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ASIAN DEMOGRAPHIC TRANSITION: AN INSTRUMENTAL-VARIABLES PANEL APPROACH

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Abstract

We examine patterns in fertility during the demographic transition using a panel data set across 25 Asian countries for 1975-2003. The adult female literacy rate is used as an instrumental variable for the *endogenous* female labor force participation rate, which has been unsolved in the population literature. The preliminary panel data analysis suggests that relative cohort size is significant in explaining the decline in fertility before controlling for simultaneity bias. This result, however, may be spurious. After considering the instrumental variables estimation in the panel data structure, the age structure variable no longer plays a dominant role in explaining declining fertility rates in many Asian countries. Systematic differences were found between East and South Asia. A policy implication in South Asia is that development may reduce fertility directly through increasing income rather than indirectly through a change in female labor force participation or urbanization. In East Asia, the indirect effects dominate.

JEL classification: J13, P20

Key words: Fertility, Easterlin hypothesis, Transition Economies, Relative Cohort Size, Age Structure

1. Introduction

The theory of the demographic transition concerns the impact of economic development on fertility, mortality and population growth. The process of development is posited to initially reduce both mortality and fertility. However, the fall in mortality is thought to fall contemporaneously with the beginning of development while fertility is thought to fall only after a long lag. While transition theory is rich in suggested hypotheses about the empirical causes of this fertility decline, the theory itself rests on shaky empirical grounds in large part due to data limitations. Much of the aggregate evidence rests on the experience of western countries, which are thought to have completed this transition, in many cases several centuries ago. These data are mostly limited to birth and death rates that can not be connected to supposed socioeconomic explanatory variable. Data, regarding birth and death, for countries that might be currently undergoing this transition are limited and sporadic. Consequently, time series evidence that a demographic transition is occurring in developing countries is weak. In this paper, we use panel data for a region, Asia, to estimate models based on transition theory and to test key propositions underlying the theory of the demographic transition.

In testing transition theory, we follow a framework considered by Macunovich (2000), who uses cross sectional data for developing countries. She extends the Easterlin hypothesis to countries that are still undergoing the demographic transition by arguing that it helps to explain the timing of the onset of fertility decline.[1] This paper examines the Easterlin hypothesis in the framework of developing Asian countries and also extends Macunovich in two ways. First, instead of the cross-sectional data used by Macunovich, we adopt a panel data structure with various ranges of income-levels among Asian countries. Second, we consider additional

[1] For reviews of the literature on the Easterlin hypothesis, see Macunovich (1998), Pampel and Peters (1995) and Waldorf and Byun (2005).

explanations for fertility decline during the demographic transition such as the role of women's labor force participation rate in determining fertility. Since women's labor force participation is often thought to be endogenous, and has been unsolved in the population literature, an instrumental-variables approach is taken for the panel data set.

The paper progresses as follows. Section 2 examines the existing population literature concerning the Easterlin hypothesis both in advanced countries and in countries that have not completed the demographic transitions. Section 3 provides an overview of the transition in certain Asian populations and economies. Section 4 describes the data set and our models for fertility in transition economies, and discusses the endogeneity problem of female labor force participation which is regarded as a key variable. Then, we discuss the empirical findings. Section 5 summarizes our conclusions and the policy implications of our findings.

2. Population Models and Relative Cohort Size

Before discussing transition theory, we will briefly discuss the Easterlin hypothesis, which attempts to explain the fertility of populations within countries that have already undergone the demographic transition. In the Easterlin hypothesis, the income of young adults relative to the income of their parents, when these adults were in their late childhood and early adolescence, is held to be a key determinant of fertility. Easterlin (1968) argues that the tastes and aspirations of today's adults are greatly influenced by the income of their parents in earlier years. A decline in their income relative to their parents' earlier income will decrease fertility.

The relative income of young adults is determined by a number of factors including the business cycle and the proportion of young workers to the labor force called relative cohort size

(RCS).[2] If younger and older workers are substitutes, this increase in the relative supply of younger workers will lead to a decrease in their relative income. Swings in economic conditions were hypothesized by Easterlin to result in swings in birth rates due to the resulting swings in relative cohort size. It was thought that these swings in births could result in demographic cycles, which in turn could result in business cycles extending into the indefinite future. More recent evidence indicates that while relative cohort size does have a negative impact on fertility in developed countries, this impact is not nearly as large as earlier research focusing on the US would suggest (Jeon and Shields, 2005).

Macunovich (2000) extends the Easterlin hypothesis in order to apply it to both developed and developing countries. She argues that the RCS influences the timing of fertility decline in the demographic transition. Before applying the Easterlin hypothesis toward explaining fertility decline in the demographic transition, she first considers some key features of transition theory. When the theory of the demographic transition was first formulated, it relied heavily on functionalism (See Thompson, 1929 and Notestein, 1949). Mortality rates before the transition were high. Any viable society needed to encourage high fertility in order to offset this high mortality. Social norms and mores, which encourage high fertility, are developed. Industrialization and the resulting modernization of a society are thought to first reduce mortality because of higher income and better medical technology. Fertility remains high because social norms and mores are developed in earlier epochs of high mortality when high fertility was necessary for society's survival. However, society will adjust over time to the lower mortality rates by developing new norms and mores consistent with lower mortality. This process will eventually cause fertility to fall. One key feature in driving this adjustment is thought to be the

[2] Some earlier studies, such as Wachter (1975), constructed estimates of relative income from current and past levels of income. The recent literature has focused on RCS as being the Easterlin variable.

declining need for high fertility as a source of social security because of declining infant and child mortality. A second key feature is thought to be urbanization, which increases the net costs of raising children and changes the unit of production from family to firm. Hence, modernization would initially cause an increase in population that, if it persisted long enough could eventually become large enough to threaten the rising economic prosperity of the society. Eventually, however, the population could stabilize at a larger, but more prosperous level, if the pace of this transition were rapid enough. The pace of fertility decline in the demographic transition is an important empirical question and whether it could be quickened by policy measures, such as providing more education for females is important for public policy.

While transition theory implies that fertility will eventually decline with modernization, it does not necessarily imply that the pace of this decline and the timing of its onset are sufficiently large enough or early enough to assure the future prosperity of society. Hence, an understanding of when and how rapidly fertility will decline and how it will respond to policy measures becomes crucial for population policy.[3] Macunovich (2000) extends the Easterlin hypothesis to explain the timing of the onset of the demographic transition within a supply and demand framework. At the initial stage of the transition, modernization results in higher income and falling mortality, creating an excess supply of surviving children. Parents may recognize the existence of this excess supply, but still will not take any action to reduce births. Macunovich argues that the timing of the onset of fertility decline depends on both the duration and the magnitude of the excess supply of births. Initially, the excess supply largely comes from the

[3] In transition theory, the lag length between declining mortality and declining fertility is largely due to the time it takes for the norms and mores of society to adjust to the new needs of society brought about by lower mortality. Theories of the demographic transition have explained the lag between declining mortality and declining fertility in numerous ways. This lag is thought to be potentially long because both individual decisions as to the utility maximizing number of children and the social norms, mores and institutions that frame this decision must change for fertility to decline in any substantial way.

decline in mortality. Eventually, however, RCS, defined as the ratio of persons 15-24 years old to those who are 15-59 years old, begins to rise due to the increased probability of survival through childhood.[4] If the Easterlin hypothesis is applicable to the economies of developing countries, this reduces the relative income of young adults resulting in an increase in the excess supply of births. Once this excess supply reaches some critical level parents begin to plan the size of their family and take action to reduce fertility.

The decline in mortality would, with a fifteen year lag, begin to increase RCS. The mechanism by which RCS affects fertility would be slightly different in developing countries, undergoing the demographic transition, than in developed countries that have already completed the transition. In developed countries, increases in the supply of young workers causing crowding in the entry-level job markets, which suppress the relative wages of young adults. In developing countries, this labor market crowding may not suppress wages for the following possible reasons. First, there may not be well functioning labor markets. Wage rates might be set more by tradition and subsistence requirements within a dualistic labor market than by market forces. Second, the government might follow a high wage policy to protect government workers and other clientele of the ruling elite. However, a higher RCS would still place economic stress on young adults through higher entry-level unemployment and less access to land.

3. The demographic transition in Asia

[4] Relative cohort size, the proportion of younger workers to older workers in the labor force, is central to the Easterlin hypothesis, which concentrates on explaining swings in fertility for countries that have already undergone the demographic transition. There have been numerous studies of the Easterlin hypothesis for various countries and for various periods of time. These studies have almost exclusively been case studies of single countries that have already undergone the demographic transition. Exceptions to these single country studies are Gauthier and Hatzius (1997) and Jeon and Shields (2005), which use panel data for industrialized countries. Another exception is Macunovich (2000), which uses cross sectional data for a single year.

The regional area of Asia is chosen primarily due to the significant size of its population and its increasing economic power over the world economy. Many of the world's most populous nations are located in Asia. Both China and India have over a billion people, Indonesia has over 200 million, and Bangladesh, Pakistan, and Japan have over a hundred million. Most of these countries have experienced dramatic economic booms since the 1950's. Another reason for studying Asia is that it consists of countries at various stages of the demographic transition. Some countries are pre-transitional and have not experienced any fertility decline. Others witnessed the onset of fertility decline during the time period being studied. Still, others began the decline before 1975, while others completed the transition before 1975. Hence, the results will reflect a variety of demographic experiences. Fertility in Asia, as a whole, has fallen dramatically since 1975. Almost all of Asia has started or completed the demographic transition from high fertility to replacement fertility (Caldwell, 1996). Hence, Asia is an effective case study for analyzing the pace of fertility decline.

Asia differs from other developing regions, such as sub-Saharan Africa and Latin America, in terms of its acceptance of active government roles in family planning. This acceptance of active family planning comes in part from differences in religion, culture, and development experience. One reason why family planning is more acceptable in Asia is that the major religions in Asia are Islam, Hinduism and Buddhism. These religions differ from Christianity, particularly Catholicism, in that they do not support a tradition of opposition to contraceptive methods and family planning. This opposition emerged in Catholicism, according to Noonan (1966), from a confusion of contraception with infanticide. A second source for the acceptability of family planning in Asia comes from higher population densities with respect to

arable land and other natural resources coupled with some major famines.[5] A third reason for the acceptability of family planning is the perception by government in some countries, particularly China and India, that rising populations pose a development problem. These governments acted on this perception with consistently implemented efforts to gain popular acceptance of birth limitation.

We will turn to a discussion of fertility and family planning for sample countries in Asia.[6] First, a well-known feature in Chinese population policy is the One-Child policy, initiated in 1979 by Chinese political leader Deng Xiaoping. Previously, Chinese government officials took overpopulation problems seriously in food supplies, housing, education and employment,[7] but early attempts at limiting the number of births were not successful because of the long-held cultural belief that having many sons signals luck and future prosperity. The One-Child policy limits couples to have only one child by imposing financial fines, exerting pressure to abort a pregnancy, and even forced sterilization accompanying second or subsequent pregnancies.[8] This policy, however, was strongly resisted by rural residents and unfortunately it stimulated sexual discrimination against girls. Although the one-child policy ensures a better chance of supporting

[5] Slogans such as "later, longer, and fewer" were widespread. They were meant to encourage a later start in childbearing, longer intervals between births, and fewer children on completion of family building (Crook 1997, p 141). Pressure for family planning did not develop as early in the land abundant regions of Latin America and Africa.

[6] The decline in the fertility rate is universally caused by socio-economic development factors such as rapid urbanization, improvement of female status through educational opportunity and economic participation, and decreasing infant mortality rates. Also other factors include nutrition and health improvement and in addition changing values in number of children, life style, family structure, marriage, family role, and supporting the elderly.

[7] In the 1950s, the communist regime strongly encouraged population growth since labor-intensive works were planned and executed by the government, such as building infrastructures including massive dams. Their slogan was "our population is our strength". Thus, China experienced policy changes from welcoming population growth to aggressive birth control program. See more in Crook (1997, Pages 140-146).

[8] All couples living in urban areas of mainland China are required to have no more than one child. But, families in most rural areas are often allowed to have two children, if the first child is female and the spacing of the second child is delayed. Another exception goes to most ethnic minority groups who are subjected to different fertility rules. Couples were induced to sign a document making this pledge and they were rewarded with certificates, financial subsidies such as work points used for commodity trade, a cash reward for sterilization, priority access to urban housing space (with disincentives on having more than two children).

a single child, there were fears of losing the only child due to nutrition-related diseases and poverty. The credibility of offered incentives by government was low. Thus, the one-child policy shows the limitation of government policies in creating demographic changes. Instead, economic conditions prevailed in the fertility decline, and Chinese policies emphasizing later marriage, the spacing of births in the 1970's and contraceptive use in the early 1980's dramatically reduced the fertility rate in China.

Although fertility in Japan has declined over the past sixty years, the main sources of fertility decline changed dramatically in the mid 1970's. The fertility decline before the mid-1970's is mainly due to reduced marital fertility, which was caused by an increase in the number of abortions, increased use of contraception and value changes in gender roles in family life. In contrast, delayed marriage has been a principle factor since the early 1970's, due to women's rising education level and their employment. This decline in fertility has caused the Japanese population to be the oldest in the world, although a variety of population policies and programs have recently been implemented to promote fertility by both central and local governments.

The fertility rate in Korea declined to a level far below the replacement level within a short span after 1960. This momentous transition in Korea was achieved mostly by government sponsored family planning programs. It also was attributed to the increase in the proportion of single women, the changing attitude of women concerning child birth and an increasing female labor force participation rate that was supported by the Korean government. The rapid decline in fertility, however, has caused negative social phenomena such as population aging, a labor shortage leading to an influx of foreign labor migrants and an increased financial burden of supporting the elderly.

One of the distinct characteristics in Indian society was that marriages were made at a very early age, leading to high fertility. Thus, female education is expected to reduce the planned number of births because it delays family formation as well as improves the self-confidence of women in the household decision-making process. Economic development along with public health programs (such as the reduction in malaria and small pox) lowered the infant mortality rate, and thus the accessibility to public health services reduced the fertility rate as well. Condom use and male sterilization, which shifts the fertility responsibility for fertility control to men, were widely provided at subsidized prices and aggressively advertised by the government. Pakistan, a neighboring country, was a pioneer among Asian countries in adopting an official family planning program in 1965. The mortality rates already declined considerably in the 1950s, and the country experienced considerable modernization and improvement in the standard of living. Although Islam encourages early marriage, contraception (or even abortion) is not clearly prohibited but its use remains unpopular.[9] Government-sponsored programs such as putting economic incentives on birth control or disincentives on having large family were not effective in Pakistan.

Other countries in Asia have experienced notable changes in fertility and have differing concerns. For example, in Singapore the government has taken a selective pro-natalist position which is targeted to increase the fertility rate among educated Singaporeans.[10] The dominant factor in rapid decline of fertility in Thailand is usage of contraception that has doubled from 1975 to 1996.[11] Sri Lanka has undergone a fertility decline beginning in the early 1960's and recently marriage ages have dramatically risen to a level well beyond those of neighboring

[9] See Sathar (1993) and Crook (1997, p 149).
[10] Gubhaju and Moriki-Durand (2003, P 9) provides examples of the selective pro-natalist position in Singapore, such as giving priority in primary school registration to children of graduate mothers; income tax relief for qualified mothers, matchmaking activities for graduate singles.
[11] See Gubhaju and Moriki-Durand (2003, P 4) for details.

countries and, thus, Sri Lanka becomes the only South Asian country to reach the replacement fertility level. Since births to single women virtually do not occur in Indonisia, the fertility patterns are the product of two variables, the proportion of married and marital fertility rates. The fertility decline in Bangladesh, despite being a Muslim country, was due to policy changes to a clinic-based delivery from the doorstep delivery of family planning services (causing cost savings and thus providing a wider range of services); both increasing availability (and high usage) of contraception and continuing urbanization reduced the demand for a high number of children, particularly for sons.[12]

4. The Data and Model

Both the validity of the Easterlin hypothesis in developing countries and hypotheses regarding the demographic transition and fertility are considered. The data are from the World Bank's *2005 World Development Indicators*. In this study, we examine fertility in a panel of Asian countries for the years 1975-2003. The total fertility rates for 25 Asian countries (17 East Asian and 8 South Asian) are shown in Table 1. Data are not available for every country for every year as seen in Table 1a. The total fertility rate (TFR) is available for at least 24 countries in years 1977, 1982, 1987, 1990, 1992, 1997, 2002, and 2003. For these countries, the average TFR fell from 4.55 to 2.67. Table 1b shows the average TFR for each country. Hong Kong, Japan, Macao, Singapore and South Korea had averages at or below replacement and had hence completed the demographic transition. Only seven countries had average total fertility rates at five or above.

The model to be estimated has TFR as the dependent variable. The independent variables consist of RCS plus variables commonly thought to be important in the demographic

[12] See Caldwell and Caldwell (2003) for details on Sri Lanka and Bangladesh.

transition. These variables are real per capita income (*Income*), the urbanization rate (*Urban*), and the labor force participation rate of women ages 14-64 (*Flabor*), which is a variable related to the status of women.[13] Relative cohort size (*RCS*) is defined as the ratio of the size of the younger generation (ages 15-29) over the size of all the generations (ages 15-65).[14] Relative cohort size is a cyclical variable representing systematic changes from an underlying trend. The basic model can be written with the fixed effect s_i as

(3) $F_{it} = \alpha_0 + \alpha_1 Income_{it} + \alpha_2 Urban_{it} + \alpha_3 FemLabor_{it} + \alpha_4 RCS_{it} + \varepsilon_i + u_{it}$

This model, which consists of these variables explaining fertility, is used to test the validity of the Easterlin hypothesis for Asian countries. The variables are available for the panel data study of the paper. There are, however, many observations missing in several important variables for the transition economies where some of the variables are not reported for every year.

Each country has a different national environment in its labor market, in its social security net and in economic policies. So, a mere replication of the experience of developed countries may not be expected to apply to developing countries. We attempt to incorporate the unobserved information through a panel data analysis with various spectrums of countries in Asia.

The standard method in empirical cross-country studies is to estimate regression equations with ordinary least squares (OLS) which assumes that the omitted variables are independent of the regressors and are independently and identically distributed. Such estimation, however, can create problems of interpretation if country-specific characteristics are not properly considered. If those omitted country-specific variables (both observed and unobserved) correlate

[13] Infant mortality is another important variable, but due to the data limitation the variable is dropped.

[14] RCS for the current year is found by dividing the current size of the population aged 30-65 into the populations aged 0-14 fifteen years ago.

with the explanatory variables, then OLS produces biased and inconsistent coefficient estimates. When using a panel data analysis, however, the fixed-effect model may produce unbiased and consistent estimates of the coefficients.[15] Furthermore, the endogeneity issue has been discussed in previous literature, for example, Pampel (1993, footnote 14) and Jeon and Shields (2005). That is, the fertility rate is influenced by female labor force participation, and vice versa.[16] Jeon and Shields (2005) compare the two different model specifications, with and without female labor force, and the impact of the Easterlin effect is confirmed in both specifications in spite of endogeneity issues.

The results of panel data analysis, assuming implicitly no endogeneity problem, are shown in Table 2. Only country fixed effects are considered but not time fixed effects because of the irregularity of the time between observations. For the whole Asian data, the fixed effects model is preferred by the Hausman test to the random effects model. The female labor variable and urban population variable are statistically significant, but age structure and income are not statistically significant at the 5% significance level. Furthermore, we consider two sub-areas, East and South Asia. By the Hausman test, the random effects model is preferred for East Asia where both higher female participation and higher urbanization reduce fertility rate but the age structure increases fertility, which seems hard to believe. In contrast, the Hausman test selects the fixed effects model for South Asia, which includes richer model specifications and all of them are statistically significant and negative. That is, female labor participation, age structure, income and urbanization would reduce the fertility rates.

[15] Section 3 reports differences in government attitude toward family planning and contraceptive prevalence through different Asian countries. The panel structure with country-specific unobserved components mostly accounts for these differences.

[16] Pampel (1993, p 511) suggests that the high female labor force participation rates depresses the effect of relative cohort size on fertility, which partially explains the declining association between relative cohort size and fertility over time. Female Labor Force is used instead of the female labor force participation rate because it filters out changes in over all labor force participation rates resulting from changes in age structure and other factors.

In summary, without considering the simultaneity problem, we may conclude that female labor participation reduces the fertility rate in Asia as a whole, and also in two sub-areas, East and South. Age structure increases the fertility rate in East Asia, but reduces it in South Asia. Income reduces the fertility only in South Asia; in contrast, the urbanization reduces the fertility rate not only in all of Asia but also both in East and South Asia.

Solving this endogeneity problem caused by the interdependence of the total fertility rate with female labor force participation necessitates finding an appropriate instrumental variable.[17] It is not easy, in practice, to find any instrumental variables for labor force participation, which leads to serious data limitations in the developing countries. However, Table 3 illustrates a suitable instrumental variable using the adult female literacy rate measured as the percentage of literate females ages 15 and over. The female literacy rate is a proxy for the labor market opportunities of women. Note that in four of the countries, Hong Kong, Japan and the two Koreas, no data on female literacy are reported. These countries are excluded from the estimation for Tables 3 and 4.[18] The random effects models are preferred by the Hausman test, and correspondingly in their first random-effects regressions in Table 3, the adult female literacy rates are significant. Thus, female literacy is a possible instrumental variable for the female labor participation but the signs of this variable are different.[19] For East Asia, the impact of adult female literacy is positive on the female labor participation, but for South Asia it is negative. Thus, we have effectively solved the endogeneity problem that female labor participation poses.

[17] See, for example, Wooldridge (2003, chapter 15).

[18] As a robust check, we tried to fill Singapore's female literary rates as a proxy for those in Hong Kong, Japan and the two Koreas. The results are shown in Table 5, with 98 observations. The age structure variable and the urbanization variable become insignificant, contradicting the Eastern hypothesis and population transition theory. One explanation is that the post transitions countries are dominating the sample, which makes the variables insignificant. Other possible explanation might be that female literacy rates may not be a good proxy for women's labor market opportunities in these countries, while the data limitations do not allow us to find another instrumental variable.

[19] Adult female literacy rate affects fertility through labor force participation, but also through a variety of other mechanisms such as improving contraceptive knowledge, household bargaining, and aspirations and so on.

In both Asia and East Asia with instrumental variables, age structure does not show any relationships with the total fertility rate, which is not consistent with the results in Table 2 and the Easterlin hypothesis in Jeon and Shields (2005) that used a data set of higher income countries. Female labor participation, which was replaced with the instrumental variable adult female literacy rate, shows a negative relationship with the total fertility rate and is significant in both the whole Asia and East Asia. In contrast, in South Asia the preferred random effects model indicates that only income is statistically significant in reducing the fertility rate. This result is dramatically different from the results in Table 2, mainly due to solving the simultaneity bias problem.

In summary, urbanization and female labor force participation, which were unpredictable without the use of the adult female literacy rate as an instrumental variable, now exhibit a sensible negative relationship with the fertility rate for East Asia. But the income variable and age structure variables do not exhibit any statistical relationship with the total fertility rate. Thus, policy tools to reduce the fertility rate would be improved through providing better job and education opportunities for females and through modernization by urbanization. In the meantime, South Asia indicates that only higher income may reduce the fertility rate, and thus improving the living standards is the only policy tool to reduce the fertility rate, if necessary. Age structure is not relevantly related with the total fertility rate. Note that an important variable, infant mortality, was not included in our analysis, but our preliminary analysis (not shown here) indicates a positive and significant co-movement with the fertility rate.[20]

5. Concluding Remarks

[20] Some Asian countries allow substantial emigration. If emigration is selective in favoring younger people or a specific gender, then the relationship between fertility and age structure may be severely compromised.

Our empirical results support the usefulness of the transition theory in analyzing fertility decline in Asia and suggest a method for analyzing fertility in other regions. These results and their policy implications are, however, more complex than suggested by transition theory. Key variables influence fertility differently in South Asia versus East Asia. These differences and the reasons for them should be kept in mind when formulating policy.

The results support the view that endogeneity problems may exist even in developing countries when estimated models include women's labor force participation rate as an explanatory variable in estimating fertility. Thus, instruments related to the status of women, such as the adult female literacy rate, need to be employed to solve the endogeneity problem. Therefore, women's education plays a key role in explaining fertility decline in East Asia, but not in South Asia. It is expected that women's education might also be an important fertility variable in some areas such as Latin America and Africa, which is one of our on-going research projects.

The results for the instrumental variable model are striking. They do not support Macunovich (2000)'s contention that RCS plays a similar role in explaining fertility both in society's undergoing the demographic transition and in post transitional societies. RCS has a relationship with fertility before controlling for the endogeneity problem, but RCS is no longer significant after solving the simultaneity problem. In Asia, it may be a false result due to this problem that the onset of fertility decline might be abrupt once RCS increases due to changes in the second phase of the transition. The results also have clear policy implications when it comes to population policy. A clear picture emerges that improving the economic status of women through education and through women's labor force participation will reduce fertility in East Asia. Increasing urbanization to reduce fertility may be a long wait indeed because the

magnitude of this coefficient is small. It is the policy choice to provide more education and labor force opportunities that drives the fertility transition and not the usual transition story of urbanization coupled with the declining need for children as a source of social security driving the transition. In South Asia, direct economic growth, rather than change of the female labor force or the social infrastructure, promotes population transitions. Thus, the different policy recommendations can be made, depending on income level, culture, and social mores.

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Table 1. Summary Statistics for the total fertility rates

(a) by year

year	Mean	Std dev	Freq
1976	2.304	0.575	3
1977	**4.554**	**1.736**	**24**
1978	2.050	0.477	3
1979	1.957	0.306	3
1980	2.009	0.460	3
1981	2.141	0.709	3
1982	**4.311**	**1.789**	**24**
1983	1.704	0.136	2
1984	1.891	0.324	3
1985	1.687	0.103	2
1986	1.961	0.681	3
1987	**3.875**	**1.707**	**24**
1988	1.808	0.209	2
1989	2.371	1.011	4
1990	**3.593**	**1.615**	**24**
1991	1.676	0.396	4
1992	**3.503**	**1.610**	**25**
1993	1.554	0.261	4
1994	2.873	1.921	5
1995	2.000	0.671	7
1996	2.067	0.911	5
1997	**2.992**	**1.346**	**24**
1998	1.793	1.035	4
1999	1.996	1.563	5
2000	1.428	0.442	3
2001	1.222	0.259	3
2002	**2.685**	**1.197**	**24**
2003	**2.671**	**1.192**	**24**
Total	3.104	1.633	264

(b) by country

	Country Names	Mean	ranking by mean	Std dev	Freq
1	Brunei	3.200	11	0.662	8
2	Cambodia	4.995	19	0.932	8
3	China	2.354	6	0.370	15
4	Hong Kong, China	1.241	1	0.350	17
5	Indonesia	3.161	10	0.774	9
6	Japan	1.583	2	0.184	28
7	Korea, Dem. Rep.	2.381	7	0.317	8
8	Korea, Rep.	1.813	5	0.424	11
9	Lao PDR	5.797	24	0.769	8
10	Macao, China	1.663	3	0.503	8
11	Malaysia	3.594	13	0.555	8
12	Mongolia	3.781	15	1.187	9
13	Myanmar	3.770	14	0.864	8
14	Philippines	4.030	17	0.639	8
15	Singapore	1.679	4	0.175	27
16	Vietnam	3.225	12	1.217	11
17	Thailand	2.416	8	0.717	11
18	Afghanistan	6.962	25	0.139	5
19	Bangladesh	4.063	18	1.251	10
20	Bhutan	5.448	21	0.408	4
21	India	3.827	16	0.848	8
22	Maldives	5.450	22	1.204	8
23	Nepal	5.059	20	0.821	9
24	Pakistan	5.571	23	0.937	10
25	Sri Lanka	2.602	9	0.644	8
	Asia	3.104		1.633	264
	East Asia	2.604		1.326	
	South Asia	4.734		1.473	

Table 2. Panel Data Analysis with Endogenous Female Labor Participation

	Asia		East Asia		South Asia	
	FE	RE	FE	**RE**	**FE**	RE
Constant		6.813 (4.24) [2.85]		6.094 (3.14) [3.31]		11.284 (4.24) [3.06]
Female labor participation Rates	-0.123 (-3.54) [-2.09]	-0.099 (-4.29) [-2.80]	-0.054 (-0.99) [-0.54]	-0.077 (-2.52) [-2.95]	-0.056 (-2.21) [-3.01]	-0.086 (-3.26) [-1.23]
Age structure	1.425 (0.75) [0.55]	4.229 (2.34) [2.14]	3.122 (1.78) [1.37]	3.885 (2.28) [2.09]	-10.175 (-3.78) [-3.88]	-1.593 (-0.36) [-0.18]
Income ($1,000)	0.036 (1.11) [1.08]	0.054 (1.70) [2.00]	0.030 (0.98) [0.87]	0.037 (1.32) [1.44]	-0.947 (-4.59) [-6.21]	-1.786 (-5.19) [-3.71]
Urban Population	-0.070 (-5.97) [-3.04]	-0.045 (-6.19) [-4.97]	-0.052 (-4.42) [-2.98]	-0.039 (-5.51) [-5.23]	-0.224 (-11.88) [-11.61]	-0.011 (-0.49) [-0.27]
no of obs	138	138	98	98	40	40
R2-within	0.508	0.486	0.512	0.504	0.943	0.598
R2-between	0.508	0.539	0.487	0.499	0.007	0.958
R2-oversall	0.488	0.534	0.459	0.498	0.144	0.731
Hausman test	16.53		4.97		72.46	
p-value	0.000		0.174		0.000	
Decision	FE		RE		FE	

Note: The dependent variable is total fertility rate (births per woman). Of the independent variables, female labor force is percentage of total labor force, *pppgdp* is for PPP GDP per capita and urban population is calculated from the percentage of urban population. The values in the parentheses are t-statistics and those in the brackets are Huber/White/ Sandwich robust t-statistics within country correlation.

Table 3. Relevance of Adult Female literacy Rate as an Instrumental Variable

	Asia		East Asia		South Asia	
	FE	**RE**	**FE**	RE	**FE**	RE
Constant		44.505 (8.98) [7.74]		40.738 (9.24) [6.07]		8.657 (0.52) [0.20]
Adult Female Literacy rate	0.124 (2.29) [0.85]	0.149 (3.73) [2.11]	0.050 (1.05) [0.63]	0.134 (3.45) [1.92]	-0.233 (-1.99) [-0.84]	-0.124 (-2.02) [-1.31]
Age structure	-21.737 (-2.96) [-1.69]	-23.436 (-3.34) [-2.52]	-10.003 (-1.79) [-1.39]	-15.494 (-2.71) [-2.90]	15.817 (0.97) [0.80]	54.275 (2.08) [0.78]
Income ($1,000)	-0.200 (-0.93) [-0.49]	-0.277 (-1.43) [-1.25]	0.106 (0.65) [0.57]	-0.134 (-0.88) [-0.90]	7.647 (4.84) [2.76]	8.571 (2.62) [1.83]
Urban Population	0.016 (0.22) [0.10]	-0.036 (-0.69) [-0.50]	0.118 (2.08) [1.51]	-0.0002 (-0.01) [-0.00]	0.052 (0.30) [0.18]	-0.637 (-5.05) [-2.19]
no of obs	90	90	57	57	33	33
R2-within	0.519	0.515	0.776	0.729	0.728	0.340
R2-between	0.070	0.145	0.282	0.041	0.004	0.573
R2-oversall	0.070	0.115	0.150	0.000	0.016	0.547
Hausman test	1.81		9.07		31.27	
p-value	0.612		0.028		0.000	
Decision	RE		FE		FE	

Note: The dependent variable is female labor force participation rate. Adult female literacy rate is measured as the percentage of literate females ages 15 and above.

Table 4. Instrumental Variable Regressions in Panel Data

	Asia		East Asia		South Asia	
	FE	**RE**	FE	**RE**	FE	**RE**
constant		19.129		19.406		7.176
		(3.73)		(3.12)		(1.07)
Female labor	-0.768	-0.305	-0.804	-0.292	0.177	0.228
participation	(-2.18)	(-3.74)	(-0.85)	(-2.59)	(1.23)	(1.21)
Age structure	-17.385	-3.153	-7.111	-3.412	-11.485	-16.783
	(-1.83)	(-0.69)	(-0.69)	(-0.84)	(-2.53)	(-1.21)
Income	-0.099	0.001	0.103	-0.022	-0.002	-3.060
($1,000)	(-0.62)	(0.01)	(0.45)	(-0.26)	(-2.72)	(-3.00)
Urban	-0.001	-0.048	0.054	-0.041	-0.173	0.167
population	(-0.02)	(-3.41)	(0.33)	(-2.69)	(-3.90)	(1.41)
no of obs	90	90	57	57	33	33
Hausman test	3.88		0.44		3.10	
p-value	0.275		0.931		0.377	
decision	RE		RE		RE	

Table 5. Robust Check – models including South and North Korea, Hong Kong and Japan

(A) The first stage regression

	Asia		East Asia	
	FE	**RE**	**FE**	RE
constant		44.505 (8.98) [7.74]		40.738 (9.24) [6.07]
Adult Female literacy rate	0.118 (3.63) [1.44]	0.135 (4.68) [2.11]	0.079 (2.97) [1.12]	0.118 (4.51) [1.93]
Age structure	-14.226 (-3.05) [-1.48]	-15.482 (-3.36) [-1.85]	-4.868 (-1.44) [-0.79]	-7.209 (-1.98) [-1.44]
Income Unit-$1000	-0.067 (-0.80) [-0.39]	-0.091 (-1.10) [-0.65]	0.083 (1.40) [0.68]	0.026 (0.42) [0.26]
Urban population	0.016 (0.44) [0.25]	-0.021 (-0.66) [-0.46]	0.060 (2.97) [1.05]	0.0002 (0.01) [0.00]
no of obs	138	138	98	98
R2-within	0.515	0.510	0.708	0.689
R2-between	0.037	0.086	0.386	0.194
R2-oversall	0.072	0.123	0.168	0.019
Hausman test	5.84		31.25	
p-value	0.120		0.000	
decision	RE		FE	

(B) The second stage regression

	Asia		East Asia	
	FE	**RE**	FE	**RE**
constant		19.129 (3.73)		14.070 (2.26)
Female labor participation	-0.594 (-3.39)	-0.305 (-4.56)	-0.278 (-1.45)	-0.258 (-1.69)
Age structure	-6.661 (-1.59)	-1.168 (-0.41)	1.708 (0.76)	1.725 (0.84)
income Unit-$1000	0.030 (0.57)	0.030 (0.73)	0.059 (1.44)	0.055 (1.57)
Urban population	-0.018 (-0.70)	-0.049 (-5.31)	-0.027 (-1.09)	-0.030 (-1.61)
no of obs	138	138	98	98
Hausman test	3.76		0.08	
p-value	0.289		0.994	
decision	RE		RE	

Note that we fill missing values of female literary variable for South and North Korea, Hong Kong and Japan with those of Singapore

Figure 1. Age structure and the total fertility rates