into their investment portfolios at the end of each year. The investment portfolios are split between equities (an index of the SET) and bonds (1-year time deposits). Although there are likely to be strict limitations on the amount of stocks than can be owned, we will consider a range of portfolios between 100 percent stocks and 100 percent bonds. Our baseline portfolio includes 15 percent equities and 85 percent bonds. We do not consider diversification into foreign assets or into real estate and other alternative assets, although we wish to do this in subsequent research. We further assume that there will be an annual administrative cost of 0.3 percentage points for the individual accounts, which is likely on the low end of possible expenses. All stock dividends and bond interest payments will be reinvested and will be free from income taxes. We will rebalance the investment portfolios at the end of each year, in order to maintain the same asset allocations over time.

At retirement, decisions must be made about the annuitization process. We assume that all of the accumulated assets will be annuitized. This helps to

protect against the risk of outliving one's assets, but it does limit NPF participants' retirement spending flexibility. Annuities are not common at present in Thailand, but it is reasonable to expect that an annuity market will be able to develop by the time that the NPF matures. We further assume that annuities will be fixed and provided in real terms, which means that they start at a lower level but enjoy annual cost-of-living adjustments that match the inflation rate. Risk-averse individuals are likely to prefer this type of annuity, because additional risks related to inflation and the investment returns of the annuity assets are avoided. We further assume that the overhead costs for purchasing an annuity are 10 percent, and we consider annuities for individuals, rather than joint and survivor annuities for married couples.

Calculating the annuity requires dividing the total assets accumulated at the time of the retirement (less the overhead costs) by the actuarial present value of each baht of savings. This value accounts for the probability of survival for each age beyond retirement, as well as an assumed interest rate for the returns on remaining annuitized assets. Regarding survival probabilities, our mortality data by age and gender comes from two sources. We adjust the by-age patterns in the World Health Organization life table for 1999, so that they match the life expectancies between 1950 and 2050 in the medium projections of the United Nations Population Division (2004). When calculating annuities, we use unisex survivor probabilities, as may be required by law, and so we weigh mortality rates by the numbers of men and women in the population at each age. As for the expected return on remaining annuitized assets, with the real fixed annuity we assume a rather conservative portfolio of 100 percent bonds for the remaining assets. The expected real return of this portfolio is equal to the mean of the forecasted 'historical data' at the date of retirement for each stochastic simulation.

IV. Results

This study attempts to determine whether the first and second pillars of the proposed NPF in Thailand can be expected to provide a reasonably adequate income for retirees. According to Chaiyasoot (2005), a suitable level for retirement pensions would be equivalent to 50–60 percent of the last month's salary at retirement. Then, it is a matter of determining whether the pension benefits would be able to replace this much income. In order to examine this issue, we will consider the nest-egg ratio and the replacement rate. As is the case with determining how the benefits are calculated in Thailand, we define the nest-egg ratio as the ratio of accumulated assets in the defined-contribution account at retirement to the average of the last 5 years of income before retirement. The replacement rate is the percentage of the average income from the last 5 years of employment that the pension annuity will provide. First, we consider the benefits from the defined-contribution pension in terms of the nest-egg ratio (Table 3 and Figure 2) and the replacement rate (Table 4). Our baseline portfolio assumes an allocation of 15 percent equities and 85 percent

Table 3 National pension fund defined-contribution (Pillar 2) stochastic distribution of nest eggs for average earners (scaled earnings) varied by year of retirement and asset allocation

		Year of retirement					
		2014	2020	2030	2040	2050	2060
Baseline	Median	0.43	1.08	2.24	3.28	4.00	4.21
case	Mean	0.43	1.10	2.35	3.46	4.34	4.51
15%	5th percentile	0.38	0.90	1.69	2.26	2.60	2.69
stocks	25th percentile	0.41	0.99	2.01	2.82	3.34	3.47
85%	75th percentile	0.45	1.18	2.58	3.97	5.02	5.25
bonds	95th percentile	0.50	1.35	3.29	5.29	7.02	7.24
	Prob (Nest Egg > 1)	0	73.9	100.0	100.0	100.0	100.0
	Prob (Nest Egg > 4)	0	0	1.1	23.9	50.1	55.3
	Prob (Nest Egg > 7)	0	0	0	0.5	5.1	6.3
100%	Median	0.41	0.95	1.73	2.32	2.73	2.80
stocks	Mean	0.47	1.27	3.08	5.28	8.97	8.06
	5th percentile	0.21	0.42	0.59	0.62	0.69	0.67
	25th percentile	0.31	0.67	1.05	1.31	1.40	1.38
	75th percentile	0.55	1.46	3.19	4.96	6.61	6.79
	95th percentile	0.97	3.20	9.24	18.89	25.57	27.26
	Prob (Nest Egg > 1)	4.4	46.6	77.5	84.7	86.5	86.1
	Prob (Nest Egg > 4)	0	2.8	18.5	30.7	36.8	39.1
	Prob (Nest Egg > 7)	0	0	7.8	17.0	23.4	24.5
50%	Median	0.42	1.07	2.17	3.19	3.87	4.11
stocks	Mean	0.45	1.17	2.62	4.14	5.66	5.78
50%	5th percentile	0.31	0.68	1.17	1.39	1.61	1.58
bonds	25th percentile	0.37	0.88	1.64	2.26	2.59	2.69
	75th percentile	0.50	1.35	3.02	4.92	6.67	6.97
	95th percentile	0.67	1.99	5.62	10.00	14.01	14.43
	Prob (Nest Egg > 1)	0	58.6	98.4	99.4	99.8	99.7
	Prob (Nest Egg > 4)	0	0	12.6	35.6	48.4	51.5
	Prob (Nest Egg > 7)	0	0	2.4	12.4	22.5	24.9
100%	Median	0.43	1.06	2.21	3.13	3.81	3.94
bonds	Mean	0.43	1.06	2.25	3.21	3.92	4.08
	5th percentile	0.39	0.93	1.78	2.35	2.69	2.70
	25th percentile	0.41	1.00	2.01	2.79	3.26	3.37
	75th percentile	0.44	1.12	2.45	3.57	4.46	4.64
	95th percentile	0.46	1.22	2.85	4.34	5.54	5.96
	Prob (Nest Egg > 1)	0	75.7	100.0	100.0	100.0	100.0
	Prob (Nest Egg > 4)	0	0	0	10.6	40.0	47.1
	Prob (Nest Egg > 7)	0	0	0	0	0.7	1.5

fixed income assets. The tables also show the results for three other asset allocations (100 percent stocks; 50/50 stocks and bonds; 100 percent bonds) in order to make further comparisons. Table 5 then considers the combined benefit from the two pillars.

Table 4   National pension fund defined-contribution (Pillar 2) stochastic distribution of replacement rates for average earners (scaled earnings) varied by year of retirement and asset allocation

|		*Year of retirement*					
		2014 (%)	*2020* (%)	*2030* (%)	*2040* (%)	*2050* (%)	*2060* (%)
Baseline	Median	1.85	4.51	8.88	12.16	13.83	13.64
case	Mean	1.86	4.58	9.32	12.84	15.01	14.63
15%	5th percentile	1.63	3.74	6.71	8.40	9.00	8.71
stocks	25th percentile	1.76	4.16	7.95	10.46	11.54	11.24
85%	75th percentile	1.96	4.92	10.23	14.71	17.36	17.06
bonds	95th percentile	2.15	5.65	13.06	19.58	24.28	23.48
	Prob (RR > 10)	0	0	28.3	80.0	89.6	87.2
	Prob (RR > 25)	0	0	0	0.5	4.3	3.3
	Prob (RR > 50)	0	0	0	0	0	0
100%	Median	1.76	3.99	6.87	8.59	9.45	9.10
stocks	Mean	2.01	5.31	12.19	19.61	31.02	26.14
	5th percentile	0.93	1.78	2.35	2.29	2.39	2.16
	25th percentile	1.32	2.79	4.17	4.85	4.84	4.49
	75th percentile	2.39	6.12	12.64	18.41	22.85	22.01
	95th percentile	4.16	13.41	36.56	70.11	88.45	88.44
	Prob (RR > 10)	0	9.6	33.0	44.4	48.2	47.4
	Prob (RR > 25)	0	0.6	9.8	17.9	22.9	21.8
	Prob (RR > 50)	0	0	3.2	7.8	10.7	10.3
50%	Median	1.83	4.47	8.61	11.86	13.39	13.34
stocks	Mean	1.92	4.88	10.38	15.35	19.59	18.74
50%	5th percentile	1.32	2.83	4.66	5.18	5.59	5.11
bonds	25th percentile	1.59	3.67	6.48	8.39	8.96	8.71
	75th percentile	2.16	5.64	11.97	18.29	23.06	22.59
	95th percentile	2.88	8.34	22.26	37.09	48.40	46.80
	Prob (RR > 10)	0	2.2	38.6	61.3	67.3	66.9
	Prob (RR > 25)	0	0	3.6	13.7	21.2	20.9
	Prob (RR > 50)	0	0	0	2.1	4.7	4.0
100%	Median	1.84	4.43	8.74	11.61	13.17	12.78
bonds	Mean	1.84	4.45	8.91	11.93	13.55	13.24
	5th percentile	1.70	3.88	7.03	8.71	9.31	8.75
	25th percentile	1.78	4.19	7.94	10.36	11.26	10.93
	75th percentile	1.89	4.68	9.71	13.24	15.43	15.05
	95th percentile	1.98	5.12	11.30	16.12	19.18	19.37
	Prob (RR > 10)	0	0	18.6	80.5	88.8	86.3
	Prob (RR > 25)	0	0	0	0	0	0.6
	Prob (RR > 50)	0	0	0	0	0	0

Figure 2 provides a visual demonstration of the stochastic distribution for the nest-egg ratio available to average wage workers who participate in the NPF starting in 2009 for the baseline asset allocation. The distribution of nest-egg ratios shows an upward trend over time that stabilizes in the mid-2050s. This is

Table 5 Total pension (OAPF + NPF) stochastic distribution of replacement rates for average earners (scaled earnings) varied by year of retirement and asset allocation

		Year of retirement					
		2014 (%)	2020 (%)	2030 (%)	2040 (%)	2050 (%)	2060 (%)
Baseline	Median	23.35	35.01	54.38	69.66	71.33	71.14
case	Mean	23.36	35.08	54.82	70.34	72.51	72.13
15%	5th percentile	23.13	34.24	52.21	65.90	66.50	66.21
stocks	25th percentile	23.26	34.66	53.45	67.96	69.04	68.74
85%	75th percentile	23.46	35.42	55.73	72.21	74.86	74.56
bonds	95th percentile	23.65	36.15	58.56	77.08	81.78	80.98
	Prob (RR > 60)	0	0	2.1	100.0	100.0	100.0
	Prob (RR > 70)	0	0	0	45.7	64.1	61.1
	Prob (RR > 80)	0	0	0	1.3	8.3	6.6
100%	Median	23.26	34.49	52.37	66.09	66.95	66.60
stocks	Mean	23.51	35.81	57.69	77.11	88.52	83.64
	5th percentile	22.43	32.28	47.85	59.79	59.89	59.66
	25th percentile	22.82	33.29	49.67	62.35	62.34	61.99
	75th percentile	23.89	36.62	58.14	75.91	80.35	79.51
	95th percentile	25.66	43.91	82.06	127.61	145.95	145.94
	Prob (RR > 60)	0	0	20.5	93.8	94.2	92.5
	Prob (RR > 70)	0	0	10.0	36.6	40.3	40.1
	Prob (RR > 80)	0	0	5.5	20.2	25.3	24.6
50%	Median	23.33	34.97	54.11	69.36	70.89	70.84
stocks	Mean	23.42	35.38	55.88	72.85	77.09	76.24
50%	5th percentile	22.82	33.33	50.16	62.68	63.09	62.61
bonds	25th percentile	23.09	34.17	51.98	65.89	66.46	66.21
	75th percentile	23.66	36.14	57.47	75.79	80.56	80.09
	95th percentile	24.38	38.84	67.76	94.59	105.90	104.30
	Prob (RR > 60)	0	0	16.1	100.0	100.0	99.9
	Prob (RR > 70)	0	0	4.0	46.2	54.0	53.7
	Prob (RR > 80)	0	0	1.2	16.7	25.8	25.1
100%	Median	23.34	34.93	54.24	69.11	70.67	70.28
bonds	Mean	23.34	34.95	54.41	69.43	71.05	70.74
	5th percentile	23.20	34.38	52.53	66.21	66.81	66.25
	25th percentile	23.28	34.69	53.44	67.86	68.76	68.43
	75th percentile	23.39	35.18	55.21	70.74	72.93	72.55
	95th percentile	23.48	35.62	56.80	73.62	76.68	76.87
	Prob (RR > 60)	0	0	0	100.0	100.0	100.0
	Prob (RR > 70)	0	0	0	35.0	60.1	53.4
	Prob (RR > 80)	0	0	0	0	1.4	1.6

a result of the increasing years of contributions since the start date for later retirees. Also, because the contribution rate rises to its maximum of 12 percent of income in 2017, it is only people who retire in 2057 who will have contributed at the maximum rate for their entire 40-year career. Retirees in 2014 contribute

Figure 2   National pension fund defined-contribution (Pillar 2) nest-egg ratio distribution for average earners (scaled earnings) investment portfolio: 15% stocks, 85% bonds
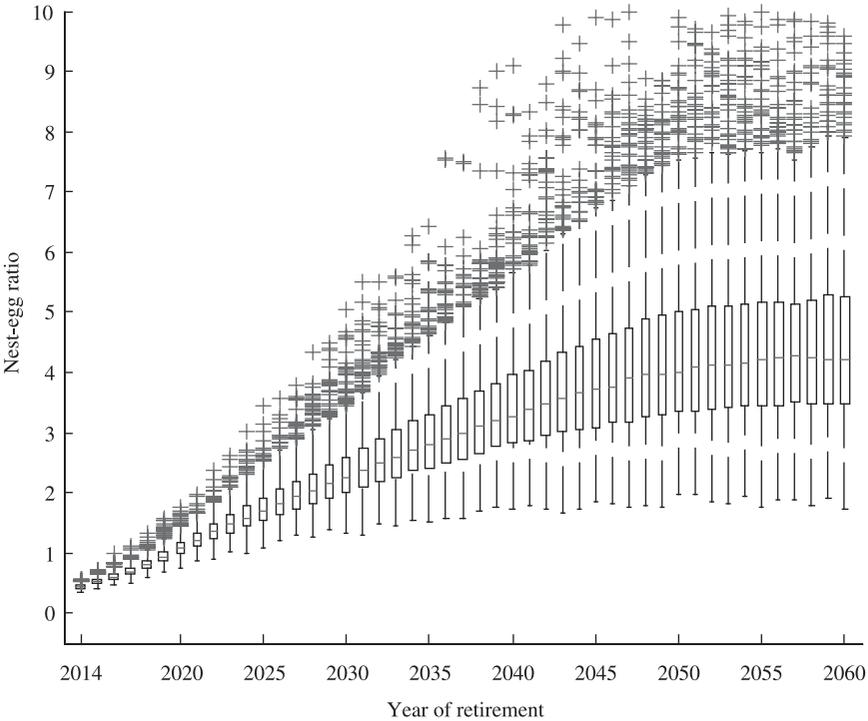
a relatively small amount during their 5 years of participation, and, therefore, can be expected to have accumulated savings that are only about half of their average salary during their last 5 years of employment. The median nest-egg ratio can be expected to rise to about twice the average salary by the late 2020s, and about four times the average salary by the 2040s, with only slight increases after that. The purpose of using stochastic forecasts is to examine the distribution of possible outcomes that workers might expect, and we find evidence of a great deal of diversity in potential outcomes. As is evident if Figure 2, the distribution is not symmetric, because the lognormal distribution of returns prevents accumulated assets from falling below zero, and it is widely dispersed with a small chance that accumulated assets become very large.

Table 3 shows specific numbers to describe the distribution in Figure 2, and it also provides results for other asset allocations. For the baseline case, in 2050, for example, the median is 4.0 and the 90 percent interval for the nest-egg ratio ranges from 2.6 to 7.0. Because the distribution is not symmetric, the mean performance could be misleadingly large. For the baseline case, Table 3 also shows the probability of obtaining a nest egg larger than 1, 4 and 7, in order to give another interpretation

about the variance of results. By the time that the system matures in 2060, workers can expect their nest egg ratio to exceed 4 more than 50 percent of the time, and there is only a 6.3-percent chance of having a nest egg ratio exceeding 7.

One must also recognize that there are two opposing reasons that explain the relative size of the nest-egg ratio. On the one hand, the nest-egg ratio can be small because the returns from the worker's investments are low, and occasionally a worker might see a large drop in the stock market in the final years of their career, leading to a smaller amount of accumulated assets. This is the risk of investing in such assets, particularly in considering the large volatility that the Thai stock market has shown in the past. On the other hand, a 'good' reason for small nest-egg ratios is when workers experience rapid wage growth in the final years of their career. This makes their final earnings much more attractive than the earnings earlier in their careers, and will decrease the value of their nest-egg ratio (because it only considers the final 5 years of income in the denominator) without necessarily making the worker feel worse with respect to their overall lifetime earnings.

Table 3 also provides the stochastic forecasts for nest-egg ratios assuming several different asset allocations ranging from 100 percent stocks to 100 percent bonds. The main trends are that as the amount of equity increases in the portfolio, the median falls (once the portion of equities exceeds 15 to 25 percent), the mean increases, the 90 percent interval widens, and the probability of having either a very small or very large nest-egg ratio increases. For example, the portfolio with 100 percent stocks produces for 2060 retirees a median nest-egg ratio of 2.8, while the mean is 8.06 and the 90 percent interval ranges from 0.67 to 27.26. The probabilities tell more of the story, as the probability of producing a nest-egg ratio less than 1 increases from 0 to 13.9 percent, but the probability of producing a nest-egg ratio larger than 7 also increases from 6.3 to 24.5 percent. Investing in 100 percent stocks produces the best chance for extreme success, but it is also incredibly risky due to potential failure. The next portfolio is 50 percent stock and 50 percent bonds, and the results of this portfolio fall somewhere between the baseline and 100 percent stocks. The median performances are quite similar to the baseline portfolio, but the range of outcomes is wider. For example, in 2060, the 90 percent interval ranges from 1.58 to 14.43. Also, the chance of producing a nest-egg ratio less than 1 in 2060 is only 0.3 percent, whereas the probability producing a nest-egg ratio greater than 4 is 51.5 percent, and the probability of producing a nest-egg ratio greater than 7 is 24.9 percent. Finally, the last portfolio considers 100 percent bonds with no diversification into stocks. This portfolio produces low but stable returns, although we would require a large degree of risk aversion before preferring this portfolio over the baseline.

More relevant to the case of retirement spending is the replacement rate a worker could expect to receive by converting their accumulated assets into an annuity at retirement. The annuity calculation translates nest-egg ratios into replacement rates using the assumptions for a real fixed annuity as explained in the methodology section. The shapes of the replacement rate distributions for the

various portfolios follow the same patterns as the nest-egg ratio, re-scaled to show the replacement value of the annuity. Therefore, the same discussion about distributions and comparisons between portfolios for nest-egg ratios applies to replacement rates.

We find in Table 4 that Thai workers cannot expect large annuities from their savings, as the median annuity amount does not rise above about 14 percent of the final salary for any asset allocation, even when the system has fully matured. Even by 2030, the median replacement rates will be below 10 percent. Again, however, the distribution of replacement rates is quite large. In 2060, the 90-percent interval for the baseline case ranges from 8.71 to 23.48 percent. Most workers (87.2 percent) can expect a replacement rate of greater than 10 percent with the baseline distribution, but only 3.3 percent will enjoy a replacement rate above 25 percent. The portfolio with 100 percent stocks is most risky, as only 47.4 percent of participants can expect a replacement rate above 10 percent, but 21.8 percent will see replacement rates above 25 percent. Meanwhile, the portfolio with 100 percent bonds gives about the same chance as the baseline case of having a replacement rate above 10 percent, but almost no chance of a replacement rate above 25 percent.

With the assumptions for the stochastic forecasts based on Thailand's historical period, and especially because the Thai stock market has shown much more volatility than most other countries, it is possible that in the future Thai economy will behave differently as it becomes more mature and stable. As such, we also consider a second forecast for the Thai stock market, which matches more general historical trends for equity returns throughout the world. This second scenario could either be interpreted as a brighter future in which Thailand's stock market behaves more in line with international trends, or as the investment of its pension assets into global equities. For this scenario, we assume an annually compounded real return to equities of 7 percent, with a standard deviation of 20 percent, which implies an arithmetic real return of 9 percent. In the baseline case, this optimistic assumption still does not have much effect, as the median replacement rate will only increase to approximately 15 percent once the system matures. As more equities are added to the portfolio, the results will increasingly differ from Table 4, as the overall distribution of replacement rates increases. For instance, in considering a portfolio with 100 percent equities, the median replacement rate for 2060 retirees is 29.8 percent, and the 90 percent interval ranges from 9.9 to 108.3 percent. Therefore, in assuming that that Thailand's economy will follow a more stable growth pattern in the future and its stock market will follow international trends, we can expect an improvement in median replacement rates, although the improvements will be minor in the baseline case and only become more noticeable when there is a higher allocation for stocks.

Next, Table 5 provides information about the probability distribution for the combined benefit replacement rate of the defined-benefit and the defined-contribution pensions. This first pillar defined-benefit pension from the OAPF is expected to provide generous benefits to participants, especially with the benefit

increases legislated in 2005. However, the OAPF only began collecting contributions in 1999, and so according to the defined-benefit pension formula, those retiring in 2014 will have had 15 years of contributions, and are thus entitled to a replacement rate of 20 percent of their last 5 years of earnings. In subsequent years, retirees will enjoy larger benefits because more years of contributions will have been available since 1999. Each year witnesses a growth in the replacement rate of 1.5 percentage points. Therefore, for example, between 2030 and 2040, the replacement rate from the OAPF would increase from 44 to 57.5 percent. Participants retiring in 2039 and later will have contributed to the OAPF for 40 years, under our assumptions of a continuous work history, which entitles them to a replacement rate of 57.5 percent. There is no stochastic distribution for the replacement rate of the OAPF benefit because it is defined with regard to wages, and the government bears the risk of funding the benefit.

Table 5 shows the overall replacement rate from the two systems, adding the replacement rates just described for the OAPF with the NPF replacement rates found in Table 4. Once the pension system matures and workers are able to contribute to both systems throughout their entire career, the median combined replacement rate in the baseline case will be approximately 71 percent. Additionally, the 5th percentile will be approximately 66 percent, and participants can be virtually guaranteed to have replacement rates larger than 60 percent. The same pattern emerges when considering other asset allocations. Contributors with a 100 percent allocation for stocks will have lower median replacement rates, but they can still enjoy a greater than 90-percent probability of having a replacement rate larger than 60 percent. In addition, because of the large volatility of stocks, some workers will enjoy replacement rates in excess of 100 percent. A conservative portfolio of 100 percent bonds will virtually guarantee replacement rates of over 60 percent and provide a 53.4-percent chance of rates above 70 percent. By international standards as well as the expectations provided in Chaiyasoot (2005), the combined replacement rate appears suitable, and voluntary savings will remain an option for people seeking larger retirement incomes. Because the defined-benefit pension provides such a large benefit, this might provide a reason for participants to desire riskier asset allocations for their defined-contribution pensions. At the same time, however, the OAPF is not expected to be sustainable, and if OAPF benefits are reduced in the future, this will have obvious implications for the overall replacement rate.

V. Conclusions and Policy Recommendations

We have examined several issues related to the suitability of Thailand's mandatory pension systems. We find that the pensions available will be suitable, although this is mostly because of the generous pensions provided by the defined-benefit OAPF. Once the defined-contribution pension from the NPF matures, workers can only expect an income replacement rate of 13 to 14 percent

from it on average, and the remainder of transfers will come from the defined-benefit pension. Therefore, these results must be accompanied by a large caveat that deserves particular emphasis. The defined-benefit OAPF pension might not be sustainable. Our analysis shows that when the pension systems mature, the defined-contribution pension will collect 12 percent of wages each year, whereas the defined-benefit pension collects 7 percent of wages. Nonetheless, the defined-benefit pension will provide a replacement rate of 57.5 percent for a 40-year career, while the median replacement rate for any portfolios from the defined-contribution pension will not exceed about 14 percent. Therefore, it is rather unclear how the OAPF will be able to fund such a large pension.

To be sure, the present paper does not complete the story about pension reform in Thailand, because use of hypothetical workers does not enable us to quantify the size of various population cohorts, and we cannot be sure that the hypothetical workers will represent the actual population of contributors in terms of total years of contributions and pattern and level of earnings. There is still much to be gained from creating a full actuarial model to better understand sustainability issues related to the OAPF. Nonetheless, we can observe that there is indeed a large discrepancy between the contributions and benefits of the two systems, and the aging population in Thailand will only serve to compound the funding problems of the OAPF. More work must be done in this regard, to provide a complete picture of suitability and sustainability issues.

Aside from the sustainability issue, many policy recommendations for both the OAPF and NPF follow from this work. First, the OAPF pension amount could be calculated based on a longer period of earnings to better match average lifetime earnings. On average, workers can obtain higher pensions by basing the amount only on the last 5 years of earnings, which increases the costs for the government, as the microdata shows that conditional on continuing work, wages do trend upward, at least until age 60 years. However, some people may experience wage reductions late in their careers, which could hurt their pensions. This might also create a large disincentive to remain in the labor force, as the prospect of a reduced wage for someone close to retirement could have serious implications for the pension amount from the OAPF.

As for other recommendations, it is questionable whether the OAPF should include funding from general government resources, as this implies a redistribution of income from the general taxpaying population to the privileged members of the formal labor sector. Additional reforms worthy of consideration include creating a spousal benefit for married workers, creating a progressive benefit formula for the OAPF, increasing the retirement age to at least 60, and expanding coverage to more workers. Meanwhile, for the defined-contribution pension in the NPF, the main issues revolve around asset allocation. Thai equities have been very volatile, but at the same time, because the defined-contribution pension is a relatively small part of the total pension, people might want to take a risk with stocks to gain potentially larger returns. Also, providing investment choice, creating life-cycle portfolios that allow for greater risk when young, and

diversifying into international and alternative assets can play an important part in the further development of the NPF. Finally, policy-makers might wish to further assess the balance between the defined-benefit and defined-contribution systems, to decide on the best allocation of contribution rates between the two systems.

More research is warranted with respect to the defined-contribution aspect of the NPF. It is important to incorporate realistic measures of risk aversion for the Thai population to determine an appropriate asset allocation for the defined-contribution pensions, particularly if the government chooses a single fund approach that matches the GPF. Additionally, further work is warranted to consider a wider variety of assets for the portfolio, including real estate, private equity and international investments. In this regard, it is also important that the correlation between different asset returns be better modeled, rather than assuming independent distributions. Finally, calibrating the number of years people spend working in the formal sector labor markets would help to better estimate pension amounts for both the defined-benefit and defined-contribution pensions.

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Output and Productivity Performance of Hong Kong and Singapore's Transport and Communications Sector, 1990 to 2005*

Boon L. Lee and William Shepherd

This paper uses the industry of origin approach to analyze value added and labor productivity outcomes arising from progressive liberalization of government and from statutory board control of transport and communications in Singapore. The paper compares these outcomes with those from the market-orientated, more privatized transport and communications sector in Hong Kong, for the benchmark year 2004 and a review period from 1990 to 2005. The study is among the first to carefully compare labor productivity in specific sectors between the two countries. Although Singapore generally recorded higher levels of labor productivity, there was some catch-up by Hong Kong in the later part of the review period. There was also substantial variation in labor productivity performance within sectoral branches in the two sectors. The study suggests there is some evidence that the different political–economic structures and policy approaches to deregulation and liberalization played a role in determining productivity performance in the transport and communications sectors in Singapore and Hong Kong. The analysis infers a potential, increasing focus on privatization as the driving force for further liberalization of the transport and communications sector in Singapore.

I. Introduction

Over the past two decades, the deregulation of industry and public utilities in industrial countries and a more general liberalization of markets and international trade and investment have ensured that service sectors have become major contributors to employment and GDP growth. Singapore has responded to this international trend by gradually moving its state-owned enterprises from a highly regulated, bureaucratic system to a stronger commercial style of operation aimed at increasing market competition. This is evident in the electricity industry deregulation reforms of 1995, the corporatization of the Port of

Singapore Authority in 1997, the deregulation of taxi fares in 1998, the financial sector liberalization in 1999 and the liberalization of telecommunications in 2000. The main aim of this paper is to provide an analysis of value added or labor productivity outcomes arising from the liberalization process in the transport and communication sector in Singapore and to compare these results with productivity outcomes in the same sector in Hong Kong over the period 1990–2005.

There are two principal motivations for the present study. First, to make any meaningful comparisons and assessment of real improvements as a result of the sectoral liberalization process in Singapore, it is necessary to compare these developments to those in a country that is similar in many respects. Hong Kong is an appropriate benchmark comparator for Singapore. Both countries, as city states, are widely regarded as two of the world's most open economies (Heritage Foundation, 2008). They are densely populated with limited land mass and natural resources but have excellent public transport systems, container ports and airline and airport services. In 2005, Singapore overtook Hong Kong as the world's busiest container port (Singapore's National Shippers' Council, 2006). From 2001 to 2005, and for the 2006 airport survey conducted by Skytrax, Hong Kong was rated the best airport in the world.[1] Therefore, both rely on efficient public transport systems domestically and efficient sea and air transport facilities internationally. Each country also has a well-reputed financial sector and over the past decade both have developed modern socioeconomic infrastructures and sophisticated information technology through extensive mobile telephony and internet telecommunications industries. Internet subscribers per capita in Singapore and Hong Kong are now broadly in line with the main internet users in the OECD: Korea, Denmark, Sweden and the USA.[2] These are essential facilities for encouraging growth and development of the service sector in general. By 2005, the service sector accounted for 82.7 and 63.1 percent of Hong Kong and Singapore's GDP, respectively. In 2005, the share of the service sector contribution by transport and communications stood at 10.1 and 11.8 percent, respectively, for Hong Kong and Singapore.[3]

Second, although the two countries have much in common, Table 1 indicates that the current transport and communications sectors evolved through different political–economic structures and policy management approaches in each

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1. Data are drawn from http://www.worldairportawards.com.
2. Data for OECD is from *The Communications Outlook* (OECD, 2003). The number of internet subscribers for Hong Kong is drawn from the Census and Statistics Department (2006b). The number of internet subscribers for Singapore is drawn from the Singapore Department of Statistics (2005). The figures for Hong Kong refer to the year 2000 and for Singapore, 2001. Population data are drawn from ILO (2000, 2005).
3. Data on local currency constant prices are drawn from each country's statistical yearbook: for Singapore, the Singapore Department of Statistics (2006) in 2000 prices and for Hong Kong in 2005 prices, the Census and Statistics Department (2006a) from http://www.censtatd.gov.hk/hong_kong_statistics/statistical_tables/index.jsp?charsetID=1&tableID=037**.**

Table 1   Comparison of the current liberalized/regulatory features of the transport and communications sectors in Singapore and Hong Kong

	Singapore	*Hong Kong*
Bus	Currently provided by two private multi-modal companies (Singapore Bus Service (SBS) transit and Singapore Mass Rapid Transit (SMRT) buses), but still regulated by the Public Transport Council.	Currently provided by five privately-owned companies (franchised public bus services – Kowloon Motor Bus Company (1933) Limited; Citybus Limited; Long Win Bus Company Limited; New World First Bus Services Limited; and New Lantao Bus Company (1973) Limited.
Rail	In 2004 Temasek Holdings (private) Ltd owns 62.29 percent of SMRT thus making SMRT quasi-government owned.	In 2000, the Mass Transit Railway (MTR) Corporation Limited became Hong Kong's first privatized rail and metro company.
Taxi	In 1998, taxi fares were deregulated and by 2004 the taxi industry was fully deregulated. (7 taxi companies).	Taxis are either privately-owned or owned by companies but the industry is regulated by the Government, as are the fare scales.
Aviation	Singapore Airlines currently government owned. The Singapore Government investment and holding company, Temasek Holdings is the majority shareholder with a 56.7 percent shareholding in 2004. Singapore Changi Airport is owned by the Civil Aviation Authority of Singapore (CAAS), which is a statutory board under the Ministry of Transport.	Cathay Pacific (Hong Kong's flag carrier) is privately-owned. Hong Kong International Airport (HKIA) is operated by the Airport Authority Hong Kong, a statutory body wholly owned by the Government of Hong Kong Special Administrative Region.
Port	In 1997, Port of Singapore Authority (PSA) Corporation Ltd was corporatized.	The facilities of Port of Hong Kong: facilities are financed, owned and operated by the private sector.
Communications	In 2000, telecommunications industry was liberalized	In 1995, telecommunications industry was deregulated.
Postal	Partly divested (2004 – 31 percent owned by SingTel which is owned by Temasek Holdings)	In 1995, began operating as a trading fund to operate more commercially.

Note: Temasek Holdings (private) Ltd is the investment arm of the Government of Singapore.

country. Singapore has a long tradition of operating industries through statutory boards as government-owned business monopolies (Ow, 1986; Soon and Tan, 1993). Table 1 indicates that deregulation of this sector in Singapore occurred first through liberalization of statutory boards under government direction then, more recently, through partial privatization of the publicly-owned monopolies. In contrast, developments in the sector in Hong Kong reflect emphasis on a more market-oriented approach with little or no restrictions on the scope of private ownership even after the establishment of the Hong Kong Special Administration Region by China in 1997. Clearly, privatization has been a stronger driving force, historically, in Hong Kong, with Singapore moving latterly in this direction as a means of stimulating market competition.

Given these motivations, the sectoral comparative analysis in the present paper addresses three related questions. The first is, the extent to which the analysis sheds light on the relative performance of the transport and communications sector in Singapore and Hong Kong since 1990; the second is the extent to which the liberalization process in Singapore has improved value added and productivity outcomes for the traditionally heavily regulated transport and communication sector; and third, have the different political–economic structures and policy emphases had detectable influences on the relative sectoral productivity performances in the two countries?

The paper is among the first to carefully compare labor productivity in a specific service sector between the two countries. Previous studies, such as Young (1995), Chen (1997) and van Ark and McGuckin (1999), have analyzed service performance, but in more aggregated forms.

Because the paper undertakes a direct comparison of sectoral value added and productivity, it uses the well-recognized industry-of-origin methodological approach, which is explicitly designed for this purpose (van Ark, 1993; Mulder, 1994; van Ark et al., 1999; Lee and Shepherd, 2002). It draws on the concept of purchasing power parity of currencies for derivation of appropriate currency converters to enable quantification of output and productivity at various disaggregated levels in national currencies. The study uses a partial productivity analysis (i.e. it discusses only labor productivity). No doubt, a more robust productivity analysis would be achieved if a multifactor approach could be adopted. The lack of reliable capital stock data and appropriate capital stock purchasing power parities (PPP) prevent the adoption of a multifactor productivity approach.

The paper proceeds as follows. Section II is a literature review, which describes the industry-of-origin methodology used in the study. Section III presents the results of the real output and productivity comparisons between Singapore and Hong Kong for the benchmark year 2004 and the productivity trends over the period 1990 to 2005. Section IV offers general concluding comments.

II. Literature Review

When a comparative analysis involves services, two major problems arise. The first is the difficulty in distinguishing prices, quantities and quality of services. Hill (1977) notes that the quantity of a service is difficult to capture as it often represents a process by which a consumer or consumer good is changing. Unlike manufactured goods, services are characterized by a greater degree of heterogeneity, which makes aggregation difficult. Some studies measure output only in physical terms. For example, Girard (1958) and Gadrey et al. (1990) measure output in terms of tones-km and passenger-km for the transport industry. Some studies consider the importance of differing average haul distances or passenger trip lengths and that the output measure must take separate account of loading and unloading services and costs, which are more important, proportionately, in a country with shorter hauls or passenger trips. This activity of loading and unloading, called terminal services, is taken into account in studies such as Paige and Bombach (1959), Smith et al. (1982), Mulder (1994) and Lee and Shepherd (2002). For the communications industry, Rostas (1948) and Paige and Bombach (1959) use the number of calls and access lines and the volume of mail handled.

Second, meaningful real output comparisons are difficult as each country's output is expressed in its own currency unit and has to be converted into a common currency. Direct comparisons require the use of an appropriate currency converter. The use of official exchange rates is not suitable because they are heavily influenced by capital movements and exchange rate adjustments and do not reflect real price differences between countries. Appropriate currency conversion makes use of the concept of PPP. Some well-known studies (see Kravis et al., 1982; OECD, 1992) have derived PPP through the expenditure side of national accounts. However, PPPs derived from the expenditure side of national accounts are not appropriate for use in the current study as they cannot be used directly in sectoral analysis of output and labor productivity comparisons because they do not produce real product by industry. This implies that the PPP to be used in the present study must be derived from the production side in order to develop real output and productivity comparisons.

The PPP derived in this paper follows the International Comparisons of Output and Productivity (ICOP) approach used in studies such as Maddison and van Ark (1988), Szirmai and Pilat (1990), van Ark (1993), Pilat (1994) and Lee and Shepherd (2002). The ICOP approach is essentially a three-stage process. The first stage matches item/service activity of similar characteristics in both countries. Assume the activity of 'mail handling' to be the same in both countries. A unit value for this matched service is derived from the ratio of its value of output to its corresponding quantity. Conceptually, this unit value represents the average price per unit of mail handling for each country. In turn, the implicit price average provides a relative price comparison between these two countries for mail handling. The second stage involves aggregation of the

matched service activities to derive branch-level aggregates and PPP. For example, under the branch 'Communications,' the matched services would include 'mail handling,' 'telephone subscription,' 'mobile phone subscription,' and 'internet subscription.' The aggregation of these industries yields branch-level PPP. The third and final stage is an aggregation of all branch PPP to derive the overall PPP, which in this case is the PPP for transport and communications. Real output and productivity levels can thus be derived using the ICOP PPP.[4]

III. Results

III.1 Relative size and structure of the transport and communications sectors in Hong Kong and Singapore, 2004

Table 2 shows the value output and quantities of freight and passengers in transport and communications in Singapore and Hong Kong for the year 2004.

Table 2   Quantity and value output of freight and passengers in transport and communications, Hong Kong and Singapore, 2004

		Quantities produced ('000) Terminal services (passengers or tonnes)			Gross value of output (d)	
		Singapore (1)	Hong Kong (2)	HK/Sin (%) (3)	Singapore (S$m) (4)	Hong Kong (HK$m) (5)
Passenger transport						
Rail	Land	487 878[a]	1 400 056	287.0		25 042
Buses		1 020 408[a]	2 203 317[b]	215.9	1223[e]	
Taxis		320 616[a]	377 828	117.8		
Sea/coastal water transport		7482	21 407	286.1	80	2323
Air (arrival and departure)		28 606	36 287[c]	126.8	8129	31 813
Freight transport						
Rail	Land	NA	272	NA		13 179
Trucks		NA	40 474	NA	921	
Sea (cargo throughput)		393 418	220 879	56.1	13 049	52 050
Port container throughput (TEU)		21 329	21 984	103.1	7318	13 709[g]
Air		1775	3090[f]	174.1	3450	17 795

4.   For a more detailed description of the ICOP approach and the algebraic equations used, see Lee and Shepherd (2002). Note that the current study excludes the use of outputs in terms of tons/km and passenger/km as these data were not released in any of the statistical publications and affiliated annual reports and surveys for each country.

Table 2   (*continued*)

		Quantities produced ('000) Terminal services (passengers or tonnes)			Gross value of output (d)	
		Singapore (1)	*Hong Kong (2)*	*HK/Sin (%) (3)*	*Singapore (S$m) (4)*	*Hong Kong (HK$m) (5)*
Communications		Singapore	Hong Kong	HK/Sin	Singapore[j]	Hong Kong[k]
Telephone lines		('000 number)	('000 number)	(%)	(S$m)	(HK$m)
(subscriptions)[h]		1864	3780	202.8	3610	19 979[m]
Mobile phone		3861	8214[i]	212.7	2105	11 970
subscriptions						
Internet Subs		512	1484	289.8		2663
(broadband)						
Internet Subs		1714	1004	58.6	1440	179
(dial-up)						
	Total	7951	14 482	182.1	7155[n]	34 791
		('000 number)	('000 number)			
Mail handled		834 402[l]	1 273 000	152.6	295[o]	3567[p]
(excludes parcels)						

Notes: [a]Figures derived by multiplying average daily passenger-trips to the number of days for 2004 (ie. 366 days). [b]Includes franchised buses, public light buses, residents' services, KCRC light rail transit feeder bus. [c]This figure is drawn from the Civil Aviation Department via http://www.cad.gov.hk/english/p-through.htm (accessed on 12 September 2006). [d]Gross value output for Singapore and Hong Kong refer to gross receipts of their respective passenger and freight revenue. Note that the sum of the value output for each country does not tally with the value output given in each country's statistical publication due to omission of services incidental to transport and others not elsewhere classified such as storage and warehousing. In addition, the gross receipts for primary activity are only taken into account. All other sideline gross receipts are excluded. [e]Chartered bus and school bus not included. [f]Only international. Tonnes refer to air cargo throughput. [g]Port container throughput value output refers to business/operating receipts of 'supporting services to water transport.' This is based on the fact that the activity relates to the need for cargo-related facilities and services. [h]At end of period. Excludes fax lines. [i]Figure refers to fiscal year ending 31 March 2005. Data drawn from website of Office of the Telecommunications Authority via http://www.ofta.gov.hk/en/datastat/hktelecom-indicators.html accessed on 6 September 2006. [j]Singapore figures drawn from individual annual reports of Singtel, Starhub, M1, and Pacific Internet. For Singtel this refers to operating revenue by service only within Singapore. Optus excluded. [k]Gross value output here refers to business receipts. It is important to note that the sum of all business receipts do not tally with the total business receipts as the primary subscription is only taken into account. All other sideline gross receipts are excluded. [l]Data drawn from IDA website http://www.ida.gov.sg (accessed on 31 October 2006). Data differs to that found in the *Yearbook of Statistics 2005* probably due to concept and coverage. Because the latter source does not clearly specify inclusion/exclusion of parcels (terms used are postal articles handled) whereas IDA only considers both domestic and international mail, the IDA data is therefore used. [m]Refers to telephone and telegraph services. [n]Figure here does not tally but are very similar to the revenue ($7190m) from the Singapore Department of Statistics (2004a; accessed 12 September 2006). Revenue in this Table refers only to primary subscription. [o]Operating revenue for mail only refers to Singapore Post. Figure is for financial year 2004/0505 (ie. 1 April 2004 to 31 March 2005). [p]Refers to general mail services turnover referred to in the Hong Kong Post Annual Report 2004/2005. NA, not available.

Sources: Census and Statistics Department (2004a; 2004b; 2005; 2006); Hong Kong Post Annual Report (2004/2005); Singapore Department of Statistics (2004a; 2004b; 2004c; 2005).

Table 3 Gross value of output, gross value added, number of persons engaged by branch, transport and communications of Hong Kong, 2004

	Gross value of output[b] (HK\$m) (1)	Gross valued added[b] (HK\$m) (2)	Share in total transport and communications (% of value added) (3)	Number of persons engaged (4)	Share in total transport and communications (%) (5)
Transport	378 669	100 216	83.1	319 994	91.2
Land	50 419[a]	29 662	24.6	204 103[e]	58.2
Sea and PCT	75 857	24 131	20.0	34 288	9.8
Air	76 117	28 216	23.4	29 288	8.4
Services allied to transport[d]	176 277	18 207	15.1	52 315	14.9
Communications	61 717[c]	20 358[c]	16.9	30 706	8.8
Telecommunications	49 705	17 151	14.2	17 887	5.1
Postal services	12 012	3208	2.7	12 819	3.7
Transport and communications					
Current table	440 386	120 574	100.0	350 700[f]	100.0
National accounts	NA	126 820	—	350 700	—
ILO	—	—	—	358 200	—

Notes: [a]Includes supporting services to land transport. [b]Values are most likely in market prices as they are based on gross receipts. Figures here differ to Table 2 as it includes all other incomes and business receipts besides passenger and freight revenue. [c]Communications figure is the sum of telecommunications and postal services. Figure here is for the whole industry and as such its figure is higher than Table 2 because Table 2 only covers primary activity. [d]The 2004 Annual Survey of Transport and Related Services does not include storage. Storage was thus included under 'services incidental to transport' so as to correspond to the Singapore concept and figures in the table. Data was drawn from the Report on 2004 Annual Survey of Storage, Communication, Banking, Financing, Insurance and Business Services. [e]From the survey coverage of land transport number of persons engaged in the 2004 Annual Survey of Transport and Related Services, non-owner operators of taxis and public light buses and individual transport labourers were excluded. Therefore, the true number of persons engaged for land transport excluding those identified is 97 562. As there was no sampling done for these and to include their numbers, we assume that the difference between the national accounts' number of persons employed and the aggregated figure of transport and communications from the annual surveys which gives an employment figures of 244 159 should arrive at a decent figure to represent the non-owner operators of taxis and public light buses and individual transport labourers. (350 700 – 244 159 = 106 541; 97 562 + 106 541 = 204 103). [f]Number of persons engaged less non-owner operators of taxis and public light buses and individual transport labourers was 244 159 persons. NA, not available; PCT, port container throughput.
Source: Census and Statistics Department (2004a) and 2004b; ILO (2005).

It is also the primary data source used in deriving PPPs. Tables 3 and 4, respectively, contain estimates of the gross value of output, gross value added and employment, by branch, for Hong Kong and Singapore for the benchmark year 2004. The output data refer to gross receipts expressed at market prices.

Table 4   Gross value of output, gross value added, number of persons engaged by branch, transport and communications of Singapore, 2004

	Gross value of output[b] (S$m) (1)	Gross valued added[b] (S$m) (2)	Share in total transport and communications (% of value added) (3)	Number of persons engaged(4)	Share in total transport and communications (%) (5)
Transport	50 723	16 508	80.2	173 752	89.1
Land	3539[a]	1935	9.4	102 258[g]	52.4
Sea and PCT	26 297	7831	38.1	21 177	10.9
Air	16 530	4811	23.4	21 682	11.1
Services allied to transport[f]	4358	1931	9.4	28 635	14.7
Communications	9345[c]	4066[c]	19.8	21 347	10.9
Telecommunications	8259	3574	17.4	15 067	7.7
Postal services[e]	1086[d]	491	2.4	6280	3.2
Transport and communications					
Current table	60 069	20 573	100.0	195 099	100.0
National accounts	NA	21 489	—	212 500	—
ILO	—	—	—	212 500	—
MRSD – manpower 2005[h]	—	—	—	191 974	
MRSD – labour market 2005[i]	—	—	—	188 224	

Notes: [a]Includes supporting services to land transport. [b]Gross value output is most likely in market prices as they are based on gross receipts. Value added is in factor cost as the concept described in the survey excludes the impact of taxes including goods and services tax (and subsidies) on products. Figures here differ to Table 2 as the values in this table include all other incomes and business receipts besides passenger and freight revenue. [c]Communications figure is the sum of telecommunications and postal services. Figure here is for the whole industry and as such its figure is higher than Table 2 because Table 2 only covers the actual activity. [d]Operating receipts. [e]Postal services estimates were derived by deducting transport, and information and communications (excludes postal) from transport, information and communications (includes postal). From the Economic Survey Series, the survey on 'Information and Communications 2004' excludes postal services while the survey 'The Services sector 2004,' which covers transport, information and communications, covers all forms of transport and communications including postal services. By taking their differences, an estimate for postal services was thus derived. [f]Includes storage and warehousing. [g]Coverage of land transport in the Economic Survey series, Transport Services reference year 2004 excludes the number of taxi drivers. In order to include them in the number of persons engaged, the number of total valid vocational licenses issued added (73 081) for 2004 is to the land transport number of persons engaged from the above source. [h]Manpower Research and Statistics Department. Refers to Dec 2004. [i]Manpower Research and Statistics Department. Data based on SSIC 2000. Refers to Dec 2004. NA, not available; PCT, port container throughput.

Source: Manpower Research and Statistics Department (MRSD), 2005 and 2006. (http://www.mom.gov.sg/publish/momportal/en/communities/others/mrsd.html) ILO, 2005. Singapore Department of Statistics (2004a, 2004b, 2004c).

Value added for Singapore is at factor cost but the value added data for Hong Kong does not specify whether it is at market prices or factor cost. The output data in Tables 3 and 4 are also much higher than those shown in Table 2. The difference reflects the fact that the output figures in Table 2 account only for the mode of transport and communications directly identified in the table.

Table 3 shows that the number of persons engaged in transport and communications in Hong Kong in 2004 was 244 159, which is approximately 70 percent of the national accounts figure of 350 700 persons. As discussed in the notes in Table 3, the difference is explained by the less extensive coverage in the *Annual Survey of Transport and Related Services, 2004*, which excludes non-owner operators of taxis, public light buses and individual transport laborers. For Singapore, in the Economic Survey series *Transport Services Reference Year 2004*, the operation by persons not registered with the Accounting and Corporate Regulatory Authority or Registry of Societies, such as taxi drivers, was excluded. Therefore, to account for the number of taxi drivers, the number of valid vocational licenses issued for 2004 (73 081) was included in the estimate of the number of persons employed in the transport and communications sector in Singapore.

In terms of size, the gross value of output in transport and communications in Hong Kong (expressed in Singapore dollars at the PPP rate: S$1.00 = HK$4.02, shown in Table 5) was S$109 582m, and for Singapore, S$60 069m. Therefore, gross output in the sector in Hong Kong was approximately 82 percent greater than Singapore's output. Using national accounts figures, transport and communications gross value added was S$31 557m in Hong Kong and S$21 489m in Singapore. On these estimates, gross value added in Hong Kong's transport and communications sector was approximately 47 percent greater than the Singapore level. However, gross value added was 29 percent of transport and communication's gross output in Hong Kong, compared with a greater 36 percent for Singapore. This suggests that Hong Kong uses relatively more intermediate inputs in producing gross value added in the transport and communications sector. Indeed, using national accounts estimates (in Tables 3 and 4), in 2004, the number of persons engaged in this sector in Hong Kong was 1.65 times that in Singapore. Overall, the sectors in both countries made a similar contribution to total GDP and total employment: 11.2 percent of GDP and 10.6 percent of employment in Hong Kong and 12 and 10.3 percent in Singapore, respectively.[5]

In terms of structure, Tables 3 and 4 show that land transport and air transport were the main gross value added contributors to the transport and communications sector in Hong Kong and that sea transport and air transport were the main contributors in Singapore.

5. Data are expressed in national currencies and are drawn from each country's statistical year books; Singapore from the Singapore Department of Statistics (2004b, c, 2005) and Hong Kong from the Census and Statistics Department (2004a, b, 2005).

Table 5   Paasche, Laspeyres and Fisher PPPs for transport and communications, Singapore and Hong Kong, 2004

	At Hong Kong quantity weights (Paasche PPP)	At Singapore quantity weights (Laspeyres PPP)	Geometric average (Fisher PPP)	Comparative price level (Singapore = 100)
Transport	4.19	4.62	4.40	95.48
Land	9.41	9.41	9.41	204.18
Sea and PCT	4.51	5.22	4.85	105.35
Air	3.04	3.05	3.04	66.07
Communications	2.77	2.73	2.75	59.69
Telecommunications	2.59	2.52	2.56	55.48
Telephone subscriptions	2.73	2.73	2.73	59.22
Mobile phone subscriptions	2.67	2.67	2.67	58.02
Internet subscriptions	1.77	1.77	1.77	38.33
Mail handled	7.92	7.92	7.92	171.78
Transport and communications	3.78	4.28	4.02	87.22
Exchange rate	—	—	4.61	

Notes: PCT, port container throughput. Paasche and Laspeyres PPP for overall transport and communications were derived by weighting the PPP of separate branches using value output as weights. Comparative price level is calculated by dividing PPP by the exchange rate. Exchange rate is period average.

Source: Exchange rate from IMF, *International Finance Statistics, 2005*, Washington DC.
      PPP from Appendix Table 1.

In Hong Kong, although land transport lagged behind air transport in terms of gross value of output, it was the main contributor to value added, at 24.6 percent, and employment, at 204 103. In contrast, land transport in Singapore was a much smaller contributor to value added at 9.4 percent, and employment, at 102 258. The bulk of employment in land transport in Singapore consisted of 37.5 percent as taxi operators and 14.6 percent as bus operators, lorry operators and those operating the Mass Rapid Transit (MRT) system. Moreover, although Hong Kong had a lower recorded level of road and rail kilometreage per capita, at 0.31 km/1000 inhabitants, against 0.78 km/1000 inhabitants in Singapore, the number of private cars per thousand population, of 96 in Singapore was almost twice that of 49.8 in Hong Kong.[6] This implies that the rate of use of public transport is greater in Hong Kong than in Singapore, thereby helping to explain the significant proportion of value added in land transport in Hong Kong. This concurs with a study by Luk and Olszewski

6.   Singapore's population was 4.273 million in 2004. The number of private cars in Singapore was 412 015. Population data are drawn from ILO (2005); and the data for the number of private cars in Singapore is drawn from the Singapore Department of Statistics (2005). For Hong Kong, private cars per thousand population is directly drawn from the Transport Department (2005).

(2003), which also shows Hong Kong has a higher rate of use of public transport than Singapore.

The contribution of air transport, at approximately 24 percent of value added, was significant in both city–state economies. This reflects award recognition of the new Hong Kong International Airport, in operation since 1998, and Singapore's Changi Airport, as well as the excellence of facilities and services provided by the national airline carriers, Cathay Pacific and Singapore International Airlines, for Hong Kong and Singapore, respectively. In Singapore, the largest contributor to gross output and value added in the transport and communications sector, sea transport, reflects its 24 h/day operational port facilities catering for large volumes of entrepot trade. Finally, the value-added contributions of telecommunications alone in Hong Kong and Singapore, at 14.2 and 17.4 percent, respectively, illustrate not only the importance of the branch contributions in their own right, but also the important role new information technology, telephony and internet services play in facilitating the growth of service industries in economies facing a paucity of natural resources but abundant supplies of skilled and unskilled labor (see below).

III.2 *Purchasing power parties and comparative price levels*

Table 5 displays comparative price levels and Paasche, Laspeyres and Fisher PPP, using branches in the transport and communications sector for the 2004 benchmark year. The similarities in the PPP at each country's quantity weight emanate from the closeness of the benchmark comparisons, the similarity in their transport and communications structures, the types of services provided and the standards of living.

In 2004, the geometric average PPP for transport and communications was HK$4.02 to the Singapore dollar compared to an exchange rate of HK$4.61 to the Singapore dollar. The ratio of the geometric average PPP to the exchange rate produces a relative or comparative price level for each branch and sector. Using Singapore as the base country, a comparative price level greater (lower) than 100 indicates that prices in that particular branch or sector in Hong Kong are higher (lower) than their counterparts in Singapore.

The comparative price levels for air transport and telecommunications were lower in Hong Kong than in Singapore in 2004. The lower air transport price level in Hong Kong reflects lower costs stemming from less labor duplication. This is explained more fully in the next section of the paper. The lower telecommunications price level reflects lower fixed line and mobile phone subscription prices arising from Hong Kong's larger number of fixed telecommunications network services (FTNS) and mobile phone service providers relative to Singapore. In 2004, Singapore had only two FTNS, Singtel and StarHub, and three mobile service providers, Singtel, Starhub and M1, compared with ten and six different providers in each category, respectively, in Hong Kong.[7]

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7. The 2004 data were not available. In 2005, there were 10 wireline-based FTNS operators in Hong Kong.

Clearly, as economic theory suggests, greater competition in fixed line telecommunications and mobile phone subscriptions lowered the comparative price level for these branches in Hong Kong. No doubt, the greater level of competition in Hong Kong's telecommunications sector reflects the country's traditional self-reliant, market-orientated structure and active policy approach to the deregulation of the sector, which commenced in 1995, with full liberalization being achieved by 2000. In contrast, Singapore lagged behind and did not commence the liberalization of the statutory authority dominance of the telecommunications sector until 2000.

Along with initiatives in fixed line and mobile telephony, both countries had similar strategic objectives (but with different approaches and time frames) of developing their telecommunications systems into significant international telecommunications branches, particularly through internet facilities and access.

Hong Kong's Telecommunications Authority introduced the Digital 21 IT Strategy in 1998. This was reviewed in 2001 and significantly updated in 2004. By 2003–2004 Hong Kong had 186 internet service providers (ISP) compared to 3 ISP in Singapore. This high level of competition enabled the International Telecommunications Union to rank Hong Kong as the world's foremost economy in terms of affordability of internet access.[8] This is demonstrated by Hong Kong having a lower price level in internet subscriptions than Singapore.

In contrast, the pace of innovation was slower in Singapore. Chia et al. (1998) review the Singapore experience prior to the late 1990s and highlight the importance of initiatives such as IT2000, I-Hub and Singapore One as government sponsored agencies for developing information technology and internet services. The main initiatives since then have been the establishment of the Singapore Infocomm Development Authority (IDA) and the launching of the Infocomm 21 strategy aimed at harnessing infocomm technologies to improve Singapore's national competitiveness and to provide reliable, efficient and cost-effective connectivity to the rest of the world.[9] This progressively improved Singapore's standing in the provision of information technology.[10]

Nevertheless, despite following broadly similar strategies, it appears that Hong Kong's more market-based deregulation of telecommunications management was more effective in facilitating ease of entry and the creation of a more competitive market structure.

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8.   Information is drawn from the International Telecommunications Union (2002). Although the report focuses on 2002, the current study confirms the results showing Hong Kong's better performance in mobile communications and internet provision relative to Singapore.

9.   The IDA was formed by merging the Telecommunication Authority of Singapore and the National Computer Board in December 1999.

10.   The report *The Global Information Technology Report 2002–2003: Readiness for the Networked World* by Lanvin et al. (2003) rates Singapore as one of the world's leading information technology countries.

Moving to land transport, it is clear that the relative price of land transport in Hong Kong in 2004 was twice that in Singapore.[11] This concurs with a study by UBS that demonstrates that in 2003 the average rate of taxi charges in Hong Kong and Singapore were US$4.78 and US$0.83, respectively.[12] The higher Hong Kong taxi costs also reflect a range of additional surcharges, for items such as additional passengers' luggage, surcharges that do not occur in Singapore. Moreover, Hong Kong's main public transport system, the Mass Transit Railway (MTR), although partially privatized in 2000, with the Hong Kong SAR Government retaining 76 percent of the MTR, remained independently managed on commercial principles. Its financial independence means that it does not depend on government subsidies, which enables it to act more like a privatized organization.

In contrast, the lower prices in private and public transport in Singapore reflect greater government involvement in the areas. Lam and Toan (2006) show that in Singapore capital investment in infrastructure, rolling stock and equipment is the responsibility of the government. In this vein, Tan and Phang (2005) show that Singapore's main public transport system, the MRT, is completely subsidized by the Singapore Government. These arguments infer that government subsidies lower production costs, particularly with respect to the mass public transport system. This also implies higher production costs in Hong Kong and a higher price level for land-based transport than in Singapore. The more heavily subsidized system in Singapore reflects the traditional government sponsored approach to the provision of land transport services.

Apart from their levels in the benchmark year 2004, trends in their PPP, exchange rates and comparative price levels offer further perspective on the transport and communications sectors in the two countries. Table 6 shows trends in the PPP, exchange rate and relative price level, as well as other trends such as output and labor productivity, over the period 1990 to 2005.

The transport and communications sectors' PPP lay below the exchange rate between the two countries from 1990 to 1997. Reflecting the onset of the Asian financial crisis, the PPP rose above the exchange rate from 1998 to 2002. The countries' exchange rate regimes influenced these trends. As Lu and Yu (1999) point out, the Hong Kong dollar's peg to the US dollar prevented it from managing its exchange rate to help stabilize domestic prices. Singapore, in contrast, could influence the domestic price level by use of its managed floating regime. Table 6 thus shows an appreciation of the Hong Kong dollar against the Singaporean dollar, but with Hong Kong's higher domestic inflation producing a declining PPP against the Singaporean currency. Therefore, in 1997–1998, the Hong Kong dollar experienced a 7-percent decline in its purchasing power as

11. It is important to note that land transport as used here only covers train services and train passenger services. There was no data available for land freight transport in Singapore; hence, this part of the land transport industry was excluded in the derivation of PPP and comparative price levels. In addition, private car ownership was not included as this activity is not part of the transport industry as defined by each country's SIC codes.
12. See UBS (2003).

Table 6   PPP, Exchange rates, comparative price levels, output and labour productivity
(Singapore = 100)

	PPP	Exchange rates	CPL	Comparative Output	GVA per hour	GVA per person
1990	3.08	4.30	72	191	108	105
1991	3.16	4.50	70	184	106	103
1992	3.62	4.75	76	186	105	100
1993	3.86	4.79	81	172	94	91
1994	4.04	5.06	80	171	90	88
1995	4.16	5.46	76	168	99	94
1996	4.57	5.49	83	161	96	93
1997	4.93	5.21	95	144	92	88
1998	5.28	4.63	114	129	80	77
1999	5.01	4.58	109	129	80	79
2000	4.63	4.52	102	139	79	78
2001	4.78	4.35	110	138	90	90
2002	4.93	4.36	113	138	87	89
2003	4.37	4.47	98	140	89	90
2004	4.02	4.61	87	147	86	89
2005	3.88	4.67	83	160	98	100

Note: Comparative price level (CPL) derived by dividing PPP by the exchange rate. Time-series
PPP derived by first calculating the ratio of Hong Kong transport and communications
GDP deflator by the Singapore transport and communications GDP deflator. Note that the
deflators are derived by taking the ratio of current over constant (at 2004 prices) transport
and communications GDP. Finally, these values are multiplied to the 2004 geometric
average PPP from Table 5. Exchange rates are in period averages and drawn from various
issues of IMF.
Source: For Hong Kong: National Income Section, Census and Statistics Department via http://
www.censtatd.gov.hk/ (accessed on 5 October 2006). Census and Statistics Department,
2005 Gross Domestic Product. For Singapore: Singapore Department of Statistics, *Yearbook
of Statistics Singapore* (various issues). Singapore Department of Statistics, *Statistical
Highlights 2006.* Singapore Department of Statistics, *Economic Survey of Singapore 2003.*
IMF, *International Financial Statistics Yearbook 1995, 2000 and 2005.*

the Hong Kong dollar fell from HK$4.93 to HK$5.28 against the Singapore
dollar. This ensured a rise in Hong Kong's comparative price level for 1998 to
the early 2000s. However, Singapore's recovery from the financial crisis from
the early 2000s progressively raised its comparative price level for the sector.
The influences of these trends on output and productivity in each country's
transport and communications sector are also shown in Table 6, and are discussed
in more detail below.

III.3   Output and labor productivity at branch level for the benchmark year, 2004

Table 7 shows value added at branch level for each country's transport and
communications sector, with Hong Kong data expressed in Singapore dollars.

Table 7 Real output and labour productivity in transport and communications, Singapore and Hong Kong, 2004 (at S$)

	Gross value added (S$m)		HK/ Singapore (%)	Value added per person		HK/ Singapore (%)
	Hong Kong	Singapore		Hong Kong	Singapore	
Transport	22 779[a]	16 508	138.0	71 187	95 007	74.9
Land	3153	1935	162.9	15 447	18 922	81.6
Sea and PCT	4971	7831	63.5	144 986	369 791	39.2
Air	9268	4811	192.6	316 440	221 879	142.6
Services allied to transport	4138[b]	1931	241.3	79 105[b]	67 428	117.3
Communications	7403[a]	4066	182.1	241 080	190 458	126.6
Telecommunications	6709	3574	187.7	375 060	237 234	158.1
Postal services	405	491	82.5	31 614	78 232	40.4
Transport and communications						
Current table[c]	30 003	20 573	145.8	85 550	105 451	81.1
National accounts[d]	31 557	21 489	146.9	89 982	101 124	89.0

Notes: PCT, port container throughput. [a]Sum of disaggregated figures do not tally with table aggregated figures due to the use of PPP. [b]Value added converted into Singapore dollars using transport PPP. [c]Value added based on transport and Communications PPP thus differs to the sum of value added of transport and value added of communications. Value added per person engaged derived using Tables 3 and 4 value added (converted into the 2004 Singapore dollars) and number of persons engaged. [d]Value added per person engaged derived using national accounts' value added and ILO employment figures.
Source: Tables 3 and 4. PPP from Table 5.

The value-added shares of each branch confirm the earlier analysis that Hong Kong's air transport and services, given the continuous expansion and innovation from its new Hong Kong International Airport (HKIA), contributes the largest proportion. Also confirmed is Singapore's largest value-added share from sea transport and port container throughput from its superior port facilities and innovations flowing from its objective of becoming a premier logistics, sea transport hub.

In 2004, based on national accounts, value added per person in Hong Kong's transport and communications was only 89 percent of that in Singapore; value added in the transport sector was 74.9 percent, but for communications it was much better, at 126.6 percent of the Singapore level. This higher labor productivity in Hong Kong communications and telecommunications in particular is consistent with the analysis in Table 5 which shows a lower comparative price level for the sector in Hong Kong. Correspondingly, Singapore's stronger labor productivity in sea transport and land transport is reflected in a lower comparative price level for the branches in Singapore. At branch level, labor productivity in Hong Kong exceeded the Singapore level in three out of six branches: air

transport was 142.6 percent, services allied to transport was 117.3 percent and telecommunications was 158.1 percent. Clearly, the main differences are in air transport and telecommunications.

Some understanding of the higher labor productivity in Hong Kong's air transport services might be gleaned from a comparison of the two countries' arrival and departure fixed inputs. In 2004, Hong Kong's single passenger terminal had a total floor area of 570 000m^2 and 49 frontal aircraft gates.[13] In contrast, Singapore's Changi airport had two passenger terminals with a total floor area of 638 020m^2 and 64 aerobridge gates.[14] Therefore, HKIA had slightly less infrastructure but was able to handle more passengers (see Table 2). This infers, as indicated previously, that a large terminal like HKIA can cut costs by reducing the amount of labor duplication. HKIA has two airfreight terminals operated by ground handling agents, whereas Changi airport has nine airfreight terminals operated by three ground handling agents. Because both airfreight terminals are designed to handle approximately three million tons of cargo, this also infers that more capital and, therefore, more labor, are being employed in the Changi air freight terminal.[15] With HKIA handling more passengers and freight it also implies that HKIA uses less labor to work with capital in the provision of airline services. Doubtless, as stated earlier, a more accurate productivity analysis could be achieved if a multifactor productivity approach could be adopted.

It can also be seen from Table 7 that sea transport and port container through-put play a major role in both countries, although more so for Singapore, because both are linked with entrepot trade. However, gross value added and labor productivity per person in Hong Kong in these branches relative to Singapore in 2004 was 63.5 and 39.2 percent, respectively.

Caution should be exercised when interpreting these results as the PPPs within the sea transport and port container throughput branch vary significantly, as shown in Appendix Table 1. Considering port container throughput (PCT) alone, Hong Kong's output and labor productivity are 70 and 73 percent of Singapore levels, respectively. (For PCT relative output, Hong Kong/Singapore, Hong Kong's PCT value added of HK$5097.5m is converted into Singapore dollars by dividing its value added by the PCT PPP 1.82 HK/SG from Appendix Table 2, which gives SG$2805m. Relative output is the ratio of SG$2805m and SG$4006.6m, which is 70 percent (SG$4006.6m is drawn from the Singapore Department of Statistics (2004c).

Relative labor productivity uses the same figures as above divided by the number of persons engaged in PCT.

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13. The handling capacity for Hong Kong is drawn from its official airport website: http://www.hongkongairport.com/eng/aboutus/wtomc6_factsheet.html.
14. The handling capacity for Singapore is drawn from its official airport website: http://www.changiairport.com/changi/en/about_us/fact_sheets/facts_changi_ap.html.
15. Data drawn from sources indicated in footnotes 13 and 14.

Adding back sea transport, passenger and freight reduced Hong Kong's relative output by 10–63.5 percent. Relative labor productivity is reduced even more, to 39.2 percent of Singapore's level. (Value added for Hong Kong's 'Sea and PCT' is SG$4971m (Table 5). This value divided by Singapore's value added of 'Sea and PCT' of SG$7831m (Table 5) gives the relative output between these two countries, which is 63.5 percent (Table 5). Labor productivity is derived by taking these figures divided by their respective employment figures: HK$4971m/34 288 = SG$144 986 (employment figure of 34 288 from Table 2); whereas for Singapore this is SG$7831m/21 177 = SG$369 791 (employment figure of 21 177 from Table 3). Relative productivity is the ratio of SG$144 986/ SG$369 791 = 39.2 percent.

Some understanding of these lower output and productivity estimates for Hong Kong may be taken from analysis of labor and infrastructure inputs. The labor input in ocean, coastal and inland water transport in Hong Kong is 18 543, and in Singapore is 4649 persons. (Hong Kong's figure is the sum of ocean and coastal water transport, 13 588, plus inland water transport, 4955, drawn from the Census and Statistics Department (2004b)). For Singapore, this is drawn from the Singapore Department of Statistics (2004c). This is four times that of Singapore's employment in these activities. Hong Kong also had twice the number of establishments than Singapore: 980 to 491.[16] (Data for each country were drawn from the same source as stated above; Hong Kong data for the respective activities are 333 and 647 establishments.) Therefore, based on the amount of cargo throughput, port container throughput and passengers in Hong Kong in 2004 relative to Singapore, Hong Kong's capital stock may be substantially less than that of Singapore. This seems probable because the approximate number of container berths for Hong Kong totaled 17, with quay length of 6125 m, 63 quay cranes, and covering 186.2 ha in 2005–2006. In contrast, Singapore figures are 41 container berths and quay length of 11 754 m, with 131 quay cranes in an area of 389 ha.[17] Hence, inclusion of capital stock in productivity measurement should help to improve Hong Kong's productivity level relative to Singapore's.

In the communications branch, output and productivity levels in Hong Kong exceeded Singapore's levels largely as a result of the previously discussed performance of the telecommunications branch. Gross value added in Hong Kong was 187.7 percent and labor productivity was 158.1 percent of the telecommunications levels in Singapore. Interestingly, as also discussed above, the progressive liberalization of Singapore's telecommunications created competition and helped to provide more service providers and innovative services. However, this does not seem to have translated into better labor

16. The enumeration or reporting unit used in the survey was the establishment. An establishment is defined as a business or organisation unit engaged in one activity operating in a single location.
17. Data for container berths, quay length, number of quay cranes, and area for both Singapore and Hong Kong are drawn from PSA International (2005).

productivity in Singapore relative to Hong Kong over the last 2 years of the review period (see below). It may well be that the simultaneous liberalization of telecommunications in Hong Kong, given its market orientation, has kept labor productivity performance in Hong Kong ahead of that in Singapore. Easier access to the Hong Kong telecommunications market, arguably, is being reflected in more competitive provision of fixed line, mobile phone subscriptions and internet services in Hong Kong relative to Singapore.

In 2004, the postal services branches in Singapore and Hong Kong had similar levels of reliability and levels of efficiency in terms of mail delivery standards. In both countries, in excess of 99 percent of mail was delivered within 1 working day.[18] However, in terms of output and productivity, Hong Kong lagged behind Singapore; output in Hong Kong's postal service was only 82.5 percent and productivity was only 40.4 percent of the Singapore levels.

The difference in output and labor productivity performances can be explained by examination of the number of persons employed and the relevant infrastructure available in each country's postal services. The number of persons employed in Hong Kong is twice that in Singapore. In terms of infrastructure, Hong Kong had 133 post offices and nearly 1000 post boxes.[19] In contrast, SingPost (Singapore Post) had approximately 60 post offices, 80 authorized postal agencies and over 800 post boxes. The fact that there are more post offices and post boxes in Hong Kong implies heavy use of labor. Additionally, the higher labor productivity in Singapore arises from the use of unstaffed services, such as Self-service Automated Machines, some 200 of which allow individuals to use postal services, including weighing parcels, buying stamps and paying bills, 24 h/day. These services are still performed by employees in Hong Kong's post offices. Clearly, in 2004, higher levels of labor productivity in postal services existed in Singapore than in Hong Kong.

III.4   Trends in real output and labor productivity, 1990–2005

Table 6 shows trends in comparative real output and labor productivity in the transport and communications sectors in Hong Kong and Singapore from 1990 to 2005. This table reflects the relative progressive developments in each country's sector as they have pushed forward with new projects and innovations in air, sea and land transport and communications, particularly telecommunications, plus the influence of the Asian financial crisis from 1998, a global economic downturn in the early 2000s and the outbreak of Severe Acute Respiratory Syndrome (SARS) in 2003.

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18.   Information is drawn from each country's postal annual reports; Singapore data is drawn from Singpost (2004/2005); Hong Kong data is drawn from the Hong Kong Post (2004/2005).

19.   Note that mobile post offices are excluded from the number of post offices as their hours of operation do not exceed 80 min/day and do not open every work day. These data are drawn from the Hong Kong Post (2004/2005).

There was some mild catch-up in Singapore's real output levels relative to Hong Kong throughout 1990 to 1998. As Singapore moved to accelerate deregulation, as outlined above, the transport and communications sector maintained 6-percent growth in 1998–1999, despite a decline in GDP and overall service sector output following the Asian financial crisis. Singapore's services relating to tourism, especially in the transport and communications sector, were severely affected by the outbreak of SARS in 2003. In contrast, over the period from 2001 to 2005, Hong Kong slowly increased its transport and communications output relative to that in Singapore, largely because of the strong performance of its communications branch.

Labor productivity trends measured by value added per person or per hour worked show variation over the review period. From 1990 to 1998, Hong Kong's labor productivity in terms of persons employed fell from 104.5 to 77.4 percent of Singapore's level, as real output in the Hong Kong sector declined. In the same period, in terms of hours worked, Hong Kong's labor productivity declined from 108.4 to 80.5 percent of the Singapore level. From 2000, Hong Kong's productivity began to improve as output in the sector again increased, up in 2005 from 77.4 to 100.3 percent of the Singapore level for persons employed, and from 80.5 to 98 percent for hours worked. Hence, productivity estimates were broadly comparable for the two counties by 2005.

Over the review period, Singapore recorded a steadier growth of real output and higher levels of labor productivity, using both measures, for all but 2–3 opening years of the period. In contrast, Hong Kong experienced initial declines in both real output and labor productivity then mild catch-up of real output and labor productivity in the transport and communications sector over the review period.

IV.   Conclusions

In terms of the first question posited for the present study, the preceding analysis successfully sheds light on the relative performance of real output and labor productivity in the transport and communications sectors in Singapore and Hong Kong, at branch level for the benchmark year 2004 and at the sectoral level for the benchmark year and the review period 1990–2005.

At branch level for 2004, in terms of value added, sea transport, air transport and telecommunications, in that order, were the main contributors for Singapore, whereas air transport, telecommunication and sea transport, in that order, were the major contributors for Hong Kong. In terms of labor productivity, telecommunications became the second largest contributor behind sea transport for Singapore, and telecommunications overtook air transport as the main branch contributor for Hong Kong. At the sectoral level, value added in Hong Kong was stronger, at approximately 147 percent, but labor productivity was weaker, at only 89 percent of Singapore's levels. On average over the review period, Singapore recorded marginally higher levels of labor productivity. In contrast,

Hong Kong experienced greater variability in labor productivity, with an initial decline through to the late 1990s, then a marginally stronger performance, or catch-up, in the last 5 years of the study, 2000–2005.

There is also some, but variable, indication that the different political structures and policy management emphases with respect to deregulation influenced sectoral real output and labor productivity outcomes in the two countries. Additionally, although retaining a regulatory role through its range of statutory boards, it is clear that Singapore is in the process of placing emphasis on commercial management practices with respect to developments in the transport and communications sector.

Given its extensive port facilities, 24 h/day service and its geographical location within the world's leading trade routes, sea transport maintained its principal contribution to sectoral real output and labor productivity in Singapore, significantly outranking Hong Kong in this area. With respect to air transport, the single, large terminal at Hong Kong International Airport recorded higher levels of labor productivity than Changi Airport in Singapore. Nevertheless, both airports have modern, sophisticated infrastructure and are experiencing continuous expansion and innovation, not only via passenger and air freight services but increasingly through a wide range of commercial activities, such as retail, restaurant and personal entertainment facilities designed to attract the general public as well as the travelling populace. Hong Kong opened its second terminal in February 2007, while Singapore opened its budget terminal in October 2006 and a third terminal (named Terminal 3) in January 2008. In addition, Singapore Airlines began using the latest Airbus A380, which carries more passengers than any other aircraft, thus increasing its total number of air passengers. In each country, it is clear that the provision of air transport services is increasingly focused on more liberalized, commercial strategies operating through two of the world's largest international airports.

Land transport and telecommunications are the branches in which the different political structures and sectoral deregulation approaches are most evident. With respect to land transport, Singapore has maintained a system of government subsidies to the public transport system, particularly with respect to the MRT system, as a means of controlling cost structures and price levels for the branch. In direct contrast, the absence of government subsidies in Hong Kong's transport system and widespread use of commercial, financial and management practices, again particularly with respect to the MTR, has ensured a higher cost and price structure for land transport than that in Singapore. Therefore, government subsidies play a strong role in enhancing productivity performance. Singapore has also gradually accelerated the liberalization of the statutory authority dominance of telecommunications, predominantly by encouraging new providers of enhanced infrastructure. This has greatly increased labor productivity in this branch. Nevertheless, the evidence provided above suggests that Hong Kong's more market-based management and liberalization of telecommunications has been more effective in facilitating infrastructural developments, through

ease of entry, a more competitive market structure and lower price levels for telecommunication services.

Therefore, the analysis in this study indicates that there is some general, indicative evidence available to suggest that different political–economic structures and policy approaches to deregulation and liberalization have played a role in influencing labor productivity performance in the transport and communications sectors in Singapore and Hong Kong. It also suggests that Singapore moved to adopt a more market-based or commercial focus in encouraging developments within the sector, with this being most evident with the improved productivity outcomes from telecommunications. However, further work in this area would need to include a more detailed analysis of the policy processes in each country and to consider how these processes might have directly influenced structural changes and competitive forces flowing through to improved sectoral productivity outcomes. This type of analysis would be enhanced by moving from the partial productivity analysis underpinning the present study to one of total factor productivity, to reflect the importance of capacity utilization in conjunction with abundant labor in influencing productivity outcomes in the two countries.

Appendix Table 1   Matching of product items, Hong Kong–Singapore, transport and communications, 2004

HSIC code	Hong Kong product item	Unit	Hong Kong quantity ('000)	Hong Kong gross value (HK$m)	Hong Kong dollar unit value	Hong Kong quantity valued at Singapore unit value (S$m)	UVR HK$/S$ Hong Kong quantity weights (Paasche)
	Land transport						
711	Passenger traffic	Passengers	3 981 201	25 042	6.29	2662	9.41
	Total			25 042		2662	9.41
	Sea/coastal Transport and PCT						
715	Passenger traffic	Passengers	21 407	2323	108.51	228	10.21
714	Freight traffic	Tonnes	220 879	52 050	235.65	7326	7.10
716	PCT	Tonnes	21 984	13 709	623.61	7543	1.82
	Total			68 083		15 096	4.51
	Air transport						
717	Passenger traffic	Passengers	36 287	31 813	876.70	10 311	3.09
718	Freight traffic	Tonnes	3090	17 795	5758.86	6006	2.96
	Total			49 607		16 317	3.04
	Communications						
7321	Telephone subscriptions	Number	3780	19 979	5285.34	7322	2.73
732901	Mobile phone subscriptions	Number	8214	11 970	1457.24	4477	2.67
732902	Internet subscriptions (broadband and dial-up)	Number	2488	2842	1142.36	1609	1.77
	Telecommunications			34 791		13 408	2.59
	Mail handled	'000 Number	1 273 000	3567	2.80	451	7.92
	Total communications			38 357		13 859	2.77

Appendix Table 1 (**continued**)

SSIC 2005 code	Singapore product item	Unit	Singapore quantity ('000)	Singapore gross value (S$m)	Singapore dollar unit value	Singapore quantity valued at HK unit value (HK$m)	UVR HK$/S$ Singapore quantity weights (Laspeyres)
	Land transport						
5221	Passenger traffic	Passengers	1 828 902	1223	0.67	11 504	9.41
	Total			1223		11 504	9.41
	Sea/coastal Transport and PCT						
53103+53202+53209	Passenger traffic	Passengers	7482	80	10.63	812	10.21
5310 (excluding 53103)	Freight traffic	Tonnes	2 393 418	13 049	33.17	92 709	7.10
5539	PCT	Tonnes	21 329	7318	343.10	13 301	1.82
	Total			20 446		106 822	5.22
	Air transport						
54002	Passenger traffic	Passengers	28 606	8129	284.15	25 079	3.09
54003	Freight traffic	Tonnes	1775	3450	1943.85	10 222	2.96
	Total			11 579		35 301	3.05
	Communications						
62011	Telephone subscriptions	Number	1864	3610	1936.91	9852	2.73
62012	Mobile phone subscriptions	Number	3861	2105	545.09	5626	2.67
62021	Internet subscriptions (broadband and dial-up)	Number	2226	1440	646.82	2543	1.77
	Telecommunications			7155		18 021	2.52
5601	Mail handled	'000 number	834 402	295	0.35	2338	7.92
	Total communications			7450		20 359	2.73

PCT, port container throughput; UVR, unit value ratio.
Source: Table 2.

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17:00–17:30 Assembly at Diamond Hotel Lobby
17:30 Bus departure for BSP
18:00 Arrival at BSP Metropolitan Museum Tour
18:30 Welcome Cocktails
Hosted Gov. Amando Tetangco, Banko Sentral ng Pilipinas

DAY 1, November 15, 2008

08:00–10:00 Registration (Diamond Ballroom Foyer 1/F)
08:30–08:40 Opening Ceremony (Diamond Ballroom, 1F)
Opening Remarks
Akira Kohsaka, Osaka University, EAEA11 Program Chair

08:40–09:45 Plenary Session 1: Keynote Address (Diamond Ballroom, 1F)
Introduction: Akira Kohsaka, Osaka University
Speaker: Barry P. Bosworth, Brookings Institution
Global Imbalances After the Financial Crisis

09:45–10:15 Coffee Break
10:15–12:15 Special ADB Sessions
Special ADB Session 1: (Diamond Ballroom, 1F)
Panel Discussion: Global Shocks and Regional Integration: Is Asia Decoupling?
Chair, Jong-Wha Lee, Asian Development Bank
Panelist:
   Giovanni Capannelli, Asian Development Bank
   Akira Kohsaka, Osaka University
   Marcus Noland, Peterson Institute of International Economics

Maria Socorro Gochoco-Bautista, University of the Philippines
Sung, Yun-Wing, Chinese University of Hong Kong

Special ADB Session 2: Inclusive Development (Ruby Function Room, 2F)
Chair, Juzhong Zhuang, Asian Development Bank.

1 Shikha Jha, Asian Development Bank, and Aashish Mehta, University of California-Santa Barbara
Effectiveness of Public Spending: The Case of Rice Subsidies in the Philippines
2 Tun Lin, Juzhong Zhuang and Damaris Yarcia, Asian Development Bank
What Drives China's Provincial Income Inequality: Evidence from Grouped Income Data
3 Hyun H. Son and Jhiedon Florentino, Asian Development Bank
Ex-ante Impact Evaluation of Conditional Cash Transfer Program on School Attendance and Poverty: The Case of the Philippines
4 Rana Hasan and Karl Robert L. Jandoc, Asian Development Bank
Trade and Wage Inequality in the Philippines: Evidence from Labor Force Surveys
5 Dr. Donghyun Park, Asian Development Bank (ADB)
Aging Asia's Looming Pension Crisis

12:15–13:15 Lunch (Diamond Ballroom, 1F)
13:15–15:15 Parallel Sessions 2a, 2b, 2c, 2d, 2e, 2f, 2g

Session 2a: Macroeconomic Policy (Ruby Function Room, 2F)
Chair, Jang-Hee Yoo, Ewha Womans University and Korea Economic Research Institute

1 Eu Chye Tan, University of Malaya
Inflation and Economic Growth in ASEAN
2 Nguyen Thi Thuy Vinh and Seiichi Fujita, Kobe University
The Effect of the Real Exchange Rate on Output and Inflation: Evidence from Vietnam
3 Han-Min Hsing, National Ping Tung Institute of Commerce, Ping Tung, Taiwan
The role of currency denomination in the effect of exchange rate changes on trade balance
4 Taizo Motonishi, Kansai University
Are the East Asian Currencies Still Misaligned?: An Analysis Based on the Balassa-Samuelson Model Using Data from 118 countries

Discussants:
1 Turkhan Ali Abdul Manap, International Islamic University Malaysia
2 Craig R. Parsons, Yokohama National University

3 Kentaro Iwatsubo, Kobei University
4 Kian-Teng Kwek, University of Malaya

Session 2b: Foreign Direct Investment (Amethyst Function Room, 2F)
Chair: Fredrick Sjoholm, Research Institute of Industrial Economics, Stockholm and Orebro University

1 Mitsuyo Ando and Fukunari Kimura, Keio University
International Production/Distribution Networks in East Asia and Domestic Operations: Evidences from Japanese Firms
2 Xayphone Kongmanila, National University of Laos and Hiroshima University
On the Relationship between Innovation and Export Behavior: An Empirical Investigation of Lao Garment Firms
3 Cassey Lee, University of Nottingham Malaysia Campus
Innovation, Productivity and Exports: Firm-Level Evidence from Malaysia
4 Haryo Aswicahyono and Dionisius Narjoko, Centre for Strategic and International Studies, Jakarta, and Hal Hill, Australian National University
Industrialization after a Deep Economic Crisis: Indonesia

Discussants:
1 Prema-chandra Athukorala and Tran Quang Tien, Australian National University
2 Eric Ramstetter, International Centre for the Studies of East Asian Development
3 Qun Liu, Japan Bank for International Cooperation Institute
4 Ludo Cuyvers, University of Antwerp

Session 2c: International Trade (Citrine Function Room, 2F)
Chair: Jayat Menon, Asian Development Bank

1 Yuan, Tao and Lu, Hong-Xv, Nankai University
An Empirical Study on the Relationship between Anti-dumping Actions against China and China's Foreign Direct Investment
2 David Jay Green, Asian Development Bank
The Role of ASEAN Economic Community as a Commitment to Policy Certainty
3 Shujiro Urata, Waseda University, and Kazuhiko Yokota, International Centre for the Study of East Asian Development
The Causes of Parts and Components Trade in East Asia -Is East Asia unique and if so, why?-
4 Erwin L. Corong, International Food Policy Research Institute, Rachel Reyes, De La Salle University, and Angelo Taningco, De La Salle University
Poverty Impacts of Preferential Trading Arrangement and Most-Favored-Nation Treatment on the Philippines: A Computable General Equilibrium Analysis

Discussants:
1 Amzul Rifin, University of Tokyo and Bogor Agricultural University, Indonesia
2 Hiro Lee, Osaka University
3 Archanun Kohpaiboon, Thammasat University
4 Innwon Park, Korea University

Session 2d: Financial Market (Opal Function Room, 2F)
Chair: Hidenobu Okuda, Hitotsubashi University

1 Tatsuyoshi Miyakoshi, Osaka University
   Mechanism Design Theory for International Finance: Incorporating International Public Goods and International Central
2 Yuniarto Hadiwibowo, Doctoral Student, Hiroshima University and Ministry of Finance of the Republic of Indonesia
   Ricardian Equivalence in Developing Countries: Fiscal Policy, Private Consumption and Investment in Indonesia
3 Yan Bin-jian, Nanjing Agriculture University, Fan Jin, Jiangsu Administration Institute
   An Empirical Macro-closure Study of CGE Model for China–Choice of Suitable Theory for Understanding China's Macro-economy
4 Bienvenido S. Cortes, Pittsburg State University
   The Role of Money in the Monetary Policy of the Philippines

Discussants:
1 Prince Christian R. Cruz, Global Property Guide
2 See Peng, Cheu, CIMB Bank Berhad, and Yiing Jia, Loke Universiti Sains Malaysia
3 Masahiro Inoguchi, Kyoto Sangyo University
4 Jamil Paolo S. Francisco, Ateneo de Manila University

Session 2e: Labor Markets (Jade Function Room, 2F)
Chair: Chris Manning, Australian National University

1 Futoshi Yamauchi, IFPRI, Megumi Muto, JICA Research Institute, Reno Dewina, IFPRI and Sony Sumaryanto, ICASEPS
   Spatial Networks, Incentives and the Dynamics of Village Economy: Evidence from Indonesia
2 Nguyen Duc Thanh, Vietnam National University
   Economywide Effects of International Remittances: A Computable General Equilibrium Assessment for Vietnam
3 Aubrey D. Tabuga, Philippine Institute for Development Studies
   International Remittances and Household Expenditures: The Philippines Case
4 Piriya Pholphirul and Pungpond Rukumnuaykit, National Institute of Development Administration
   Economic Contribution of Migrant Workers to Thailand

Discussants:
1 Chris Sakellariou, Nanyang Technological University, Singapore
2 Chih-Hai Yang, National Central University
3 Phanhpakit Onphanhdala and Terukazu Suruga, Kobe University
4 David Newhouse, World Bank Office, Jakarta

Session 2f: Income Inequality (Onyx Function Room, 2F)
Chair, Lim Chong Yah, Nanyang Techinical University

1 Tony Irawan M., Bogor Agricultural University, and Djoni Hartono, University of Indonesia
   Decentralization Policy and Equity: A Theil analysis of Indonesian Income Inequality
2 Rahmah Ismail and Ishak Yussof, University Kebangsaan Malaysia
   Human Capital and Income Distribution in Malaysia
3 Sothea Oum, Monash University
   Meeting Millennium Poverty Reduction Target – A CGE Assessment for Cambodia
4 Ragayah Haji Mat Zin, Universiti Kebangsaan Malaysia
   Income Distribution in Malaysia: Old Issues, New Approaches

Discussants:
1 Masahiro Shoji, University of Tokyo
2 Prijono Tjiptoherijanto, University of Indonesia
3 Giang Thanh Long, National Economics University (NEU)
4 Dinah Pura T. Depositario, University of the Philippines Los Baños

Session 2g: Energy and Infrastructure (Emerald Function Room, 2F)
Chair: Xiaoguang Chen, Renmin University of China

1 Xunpeng Shi, Australian National University
   Can coal be reconciled with the environment?
2 Nagendra Shrestha, Japan Bank for International Cooperation
   Why Estimate the International Input–Output Table? Lesson from the Machinery and Energy Trade Data
3 Budy P. Resosudarmo, Australian National University, Frank Jotzo, Australian National University, Arief A. Yusuf, Padjadjaran University and Ditya A. Nurdianto, Australian National University
   Decomposing CO_2 Emission from Fossil Fuel Combustions in Indonesia to Understand the Options for Mitigation
4 Kitja Topaiboul and Supachok Koydulya, Payap University, Chiang Mai, Thailand
   Economic Analysis of Jatropha as an Energy Source of Bio-Diesel in Community and Commercial Basis in Thailand

Discussants:
1 Kitja Topaiboul, Payap University, Chiang Mai, Thailand
2 Yuan-Ho Hsu, and Wanida Khongkim, National Cheng Kung University
3 Xunpeng Shi, Australian National University
4 Al-Amin, Abdul Hamid, and Chamhuri Siwar, Universiti Kebangsaan Malaysia

15:15–15:45 Coffee Break
15:45–17:45 Parallel Sessions 3a, 3b, 3c, 3d, 3e, 3f, 3g

Session 3a: Macroeconomic Policy (Ruby Function Room, 2F)
Chair: Shigeyuki Abe, Doshisha University

1 Kiyotaka Sato, Yokohama National University, Zhaoyong Zhang, Edith Cowan University and Michael McAleer, University of Western Australia
  The Effect of External Shocks on Macroeconomic Fluctuations: Implications for a Monetary Union in East Asia
2 Abdul Hamid Jaafar, and Abul Quasem Al-Amin, Universiti Sains Malaysia
  Impacts of External Price Shocks on the Malaysian Economy
3 Craig R. Parsons, Yokohama National University
  The Disappearance of Exchange Pass-Through in Japanese Auto Exports: A Very Detailed Look (1980–2006)
4 Josef T. Yap, Philippine Institute for Development Studies
  Evaluating Sterilized Intervention under an Inflation Targeting Framework: the case of the Philippines

Discussants:
1 Donghyun Park, Asian Development Bank (ADB)
2 Kun-Ming Chen, National Chengchi University
3 Jun-ichi Shinkai, Osaka University
4 Esta Lestari, Centre for Economic Research Indonesian Institute of Sciences

Session 3b: Foreign Direct Investment (Amethyst Function Room, 2F)
Chair: Myrna Austria, De La Salle University

1 Sadayuki Takii, International Centre for the Study of East Asian Development
  Who Gained Market Share in Indonesian Manufacturing?
2 Eric D. Ramstetter, International Centre for the Study of East Asian Development
  Producer Concentration, Conglomerates, Foreign Ownership, and Import Protection: Thai Manufacturing
3 Ayako Obashi, Keio University
  Stability of Production Networks in East Asia: the Duration and Survival of Trade
4 Masatsugu Tsuji, University of Hyogo, Shoichi Miyahara, Aoyama Gakuin University, and Yasushi Ueki, Bangkok Research Center, JETRO, Thailand
  Consolidated Multi-country Analysis of Industrial Agglomeration, Upgrading and Innovation

Discussants:
1 Remco H. Oostendorp, Vu University Amsterdam
2 Alvin Ang, University of Sto. Tomas
3 Yuan Yuan, the University of Tokyo
4 Pratiwi Kartika, Centre for Strategic and International Studies

Session 3c: International Trade (Citrine Function Room, 2F)
Chair, Hiro Lee, Osaka University

1 Jayant Menon, Asian Development Bank
  Dealing with the Proliferation of Bilateral Trade Agreement
2 William E. James, Asian Development Bank
  Have Antidumping Measures of Members of the EU and NAFTA Against East Asian Countries Provoked Retaliatory Respons
3 Noor Aini Khalifah, Universiti Kebangsaan Malaysia, and Radziah Adam, Universiti Sains Malaysia
  Comparison of Backward Linkages between Foreign and Local Establishments in Malaysian Electrical and Electronics Sector: A Panel Analysis

Discussants:
1 Kazuhiko Yokota, International Centre for the Study of East Asian Development
2 Shoichi Hisa, Hitotsubashi University
3 Chee Wooi Hooy, Universiti Sains Malaysia, and Ahmad Zubaidi Baharum-shah, Universiti Putra Malaysia

Session 3d: Financial Markets (Opal Function Room, 2F)
Chair: Donghyun Park, Asian Development Bank

1 Stephanie L. Chan, Pricewaterhouse Coopers Transactions Group, and Andrew Adrian Y. Pua, De La Salle University
  Is the Special Purpose Vehicles Act Responsible for the Decline in the Non-performing Loan Ratios in the Philippines?
2 Yuan Yuan, University of Tokyo, and Hiroshi Gunji, Tokyo International University
  How does foreign entry affect domestic banking markets? Evidence from China
3 Fumiharu Mieno, Kobe University
  Foreign Owned Firms, Listing Status and the Financial Systems in East Asia: Evidence from Thailand and Malaysia
4 Siti Astiyah, Bank Indonesia
  Financial Deepening and Regional Economic Growth: The Case of Indonesia during post financial crises

Discussants:
1 Fumiharu Mieno, Kobe University
2 Siti Astiyah, Bank Indonesia

3 Chan Tze-Haw1 and Khong Wye Leong Roy, Multimedia University
4 Tatsuyoshi Miyakoshi, Osaka University

Session 3e: Household Welfare (Jade Function Room, 2F)
Chair: Arsenio Balisacan, SEARCA

1 Lawrence B. Dacuycuy, De La Salle University
   Sector choices of female workers, wage differentials and inequality: The
   Philippine case
2 Oleksandr Movshuk, University of Toyama
   Household Consumption over the Life Cycle: Evidence from Micro Data
3 Dennis S. Mapa, University of the Philippines
   Population Dynamics and Household Saving: Evidence from the Philippines
4 Masayoshi Maruyama and Le Viet Trung, Kobe University
   The Nature of Pavement Economy in Transition Economies: The Case of
   Vietnam

Discussants:
1 Yiing Jia Loke, Universiti Sains Malaysia
2 Chris Manning , Australian National University
3 Ishak Yussof, Universiti Kebangsaan Malaysia
4 Alberto Posso, Australian National University

Session 3f: Income Inequality (Onyx Function Room, 2F)
Chair: Rana Hasan, Asain Development Bank

1 Yang Jian-hong, Jiangsu Administration Institute, Fan Jin, Jiangsu Administra-
   tion Institute, Sakamoto Hiroshi, The International Centre for the Study of
   East Asian Development
   Dynamic Evolution and the Industrial Reasons for "The Poor Getting Poorer,
   and The Rich Richer" in China: 1978-2006
2 Fan Jin, Jiangsu Administration Institute, Yang Jian-hong, Jiangsu Administration
   Institute, Sakamoto Hiroshi, The International Centre for the Study of East Asian
   Development
   An Analysis on Subregional Convergence by Using Distribution Dynamic
   Method in A Province of China: Jiangsu's Study
3 Daniel Suryadarma, Australian National University
   Corruption, Public Spending, and Education Outcomes: Evidence from
   Indonesia
4 Lim Chong Yah, Nanyang Technological University
   The World Bank Spence Commission report and the Trinity Growth
   Theory

Discussants:
1 Catur Sugiyanto, Gadjah Mada University
2 Djoni Hartono, University of Indonesia

3 Binzhen Wu, Tsinghua University
4 David Jay Green, Asian Development Bank

Session 3g: Energy, Environment, Underground Economy (Emerald Function Room, 2F)
Chair: Peter Lee U, University of Asia and the Pacific

1 Al-Amin, Abdul Hamid, and Chamhuri Siwar, Universiti Kebangsaan Malaysia
   Macroeconomic Effects of Carbon Dioxide Emission Reduction: A Computable General Equilibrium Analysis for Malaysia
2 Manabu Fujimura, Aoyama Gakuin University, and Ramesh Adhikari, Asian Development Bank
   Externalities for cross-border infrastructure projects: evaluation challenges
3 Roberto Galang, Asian Institute of Management and IESE Business School
   State Institutions and Market Development: Why Markets Exist in Certain Countries but not in Others
4 Lucinda David, Lund University, Sweden
   An Institutional Analysis of Political Capital and Market Transition

Discussants:
1 Budy P. Resosudarmo, Australian National University
2 Monica Flerida B. Sandoval, National Statistical Coordination Board (NSCB)
3 Xiaohui Yuan, Jiangsu Administration Institute
4 Joel Rodrigue, Vanderbilt University

17:30–19:00 EAEA Board Meeting (Restaurant Le Bellevue, 27F)
19:30–21:30 Reception (Galaxias Function Room, 27F)
Hosted by Asian Development Bank
Speaker: Haruhiko Kuroda, President, Asian Development Bank

DAY 2, 16 November 2008

08:00–10:00 Registration
08:30–09:30 Plenary Session 2: (Diamond Ballroom, 1F)
Title: The Philippine Economy Amidst the Current Global Crisis
Chairs: Fernando Aldaba, Ateneo de Manila University and V. Bruce Tolentino, The Asia Foundation
Speakers
   Diwa Guinigundo, Banko Sentral ng Pilipinas
   Felipe Medalla, University of the Philippines
   Ponciano Intal Jr., De La Salle University

09:30–10:00 Coffee Break
10:00–12:00 ERIA and Parallel Sessions 4a, 4b, 4c, 4d, 4e, 4f, 4g

Special ERIA Session 1: Deepening Economic Integration and Energy Security (Diamond Ballroom, 1F)
Moderator: Fukunari Kimura, Keio University and ERIA

1 Speakers: Jenny Corbett, Australian National University, and So Umezaki, Bangkok Research Center, JETRO
Deepening Economic Integration in East Asia: Summary of Findings and Ongoing Research Agenda
Discussant: Hyun-Hoon Lee, Professor, Kangwon National University, Korea

2 Speakers: Toshitaka Gokan and Ikumo Isono, IDE/JETRO
Discussant: Ho-Yeon Kim, Professor, Sungkyunkwan University (TBC)

3 Speaker: Zenada Ygnacio Monsada, Department of Energy, Philippines
Discussant: Nuwong Chollacoop, Bioenergy Laboratory, National Metal and Materials Technology Center (MTEC), National Science and Technology Development Agency (NSTDA), Thailand (TBC)

Session 4a: Macroeconomic Policy (Ruby Function Room, 2F)
Chair: Alvin Ang, University of Santo Tomas

1 Hsiufen Hsu, Osaka University
Is a Common Currency Area Feasible for East Asia? A Multivariate VAR Approach

2 Andrew Sheng, University of Malaya and Tsinghua University, Kian-Teng Kwek and Cho Cho Wai, University of Malaya
The Rise of an Asian Currency Bloc: Patterns of Currency Behaviour

3 Esta Lestari and Siwage Dharma Negara, Centre for Economic Research Indonesian Institute of Sciences
The Spillover Effects of the Subprime Mortgage Crisis to The Asian Stock Markets

4 Jun-ichi Shinkai and Akira Kohsaka, Osaka University
Global Shocks and the Japanese Economy: Structural Changes in the 1990s

Discussants:
1 Kiyotaka Sato, Yokohama National University
2 Wong Chin-Yoong, Universiti Tunku Abdul Rahman, Malaysia.
3 Nguyen Thi Thuy Vinh, Kobe University
4 Soyoung Kim, Korea University and Jaewoo Lee, International Monetary Fund

Session 4b: Foreign Direct Investment (Amethyst Function Room, 2F)
Chair: Rafaelita M. Aldaba, Asia Regional Integration Center

1 Elias Hossain, University of Rajshahi
Impact of Foreign Capital Inflows on Domestic Investment: Evidence from Malaysian Panel Data

2 Robert E. Lipsey, NBER and City University of NY, and Fredrik Sjöholm, Research Institute of Industrial Economics, Stockholm, and Örebro University
Foreign Takeovers and Employment in Indonesian Manufacturing
3 Lee, Xinzhong, Chinese Academy of Social Sciences
Spatial Agglomeration of Foreign Direct Investment and Technological Renovation: Empirical Evidence from China

Discussants:
1 Masatsugu Tsuji, University of Hyogo
2 Mitsuyo Ando, Keio University
3 Sung, Yun-Wing, Chinese University of Hong Kong

Session 4c: International Trade (Citrine Function Room, 2F)
Chair: Leonardo Lanzona, Ateneo de Manila University

1 Haitao Wu, Shijun Ding, Zhongnan University of Economics and Law, China, Sushil Pandey, International Rice Research Institute, Philippines, and Dayun Tao, Yunnan Academy of Agriculture Science, China
Assessment the Impact of Agricultural Technology Adoption on Farmers' Well-being Using Propensity-Score Matching Analysis for Rural China
2 Juthathip Jongwanich, Asian Development Bank
Processed Food Exports from Developing Countries: Patterns and Determinants
3 Ghin Yin, Leow and Soo Y. Chua, Universiti Sains Malaysia
An Analysis of Malaysia's Manufactured Exports Competitiveness Between 1980 and 2006

Discussants:
1 Tao Yuan Yuan and Hong-Xu Lu, Nankai University
2 Rachel Reyes, De La Salle University
3 Haitao Wu, Zhongnan University of Economics and Law, China

Session 4d. Financial Markets (Opal Function Room, 2F)
Chair, Tatsuyoshi Miyakoshi, Osaka University

1 Takuma Matsuda, Kanto Gakuin University and Yuan Yuan, University of Tokyo
Productivity and Banking Reforms in China
2 Ratna Sri Widyastuti and Luhur Fajar Martha, University of Indonesia
Testing Competition among Indonesian Banks
3 Hidenobu Okuda, Hitotsubashi University
Could the Reform Policies Change the Corporate Financing in Indonesia? : Estimating the Differential Effects of Business Groups, Social Factors, and Ownership
4 Prince Christian R. Cruz, Global Property Guide
Factors Affecting Asian Housing Markets

Discussants:
1 Wai-Ching Poon, Monash University Malaysia
2 Yuniarto Hadiwibowo, Doctoral Student, Hiroshima University and Ministry of Finance of the Republic of Indonesia
3 Bienvenido S. Cortes, Pittsburg State University
4 Bin-jian Yan, Nanjing Agriculture University, Jin Fan, Jiangsu Administration Institute

Session 4e: Labor Markets (Jade Function Room, 2F)
Chair: Winfred Villamil, De La Salle University

1 Kristen Schultz Lee, The University at Buffalo, and Hiroshi Ono, Texas A&M University
Specialization and Happiness in Marriage: A U.S. – Japan Comparison
2 Yiing Jia Loke, Universiti Sains Malaysia, and Ching Szu Foo
Ownership of Computer and its Usage at Home: A Case in Malaysia
3 Chris Manning and Alberto Posso, Australian National University
Labour Market Outcomes Associated with Rapid Growth: Why Did the Southeast Asian Countries Lag Behind the NIEs?
4 Ishak Yussof, Rahmah Ismail and Zulkifly Osman, Universiti Kebangsaan Malaysia
Workers Competitiveness in the Malaysian Education Sector

Discussants:
1 Lawrence B. Dacuycuy, De La Salle University
2 Nguyen Duc Thanh, Vietnam National University
3 Aubrey D. Tabuga, Philippine Institute for Development Studies
4 Hiroshi Ono, Texas A&M University

Session 4f: Disasters and Risk Management (Onyx Function Room, 2F)
Chair: Xiaguang Chen, Remnin University of China

1 Budy P. Resosudarmo, Australian National University, Catur Sugiyanto, Gadjah Mada University, and Ari Kuncoro, University of Indonesia
Livelihood recovery after natural disaster and the roles of aid: The case of 2006 Yogya earthquake
2 Sakuya Tamura, Boston Consulting Group, and Yasuyuki Sawada, University of Tokyo
Consumption Insurance against Unforeseen Epidemics: The Case of Avian Influenza in Vietnam
3 Yasuyuki Sawada, University of Tokyo, Jonna P. Estudillo, Foundation for Advanced Studies on International Development, Nobuhiko Fuwa, Chiba University, and Kei Kajisa, International Rice Research Institute
How do People Cope With a Natural Disaster? The Case of Super Typhoon Milenyo in the Philippines

4 Stephan Haggard, University of California-San Diego, and Marcus Noland, Peterson Institute for International Economics and the East-West Center
  Famine in North Korea Redux

Discussants:
1 Tony Irawan M., Bogor Agricultural University
2 Rahmah Ismail , University Kebangsaan Malaysia
3 Sothea Oum, Monash University
4 Ragayah Haji Mat Zin, Universiti Kebangsaan Malaysia

Session 4g: Institutions and Human Capital (Emerald Function Room, 2F)
Chair: Michael Alba, De La Salle University

1 Dennis S. Mapa, University of the Philippines, Monica Flerida B. Sandoval, National Statistical Coordination Board (NSCB), and David Joseph Emmanuel B. Yap II, University of the Philippines
  Regional Economic Growth Convergence in the Philippines
2 Dennis S. Mapa, Kristine Joy S. Briones, and Manuel Leonard F. Albis, University of the Philippines
  What Really Matters for Income Growth in the Philippines: Empirical Evidence from Provincial Data
3 Geeta Krishnasamy and Elsadig Musa Ahmed, Multimedia University
  Regional Productivity Growth Analysis in Asia: Application of Data Envelopment Analysis

Discussants:
1 Shandre M. Thangavelu, National University of Singapore
3 Hidefumi Kasuga, Kansai University
4 Michael R. Cabalfin, Philippine Institute for Development Studies

12:00–13:15 Lunch (Diamond Ballroom, 1F)
Introduction: Akira Kohsaka, Osaka University
Speaker: Hidetoshi Nishimura, Executive Director, ERIA

13:15–15:15 ERIA and Parallel Sessions 5a, 5b, 5c, 5d, 5e, 5f, 5g
Special ERIA session 2: Narrowing Gaps of Economic Development (Diamond Ballroom , 1F)
Moderator: Hank Lim, SIIA, Singapore

1 Tomohiro Machikita, Institute of Developing Economies, JETRO, Japan, Masatsugu Tsuji, University of Hyogo, and Yasushi Ueki, Bangkok Research Center, JETRO, Thailand
  Firm-Level Evidences on Innovation and Technology Sources from Indonesia, Thailand and Viet Nam
  Discussant: Archanun Kohpaiboon, Thammasat University

2 Masami Ishida, Institute of Developing Economies, JETRO
Narrowing Gaps of Economic Development between Forerunning ASEAN and CLMV Countries
Discussant: Weerapat Sessomboon, Khon Kaen University, Thailand
3 Shuji Uchikawa, Bangkok Research Centre, JETRO
Development of Multi-tier Subcontracting System in India
Discussant: Keshab Das, Gujarat Institute of Development Research, India

Session 5a: Macroeconomic Policy (Ruby Function Room, 1F)
Chair: Giovanni Capannelli, Asian Development Bank

1 Turkhan Ali Abdul Manap, International Islamic University Malaysia
Sources of Macroeconomic Fluctuations in China: A Structural (Cointegrated) VAR Approch
2 Donghyun Park, and Gemma Esther B. Estrada, Asian Development Bank (ADB)
Are Developing Asia's Foreign Exchange Reserves Excessive? An Empirical Examination
3 Masahiro Enya, Osaka International University
Asset Price Fluctuations and Macroeconomic Behavior in East Asia
4 Eiji Ogawa, Hitotsubashi University, and Kentaro Iwatsubo, Kobe University
External Adjustments and Coordinated Exchange Rate Policy in Asia

Discussants:
1 Masahiro Enya, Osaka International University
2 Eu Chye Tan, University of Malaya
3 Eng Yoke-Kee, Universiti Tunku Abdul Rahman, Malaysia.
4 Hsiufen Hsu, Osaka University

Session 5b: Foreign Direct Investment (Amethyst Function Room, 2F)
Chair, Hal Hill, Australian National University

1 Ludo Cuyvers, University of Antwerp, Joseph Plasmans, University of Antwerp, Reth Soend, University of Antwerp, and Daniel van den Bulcke, University of Antwerp
Determinants of Foreign Direct Investment in Cambodia: Country-Specific Factor Differentials
2 Kazuyuki Motohashi, the University of Tokyo and Yuan Yuan, the University of Tokyo
R&D Spillovers from Multinational Firms and Domestic Firms: Evidence from Auto Industry and Electronics Industry
3 Prema-chandra Athukorala and Tran Quang Tien, Australian National University
Foreign Direct Investment in Industrial Transition: The Experience of Vietnam

4 Remco H. Oostendorp, VU University Amsterdam, Tran Quoc Trung, Ministry of Planning and Investment, Vietnam, and Nguyen Thanh Tung, Management Development Foundation (MDF) Indochina, Vietnam
The Changing Role of Non-Farm Household Enterprises in Vietnam

Discussants:
1 Cassey Lee, University of Nottingham Malaysia Campus
2 Xayphone Kongmanila, National University of Laos and Hiroshima University
3 Sadayuki Takii, International Centre for the Study of East Asian Development
4 Eric D. Ramstetter, International Centre for the Study of East Asian Development

Session 5c: International Trade (Citrine Function Room, 2F)
Chair, William E. James, Asian Development Bank

1 Amzul Rifin, University of Tokyo and Bogor Agricultural University, Indonesia
The Effects of Export Tax on Indonesia's Crude Palm Oil (CPO) Export Competitiveness
2 Hiro Lee, Osaka University
Japan's Agricultural Protection and the Implications for Its FTA Strategies
3 Cristela Goce-Dakila, De La Salle University-Manila, and Shoshi Mizokami, Kumamoto University
The Spatial Impact of New Technology on the Transport Sector in the Philippines: A General Equilibrium Approach
4 Innwon Park, Korea University, and Soonchan Park, Kongju National University
Free Trade Agreements versus Customs Unions: An Examination of East Asia

Discussants:
1 Jayant Menon, Asian Development Bank
2 Cristela Goce-Dakila, De La Salle University-Manila, and Shoshi Mizokami, Kumamoto University
3 Ghin Yin, Leow and Soo Y. Chua, Universiti Sains Malaysia
4 Radziah Adam, Universiti Sains Malaysia

Session 5d: Financial Markets (Opal Function Room, 2F)
Chair: Angelo Unite, De La Salle University

1 See Peng Cheu, CIMB Bank Berhad, and Ying Jia Loke Universiti Sains Malaysia
Credit Cardholders: Distinguishing the Good Apples from the Bad Apples
2 Masahiro Inoguchi, Kyoto Sangyo University
Bank Loans and Real Estate Prices in Asia: The Influences of Real Estate Prices on Lending Behavior of Domestic Banks

3 Jamil Paolo S. Francisco, Ateneo de Manila University
  Stock Market Volatility and Liberalization
4 Turkhan Ali Abdul Manap, Ruzita Mohd Amin and Salina H. Kassim, International Islamic University Malaysia
  The Impact of Monetary Policy on Stock Prices: Evidence from Standard and Structural VAR

Discussants:
1 Andrew Adrian Y. Pua, De La Salle University
2 Hiroshi Gunji, Tokyo International University
3 Fumiharu Mieno, Kobe University
4

Session 5e: Education (Jade Function Room, 2F)
Chair: Aniceto Orbeta, Philippine Institute for Development Studies

1 Phanhpakit Onphanhdala and Terukazu Suruga, Kobe University
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4 Lucinda David, Lund University, Sweden

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4 Eng Yoke-Kee, Wong Chin-Yoong, Universiti Tunku Abdul Rahman, Malaysia, and Muzafar Shah Habibullah, Unievrsiti Putra Malaysia

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Discussants:

1 Eiji Ogawa, Hitotsubashi University
2 Abdul Hamid Jaafar, Universiti Sains Malaysia
3 Taizo Motonishi, Kansai University
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1 Achmad Tohari, The Institute for Development of Economic and Finance (INDEF)

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2 Hideaki Sakawa and and Naoki Watanabel, Osaka University

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2 Fredrik Sjöholm, Research Institute of Industrial Economics, Stockholm, and Örebro University
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1 Shoichi Hisa, Hitotsubashi University

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3 Juthathip Jongwanich, Asian Development Bank
4 Shujiro Urata, Waseda University

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2 Chan Tze-Haw1 and Khong Wye Leong Roy, Multimedia University
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2 Takuma Matsuda, Kanto Gakuin University and Yuan Yuan, University of Tokyo
3 Hidenobu Okuda, Hitotsubashi University

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1 Fanglin Su, Dongni Jing, Jieming Liang, and Renbing Yang, Guangxi Normal University
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1 Yasuyuki Sawada, University of Tokyo
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3 Marcus Noland, Peterson Institute for International Economics and the East-West Center

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1 Xiaohui Yuan and Jin Fan, Jiangsu Administration Institute
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2 Joel Rodrigue, Vanderbilt University
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Discussants:
1 Nagendra Shrestha, Japan Bank for International Cooperation
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Role of Education in Cigarette Smoking: An Analysis of Malaysian Household Survey Data*

Andrew K.G. Tan, Steven T. Yen and Rodolfo M. Nayga, Jr.

Heckman's sample selection model is used to examine the role of education on household purchase decisions and expenditures of tobacco products in Malaysia. Results of the marginal effects of education, segmented by ethnic and gender groups, suggest that education decreases the probability, conditional levels and unconditional levels of tobacco expenditures amongst Malaysian households. Specifically, an additional year of education of the household head, irrespective of ethnic or gender considerations, decreases smoking probability by 1.5 percent. However, the negative effect of education seems to be higher for Chinese (US$1.07) than Malay (US$0.26) households in terms of conditional expenditures. Furthermore, education significantly decreases conditional tobacco expenditures within male-headed households.

I. Introduction

Cigarette smoking in Malaysia has been estimated to account for 1 out of every 5 deaths in the country (MOH, 2003). While Malaysian health statistics have recorded close to 40 000 deaths over the past 5 years, an additional half a million coronary events have been attributed to cigarette smoking (WHO, 2002; MOH, 2003). In addition, incidents of lung cancer are increasing at an annual rate of 17 percent, with approximately 3500 new cases reported each year (WHO, 2002; Aljunid et al., 2006).

The latest projections indicate that there are currently approximately 3.1 million smokers between the ages of 25 and 64 years in Malaysia. The prevalence of current smokers is reported to be 25.5 percent, comprising

approximately 46.5 percent of men and 3.0 percent of women (MOH, 2006; 2003). These figures translate to one in every 2 men and 1 in every 33 women smoke an average of 14 cigarettes per day nationwide.

In terms of monetary costs, besides sizeable consumer expenditure of US$4.3m daily on cigarettes, the Malaysian Government is estimated to spend approximately US$1bn each year on smokers treated in public hospitals for ischemic heart disease, lung cancer and chronic obstructive airway diseases. This staggering cost will constitute half of the Malaysian Government's annual health budget by the year 2010 (equivalent to 0.8 percent of the overall forecast 2010 GDP of US$136bn) (MOH, 2006; *The Star*, 2007). Other indirect costs to society include the loss of productivity from premature deaths, the cost borne by passive smokers, social losses due to fires caused by cigarettes, work-hour loss when those affected take leave, resulting in additional costs for employers, and insurance claims either under health-care schemes or upon death (WHO, 2002).

From the perspective of monetary benefits, the contributions of the Malaysian tobacco industries are just as notable. Between 2004 and 2006, the combined export earnings from tobacco and tobacco products was nearly US$612m, while the value of imported cigarettes totaled US$336m. During the same period, revenues derived from import duties and excise duties from the tobacco industry amounted to US$1236m (MPIC, 2006). In addition, the amount of outlays by the tobacco industry on advertising in Malaysia is extremely high. For example, approximately US$90m was spent on advertising in 1997 (WHO, 2002). In addition, two major tobacco firms were reported to have forked out more than US$40m in 2000 for advertising purposes.

Notwithstanding its negative health impacts and considerable economic significance, the Malaysian Government is determined to curb the growing influence of tobacco usage in the country. Cigarette taxes increased by more than 53 percent between 2004 and 2006 as the government intensified efforts to encourage Malaysians to adopt a healthier lifestyle. Other measures include a RM (Malaysian ringgit) 100m (US$29m) *Tak Nak* (translated as *Don't Want* in the Malay language) national anti-smoking campaign aimed at creating awareness and educating the public on the negative effects of smoking and tobacco usage.[1] Unfortunately, preliminary reports have been indicative of the failure of this campaign, as initial targets have not been achieved (Chok, 2006).

An extensive review of the published literature reveals that although previous attempts have been made to study cigarette consumption patterns in Malaysia (Lim et al., 2006; Haniza and Suraya, 1997), there has been little detailed econometric analysis of tobacco expenditures by Malaysian households. As such, the present study attempts to complement existing studies by using available household expenditure survey data to quantitatively examine the role of education and other socio-demographic characteristics on tobacco (including

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1. US$1.00 = RM3.49; RM1.00 = US$0.29 (approximately as of 15 November 2007).

cigarettes, cigars and other tobacco related items) consumption amongst households in Malaysia. Understanding how socio-demographic factors, such as education, influence the likelihood of purchasing and the amount spent on tobacco products is important to policy-makers interested in identifying household characteristics that determine the demand for tobacco products in Malaysia. This may, in turn, be relevant in designing effective smoking prevention and cessation programs aimed at specific target groups in Malaysia.

II. Sample Selection Model

To accommodate the zero observations typically encountered in household tobacco expenditure studies, we use the sample selection model (Heckman, 1979), also known as the type 2 Tobit model (Amemiya, 1985). The model is characterized as:

$$
\begin{array}{lll}
\log y = x'\beta + v & \text{if} & z'\alpha + u > 0 \\
y = 0 & \text{if} & z'\alpha + u \leq 0,
\end{array}
\tag{1}
$$

where y is the dependent variable, x and z are vectors of explanatory variables, β and α are conformable vectors of parameters, and the error terms u and v are distributed as bivariate normal with zero means and a finite covariance matrix:

$$
\begin{bmatrix} u \\ v \end{bmatrix} \sim N \left\{ \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho\sigma \\ \rho\sigma & \sigma^2 \end{bmatrix} \right\},
\tag{2}
$$

where, σ is the standard deviation of v, and ρ is the correlation between u and v. The standard deviation of u is not identified and, therefore, is set at unity because the selection outcomes are observed as binary. The sample likelihood function is:

$$
L = \prod_{y=0} [1 - \Phi(z'\alpha)] \prod_{y>0} \Phi \left[\frac{z'\alpha + \rho(\log y - x'\beta)/\sigma}{(1 - \rho^2)^{1/2}} \right] y^{-1} \frac{1}{\sigma} \phi \left(\frac{\log y - x'\beta}{\sigma} \right), \tag{3}
$$

where y^{-1} is the Jacobian of the transformation from $\log y$ to y, and $\phi(\cdot)$ and $\Phi(\cdot)$ are the standard normal probability density function and cumulative distribution function (cdf), respectively. The likelihood function (Equation 3) reduces to that of the two-part model when the errors are independent ($\rho = 0$), in which case the log-likelihood function is separable in parameters α and $[\beta', \sigma]'$ and, therefore, estimation can be broken down to a probit model (to estimate α) using the whole sample and a linear regression of $\log y$ on x (to estimate β and σ) using only the non-limit observations.

There is continued interest in the marginal effects calculation in the sample selection model. In applications of log-transformed sample selection models, marginal effects are often calculated by differentiating the conditional mean of the logarithm of the dependent variable (e.g. Cheng and Capps, 1988;

Hoffman and Kassouf, 2005). Yen and Rosinski (2008) show that such an approximation can lead to substantial errors. They also present the conditional mean of the dependent variable and marginal effect formulas for a log-transformed sample selection model.

In essence, the conditional mean of the dependent variable y is (Yen and Rosinski, 2008):

$$E(y|y > 0) = \exp(x'\beta + \sigma^2/2)\ \Phi(z'\alpha + \rho\sigma)/\Phi(z'\alpha). \qquad (4)$$

Because the marginal probability of a positive observation is:

$$\Pr(y > 0) = \Phi(z'\alpha) \qquad (5)$$

the unconditional mean of y is:

$$E(y) = \exp(x'\beta + \sigma^2/2)\ \Phi(z'\alpha + \rho\sigma). \qquad (6)$$

Differentiating Equations (4), (5) and (6) gives the marginal effects on probability, conditional mean and unconditional mean of a common element of x and z (say $x_j = z_j$):

$$\partial \Pr(y > 0)/\partial x_j = \phi(z'\alpha)\alpha_j \qquad (7)$$

$$\partial E(y|y > 0)/\partial x_j = [\Phi(z'\alpha)]^{-2} \exp(x'\beta + \sigma^2/2)\{[\Phi(z'\alpha)\phi(z'\alpha + \rho\sigma)$$
$$- \phi(z'\alpha)\Phi(z'\alpha + \rho\sigma)]\alpha_j + \Phi(z'\alpha)\Phi(z'\alpha + \rho\sigma)\beta_j\} \qquad (8)$$

$$\partial E(y)/\partial x_j = \exp(x'\beta + \sigma^2/2)\ [\phi(z'\alpha + \rho\sigma)\alpha_j + \Phi(z'\alpha + \rho\sigma)\beta_j]. \qquad (9)$$

These marginal effects can be evaluated at data points of interest, such as the sample means of explanatory variables.

III. Data and Variable Definitions

III.1   The survey

The dataset used in the present study is from the Malaysian Household Expenditure Survey 2004/2005 collected by the Department of Statistics Malaysia (2005). This dataset is the most recent of the national household expenditure surveys. The sample was designed using a stratified multi-stage, area probability sampling method, thus ensuring that socio-economic and geographical considerations are taken into account to reflect the Malaysian population.

In the survey, respondents were asked to record their monthly expenditure on tobacco products. In addition, socio-economic and other demographic characteristics of the respondents were also recorded. Although a total number of 14 084 households responded to this survey, 2 of those households were found to have incomplete information. Therefore, a total of 14 082 observations were subsequently retained for analysis. From this sample, a total of 5291 households

Table 1   Variable definitions and sample statistics

Variable	Definition	Mean	Standard deviation
EXPENDITURE	Household expenditure on tobacco (RM/month) (dependent variable)	27.84	57.45
	Consuming households ($n = 5291$)	74.09	73.20
EDUC	Number of years of formal education of household head	8.51	4.81
HHSZ	Total number of family members in household	4.35	2.22
INCOME	Gross monthly household income (in RM)	2732.03	2669.17
AGE	Age of household head (years)	46.85	14.06
Binary variables (yes = 1; no = 0)			
MALAY	Malay household head (reference)	0.57	0.50
CHINESE	Chinese household head	0.23	0.42
INDIAN	Indian household head	0.06	0.23
OTHER	Household head of other race	0.15	0.36
WHITE	Household head is a white-collar worker	0.25	0.43
URBAN	Household resides in an urban area	0.67	0.47
MALE	Household head is male	0.84	0.37
AGE 15–30	Household head is between 15–30 years old	0.12	0.33
AGE 31–56	Household head is between 31–56 years old (reference)	0.64	0.48
AGE ≥57	Household head is ≥57 years old	0.24	0.43

Source: Compiled using the Malaysian Household Expenditure Survey 2004/2005 (Department of Statistics Malaysia, 2005).

(37.57 percent) reported tobacco expenditures during the survey period (Table 1).

III.2   The variables

Given the lack of empirical research on Malaysian tobacco products, the selection of variables likely to affect household purchase decisions and expenditure levels relies on previous cigarettes and tobacco studies by Wasserman et al. (1991), Blaylock and Blisard (1992a,b), Douglas and Hariharan (1994), Jones and Labeaga (2003), Ross and Chaloupka (2004) and Yen (2005a,b). The following socio-demographic variables are therefore hypothesized to influence the probability and amount of expenditure on tobacco products: (i) ethnicity/race; (ii) education level; (iii) occupation type; (iv) location of residence; (v) household size; (vi) gender of household head; (vii) gross monthly household income; and (viii) age of household head (Table 1).

Studies by Blaylock and Blisard (1992a,b), Douglas and Hariharan (1994), Ross and Chaloupka (2004) and Yen (2005a,b) suggest that ethnicity be included to allow for the possibility of cultural and taste differences influencing tobacco expenditure. As most of these previous studies compare whites, blacks, Hispanics

and Asians in their ethnicity/race categories, the unique racial composition in Malaysia allows a comparison of four distinct races (Malay, Chinese, Indian and a small proportion of various other races). In the current study, respondents are segregated into Malay (base group), Chinese, Indian, and other races to allow for the possibility of cultural, ethnic and religious differences to influence tobacco consumption patterns amongst Malaysians.

Prior health economics studies have consistently emphasized the importance of education or schooling (Jones, 1989; Chaloupka, 1991; Sander, 1995; Dorsett, 1999; Nayga, 1999; Jones and Labeaga, 2003; Yen, 2005a). The various theories that arise include the contention that education is a form of human capital investment that improves cognitive skills and enhances the understanding of the relationship between health behavior and health (Berger and Leigh, 1989; Kenkel, 1991). Others have hypothesized that the reverse might be true, as having healthier individuals could result in an increase in the demand for education (Currie and Hyson, 1999). Education could also be a proxy for unobservables, such as time preference, that are related to health. In such instances, self-selection processes might be evident (Becker and Murphy 1988; Chaloupka, 1991; Sander, 1995). In the current study, the number of years of formal education (*EDUC*) possessed by the household head is used, with the range varying from those without any formal education (0) to those with tertiary education (17).

Occupation type (*WHITE*) consisting of white-collar and blue-collar households is included to reflect the social status of respondents (Yen, 2005a; Yen and Jones, 1996). Location of residence (*URBAN*) is included given that peer or work pressure in urban surroundings or more intense media advertising in metropolitan areas might determine tobacco consumption patterns (Blaylock and Blisard, 1992a,b; Jones and Labeaga, 2003; Yen, 2005a).

Blaylock and Blisard (1992a) provide evidence to suggest that household size (*HHSZ*), represented by the number of individuals living in the household, might determine decisions made in relation to tobacco consumption expenditure. A gender variable (*MALE*) is included in the present study as Yen (2005a,b) and Douglas and Hariharan (1994) determine that gender might account for preferences among consumers of tobacco products.

Total monthly household *INCOME* (R*M*) is considered to account for household spending patterns as previous researchers have found that wealth might have positive (Douglas and Hariharan, 1994; Goel and Morey, 1995), negative (Wasserman et al., 1991) or even no (Blaylock and Blisard, 1992b; Dorsett, 1999) statistical effects on participation decisions or expenditure levels for tobacco consumption.

Finally, *AGE* of the household head (in years) and age groups denoting younger (*AGE*15–30), middle age (*AGE*31–56) and retiree (*AGE* ≥ 57) households are used in the current model with the assumption that differences in age and life-cycle patterns lead to variations in preferences and expenditure patterns for tobacco products (Jones, 1989; Blaylock and Blisard, 1992a,b; Jones and Labeaga, 2003; Ross and Chaloupka, 2004; Yen, 2005a,b).

III.3 Characteristics of survey respondents

Descriptive statistics for the sample are presented in Table 1.[2] The average household expenditures on tobacco amount to RM27.84 for the overall sample compared to RM74.09 amongst consuming households. In the entire sample, the average educational attainment of the household head is slightly more than 8 years of formal education (at least high school education) and the average household size is approximately 4. The ethnic composition of the sample reflects the population of Malaysia, whereby Malays (57 percent) (base group), Chinese (23 percent) and Indians (6 percent) form the main ethnic groups, and approximately 15 percent belong to various other races.

With 25 percent of the total sample classified as having white-collar occupations, these households have an average monthly income of approximately RM2732. Approximately 67 percent of the sample resides in urban areas, with 84 percent of households being headed by men. The average age of the household head is approximately 47 years. Approximately 12 percent of the sample is in the younger age group between 15–30 years old; 64 percent in the middle age group between 31–56 years old (base group); and 24 percent are retirees in the 57 years and above age group (Table 1).

IV. Estimation results

Maximum likelihood (ML) estimation was carried out by maximizing the likelihood function in Equation (3). Our empirical strategy includes first testing for the appropriateness of the use of a pooled sample versus stratified samples by ethnicity and gender. The maximum log-likelihoods for the male, female and pooled samples are denoted as $\log L_m$, $\log L_w$ and $\log L_p$, with corresponding numbers of parameters k_m, k_w and k_p, respectively. Then the test statistic $LR = 2(\log L_m + \log L_w - \log L_p)$ is χ^2-distributed with $k_m + k_w - k_p$ degrees of freedom (df). The test procedure is similar for sample stratification into three or more categories. ML estimates are not presented due to space considerations but we summarize the results here.[3] According to the separate and pooled sample results, the hypotheses of equal slope parameters across ethnic groups (LR = 215.82, df = 36, p-value < 0.0001) and between genders (LR = 359.25, df = 23, p-value < 0.0001) are both rejected, thus suggesting the analysis by segmented samples. One other empirical issue in the estimation was the choice of regressors. As in other sample selection models, use of exclusion conditions can be useful in identifying the model parameters. Although there is no a priori exclusion conditions for the current sample, our empirical approach is to use an age variable in the selection equation and two age category variables in the

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2. A more comprehensive discussion of the characteristics of survey respondents can be obtained from the authors upon request.
3. ML estimates for all samples are available upon request.

level equation. Use of such different sets of variables in the two equations guarantees that the model identification conditions are met.

According to ML results for all samples (not presented), the error correlation coefficient (ρ) are all significant at the 1-percent level of significance. Statistical insignificance of the error correlation would have suggested a lack of endogenous sample selectivity and use of the two-part model discussed above. In addition, when a quadratic term of income ($INCOME^2$) was included in the model to accommodate the nonlinear relationship between income and the probability and level of cigarette smoking, we found evidence to support this hypothesis.

With the separate equations to accommodate sample selection and level, and with the logarithmic transformation in the dependent variable, the effects of explanatory variables on the probability and level of expenditure are non-trivial. To further explore the effects of explanatory variables, we calculate the marginal effects of these variables according to the procedure discussed (Equations 7, 8 and 9). The results are presented in Table 2 for the pooled sample (for comparison

Table 2   Marginal effects of explanatory variables: pooled sample

Variable	Probability	Conditional level	Unconditional level
		Continuous explanatory variables	
EDUC	−0.016***	−1.070***	−1.561***
	(0.001)	(0.298)	(0.144)
INCOME × 10⁻³	0.002	14.384***	5.397***
	(0.003)	(0.930)	(0.457)
HHSZ	0.002	−0.961**	−0.224
	(0.002)	(0.460)	(0.218)
AGE ÷10	−0.028***	−8.869***	−5.289***
	(0.003)	(0.882)	(0.530)
		Binary explanatory variables	
CHINESE	−0.122***	12.748***	−5.617***
	(0.010)	(2.923)	(1.221)
INDIAN	−0.022	−8.018**	−4.652***
	(0.019)	(4.066)	(1.889)
OTHER	−0.018	−13.068***	−6.315***
	(0.012)	(2.591)	(1.319)
WHITE	−0.051***	−5.596**	−5.758***
	(0.011)	(2.670)	(1.225)
URBAN	−0.046***	1.118	−3.009***
	(0.009)	(2.130)	(1.070)
MALE	0.209***	11.886***	18.382***
	(0.010)	(3.534)	(1.065)
AGE 15–30		−11.533***	−4.235***
		(2.635)	(0.966)
AGE ≥57		9.875***	3.626***
		(3.632)	(1.333)

Note: Asymptotic standard errors in parentheses. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

purposes) and Tables 3 and 4, for the stratified samples by ethnicity and by gender, respectively. The effects of binary explanatory variables on the probability (Equation 5), conditional level (Equation 4) and unconditional level (Equation 6) are evaluated by simulating a finite change (e.g. from 0 to 1) in each variable, ceteris paribus. For statistical inference, standard errors of all marginal effects are calculated using the delta method (Greene, 2007).

IV.1 By ethnic groups

To further examine the marginal effects of the explanatory variables on household tobacco expenditure, the sample is segregated into the three main ethnic groups in Malaysia (Malay, Chinese and Indian/others).[4] Conforming to results from the pooled sample and previous studies (Kenkel, 1991; Sander, 1995; Nayga, 1999), education levels are also statistically significant and negatively associated with the probability of purchasing tobacco amongst Malay, Chinese and Indian/other households (Table 3). In fact, an additional year of education possessed by the household head decreases the probability of tobacco purchases amongst Malay, Chinese and Indian/other households by 1.8, 1.5 and 1.5 percent, respectively.

The marginal effects of income by ethnic groups indicate that income is statistically significant and positively associated with the probability of smoking only amongst Malay households. However, the magnitude is fairly small, with each additional RM1000 in household income increasing the probability of smoking by only 1.1 percent. The results also show that, based on ethnic considerations, age is inversely related to the probability of smoking amongst Malay, Chinese and Indian/other ethnic groups, with each additional 10 years decreasing the probability of smoking by 2.8, 3.6 and 1.9 percent, respectively, among these groups. Having a white-collar occupation lowers the probability of purchasing tobacco among Malay (5.3 percent), Chinese (4.4 percent) and Indian/other (7.2 percent) ethnic households. Residing in an urban locality significantly lowers the probability of smoking for Malay (2.8 percent), Chinese (7.0 percent) and Indian/others (8.7 percent), compared to their rural counterparts. Meanwhile, Malay households (23 percent) led by men are more likely to purchase tobacco products compared to Chinese (15.6 percent) or Indian/other (21.4 percent) households with male heads.

The results also suggest that education lowers the conditional level of expenditure for Malay (RM0.91 per additional year) and Chinese (RM3.74 per additional year) households in a statistically significant manner. Similarly, as education levels increase by an additional year, the unconditional level of expenditure for Malay (RM1.56), Chinese (RM2.33) and Indian/other (RM0.91)

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4. Although the estimation of separate dummies for 'Indian' and 'Others' causes no problem in the pooled model, we decided to combine these two categories in the analysis due to the relatively small number of Indian households in the sample (only 6 percent of the sample).

Table 3 Marginal effects of explanatory variables by ethnic groups

Variable	Malay			Chinese			Indian and other		
	Probability	Conditional level	Unconditional level	Probability	Conditional level	Unconditional level	Probability	Conditional level	Unconditional level
				Continuous explanatory variables					
EDUC	−0.018***	−0.907***	−1.557***	−0.015***	−3.736***	−2.326***	−0.015***	−0.189	−0.911***
	(0.002)	(0.347)	(0.181)	(0.002)	(0.806)	(0.311)	(0.002)	(0.469)	(0.241)
INCOME × 10⁻³	0.011*	18.707***	8.168***	0.000	11.625***	3.077***	0.003	24.588***	10.144***
	(0.006)	(1.520)	(0.748)	(0.005)	(1.664)	(0.643)	(0.008)	(2.091)	(0.957)
HHSZ	0.004*	−0.104	0.251	−0.002	−1.610	−0.596	−0.004	−3.028***	−1.474***
	(0.003)	(0.558)	(0.279)	(0.004)	(1.315)	(0.515)	(0.004)	(0.757)	(0.387)
AGE ÷ 10	−0.028***	−8.313***	−5.195***	−0.036***	−15.852***	−7.511***	−0.019***	−4.126***	−2.743***
	(0.004)	(1.091)	(0.686)	(0.006)	(2.285)	(1.106)	(0.006)	(1.380)	(0.921)
				Discrete explanatory variables					
WHITE	−0.053***	−5.066	−5.781***	−0.044**	−5.184	−5.450**	−0.072***	−13.428***	−9.585***
	(0.014)	(3.240)	(1.582)	(0.019)	(6.654)	(2.505)	(0.026)	(5.001)	(2.410)
URBAN	−0.028***	4.217*	−0.371	−0.070***	−14.581*	−11.267***	−0.087***	−6.023	−8.311***
	(0.011)	(2.488)	(1.286)	(0.025)	(8.227)	(3.562)	(0.020)	(4.041)	(2.322)
MALE	0.230***	6.919	18.485***	0.156***	3.917	15.357***	0.214***	27.018***	21.472***
	(0.014)	(4.453)	(1.426)	(0.018)	(11.216)	(2.445)	(0.023)	(4.971)	(1.826)
AGE 15–30		−11.591***	−4.636***		−9.727	−2.563		−7.669	−3.132
		(3.246)	(1.298)		(7.383)	(1.943)		(4.758)	(1.941)
AGE ≥57		12.315***	4.925***		22.229***	5.857***		−6.825	−2.788
		(4.756)	(1.902)		(8.621)	(2.271)		(6.738)	(2.754)

Note: Asymptotic standard errors in parentheses. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

Table 4 Marginal effects of explanatory variables by gender

Variable	Male			Female		
	Probability	Conditional level	Unconditional level	Probability	Conditional level	Unconditional level
Continuous explanatory variables						
EDUC	−0.015***	−1.242***	−1.611***	−0.015***	−0.062	−0.793***
	(0.001)	(0.318)	(0.168)	(0.002)	(0.705)	(0.174)
INCOME × 10⁻³	−0.005	14.021***	5.298***	0.036***	24.813***	6.224***
	(0.004)	(0.950)	(0.487)	(0.013)	(3.647)	(0.960)
HHSZ	−0.006***	−0.795*	−0.736***	0.029***	−1.599	1.251***
	(0.002)	(0.485)	(0.251)	(0.004)	(1.531)	(0.348)
AGE ÷ 10	−0.036***	−10.736***	−7.003***	0.006	2.690	0.783
	(0.003)	(0.944)	(0.623)	(0.005)	(2.345)	(0.684)
Discrete explanatory variables						
WHITE	−0.057***	−4.431	−6.068***	−0.017	−4.528	−1.772
	(0.012)	(2.768)	(1.379)	(0.031)	(16.536)	(3.546)
URBAN	−0.041***	2.007	−2.330*	−0.069***	−4.356	−4.952*
	(0.010)	(2.279)	(1.226)	(0.020)	(6.118)	(1.816)
CHINESE	−0.132***	12.185***	−6.197***	−0.053*	14.388	−0.888
	(0.011)	(2.982)	(1.328)	(0.021)	(9.279)	(2.000)
INDIAN	−0.060***	−4.916	−6.390***	0.132***	−24.078***	0.485
	(0.020)	(4.631)	(2.064)	(0.042)	(6.689)	(2.339)
OTHER	−0.014	−12.142***	−5.839***	−0.021	−14.946**	−3.798**
	(0.013)	(2.924)	(1.550)	(0.023)	(7.73)	(1.851)
AGE 15–30		−14.552***	−5.846***		2.213	0.410
		(2.673)	(1.073)		(13.397)	(2.482)
AGE ≥ 57		11.232***	4.512*		−1.012	−0.188
		(4.070)	(1.634)		(7.341)	(1.360)

Note: Asymptotic standard errors in parentheses. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.

households would invariably decrease. This reinforces the negative impact of education on the expenditure levels of tobacco products among Malaysian households.

Amongst households with tobacco expenses, an increase of RM1000 in income leads to statistically significant and higher expenditure levels for Malay (RM18.71) and Indian/other (RM24.59) compared to Chinese (RM11.63) households. Income levels are also statistically significant in determining unconditional levels of tobacco expenditure for Malay (RM8.17), Chinese (RM3.08) and Indian/other (RM10.14) households. For every 10-year increase in the age of the household head, Chinese households (RM15.85) reduce conditional expenditure by greater amounts compared to Malay (RM8.31) or Indian/other (RM4.13) households. Furthermore, each additional 10 years in age results in decreases in the unconditional level of expenditure for Malay (RM5.20), Chinese (RM7.51) and Indian/other (RM2.74) households. White-collar workers have lower unconditional levels of expenditures than blue-collar workers among Malay (RM5.78), Chinese (RM5.45) and Indian/other (RM9.59) households. Among smokers, urban Malay households have higher levels of tobacco expenditure (RM4.22), whereas urban Chinese households have lower levels of tobacco expenditure (RM14.58) compared to their rural counterparts. In contrast, urban Chinese (RM11.27) and Indian/other (RM8.31) households have lower unconditional tobacco expenditure compared to their rural cohorts. Having a male household head increases the unconditional level of expenditure for Malay (RM18.49), Chinese (RM15.36) and Indian/other (RM21.47) households.

Malay households in the younger age group (between 15 and 30 years) have lower conditional (RM11.59) and unconditional (RM4.64) levels of tobacco expenditure compared to those in the middle age group (between 31 and 56 years). However, while retired Malay households have higher conditional (RM12.31) and unconditional (RM4.93) levels of tobacco expenditure, retired Chinese households have slightly higher levels of conditional (RM22.23) and unconditional (RM5.86) expenditure compared to their middle-age counterparts. Interestingly, Chinese households in the younger age group (between 15 and 30 years) and Indian/other households in both younger (between 15 and 30 years) and middle-age (between 31 and 56 years) groups do not have statistically significant conditional and unconditional tobacco expenditure. These results underscore the relevance of analysis using segmented ethnic samples as opposed to the pooled sample.

IV.2 By gender

The marginal effects of education by gender indicate that education is statistically significant and inversely related to the probability of smoking among households led by both male and female household heads (Table 4). An additional year of education decreases the probability of tobacco expenditure amongst both male and female household heads by 1.5 percent in a statistically significant manner.

The marginal effects of explanatory variables by gender indicate that income is statistically significant and positively associated with the probability of smoking only among households with female heads (3.6 percent), whereas age (3.6 percent) and having white-collar occupations (5.7 percent) are inversely related to the probability of smoking among male-headed households only. It is also of interest to note the contrasting effects of household size on the likelihood of smoking for households led by male and female heads. For instance, an additional household member decreases (0.6 percent) and increases (2.9 percent) the probability of tobacco expenditure among male and female-headed households, respectively. Again, such differences between gender are masked in the pooled sample analysis and, therefore, further highlight the importance of the current analysis using gender groups.

At the same time, the likelihood of smoking for urban households led by male and female household heads is lower by 4.1 and 6.9 percent, respectively, compared to those living in rural areas. Chinese and Indian households with male heads have a 13.2 and 6-percent lower probability of purchasing tobacco products, respectively, compared to their Malay counterparts. In comparison, although Chinese households with female heads have a 5.3 percent lower likelihood of tobacco expenditure, Indian households with female heads have a 13.2 percent higher probability of spending on tobacco compared to their Malay cohorts.

As conditional expenditure decreases by RM1.24, unconditional expenditure falls by RM1.61 for every additional year of education possessed by the male household head. In response, although education does not affect the tobacco purchasing decisions of households headed by women, the unconditional level of expenditure decreases by RM0.79 for every additional year of education acquired by the female household head. The marginal effects of conditional and unconditional expenditure by gender of household head show that an additional RM1000 in income increases expenditure of tobacco by RM14.02 and RM5.30, respectively, among households headed by men and RM24.81 and RM6.22, respectively, among households with women as heads.

For every one person increase in the size of households headed by a man, the conditional expenditure decreases by RM0.80 and the unconditional level of tobacco expenditure falls by RM0.74. However, for every additional member in a household headed by a woman, unconditional tobacco expenditure increases by RM1.25. This result suggests that household size has a negative effect on the tobacco expenditure of male household heads but a positive effect on the tobacco expenditure of female household heads.

The marginal effects of age suggest a statistically significant decrease in the conditional (RM10.74) and unconditional (RM7.00) levels of expenditure among male household heads. Of male-headed households that purchase tobacco products, Chinese households spend significantly more (RM12.19) than those of other races (RM12.14). For tobacco users, households with younger (between 15 and 30 years old) male household heads spend significantly less

(RM14.55), whereas retirees (above 57 years old) spend significantly more (RM11.23) than their middle-age (between 31 and 56 year old) cohorts. Other factors such as holding a white-collar occupation (RM6.07), being located in an urban environment (RM2.33), being in the younger age group (RM5.85), or being of Chinese (RM6.20), Indian (RM6.39) or other (RM5.84) heritage all contribute to lowering the unconditional level of expenditure among male household heads. However, male-headed households in the retiree age group have significantly higher (RM4.51) unconditional expenditure levels compared to their middle age counterparts.

Finally, among households with female heads who indulge in cigarette smoking, those of Indian and other ethnicities spend RM24.08 and RM14.95 less, respectively, compared to their Malay equivalents.

V. Concluding Remarks

Overall, the results of the present study suggest that education has a significant impact in reducing the likelihood of smoking among households in Malaysia. This is consistently true according to results from the pooled sample as well as the segmented samples by ethnicity and gender. In fact, an additional year of education possessed by the household head, irrespective of ethnic or gender group, decreases the probability of smoking by approximately 1.5 percent. However, among tobacco purchasing households, the negative effect of an additional year of education seems to be higher among the Chinese (RM3.73) than the Malay (RM0.91) households. In addition, education might play a significant role in decreasing conditional tobacco expenditure, particularly within households headed by men.

The results of the study also suggest that age has a statistically significant impact on lowering the probability and expenditure levels of tobacco purchases across various races. In fact, for every 10-year increase in age of the household head, conditional level of cigarette expenditure of Chinese households is lower in percentage terms compared to Malay (by 90 percent) and Indian/other (by 280 percent) households. Similarly, unconditional tobacco expenditure of Chinese households is lower in percentage terms compared to Malay (by 45 percent) and Indian/other (by 174 percent) households for each decade increase in age of the household head. A likely rationalization for this phenomenon is that older Chinese households might be more receptive towards altering their tobacco usage habits as compared to the other races.

Occupation of the household head as well as location of residence also have significant effects on the probability of smoking across the different races, especially among male household heads. In addition, households of Malay or Chinese descent with higher levels of income or in the retiree age group spend significantly more in terms of conditional and unconditional tobacco expenditure.

The explanatory variables that did not appear statistically significant merit some discussion. For example, there were few significant results obtained in the

case of female household heads. One possible explanation is the relatively low sample of female household heads (16 percent) compared to male household heads. As such, some of the typical effects might have been encapsulated by the latter group.

The main policy implication of our findings is that additional years of education can indeed reduce both the likelihood of smoking and the amount spent on tobacco products. Based on this, the Malaysian Government should further enhance programs that would encourage Malaysians to pursue further education or schooling. Recent announcements that education is now to be free in Malaysia because of the abolishment of school fees and the provision of free textbooks to all high school and elementary school children in the country should have positive external effects on the long-term health of its citizens. Other suggested measures to decrease the likelihood of smoking might include targeting education and smoking cessation programs toward the younger generation, households with blue-collar occupations and those living in rural locales, as these socio-demographic characteristics are found to define those who are more likely to indulge in smoking activities.

Steps could also be undertaken to reduce the spending of existing smokers. Based on our findings, anti-smoking programs aimed at curtailing current smoking and tobacco usage could be directed towards the younger, less educated, urban Malay or rural Chinese communities, and households with retired Malay or Chinese household heads. Besides, because cigarette expenditure increases in tandem with incomes of smokers, further increases in cigarette taxes could be justifiable to discourage consumption as well as to raise tax revenues.

Our study represents one of the first attempts at definitively and econometrically determining the effect of education on household tobacco expenditure in Malaysia. Future studies should replicate our analysis using individual tobacco expenditure or consumption data and also with longitudinal panel data to assess the robustness of our findings and the definitive reasons for differences in the effects for ethnic and/or gender groups. Longitudinal studies could also focus on the analysis and assessment of the effectiveness of anti-smoking campaigns that have been implemented in Malaysia.

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