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FERTILITY DECLINE IN TAIWAN, SINGAPORE AND HONG KONG:
TESTING DEMOGRAPHIC TRANSITION THEORY

by
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Fertility Decline in Taiwan, Singapore and Hong Kong:

Testing Demographic Transition Theory

by

Hung-Ling Chou

Chapter 1

INTRODUCTION

Classical demographic transition theory interprets socioeconomic development as the major factor responsible for fertility decline as evidenced by the western and northern European countries in the nineteenth century. It is often used as a research framework by students of sociology, demography and economics to study population change. However, different conclusions resulted from empirical data of both developing and developed nations. The purpose of this research is to review fertility trends over time in Taiwan, Singapore and Hong Kong. These three countries experienced remarkable declines in fertility since 1960s. And they have experienced rapid urbanization and industrialization. Perhaps they may provide a unique contemporary setting for research on socioeconomic and psychological factors underlying the stage of fertility decline. The objective is to see whether their models of fertility transition confirm or reject the proposition of classical demographic transition theory.

This thesis starts with a discussion of the importance of the research area. It then proceeds to the literature review of related research. Chapter three concentrates on research design and hypothesis testing. The fourth chapter discusses the analysis and interpretation of data. The final

chapter discusses the findings and conclusions.

Importance of problem

Taiwan, Singapore and Hong Kong are relatively small in land area, and are densely population nations. Each has experienced rapid economic growth, according to economists, every percent of population growth requires a three or four percent growth in the gross national product (Weller and Bouvier, 1981:42). Therefore, it is important for these countries to effectively control their population growth. Hopefully, results from this study will contribute to the formulation of policy. Thus, these nations may be able to continuously and efficiently reduce their population growth and fully take advantage of economic growth to raise the standard of living. At the same time, the full documentation and understanding of their transitions may test the applicability of transition theory concepts to the developing countries of Asia and perhaps the world.

Chapter 2

LITERATURE REVIEW

In this chapter different perspectives are reviewed in order to interpret population change, particularly the Malthusian model and transition theory. Detailed interpretations for how and why fertility and mortality rates declined will be emphasized.

Malthus (1836) assumes if there are no 'checks', population growth will push the human race to its finite limits, because of food and resource shortage. In the long run he interprets food supply increases as an arithmetic progression, i.e., 1,2,3,4,---. But population growth increases at a geometric progression, i.e., 1,2,4,8,---. According to Malthus, there are two kinds of checks. 'Preventive' checks lowers the birth rate and includes the postponement of marriage and moral restraint. The other is 'positive' checks which increase the death rate and includes war, famine and disease. Malthus doubts the ability of human beings to apply moral restraint but also views other types of preventive checks as unacceptable, because they are immoral (e.g., abortion and contraception). His crucial assumption is that the preventive checks operate effectively only with the coercive threat of misery. Therefore, positive checks are the only means to limit future population growth. But in fact, according to historical facts or today's situation we understand population growth does not lead human kind to its limit. Agriculture innovation can increase food supplies for a growing population. At the same time, stabilizing population growth is not brought about by increased mortality, but by fertility declining as people voluntarily adopt contraception.

Transition theory was originally presented by Thompson (1929) and has been modified and expanded by both sociologists and demographers since its first appearance in 1929 (David, 1949; Notestein, 1953; Cowgill, 1963; Thomlinson, 1965; Wrong, 1967; Matras, 1973). According to transition theory the growth of world population is mainly determined by two factors, fertility and mortality. Transition theory demonstrates the model of population change according to European demographic patterns of the nineteenth century. It does not accord with Malthusian ideas. Transition theory is characterized by three stages of fertility and mortality level in a society; the industrially developed countries experienced a lowering in their fertility and mortality rates, and this transition parallels the fundamental economic and social change of development or modernization. The modernization includes industrialization and urbanization. Industrialization denotes an increase in the proportion of the population engaged in industrial occupations and a diminution of the agricultural labor force. As to urbanization, it represents the percentage of population living in urban areas and the life style and value system associated with it. Transition theorists propose a causal sequence that modernization reduces fertility.

The first stage of transition theory is that of high growth potential. Before the transition begins, a Malthusian equilibrium of uncontrolled fertility within marriage coupled with both high rates of fertility and mortality prevail. Little natural increase takes place. A population balance results from fertility being close to the biological limit and very high mortality. High growth occurs in the second stage when mortality falls sharply, but fertility does not decline coincidentally with mortality.

The difference between fertility and mortality rates produces a high rate of natural increase. The third stage is called controlled decline of fertility which removes the pressure of the second stage. Thus low rates of fertility combined with a low/controlled rate of mortality to produce a manageable and low rate of natural increase.

In the first stage, the high rates of mortality are taken as inevitable. The reasons were war, economic difficulties, crop failures, epidemics, and a lack of public health or medical means of controlling death. Under this situation of high rates of mortality, high rates of fertility are required for survival (Scrimshaw, 1978). Two existing hypotheses concern this viewpoint. They are closely related and are frequently discussed with little distinction between them. One is the child replacement hypothesis, which states that parents try to replace children who die. The other is the child survival hypothesis, which states that couples aim to produce enough children to ensure the survival of some intended number to adulthood. Parents seek to guarantee that one son will survive to support them in their old age. So most families have high fertility rates. At the same time, pre-urban and pre-industrial societies are characterized by powerful pronatalist norms that are often effectively enforced by institutionalized societal sanctions which result in fertility rates changing slowly. This also occurs in the second stage when fertility rates do not decline with the reduction of mortality rates. Urbanizing, industrializing peoples are still under the control of traditional social institutions.

As to the reasons for mortality decline, there is some debate whether improvements in the popular level of living, particularly in diet and shelter, have been more important than are better sanitation, and

preventive medicine. Coale's (1973) evidence strongly supports improvements in sanitation, public health measures, and medicine as the more important factors. Preston (1975) fits cross-sectional curves in 1930 and in 1960 to the relation between expectation of life at birth and price-adjusted per capita income in the various countries of the world to find that life expectancy associated with a given per capita income in 1960 is about ten years greater than the average duration of life associated with the same per capita income in 1930. Hence, he estimates that the increase in life expectancy associated with the raise in world per capita income between 1930 and 1960 will be less than two years.

Orubuloye and Caldwell (1975) examined mortality in two villages in Nigeria. Their data show infant mortality in the village without modern health facilities is more than twice as high as the other. It appears that a population applies technology controlling mortality as it develops socioeconomically. According to them, introducing modern medicine and public sanitation result in declining mortality rates. Also societies develop agricultural expertise and sophistication, involving changes from extensive to intensive methods of production. Improving agricultural productivity results in people being better able to feed existing and future population. In addition, improvement in transportation stimulates commerce and handicraft production, which contributes to overall development. Under these conditions of food surpluses and better nutrition and health, mortality rates declined during the late eighteenth and the entire nineteenth century in Europe. A population balance was achieved in the third stage. Transition theory says relatively little about the inter-relationship between population change and industrial development. It never explicitly posits how demographic factors set off the sequence of

urbanization and industrialization. Does industrialization set off demographic shifts or vice versa? Cochran and O'Kane (1977) suggest that population growth and population density are crucial to initiating industrialization. From this point, it is interpreted that because of vast natural increase in population size and density, the society expands towards the maximum of existing food, economic and social resources. Population quality provides the impetus for initiating the industrialization sequence. The economies of scale, increased division of labor and in producing more abundance than in the pre-industrial era.

In the meantime, the growing density of population in limited land areas necessitates the growth of cities. Rapid urbanization accentuates partly because urban industry needs a large labor force for expansion of manufacturing and also due to the innovation in urban industry. Here it provides an important organizing framework for viewing the aggregate relationship between demographic change and socioeconomic modernization and applies high levels of social and economic development that will eventually have an important downward effect upon fertility rates. In this situation people begin widespread use of modern contraceptives to control their fertility.

Davis and Blake (1956) also sustain that natural increase of population and the reorganization from an agricultural to an industrial economy are the basic independent variables to explain demographic change in industrialized countries. Davis (1963) intends to explain the movement of fertility after a sustained mortality decline in the context of industrialization. His basic proposition is as infant mortality declines, there is an increasing recognition that large numbers of children will be a disadvantage.

Davis claims the "status" value of large families declines. Also the

development of institutionalized forms of economic support in older ages such as pension schemes, insurance policies and saving accounts rather than the traditional support by the family of the elderly, reduce the advantages to be gained from having a large number of children. He states that when faced with persistent high rates of natural increase resulting from past success in controlling mortality, families tend to use every means possible to limit their fertility. The means of demographic responses include celibacy, the rise of age at marriage (or postponed marriage), rural/urban migration, external/international migration, the use of contraceptive, abortion and sterilization. But according to Friedlander (1969:369), "since demographic change is the outcome of demographic responses of people, and these responses should include both vital and migratory movement, so a realistic analysis must be in terms of all four demographic components, i.e., fertility, mortality, rural/urban migration and international migration." He implies Sweden experienced transition as the aspects of fairly early reduction in rural birth rates, fairly substantial outwards external migration, but only relatively small scale and rather slow urbanization. But according to the economic model's viewpoints, it assumes childbearing as a type of utility maximization where preference for children are balanced against available resources and incurred costs.

In primitive societies expenditures of money and time on children are limited and children begin to work at an early age and before long are contributing equal or more to the family than they consume, which is not the case in industrialized society. Industrial and urban life modify the role of the family in production, consumption, education and recreation. The economic value of children is lowered by the growth of widespread compulsory education, which removes children from the labor force. Children are viewed as expensive to raise and educate.

Comparatively, in urban areas, nearly everything must be purchased in regards to feeding and clothing a family, and children are not able to be productive as they might be in rural agricultural areas. Also, the necessity of educating children if they are to succeed in the urban milieu drain to some degree the economic resource of the family. At the same time, with urbanization grows the importance of social relationship and institutions not based on kinship, increases secularization of life, and shift from normative to functional integration. The nuclear family becomes the basic family unit.

Lorimer (1954) shows the declining importance of kinship structure that accompanies development has often been accorded a special theoretical position in the explanation of fertility decline. Cowgill (1963) includes the rise of the nuclear family and the age structure of the population as explanatory factors. Another condition is urbanization tends to foster a more highly skilled and better educated labor force, which tends to make the laboring class more similar to the upper class. So urban women are less restricted by traditional sex roles and more often are employed outside the home (Notestein and Stix, 1940:148).

Hill, et al., (1971) regard the attitudes with which husband and wife approach one another in making decisions has been viewed as a key determinant of fertility. Rosen (1971) analyzes industrialization and how it operates through education, increased work opportunities and the nature of work to change female attitudes toward themselves and in turn influences family structure as indexed by participation in family decision. These variables are linked together in a way which operates to reduce family size preference and fertility. Rosen states that the new planning values allow the couples to better assess their family size goals and then find the means to attain these goals. So the new aspirations, the changes in function of the family and new

perceptions of the 'costs' and 'benefits' of child are seen as the necessary and almost incidental consequences of the developmental changes which lead to demand for fewer children. Therefore, the reduction of fertility only occurs after the traditional social and economic institutions change sufficiently.

Although it is widely agreed that socioeconomic development is somewhat responsible for fertility decline there are other explanations. Carr-Saunders (1936) tends to stress the increasing availability of modern contraceptive devices that accompanies development. But some demographers claim that family planning programs have merely speeded a fertility reduction in some situations in which a decline was already under way. Freedman (1979) assumes the concept and means of family limitations have an additional independent effect, once motivation is present. Easterlin (1976) assumes the adjustment of population to the farming opportunities in a given area is substantially accompanied by reduction of fertility. Moreover, this decrease in fertility is entirely a matter of individual voluntary behavior. Rosen (1971) also studied the relationship among industrialization, social structural factors, husband-wife decision making/social psychological variables and fertility. He found that modern-commercial life produces special motivational constraints on marriage and procreation.

Willis (1982) assumes the interaction of stable parental preferences for children and improvements in the technological productivity of investment in human and physical capital cause changes in the patterns of life-cycle production and consumption and in the direction on magnitude of inter-generational transfers. These changes tend to reduce desired fertility. Beshers (1967) claims that with increased mobility and the expansion of

opportunities accompanying the process of urbanization and industrialization, people tend to become less fatalistic and more oriented toward planning their lives with regard to distant future goals. Therefore, fertility is regulated. Knodel (1979) regards fertility decline as the result of an 'adjustment' process utilizing well established, pre-existing forms of behavior. Carlsson (1966) rejects the 'innovation' perspective. His assertion is that birth control is widely practised prior to the beginning of the modern fertility transition. It is employed by couples to adjust their fertility to a new set of structural and motivated forces. He emphasizes how the pressure of land scarcity makes couples feel and determine their fertility. He also claims that western European fertility dropped long before the modern contraceptive methods or safe medical abortion were available. Europeans long knew and used delayed marriage, abstinence and coitus interruptus, etc.

Additionally, some demographers postulate that mortality decline itself causes fertility decline (Freedman, 1963; Coale, 1969). At the same time, Graff (1979) states that some of the failing of transition theory includes the role of education. If a broad consensus does exist it revolves around education or literacy which stands as its proxy in most historical-demographic studies and in much contemporary research of less developed areas. Also Bogue (1969) includes in his elaborate consideration the educational impact on fertility, both recent U.S. Census Bureau data and international comparisons, concluding from surveys of both that throughout the world there seems to be a strong inverse correlation between the amount of educational attainment and the level of fertility.

Generalizing from above, there is an interrelated nexus of social, economic and psychological changes that accompany socioeconomic development and makes having large families less desirable. Knodel et al., (1979)

claims there is a broad inverse relationship between the degree of development and the level of fertility rates. He says fertility decline takes place under a wide variety of social, economic and demographic conditions, but it is not a pre-condition and increase in the practice of family limitation influences the decline of marital fertility. Teitelbaum (1975) claims that when transition theory is substantially modified and additional causal variables including cultural factors are introduced, Latin America can achieve a similar moderate level of success. This is because in most countries the data show subnational regional clusters which tend to correspond more to cultural and linguistic groups than to socioeconomic variables. Staff and associates of the Office of Population Research at Princeton proceeded with the most intensive studies examining the more specific and explanatory propositions of transition theory. They indicate cultural and ethnic factors should be included, as well as poverty and economic inequality.

Freedman (1978) shows some less advanced areas begin their fertility declines before more advanced areas. Also Teitelbaum claims that transition theory only offers partial explanation of European trends because certain socioeconomic factors are associated with, not necessarily causes of, the demographic changes. In other countries these relationships are not apparent at all. Concerning this point, the Princeton Revision model also denies a direct causal relationship between economic modernization and fertility decline. Kelly and Cutright (1980) test transition theory by using cultural, geographic, demographic and family planning variables, in addition to a measure of socioeconomic modernization. Caldwell (1982) claims there is a need for a unitary theory of social, economic and demographic change because of the failure of theories of social and economic change to explain the onset of fertility transition. All of the above inter-

pretations are far from clear in understanding the causal structure of fertility and of changes in fertility rates. There is a lack of agreement on how many of the proposed associations might actually fit together causally and interpretively.

Peck and Kuhn (1977) indicated demographic transition theory failed to show plausible causes of fertility decline and a failure to allow for predictive precision regarding the onset of fertility decline. Cochran (1977) also mentioned that the highly developed nations have an equilibrium of fertility and mortality rates in the third stage. The actual situation is not like this. Since World War II, baby booms in many western nations created fertility rate increases which was scarcely explained by the theory's last stage. And the present situation of approaching zero population growth and possibly even negative growth in a number of European nations, in Japan, and in the United States seriously challenges the equilibrium model of stage III. So, transition theory leaves too many substantive questions unanswered. As to the conditions of applying transition theory to the present developing countries, Alexandersson (1981) assumed the theory was inappropriate for those countries in which mortality and fertility started at higher levels and mortality had declined much more sharply.

Chaudhry (1982) examines India's demographic change within the framework of the theory of demographic transition. He concludes only at a very broad level of generality that social development rather than industrial and agricultural development better explained the fertility decline in India from 1961 to 1971. Freedman (1979) says there are multiple pathways to fertility decline for developing countries. Motivation for fertility decline can arise from (a) subsets of objective changes much less than those that characterized the west, (b) new ideas and aspirations arising from worldwide communications networks. Mosher (1980) assumes that an application of transition theory

should begin only when the following conditions are satisfied. First, is sustained natural increase. Sustained natural increase occurs in the context of a period of declining death rates and lagging birth rates. Second, is reductions in absorptive/employment capacity of agriculture. It results in surplus labour in agriculture. Third, is use of demographic response. Demographic response is a kind of change in demographic behavior that limits or reduces fertility and/or population growth. The reasons which provoke people to adopt the means of demographic responses are sustained natural increase and surplus agricultural labor. Coale (1976) indicates there is no evidence to show these three pre-conditions for declining fertility are necessary but they are sufficient. Also Teitelbaum indicates in some respects there are quite different circumstances in developing countries. For instance, the declines in mortality of European countries were gradual, and were gradually related to the social and economic forces of development and industrialization. But for developing countries, their fast mortality decline including general and infant mortality is due to the import of disease control technology, such as DDT, modern, and public health knowledge and aid from western developed countries. Fertility in most developing countries today is much higher than pre-transition Europe. Moreover, substantial international migration is no longer a potential outlet for excessive population growth due to political and economic realities.

Population growth can be reduced only by raising mortality, promoting migration, or lowering fertility. The first one is unacceptable. If out-migration can work, it may serve as an escape valve relieving the pressure for fertility decline. Also it seems to be preferred over marital fertility control. Migration can increase or decrease the size/component of the population faster than fertility change; at the family level, avoiding a birth may merely prevent the situation of a family from deteriorating but the

migration of one or more members can bring economic advantages to the family. The out-migration of adolescents requires changes in their behavior, rather than in the behavior of their parents; and migration does not require a re-definition of traditional sex and marital roles, including communication regarding sexual matters, as does marital fertility control. At the same time, Teitelbaum also indicates population growth in most developing countries is literally extraordinary. It is quite unprecedented in human experience, popularly termed 'population explosion'. Also modern developing countries have 'younger' age structures than Europe had, and therefore a far greater potential for further growth. Rapid natural increase of developing countries presents great difficulties to the provision of comparable opportunities for occupational and spatial rural to urban mobility. Also, with school-age cohorts doubling in only two or three decades many developing countries are unable to expand educational facilities at rapid enough rates to provide educational opportunities for a growing population. But some differences favor developing countries. Their social and economic development has been more rapid completion of demographic transition as well. Also improved contraceptive technology and safe abortion techniques have been developed, offer more frequent and effective practice, with consequently greater demographic effects.

Fertility in developing countries may be reduced due to changes both in marriage practices and fertility within marriage, unlike the European experience which was due to late marriage and non-marriage. And the demonstration effect of the European transition has provided modern allowance for the smaller family norm and evidence that its achievement is feasible, and many factors have accelerated the process of cultural and intellectual discussion.

Leaders of developing countries are better aware of the fundamental importance of rapid population growth as a variable in development. Many developing countries now have economists and planners able to foresee future problems. They understand developing countries need to lower fertility in order to foster socioeconomic development, rather than waiting for economic development to bring about reduction in fertility. Most modern developing countries have the administrative and technological infrastructure, i.e., central planning and administration, wide spread publication in multiple language, improved transportation, telecommunication, radio and TV, and a postal system to enable them to penetrate subnational linguistic/cultural barriers. Developing countries call upon substantial outside/international resources and experience for assistance.

It has already been mentioned that some developing countries have experienced more rapid fertility decline than in nineteenth century Europe. Additionally, will moderate levels of development to which many developing countries can realistically aspire in the medium term future be sufficient to establish the pre-conditions for natural fertility decline. If such declines do occur, will they occur soon enough at a pace rapid enough to compensate for the sharply increased pace of mortality decline and higher initial fertility levels of these countries as compared with transitional Europe.

In conclusion, under certain circumstances today's developing countries resemble social and demographic conditions, similar to the massive fertility decline in Europe. Fortunately, quantitative data are available to measure demographic variables and many aspects of socioeconomic structure. The time is ripe for a refining and expanding of the theory to test it and give a more complete explanation to the developing countries' demographic transition.

Chapter 3

METHODOLOGY

The theoretical framework of model design

Sociological explanations for the relationship between modernization and fertility emphasize that increasing modernization (level of urbanization, industrialization, education, and health) creates pressure to reduce fertility. This pressure is a result of declines in mortality and infant mortality which reduces the number of births required to achieve a given number of surviving children. At the same time, modernization breaks down traditional kinship domination and nuclear family decision-making and reproductive goals arise; it also changes traditional sex roles and generate alternatives to early marriage and large families for women. Finally, modernization stimulates aspirations of adults for themselves and their children to participate in the new, achievement-oriented, and socio-economic institutions.

Achievement of these new goals is made easier by small families. This is the traditional form of transition theory which emphasizes the role of national socio-economic development. Both early (Davis, 1955; Freedman, 1963) and recent (Goldscheider, 1971; Coale, 1973; Cutright, Hout and Johnson, 1976) expositions of this theory emphasize structural modernization. But in fact, the process of fertility decline is not adequately described only by a simple development model. Economic development per se will not necessarily reduce fertility, but must be accompanied by other social changes. Coale (1973) and Freedman (1979) note that before marital fertility rates decline, (1) couples must be motivated to balance the advantages and disadvantages of having a child, (2) they must believe that lower fertility will be advantageous and morally proper, and (3) they must have access to and be able to use methods of birth control effectively. Cultural and institutional differences exist within and among countries. Thus, the time necessary for modernization to

affect these three preconditions and thus generate a decline in marital fertility will vary. The revised model (Goldscheider, 1971; Coale, 1973; Cutright, Hout, and Johnson, 1976) has incorporated geographic, cultural and demographic factors, in addition to structural modernization. Kelly and Cutright (1980) assume that the early fertility transitions in northern European nations should reduce southern Europe's fertility below the expected level. This would result from the effects of the diffusion of modernization and birth control practice from North to South.

This research will concentrate on countries in eastern Asia, Taiwan, Singapore and Hong Kong. Singapore is located in South-East Asia, and Taiwan and Hong Kong are in East Asia. There are no significant geographic differences between these countries. Therefore, the geographic component is not a factor in this research. As to the cultural component, Taiwan is composed of 100 percent Chinese and still sustains traditional Chinese culture. The population of Taiwan is composed of Taiwanese Chinese, and Mainland Chinese who moved to Taiwan after 1949 because the Mainland was occupied by communists. Though the majority of people in Taiwan are Taiwanese, they sustain traditional Chinese culture. Because their ancestors also came from Mainland China, they share the same Chinese traditional teaching and thoughts, and use the same characters, as well as communicate with Mainland Chinese without any problem.

In the Chinese animal calendar, 1976 was the 'year of the Dragon', which was regarded as an auspicious time for births. As a result Taiwan experienced its first fertility rate increase since 1958. This is a reflection of cultural influence. The fertility rate increase of 1976 was not apparent in 1964 the previous Dragon Year, on the 12-year cycle. The reason for this is

that in 1964 the practice of contraception was at much lower levels and almost all contraceptive use began after than the desired number of children were born. This example of the year of the Dragon indicates that traditional practices can still have a significant effect on fertility in Taiwan.

According to the 1980 census of Singapore (see Table 1), Chinese still dominate as major ethnic group. Chinese (Mandarin) is one of Singapore's official languages, the other three are: Malay, Tamil and English. From its fertility trend, we can see that in 1976, the year of Dragon, Singapore shows a slight increase in its fertility rates, but not as dramatically as Taiwan's. This situation may be traced to the history of Singapore. After World War II, Singapore was governed by the British Military Administration. When civil rule was restored in 1946, it was detached from the other straits settlements and become a separate crown colony. A new constitution in 1955 introduced some measure of self-government, and in 1959 the state achieved complete internal self-government. The federation of Malaysia came into being in September 1963 with Singapore as a constituent state. On August 9, 1965 the association was ended and was 'separated' from Malaysia and become a fully independent and sovereign nation. At the same time, Singapore is the largest port in South-East Asia and the World's second busiest port, which is used by more than 300 major shipping lines (The Europa Yearbook, 1982, Vol. II). It handles most of Peninsular Malaysia's external trade and is the world center of the rubber and tin markets. The labour shortage also made it necessary for Singapore to import workers from other Asian countries (totalling over 100,000 by the end of 1979).

Singapore is influenced by traditional Chinese culture, however due to their frequent contact with other foreign countries, especially the western nations, the influence of the Chinese culture could be decreasing. Hong Kong demonstrates a similar case, over 98 percent of its population is Chinese,

TABLE 1
Census of Singapore : 1980

Chinese	1,856,200
Malays	351,500
Indians	154,500
Others	51,600
Total	2,413,900

Source: Europa Yearbook, 1982, Vol. II.

but it was ceded to Britain by China in 1842. Therefore, unlike Singapore and Taiwan, Hong Kong had a greater opportunity to be influenced by western nations. In tracing the three countries' contact time with western nations in order to assess the influence of tradition which results in differential fertility behavior, it was found that Hong Kong experienced low fertility rates earlier than Singapore and Taiwan. Because of the cultural differences between these three countries a precise measure cannot be used to scale the cultural differences. There are only some rough informations available for reference (see Table 2). Therefore, this variable must be abandoned in the forthcoming model. The component of contraceptive application has been added to the model, because the promotion of a family planning project is an important factor in the influence of fertility decline in developing countries. In this study, a model of the macro-level determinants of fertility was specified and hypothesized that demographic and contraceptive application factors, other than modernization, influence fertility.

This study consists of a cross-national-longitudinal analysis of Taiwan, Singapore and Hong Kong. Both hypothesis and data refer to national-level aggregation. Previous cross-sectional studies have used independent variables measured in the same year as the dependent variable, thus assuming no time lag for causal impact (Beaver, 1975). Data from only one point in time was used so that change over time was ignored. In order to compensate for these two deficiencies, the following equation is used to express the form of the model employed in this research to estimate the effect of several independent variables on cross-national differences in fertility. There will be two time periods (1965-1970) and (1975-1980) to be tested. At the same time, modernization indicators are measured five to ten years before the fertility variable. The theory states a lag between modernization and decline in fertility, and prior work does not specify a precise lag period i , nor is it

TABLE 2
Measurement of Modernization Difference

	a Live Stock- Cattle (thousand head)	b External Trade Value of Export (million U.S. dollars)	c Government Revenue (million U.S. dollars)	d The Number of English Daily Press
Taiwan	9,028	1,050	530	2**
Singapore	10*	1,000	500	3**
Hong Kong	16	2,178	340	2**

* data for 1968.

** data for 1970.

The remaining data are for 1969.

Source: a,b,c, from Statistical Yearbook for Asia and the Pacific, 1970.

d, from the Europa Yearbook, 1972.

known that only one lag is involved. Beaver (1975) used 7.5 years as the lag period in his study of Latin America, and Kelly and Cutright (1980) used 10 to 15 years before fertility as the lag range. Five to ten years is used in this research because of the ease for data consistency among Taiwan, Singapore and Hong Kong. This rough assumption may effect the reliability of research, because the actual effect may be earlier or later.

$$\begin{aligned} \text{Fertility (t)} = & B_0 + B_1 \text{ urbanization (t-1)} \\ & + B_2 \text{ education (t-1)} \\ & + B_3 \text{ economic standard (t-1)} \\ & + B_4 \text{ communication (t-1)} \\ & + B_5 \text{ health (t-1)} \\ & + B_6 \text{ demographic factors (t-1)} \\ & + B_7 \text{ contraceptive application (t)} \end{aligned}$$

t denotes time of (1965-1970) or (1975-1980).

t-1 represents some prior time before (1965-1970) or (1975-1980).

B are regression coefficients..

Measurement of the dependent variable

The dependent variable is the age-sex standardized birth rate. Crude birth rate (the number of births in a year per 1,000 midyear population) is affected by variations in demographic composition. The effect of differences in the age-sex composition of the population can be eliminated by using age-specific fertility rates (age 15-19 45-49) of the United States as a standard.

The calculation of the age-sex standardized birth rate is illustrated

for Hong Kong in 1979 as an example of the procedure of standardization of the indirect method. The age-specific fertility rate of the United States in 1979 was used as the standard (see Table 3). The reason of choosing the United States as a standard is not based on a theoretical assumption (in fact, there is no specific theoretical rule to choose a standard population). It is chosen because a developed country has more reliable and consistent data of age-specific fertility rates by age of mother (15-49) than the developing countries.

The problem of studies of this nature is the lack of consistent data among Taiwan, Singapore and Hong Kong. The data for female population are only available from 1967 to 1980 in Singapore; from 1950 to 1968, 1970 to 1978 in Taiwan; and from 1963 to 1976, 1978, and 1979 in Hong Kong. In order to compensate for these deficiencies, one must assume that the data for female population (y_i , dependent variable) are linearly correlated with year (x_i , independent variable). Thus, the following equation can be used to estimate female population of the years lacking data:

$$y_i = B_0 + B_1x_i + e,$$

B_0 is the intercept.

B_1 is the slope of the regression.

e is the error term.

This regression model of female population ($\hat{u}_{y|x}$) is the mean of the distribution of female population for a given year (x_i). The only problem with this assumption is that if the real data distribution of female population are not linear with year, then their residuals ($y_i - \hat{u}_{y|x}$) will be very large and the assumed linear model is not adequate. The data have been plotted ($y_i - \hat{u}_{y|x}$) to check whether the assumption made in a regression model was satisfied in the data. The plot y_i against $\hat{u}_{y|x}$ gives a rough check on constancy of residual variances as y changes. The most common departure is finding that the $y_i - \hat{u}_{y|x}$ values increase with y , suggesting that σ^2 increases

TABLE 3
Standardization Procedure of the Indirect Method

Age of mother (year)	Age-specific fertility rate, the United States (1979), F_a	Female population, Hong Kong (1979), P_a^f
15-19*	54.5	285,400
20-24	115.5	262,200
25-29	115.5	207,500
30-34	61.8	148,800
35-39	19.4	92,900
40-44	3.9	117,400
45-49	0.2	123,300
<hr/>		
(1) $\sum P_a^f F_a$, expected births, Hong Kong (1979)81,285		
(2) b, registered birth, Hong Kong (1979)82,157		
(3) standardizing ratio= $\frac{b}{\sum P_a^f F_a} = \frac{82,157}{81,285} = 1.01$		
(4) age-sex standardized birth rate, Hong Kong (1979) =		
(standardizing ratio) x (crude birth rate, the United States, 1979)		
= (1.01) x (15.9) = 16.01		

Note:

* includes birth to women under 15 years of age.

with y . Possible remedies are a weighted stabilizing transformation for y if this does not distort linearity (Snedecor and Cochran, 1980:349-350). After plotting by the means of SAS (Statistical Analysis System) programming, the distribution shows no pattern, which means the assumed linear model is possibly adequate.

This estimation procedure reveals partial limitation of this research, which may harm the reliability of the research, especially for Singapore and Hong Kong. This is a result of estimating the female population of 1950-1960 according to population trends of recent years (1966-1980) in Singapore and Hong Kong. The growth of a population is influenced by two factors: natural increase and migration. Migration was the major factor contributing to the growth of Hong Kong and Singapore in the early 1950s. It is reported in the 1950s that natural increase accounted for about 60 percent of the population increase (The Population of Hong Kong, the Committee for International Coordination of National Research in Demography, 1974:18). This estimation may show lower figures than its real situation in the female population of Hong Kong and Singapore.

Measurement of independent variables

The independent variables are either taken directly or calculated from data in the Statistical Yearbook for Asia and the Pacific; the Demographic Yearbook, published by United Nations; and, the Europa Yearbook published by Europa Publications, Inc. The independent variables are described as follows:

1. modernization variables

- a. urbanization: percentage of urban population, or percentage of population in localities of 100,000 or more

b. health

- (1) population per hospital
- (2) life expectancy at birth for males: the expected number of years to be lived by males
- (3) crude death rate: the number of deaths in a year per 1,000 midyear population

c. education

- (1) percentage of population aged 5-19 enrolled in the primary and secondary school
- (2) daily newspaper circulation per 1,000 population

d. economic standard (industrialization): telephone sets in use per 1,000 population

e. communication: domestic mail letter per 1,000 population

2. demographic components

- a. percentage of women marrying aged 15-19
- b. age-specific fertility rate for age group 20-24
- c. infant mortality rate: the number of deaths per 1,000 infants under one year of age in any given calendar year

3. contraceptive application

- a. family planning utility: proportion of women who use contraceptive methods (the countries with family planning utility under 20 are coded 0, family planning utility from 20 to 40 are coded 1, 40 to 60 are coded 2, above 60 are coded 3)
- b. legal abortion rate: legal induced abortion per 1,000 women aged 15-44 (the countries with missing legal abortion rates are coded 0, legal abortion rate under 20 are coded 1, above 20 are coded 2)

Socioeconomic development was measured in terms of five basic sub-components: urbanization, health, education, economic standard, and communication. Each will be measured five to ten years previous to fertility rates, to allow for the assumed lag effect. Urbanization is measured by the percentage of population in localities of 100,000 or more, except for Hong Kong, it is measured by percentage of the population said to be urban, due to lack of consistent data of percentage of population in localities of 100,000 or more. Although there is considerable variance across countries in the definition of urban, Davis (1969:18) concludes that the official data are quite comparable from one place to the next. Fortunately, there are estimates available that attempt to improve on official data since 1950 (Davis, 1969; United Nations, 1970). Population per hospital is assumed as a proxy for life expectancy and development of health resources, instead of the number of hospital per 1,000 population. Most researchers used the number of hospitals per 1,000 population as the indicator of health variable. Then, life expectancy at birth for males and crude death rates will represent the direct measurements of health. The expectation of life at birth proposes as an indicator of child-infant survivorship because it gives greater weight to the deaths of the young, who lose many more years of potential life. An early fall in crude birth rates stems from the combined effect of infant mortality and life expectancy; of increased agricultural productivity and resulting improvements in nutrition; wide-spread sanitation, public health improvements, and rising incomes.

Percent aged 5-19 enrolled in primary and secondary school, and daily newspaper circulation per 1,000 population are used as the measurements of education. The indicator of percent aged 5-19 enrolled in primary and secondary school can be distorted by age structure in much the same way as crude birth and death rates, but probably is a reasonably good index in the long run.

Beside this measurement, daily newspaper circulation per 1,000 population was used to support the representative strength of the education variable. The advantages of the telephone as a measure of industrialization (economic standard) are detailed by Barbera (1973). Kelly and Cutright (1980) state that a telephone indicator has a stronger zero-order relationship to fertility than does Gross National Product per capita (GNP/C). Though GNP/C is a traditional economic indicator, it was not included in this research due to a lack of consistent GNP/C data for each specific year among the three nations. The rise of telephone sets in use per 1,000 population was considered an appropriate measure which reflects change in the economic standard.

The communication component of domestic mail letter per 1,000 population was selected because it is a measure of effective access which is essential to fertility behavior change. The percentage of women marrying at ages 15-19 and age-specific fertility rate in the age group 20-24 are assumed to be important factors that influence marital fertility in developing countries. These two indicators were used to see whether they also play significant roles among Taiwan, Singapore and Hong Kong. The infant mortality rate was assumed to be an important factor in declining fertility in developing countries. Conceptually, it seems likely that a decline in infant mortality will result in a decline in crude birth rates. This would be result of families who adjust their fertility behavior because of the likelihood that an infant will survive a first year of life and into adulthood. Then family planning program utility and legal abortion rate are conceptualized as the intervening simultaneous effect variables which may reduce fertility. This would be a result of the multitude of major social transformations which would weaken the pressures for high fertility as the acceptance of conscious control of fertility gradually strengthen. Therefore these variables are included in

the model.

Hypothesis

The direct and lagged effect of rising urbanization, education, health, economic standard, the measures of modernization, contraceptive application and the decline in the demographic variables are to reduce fertility.

Analytic procedure

A multivariate regression of age-sex standardized birth rates on most of the independent variables of the theoretical system will evaluate the above hypothesis. There will be a cross-national analytic procedure 1, as well as longitudinal analytic procedure 2. Due to the restrictions of inconsistent data as well as experiencing transition stage at different times, only (1965-1970) and (1975-1980) will be included in these analytic procedures. These two time periods are used to estimate independent variables effects of each country on fertility before and after their transition. The restriction lies in the impossibility of obtaining a reasonably long historical series for the great majority of the time periods. This was due to Taiwan withdrawing from the United Nations in 1971. The United Nations Demographic Yearbook and all its related documents exclude Taiwan's information after 1971.

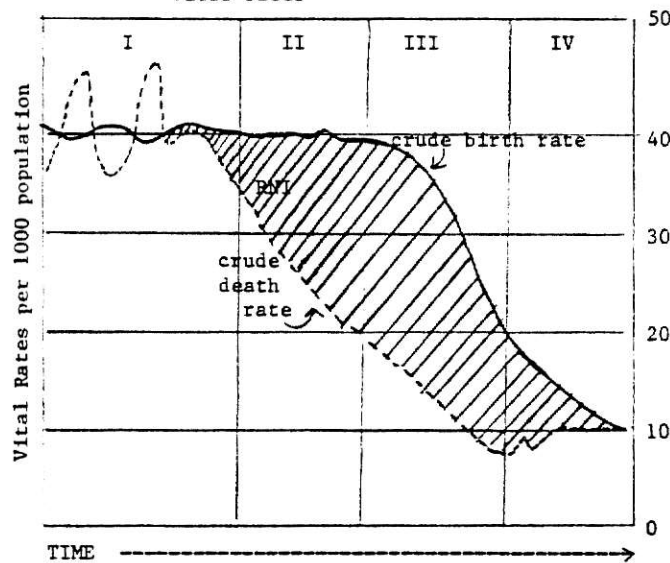
Singapore became independent from Malaysia in 1965, and most of its data before 1965 were included in Malaysia. For Hong Kong, there is little quantitative data available prior to 1960, possibly because of the omission of registrations. Since the number of years each population spends in stage III varies (see Figures 1 and 2), and the birth rate differs among populations before and during the transition, it was assumed that a country which has lowered the crude birth rate/age-sex standardized birth rate by 15 percent

**THIS BOOK
CONTAINS
NUMEROUS PAGES
WITH DIAGRAMS
THAT ARE CROOKED
COMPARED TO THE
REST OF THE
INFORMATION ON
THE PAGE.**

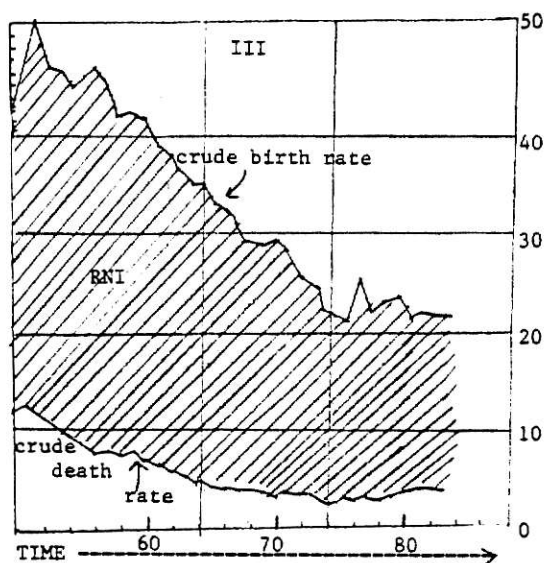
**THIS IS AS
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FIGURE 1
TRANSITION MODEL (I)

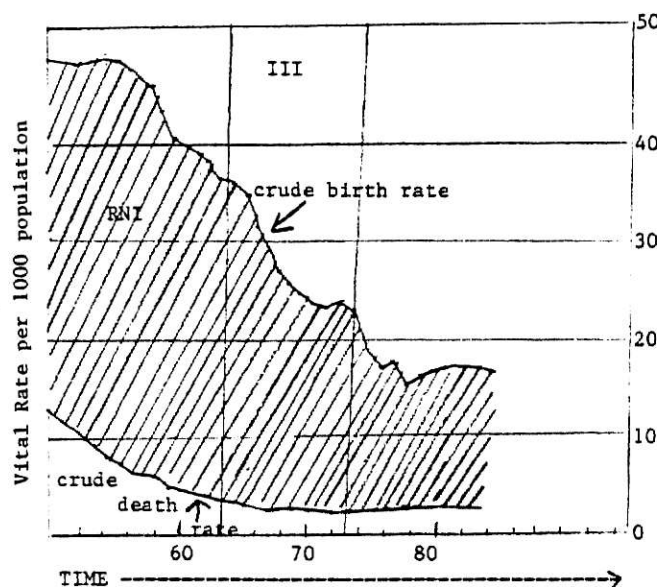
General Model for four stages in the demographic transition from high to low vital rates



Taiwan's Model



Singapore's Model



Hong Kong's Model

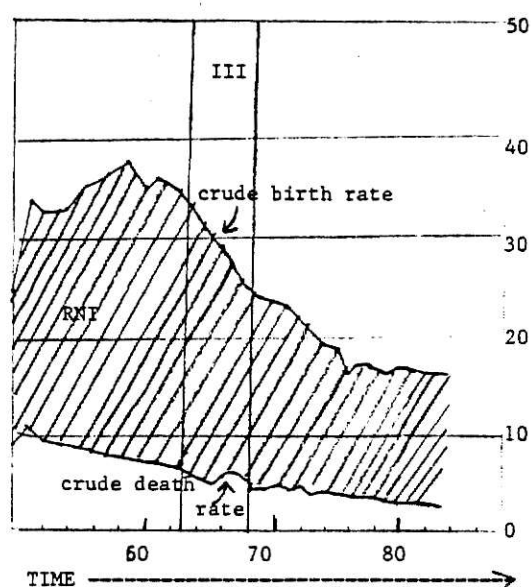
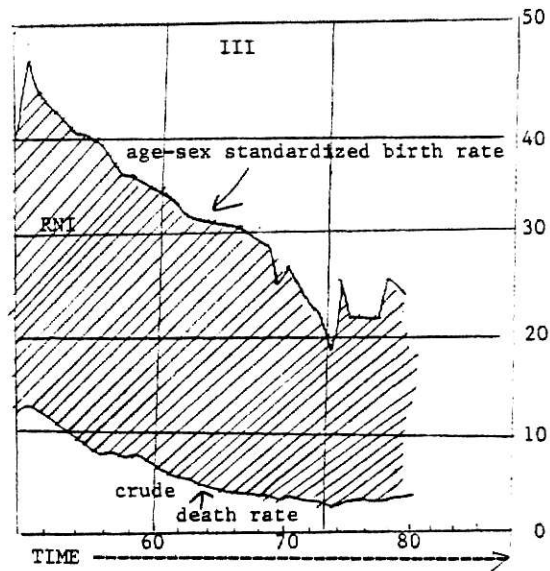
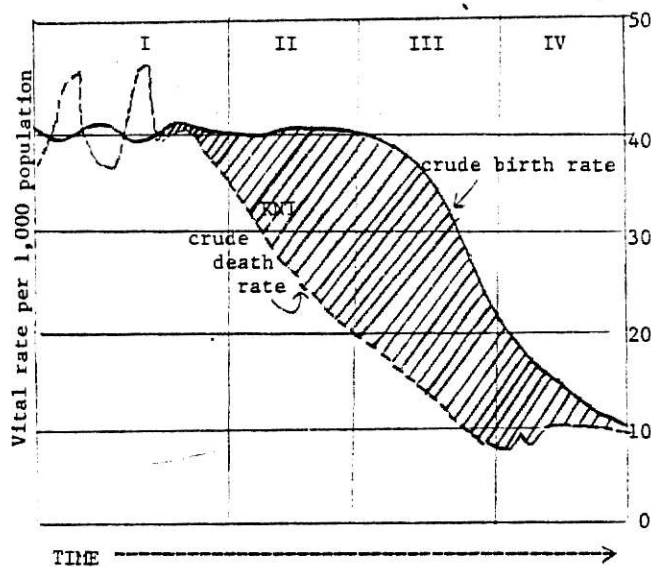


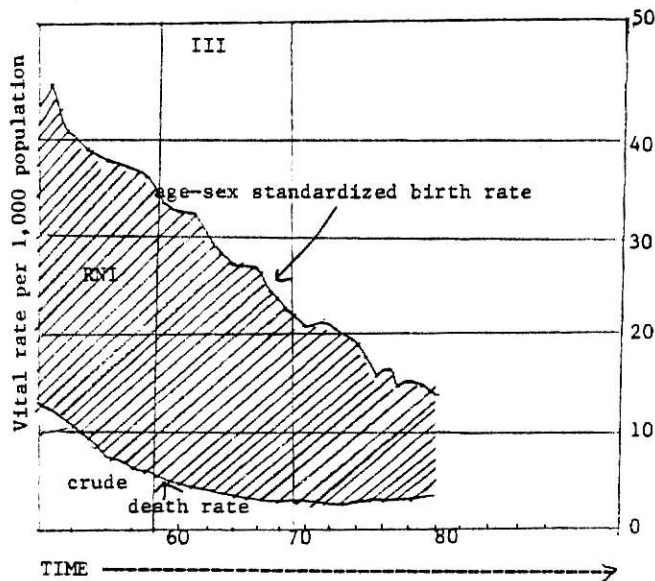
FIGURE 2
TRANSITION MODEL (II)

General Model for four stages in the
demographic transition from high to
low vital rates

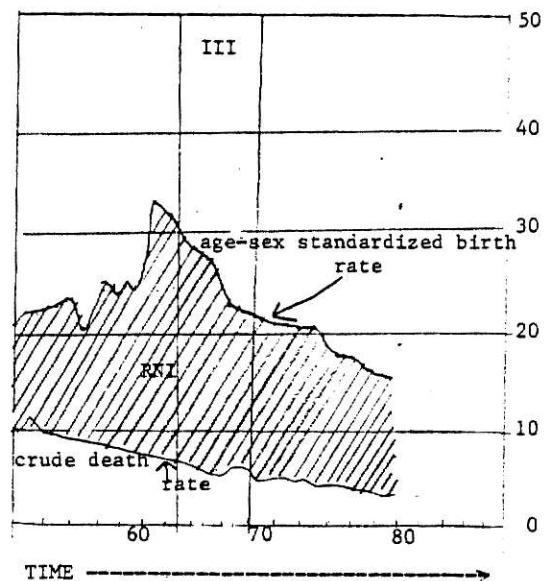
Taiwan's Model



Singapore's Model



Hong Kong's Model



or more from its three-year peak to a level of 35 or less was defined as having begun fertility decline (Beaver, 1976:81). Taiwan, Singapore and Hong Kong have birth rates in the 23-35 range and appear to be moving from stage III toward stage IV since the 1965-1970 period, the beginning of stage III; and the 1975-1980 period, which is the most recent data available for stage IV.

Analytic procedure 1: Cross-national differences in fertility,
1965-1970 and 1975-1980

The premises suggested the need for investigation of the nations both in the historical situation of high fertility immediately before fertility decline and in contemporary situations of high fertility in which indexes of economic and social changes suggested that the family structure and the high fertility system might be under strong pressure. In this section, two equations are used. One is for 1965-1970 period. The other is for 1975-1980 period.

$$\begin{aligned}
 y_t = & B_0 + B_1X_1(t-10) + B_2X_2(t-10) + B_3X_3(t-10) + B_4X_4(t-10) \\
 & + B_5X_5(t-10) + B_6X_6(t-10) + B_7X_7(t-5) + B_8X_8(t-5) \\
 & + B_9X_9(t-10) + B_{10}X_{10}(t-10) + B_{11}X_{11}(t-10) \\
 & + B_{12}X_{12}(t) + B_{13}X_{13}(t)
 \end{aligned}$$

y represents age-sex standardized birth rate.

X_1 represents urbanization.

X_2 represents population per hospital.

X_3 represents life expectancy at birth for males.

X_4 represents crude death rate.

X_5 represents percent of age 5-19 enrolled in primary and secondary school.

X_6 represents daily newspaper circulation per 1,000 population.

X_7 represents telephone sets in use per 1,000 population.

X_8 represents domestic mail letter per 1,000 population.

X_9 represents age-specific fertility rate at age 20-24.

X_{10} represents percent of women marrying at age 15-19.

X_{11} represents infant mortality rate.

X_{12} represents family planning utility.

X_{13} represents legal abortion rate.

t represents either (1965-1970) or (1975-1980).

B represents regression coefficients.

Both equations test the direct, lagged effect of rising urbanization, education, health, economic standard, the measures of modernization, as well as demographic and contraceptive application to reduce the fertility rate. The first equation (1965-1970) tests their effect on the beginning of stage III. The second equation (1975-1980) tests their effect during stage IV. Caldwell (1978) notes fertility behavior in both pre-transitional and post-transitional societies is economically rational within the context of socially determined economic goals and within bounds largely set by biological and psychological factors.

Analytic procedure 2: Longitudinal analysis of fertility,

1950-1959 to 1975-1980

$$Y_{1975-1980} = B_0 + B_1 Y_{1950-1959} + B_i X_i + e$$

$Y_{1975-1980}$ age-sex standardized birth rate in 1975-1980.

$Y_{1950-1959}$ mean of age-sex standardized birth rate from 1950 to 1959.

X_i represents time 1 measures of the independent variables employed in the cross-national analysis above.

e error term.

B regression coefficient.

The mean of the age-sex standardized birth rate between 1950-1959 was used as the base year to estimate determinants of change over the 1950 to 1980 period. A major methodological problem involved in the analysis of change is the dependence of change on initial standing. That is, change is often negatively correlated with time 1 levels, resulting in 'regression effect' (Kelly and Cutright, 1980:322). For instance, the age-sex standardized birth rate of Taiwan in 1960 was 34.8 per 1,000; for Hong Kong, it was 26.2 per 1,000. Taiwan had a higher age-sex standardized birth rate than Hong Kong. In 1965, the age-sex standardized birth rate of Taiwan was 30.5 per 1,000; for Hong Kong, it was 29.3 per 1,000. Taiwan still had a higher age-sex standardized birth rate than Hong Kong. This is possibly because in the initial year 1960, Taiwan had a higher age-sex standardized birth rate. Therefore, Taiwan had a higher age-sex standardized birth rate in the later year. Bohrnstedt (1969) determined that a satisfactory method of measuring change, and eliminating the correlation of change and initial standing, is the residualization of the dependent variable in time 2 in terms of time 1. That is, use the result of the age-sex standardized birth rate of 1980 'minus' the mean of the age-sex standardized birth rate of 1950-1959 to interpret the real change between 1950 and 1980. For example, the age-sex standardized birth rate of Singapore in 1960 was 32.2 per 1,000, and for Hong Kong it was 26.2 per 1,000. In 1968, the age-sex standardized birth rate of Singapore was 23.0 per 1,000; and 23.4 per 1,000 for Hong Kong. For the same number of years, Singapore experiences

more rapid change than Hong Kong. Therefore, the net effect of the other independent variables in the regression will then reflect their relation to change.

Chapter 4

ANALYSIS

The research and subsequent interpretations are based on multiple regression analysis and multiple correlation. Multiple regression analysis is used to measure the existence of a linear relationship in the coefficients between the dependent variable and a number of independent variables by looking at the proportion of variance explained. Each multiple-regression coefficient represents the direct, and amount of change in the dependent variable caused by the change of a standard deviation in the independent variable while holding constant all other independent variables. A simple correlation coefficient indicates the extent of linear relation between a dependent variable and independent variable. The multiple correlation coefficient (or its square, the coefficient of determination) characterizes the closeness of the measured linear relationship. It gives a measure of the general level of a linear relationship between a dependent variable and independent variables. The limitation of multiple regression analysis is that relations between variables are only direct or indirect relative to the variables in the system under consideration and not in any absolute sense. Obviously, one can not control statistically for the effect of all possible extraneous sources of covariation to reveal the true causal relationship between a pair of variables.

Correlation between a dependent variable and independent variables

The correlation matrix shown in Table 4 and 5 show that independent variables are associated with the level of age-sex standardized birth rates, and with change in age-sex standardized birth rates between the 1965-1970 and 1975-1980 periods. Most of the correlations range from moderate to high,

which can be considered as possible explanatory variables for age-sex standardized birth rates or for changes in these levels. There are a number of variables with low coefficients and subsequently a significance level of .10 or greater. These are: population per hospital, daily news circulation per 1,000, school enrollment, domestic mail letter per 1,000, percent of women married aged 15-19, infant mortality rate, and legal abortion rate in the 1965-1970 period, as well as crude death rate, population per hospital, domestic mail letter per 1,000, and family planning utility in the 1975-1980 period. These variables are intercorrelated with other variables which are highly correlated with the age-sex standardized birth rates, such as daily news circulation per 1,000 and telephone sets in use per 1,000 ($r = .99$) in the 1965-1970 period. The correlation coefficient between the age-sex standardized birth rates and telephone sets in use per 1,000 is .74, therefore daily news circulation per 1,000 is removed from the model and would not harm the representation of the multiple regression model, because the telephone sets in use per 1,000 can also represent its effect on age-sex standardized birth rates. Therefore, the variables which have low correlation coefficients with the age-sex standardized birth rates are removed from the multiple regression model in the following analysis.

Cross-national difference in fertility: 1965-1970 and 1975-1980

Tables 6 and 7 show that the most important influence on cross-national differences in the 1965-1970 period and the 1975-1980 period age-sex standardized birth rates was the level of modernization. In the 1965-1970 period analysis, explained variance using only the modernization index was .8403, compared to an R^2 of .8424 when the demographic variables were included; and, compared to an R^2 of .88 when the remaining family planning application variable was included. In the 1975-1980 period analysis, explained variance

TABLE 4

Zero-Order Correlation Matrix:1965-1970 Age-Sex Standardized Birth Rate*

		<u>Pearson Correlation Coefficients</u>													
		Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13
Age-sex standardized(Y)	birth rate	1.00 .00													
Urbanization	(X1)	-.42 .08	1.00 .00												
Crude death rate	(X2)	.86 .01	-.30 .23	1.00 .00											
Life expectancy at birth for males	(X3)	-.73 .01	.40 -.10	-.79 .01	1.00 .00										
Population per hospital	(X4)	-.23 .36	.36 .14	-.18 .47	-.19 .46	1.00 .00									
Telephone sets in use per 1,000	(X5)	-.74 .02	.52 .03	-.59 .01	.36 .14	.58 .01	1.00 .00								
Daily news circulation per 1,000	(X6)	.20 .70	-.24 .33	-.46 .05	-.22 .37	-.14 .59	.99 .01	1.00 .00							
School enrollment	(X7)	.22 .38	-.66 .01	.54 .02	.66 .01	.34 .16	.52 .02	.94 .01	1.00 .00						
Domestic mail letter per 1,000	(X8)	.14 .59	.12 .65	.12 .63	.27 .29	-.65 .01	-.62 .01	-.56 .02	-.44 .07	1.00 .00					
Age-specific fertility rate aged 20-24	(X9)	.45 .06	-.39 .11	.27 .28	.01 .98	.66 .01	-.89 .01	-.55 .02	-.79 .01	.80 .01	1.00 .00				
Percent of women marrying aged 20-24	(X10)	.01 .97	.47 .04	-.26 .30	.32 .17	.03 .90	-.79 .01	-.89 .02	-.71 .01	-.89 .01	.69 .01	1.00 .00			
Infant mortality	(X11)	.12 .62	-.23 .36	.23 .35	.54 .02	.84 .01	.42 .08	.76 .01	.45 .06	-.65 .01	-.63 .01	-.74 .01	1.00 .00		
Family planning utility	(X12)	.68 .01	-.76 .01	.46 .05	-.66 .01	.70 .01	-.12 .64	.42 .08	-.10 .69	.45 .06	.23 .36	.11 .66	.19 .46	1.00 .00	
Legal abortion rate	(X13)	.00 1.00	.00 1.00	.00 1.00	.00 1.00	.00 1.00	.00 1.00	.00 1.00	.00 1.00	.00 1.00	.00 1.00	.00 1.00	.00 1.00	.00 1.00	1.00 .00

*Top figures are the zero order correlation coefficients; bottom figures are significant levels.

TABLE 4 (continued)

	Mean	Standard Deviation
Age-sex standardized birth rate (Y)	25.77	3.19
Urbanization	34.56	20.39
Crude death rate (X2)	7.43	.72
Life expectancy at birth for males (X3)	60.72	.49
Population per hospital(X4)	2755.94	1166.15
Telephone sets in use per 1,000 (X5)	22.72	12.76
Daily news circulation per 1,000 (X6)	112.50	-9.97
School enrollment (X7)	61.11	6.17
Domestic mail letter per 1,000 (X8)	16.28	6.45
Age-specific fertility rate aged 20-24 (X9)	288.61	46.43
Percent of women marrying aged 15-19 (X10)	6.72	5.42
Infant mortality (X11)	43.17	10.49
Family planning utility (X12)	.83	.51
Legal abortion rate (X13)	0.00	0.00

TABLE 5
Zero-Order Correlation Matrix:1975-1980 Age-Sex Standardized Birth Rate*

		<u>Pearson Correlation Coefficients</u>													
		Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13
Age-sex standardized birth rate	(Y)	1.00													
		.00													
Urbanization	(X1)	.57	1.00												
		.01	.00												
Crude death rate	(X2)	.02	.39	1.00											
		.95	.11	.00											
Life expectancy at birth for males	(X3)	.39	.77	-.41	1.00										
		.10	.01	.09	.00										
Population per hospital	(X4)	-.33	-.34	-.41	.03	1.00									
		.18	.17	.09	.91	.00									
Telephone sets in use per 1,000	(X5)	-.50	.18	.60	.40	.50	1.00								
		.03	.48	.01	.10	.03	.00								
Daily news circulation per 1,000	(X6)	-.40	-.38	-.65	.39	.72	.93	1.00							
		.10	.12	.01	.11	.01	.01	.00							
School enrollment	(X7)	-.43	-.16	-.56	.39	.54	.86	.78	1.00						
		.08	.53	.02	.11	.02	.01	.01	.00						
Domestic mail letter per 1,000	(X8)	.36	.39	.34	-.19	-.92	.63	-.79	-.62	1.00					
		.14	.11	.17	.46	.01	.01	.01	.01	.00					
Age-specific fertility rate aged 20-24	(X9)	.61	-.01	.56	.01	-.65	-.83	-.58	-.63	.60	1.00				
		.01	.99	.02	.99	.01	.01	.01	.01	.01	.00				
Percent of women marrying aged 20-24	(X10)	.82	-.31	-.09	.42	-.50	-.37	.42	-.17	.25	-.60	1.00			
		.01	.22	.71	.08	.03	.14	.08	.50	.32	.01	.00			
Infant mortality	(X11)	.61	.33	.25	.47	.60	.09	.15	.25	-.52	-.16	-.60	1.00		
		.01	.18	.32	.05	.01	.71	.54	.32	.03	.51	.01	.00		
Family planning utility	(X12)	.35	.49	-.13	-.21	-.18	.65	.26	.24	-.40	.42	-.17	.20	1.00	
		.16	.05	.61	.41	.47	.06	.30	.34	.10	.08	.51	.42	.00	
Legal abortion rate	(X13)	.71	.76	-.06	-.43	-.21	-.35	.10	.19	.18	.42	-.42	.12	.70	1.00
		.01	.01	.82	.07	.41	.26	.69	.44	.48	.10	.08	.63	.01	.00

*Top figures are the zero order correlation coefficients; bottom figures are significant levels.

TABLE 5 (continued)

	Mean	Standard Deviation
Age-sex standardized birth rate (Y)	18.65	3.81
Urbanization (X1)	49.73	33.99
Crude death rate (X2)	5.26	.23
Life expectancy at birth for males (X3)	65.78	.73
Population per hospital (X4)	1939.44	396.53
Telephone sets in use per 1,000 (X5)	61.39	40.16
Daily news circulation per 1,000 (X6)	167.78	92.85
School enrollment (X7)	65.17	3.62
Domestic mail letter per 1,000 (X8)	27.50	6.50
Age-specific fertility rate aged 20-24 (X9)	182.22	33.42
Percent of women marrying aged 15-19 (X10)	13.06	6.29
Infant mortality rate (X11)	22.06	2.36
Family planning utility (X12)	2.18	.51
Legal abortion rate (X13)	.56	.70

TABLE 6

Multiple Regression Coefficients of 1965-1970 Age-Sex Standardized Birth Rate (ASSBR) on Independent variables - cross-national model

Independent variables	Multiple-regression coefficients
Urbanization (X1)	- .001
Crude Death Rate (X2)	1.42
Life Expectancy at Birth for Males (X3)	- .32
Telephone Sets in Use per 1,000 (X5)	.10
Age-Specific Fertility Rate 20-24 (X9)	.001
Family Planning Utility (X12)	- 1.98
Constant	37.50
$Y = 37.50 - .001X1 + 1.42X2 - .32X3 + .10X5 + .001X9 - 1.98X12$	
$R^2: \text{modernization (X1-X5) and ASSBR (Y)} = .8403$	
$R^2: \text{modernization (X1-X5) + demographic factor (X9) and ASSBR (Y)} = .8424$	
$R^2: \text{modernization (X1-X5) + demographic factor (X9) + family planning application (X12) and ASSBR (Y)} = .88$	

TABLE 7

Multiple-Regression Coefficients of 1975-1980 Age-Sex Standardized Birth Rate (ASSBR) on Independent variable -cross-national model

Independent variables	Multiple-regression coefficients
Urbanization (X1)	- .004
Life Expectancy at Birth for Males (X3)	- 1.87
Telephone Sets in Use per 1,000 (X5)	.04
Daily News Circulation per 1,000 (X6)	- .003
School Enrollment (X7)	- .35
Age-Specific Fertility Rate 20-24 (X9)	.02
Percent of Women Marrying Aged 15-19 (X10)	.35
Infant Mortality Rate (X11)	- .32
Legal Abortion Rate (X13)	- 2.06
Constant	164.71

$$Y = 164.71 - .004X_1 - 1.87X_3 + .04X_5 - .003X_6 - .35X_7 + .02X_9 + .35X_{10} - .32X_{11} - 2.06X_{13}$$

R^2 : modernization (X1-X7) and ASSBR (Y) = .75

R^2 : modernization (X1-X7) + demographic factors (X9-X10) and ASSBR (Y) = .94

R^2 : modernization (X1-X7) + demographic factors (X9-X10) + family planning application (X13) and ASSBR (Y) = .95

using only the modernization index was .75, compared to an R^2 of .94 when the demographic factors were included. When the family planning application variable was added, R^2 increases to .95. The increase in R^2 suggests the relative importance of the remaining factors net of modernization, but also reaffirms the dominant role of development (modernization). However, modernization shows much greater influence in the beginning of the transition (the 1965-1970 period) rather than in the latter part of the transition (the 1975-1980 period).

The effect of age-specific fertility aged 20-24 is positive (multiple regression coefficients are .001 and .02, respectively) for the 1965-1970 and 1975-1980 periods. In the 1975-1980 period, the multiple-regression coefficient shows that net of other factors, one percent increases in the percentage of women marrying aged 15-19 will have a higher age-sex standardized birth rate of .35 points. But it is not important in the 1965-1970 period. The multiple-regression coefficient for the infant mortality rate indicates that Taiwan, Singapore and Hong Kong in the 1975-1980 period has an average age-sex standardized birth rate .32 points lower when the infant mortality rate was reduced one per 1,000. It is also not important in the 1965-1970 period. Only in the 1965-1970 period, the multiple-regression coefficient for family planning utility shows that these three nations will be expected to have an age-sex standardized birth rate 1.98 points lower when a country is grouped in the family planning utility coded category (20 to 40 percent of women who use contraceptive methods). But this variable was not important in the 1975-1980 period.

Finally, the legal abortion rate had a strong negative effect on age-sex standardized birth rates in the 1975-1980 period. Countries with the higher abortion coded category (above 20 per 1,000 women aged 15-44) such

as Singapore averaged an age-sex standardized birth rate 4.12 points less than comparable nations with negligible legal abortion rates.

Longitudinal analysis of age-sex standardized birth rate:1975-1980 to 1950-1959

The lagged dependent variable analysis confirms conclusions drawn from the cross-national results. Modernization is the most important influence on fertility change. However, demographic factors and family planning application again exhibit significant effects, and all are in the expected direction (see Table 8).

The fact that the effects of variables from both the cross-national and change analyses are in the same direction and generally exhibit the same magnitude of effect provides added support for our specification of a revised transition model especially during stage IV after the transition began (i.e., 1975-1980) in these three countries. In the longitudinal analysis, the explained variance using only the modernization index is .77, compared to an R^2 of .94 when the demographic factors were included. When the family planning application is added, R^2 increases to .95. This is similar to the results of cross-national analysis in the 1975-1980 period.

In conclusion, the following findings emerge from the above analyses: First, on the basis of the crude birth rate change, Hong Kong and Singapore both have greater rates of decline than Taiwan, with Taiwan's rate of decline lowest of all. That is, the crude birth rate of Singapore averaged 26.5 per 1,000 in the 1965-1970 period, and 17.5 per 1,000 in the 1975-1980 period, a fall of 34 percent in fifteen years or 5.7 percent of the initial level per year. In Hong Kong, the crude birth rate declined from 23.6 per 1,000 in 1965-1970 to 17.5 per 1,000 in 1975-1980, a fall of 26 percent in fifteen

TABLE 8

Coefficients, the Explained Variance from Regressions of 1975-1980 Age-Sex Standardized Birth Rate on Independent Variables - Lagged Dependent Variable Model

Independent variables	Multiple-regression coefficients
Urbanization (X1)	- .03
Life Expectancy at Birth for Males (X2)	- 1.52
Telephone Sets in Use per 1,000 (X5)	.03
Daily News Circulation per 1,000 (X6)	- .02
School Enrollment (X7)	- .40
Age-Specific Fertility Rate 20-24 (X9)	.006
Percent of Women Marrying at age 15-19 (X10)	.37
Infant Mortality Rate (X11)	- .33
Legal Abortion Rate (X13)	- 1.52
1950-1959 Age-Sex Standardized Birth Rate (X14)	- .30
Constant	159.86

$$Y = 159.86 - .03X_1 - 1.52X_2 + .03X_5 - .02X_6 - .40X_7 + .006X_9 + .37X_{10} - .33X_{11} - 1.52X_{13} - .30X_{14}$$

R^2 : 1950-1959 ASSBR + modernization (X1-X7) and ASSBR (Y) = .77

R^2 : 1950-1959 ASSBR + modernization (X1-X7) + demographic factors (X9-X11) and ASSBR (Y) = .94

R^2 : 1950-1959 ASSBR + modernization (X1-X7) + demographic factors (X9-X11) + family planning application (X13) and ASSBR (Y) = .95

years or 4.3 percent of the initial level per year. The crude birth rate declined in Taiwan from 29.8 per 1,000 in 1965-1970 to 24.1 per 1,000 in 1975-1980, a fall of 19 percent in fifteen years or 3.2 percent of the initial level per year. The situation looks quite the same when age-sex differences are taken into consideration by standardizing. Taiwan still has lower rates of decline than Singapore and Hong Kong, though the rates of difference were smaller. That is, the age-sex standardized birth rate of Singapore averaged 23.8 per 1,000 in the 1965-1970 period and 15.0 per 1,000 in the 1975-1980 period, a fall of 37 percent in fifteen years or 6.2 percent of the initial level per year; Hong Kong averaged 25.4 per 1,000 in 1965-1970 and 18.0 per 1,000 in 1975-1980, a fall of 29 percent in fifteen years or 4.8 percent of the initial level per year; and, Taiwan averaged 28.2 per 1,000 in 1965-1970 and 23.0 per 1,000 in 1975-1980, a fall of 18 percent in fifteen years or 3 percent of the initial level per year. But when we compared the indicators of modernization among Taiwan, Singapore and Hong Kong (see Tables 6-12), we find that several variables for Taiwan had the highest infant mortality rate, percentage of women marrying aged 15-19, and age-specific fertility rate aged 20-24, and simultaneously, the lowest contraceptive application and legal abortion rate.

These results indicate that Taiwanese marry at an earlier age, and perhaps a more effective family planning program is needed in order to reach the fertility level of Singapore and Hong Kong. Therefore, it seems that the reason Taiwan ranks the lowest in the rate of decline is because traditional kinship institutions and values persist (the year of Dragon is an example).

The obligation under strongly patrilineal systems of descent and inheritance to produce a son results in strong preference for one son

TABLE 9

Comparisons of Rate of Decline in Crude Death Rate (CDR) and Rate of Age-Sex Standardized Birth Rate (ASSBR) Decline

	Approximate year at which CDR=7.0	Approximate year at which CDR=5.2	Years needed CDR 7.0 to 5.2	Rank	Rate of ASSBR decline per year	Rank on rapidity of ASSBR decline
Taiwan	60	69	10	1	.891	3
Singapore	61	75	15	3	1.157	1
Hong Kong	63	76	14	2	1.084	2

TABLE 10

Comparisons of Rate of Increase in Expectation of Life at Birth for Male (E_0^m) and Rate of Age-Sex Standardized Birth Rate (ASSBR) Decline

	Approximate year at which $E_0^m=60$	Approximate year at which $E_0^m=68$	Years needed E_0^m 60 to 68	Rank	Rate of ASSBR decline per year	Rank on rapidity of ASSBR decrease
Taiwan	57	75	19	2	.93	2
Singapore	56	76	21	3	.98	1
Hong Kong	57	74	18	1	.23	3

TABLE 11

Comparisons of Rate of Decline in Infant Mortality Rate (IMR) and Rate of Age-Sex Standardized Birth (ASSBR) decline

	Approximate year at which IMR=35	Approximate year at which IMR=25	Years needed IMR 35 to 25	Rank	Rate of ASSBR decline per year	Rank on rapidity of ASSBR decline
Taiwan	58	64	7	2	.64	3
Singapore	60	67	8	3	.86	2
Hong Kong	63	65	3	1	1.32	1

TABLE 12

Comparisons of Age-Specific Fertility Rate (ASFR) 20-24 in the 1975-1980 period

	Mean of ASFR in the 1975-1980 period	Rank
Taiwan	221	3
Singapore	166	2
Hong Kong	150	1

TABLE 13

Comparisons of Percent of Women Marrying Aged 15-19 in the 1975-1980 period

	Mean of percent of women marrying aged 15-19	Rank
Taiwan	19	3
Singapore	9	1
Hong Kong	11	2

TABLE 14

Comparisons of Increase in Contraceptive Application in the 1975-1980 period

	Mean of contraceptive application	Rank
Taiwan	68	3
Singapore	83	1
Hong Kong	75	2

TABLE 15

Comparisons of Rate of Increase in Legal Abortion Rate in 1975-1980 period

	Mean of legal abortion rate	Rank
Taiwan	0 (Taiwan did not carry out the legal abortion law yet)	
Singapore	24	1
Hong Kong	1	2

when it is increasingly a preference combined with a smaller total preferred number of children. Furthermore, developing countries are influenced by the ideas of the West. Not that developing nations adopt the whole idea system of the West, because families retain many traditional forms and attitudes while the massive adoption of contraception reduces fertility rates. A large majority of Taiwanese young couples still begin married life by living with the husbands' parents. A nuclear-family system requires that the husband is able to support his family with land or housing of his own prior to marriage, and such economic independence is not necessary with a joint family arrangement since the young couples can live with the parents. Beside promoting marriage at an early age, child care is easier which encourages the couples to produce more children.

Therefore, the multiple regression analysis confirms that the combination of modernization, demographic components and family planning application are highly conducive in reducing the fertility rate rapidly after the transition period began. This result partially confirms our hypothesis, though modernization plays a more significant role in the beginning of the transition period. Demographic factors and family planning play a significant role in reducing fertility latter in the transition. Tradition, especially in Taiwan, keeps fertility from reaching the lower level of Singapore and Hong Kong. This could be due to the fact that Singapore and Hong Kong are city-states. Population density is high and the population is heterogeneous. It is easier for these two nations to become westernized and carry out family planning programs effectively. In Taiwan, the population is more homogeneous and people tend to more strongly sustain traditional culture. It is more difficult for Taiwan to modify the traditional values, norms, and customary ways of large families.

Chapter 5

SUMMARY AND CONCLUSIONS

This research has attempted to see whether the models of fertility transition in Taiwan, Singapore and Hong Kong confirm or reject the proposition of classical demographic transition theory by reviewing their fertility trends over time. The purpose and importance of this research were made in chapter one.

The traditional form of classical transition theory emphasizes the role of national socio-economic development. It explains the relationship between modernization and fertility by emphasizing that increasing modernization creates pressure to reduce fertility. This pressure is a result of declines in mortality and infant mortality which reduces the number of births required to achieve a given number of surviving children. Two existing hypotheses concern this viewpoint. They are closely related and are frequently discussed with little distinction. One is the child replacement hypothesis. The other is the child survival hypothesis. At the same time, modernization breaks down traditional kinship domination and nuclear family decision-making and reproductive goals arise; it also changes traditional sex roles and generates alternatives to early marriage and large families for women. Finally, modernization stimulates aspiration of adults for themselves and their children to participate in the new, achievement-oriented, and socio-economic institutions. Achievement of these new goals is made easier by small families.

Chapter two mainly reviewed these related studies of transition theory. However, several researchers concluded the process of fertility decline was

not adequate for the developing countries. Therefore, a revised model was needed.

In chapter three, the revised model was adopted by incorporating demographic factors and family planning application, in addition to structural modernization. It was hypothesized that the direct and lagged effect of rising modernization as well as demographic factors, and contraceptive application were to reduce fertility. This research consisted of a cross-national-longitudinal analysis. Both hypothesis and data referred to national-level aggregation. Two time periods (1965-1970) and (1975-1980) were tested. The dependent variable was the age-sex standardized birth rate, instead of the crude birth rate, which was used for the purpose of eliminating the effect of differences in the age-sex composition of the population.

The independent variables were structural modernization variables and included urbanization, health, education, economic standard, and communication; demographic factors which included age-specific fertility aged 20-24, percent of women marrying aged 15-19, and the infant mortality rate; and, family planning application covered family planning utility and the legal abortion rate. Multiple regression analysis was the major statistical technique used in this analysis. A multivariate regression of age-sex standardized birth rates on most of the independent variables of the theoretical system evaluated the hypothesis.

The major findings in chapter four were as follows: First, the most important influence on cross-national differences in the 1965-1970 period age-sex standardized birth rates was the level of modernization. In the 1965-1970 period analysis, explained variance using only the modernization index was .8403, and in the 1975-1980 period analysis, explained variance using only the modernization index was .75. For social science

research, if the square of the multiple correlation coefficient is greater than .70, we can assume the relationship between a dependent variable and independent variables are highly correlated. However, modernization was considered as an important factor to affect the birth rate, and it showed a much greater influence in the beginning of the transition (the 1965-1970 period) rather than in the latter part of the transition (the 1975-1980 period).

Second, the longitudinal analysis confirmed the same conclusion drawn from the cross-national results. Modernization was the most important influence on fertility change. Because the explained variance using only the modernization index was .77 and this analysis already considered the effect of age-sex standardized birth rates of the 1950-1959 period on that of the 1975-1980 period.

Third, the multiple regression analysis of cross-national and longitudinal models confirmed the combination of modernization, demographic components and family planning application were highly conducive in reducing the fertility rate rapidly after the transition period began. In the 1965-1970 period, explained variance using only the modernization index was .8403, compared to an R^2 of .8424 when the demographic variable was included and compared to an R^2 of .88 when the remaining family planning application variable was included. In the 1975-1980 period, explained variance using only the modernization index was .75, compared to an R^2 of .94 when the demographic factors were included. When the family planning factor was added, R^2 increased to .95. The increase in R^2 suggested the relative importance of the remaining factors net of modernization, but also reaffirmed the dominant role of modernization.

General Implications

The analysis in chapter four made a strong claim that socioeconomic modernization, lowered age-specific fertility (20-24), and the availability of contraception were necessary and sufficient conditions for fertility decline in the beginning of the transition. For recent years, the necessary and sufficient conditions were socioeconomic modernization, lowered infant mortality, age-specific fertility (20-24), percent of women marrying aged 15-19, and the availability of legal abortion. The theory of the demographic transition has received empirical support in the present study, that is, modernization was a significant pathway to lower fertility for Taiwan, Singapore and Hong Kong. Though, it is often tested by students of sociology, demography and economics, different conclusions resulted from empirical data of both developing and developed countries. Since, no theory can encompass all phenomena within its scope, and in particular no social theory is likely to explain all the salient features of a particular phenomenon. In this research, some other variables known to affect the birth rate but not a part of older versions of transition theory were included, they enhanced the predictability of the demographic transition model. Therefore, the most important contribution of this analysis is supporting demographic transition theory predictions, at least in the eastern Asian region. And, that the three component predictors, modernization, demographic factors and family planning application have different impacts in the early and latter segments of the transition. Modernization is clearly the dominant component in both periods, however, demographic factors play an increasingly significant role in the latter period. At the same time, it also interprets that appropriate policies and programs were able to serve as functional equivalents for modernization. This seemed to offer some guidance to the future of Taiwan, Singapore and Hong Kong. Besides the further promotion of modernization, more

efforts to design fertility reduction policies and programs would further reduce fertility.

Future Research

The proposition of mortality and migration which also play significant roles in the process of transition challenges the substance of the demographic transition theory. In the demographic transition theory, mortality reduction is assumed as a given component and migration is not taken into consideration. In fact, the mortality decline in developing countries is due in large measure because of the import of health care technology from developed countries. It is not the same process as the developed countries that took place as they underwent industrialization. At the same time, migration is a common means of demographic response, for instance, in the 1800s and early 1900s, people moved from European nations to North America. More recently a mass of illegal immigrants from developing countries to the developed countries is a response to conditions in those countries.

Besides the above weakness of demographic transition theory, both theoretical and technical problems remain to be solved in future related research.

First, the further improvement of the more refined measurement of the structural modernization variables are required. Because there is a lack of fitness between theoretical concepts and operational definitions in this research.

Second, the culture component must be taken into consideration. Because it highly influences fertility rates in the nations studies in this research, especially in Taiwan. A large majority of Taiwanese young couples still begin married life by living with the husbands' parents. Besides promoting marriage at an early age, it also encouraged the couples to produce more

children. So an institutional change is needed, which modified the traditional values, norms, and customary ways of behaving.

Finally, the colonialist economy of developing countries, for instance, Singapore's dependence on labor supply and agricultural products of Malaysia, as well as Hong Kong's dependence on the agricultural supply of Mainland China, may partially influence their population change. The economic interdependence of developing countries with the West, as well as historical relationships have been overlooked by Transition Theory.

These deficiencies should be taken into consideration in future research in order to revise, expand and improve our understanding of this complex phenomenon.

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FERTILITY DECLINE IN TAIWAN, SINGAPORE AND HONG KONG:
TESTING DEMOGRAPHIC TRANSITION THEORY

by

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ABSTRACT

This research was carried out by reviewing fertility trends over time in Taiwan, Singapore and Hong Kong to see whether their models of fertility transition confirm or reject the proposition of classical demographic transition theory. In addition to structural modernization variables which were suggested by classical transition theory, demographic factors were incorporated as well as family planning application to test a hypothesis stating the direct and lagged effect of these variables on declining fertility.

The measurements of independent variables were gathered directly or calculated from data in the Statistical Yearbook for Asia and the Pacific, the Demographic Yearbook, and the Europa Yearbook. The structural modernization variables include urbanization (either percentage of urban population or percentage of population in localities of 100,000 or more), health (population per hospital, life expectancy at birth for males, crude death rate), education (percentage of population aged 5-19 enrolled in the primary and secondary school, daily newspaper circulation per 1,000), economic standard (telephone sets in use per 1,000 population), and communication (domestic mail letter per 1,000 population). Demographic factors include age-specific fertility aged 20-24, percent of women marrying aged 15-19, and infant mortality rate. The family planning application covers family planning utility and the legal abortion rate. The dependent variable was the age-sex standardized birth rate which was computed by the procedure of standardization of the indirect method. The age-specific fertility rate (age 15-19....45-49) for the United States was used as the standard population. The purpose of standardization is to eliminate the variation of age-sex composition of the population.

Multiple regression analysis was the major statistical technique used in this research. A multivariate regression of age-sex standardized birth rates on most of the independent variables of the theoretical system evaluated the hypothesis. There were a cross-national analytic procedure as well as a longitudinal analytic procedure. Due to the restrictions of inconsistent data as well as experiencing transition stage at different times, only (1965-1970) and (1975-1980) periods were tested in these analytic procedures.

The multiple regression analysis confirmed that the combination of modernization, demographic components and family planning application were highly conducive in reducing the fertility rate rapidly after the transition began. And modernization was a significant pathway to lower fertility, especially in the beginning of the transition period. During the latter part of the transition demographic factors and family planning played an increasingly significant role in fertility reduction. These findings empirically support the predictability of the demographic transition theory. It also offered the guidance to the future of Taiwan, Singapore and Hong Kong. Besides the further promotion of modernization, more efforts to design fertility reduction policies and programs would further reduce fertility.