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Population and Health Series

No. 120, May 2009

Population Policy, Economic Reform, and Fertility Decline in Guangdong Province, China

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Abstract

This paper examines Guangdong's fertility decline between 1975 and 2005 and analyzes how it has been influenced by both fertility policy and economic development. Guangdong's economic development has been very rapid and has attracted huge numbers of migrants from other provinces. The effect of this migration on Guangdong's fertility is an important part of the story. Measures of fertility and nuptiality employed in the analysis include the total fertility rate, parity progression ratios, mean age at first marriage, mean age at first birth, and mean closed birth interval between first and second birth. These measures are calculated from birth histories reconstructed from data from China's 1990 and 2000 censuses and 2005 mini-census. An overlapping-trend analysis provides indications of the accuracy of the estimates.

China’s one-child policy, announced in 1979, has been a major cause of the country’s continued fertility decline since then (Hesketh et al. 2005; Attainé 2006; Potts 2006). Economic development, accelerated by economic reforms commencing in 1978, has also contributed to this fertility decline (Tien 1984; Peng 1993; Poston and Gu 1987). This paper focuses on Guangdong province and shows how both fertility policy and economic development have affected the trend in fertility in the province.

Guangdong is of particular interest because, among major provinces, it has experienced faster economic growth than any other province. As a result of its rapid economic growth, Guangdong has received massive in-migration from other provinces, and this in-migration has also influenced the trend of fertility in the province. Compared with other provinces, Guangdong has also had, until 1998, a relatively lenient fertility policy. The combination of rapid development and relatively high fertility in Guangdong has puzzled policy makers and demographers both inside and outside of China (Documents 1983; Feeney and Wang 1993; Akkerman and He 1998, 1999; Schultz and Zeng 1999; Attainé 2001, 2002; Scharping 2003). This paper sheds light on this puzzle by analyzing how both fertility policy and economic development have affected the trend in fertility in Guangdong during the period 1975–2005.

The analysis of the trend in fertility in Guangdong builds on two earlier studies, the first pertaining to all China (Retherford et al. 2005) and the second to provinces of China (Li et al. 2008). Both of these earlier studies were based on microdata samples from China’s 1990 and 2000 censuses and used similar methodology to estimate fertility trends between 1975 and 2000. The present study, pertaining to Guangdong, is based on microdata samples from not only the 1990 and 2000 censuses but also the 2005 mini-census. Trends in fertility and nuptiality are estimated not only for the whole province of Guangdong but also by region, urban/rural residence, migration status, education, and occupation. These estimated trends, supplemented by information on the evolution of Guangdong’s fertility policies, economic policies, and economic and social development, allow analysis of the forces that have been driving fertility decline in the province between 1975 and 2005.

Background

Economic reform

Located strategically along China’s southeast coast, Guangdong is a large semitropical province with a land area of about 179,800 square kilometers and a population of 86.4 million in 2000 (SBG 2001). The province is almost twice the size of South Korea in both land area and population (SBG 2001; Johnson 2003). Hainan was part of Guangdong province until 1988, when it became a separate province. Our pre-1988 fertility estimates for Guangdong do not include Hainan.

Guangdong’s economic core is the Pearl River Delta — referred to here as the Delta region — including the provincial capital city of Guangzhou as its regional center. The Delta region, which borders Hong Kong and Macao, covers 23 percent of the total land area of the province (Ye et al. 2003; Huang 2004). The rest of the province — referred to here is the non-Delta region — with the exception of the Han River Delta, consists mainly of relatively infertile hill and mountain lands located mostly in the western, northern, and northeastern areas of the province. These hill and mountain lands constitute about 60 percent of the land area of the province (Johnson 2003).

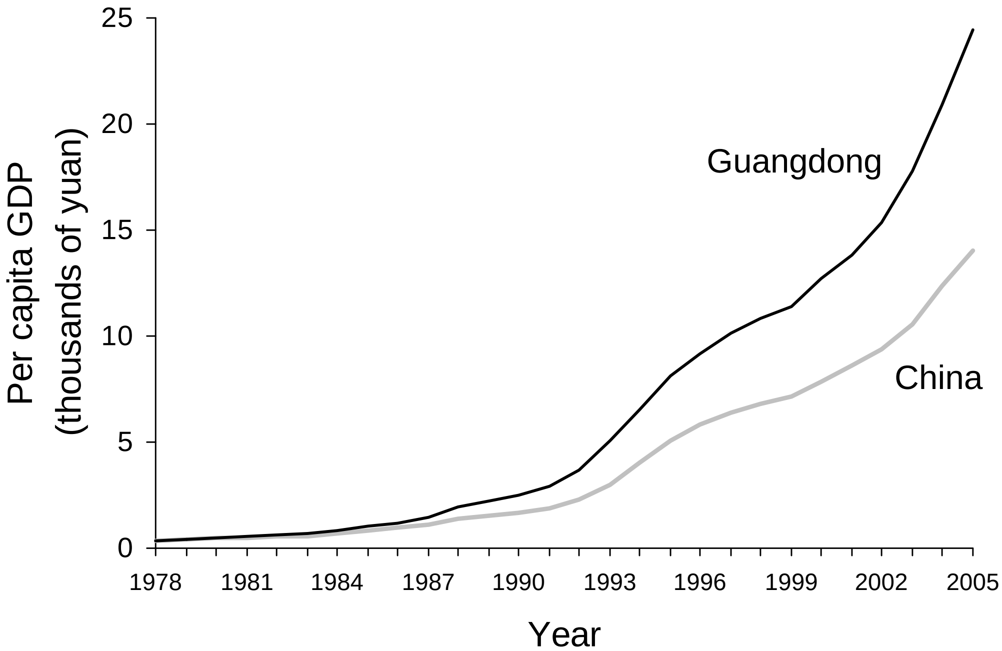
On the eve of the 1978 economic reforms, Guangdong's rural sector, accounting for about 73 percent of the province's population, dominated the province's economy. The rural economy was still organized under the commune system and was semi-subsistent, with about 40 percent of the rural population living below the official poverty line (Vogel 1989; Wen and Zhang 1992; Johnson 1993, 2003; Edmonds 1996; Akkerman and He 1998).

In early 1979, Guangdong was one of the first of a few provinces to start implementing the strategies for economic reform proposed at the Third Plenary Session of the Eleventh Chinese Communist Party Congress held in December 1978. The reform era began with rural reform, first in poor and mountainous areas and soon after in wealthier areas, focusing on a shift from the commune system to the family-centered "household responsibility system". By late 1982, over 90 percent of communes in Guangdong had converted to the new system, compared with 50 percent for the country as a whole (Lin 1988; Vogel 1989; Wen and Zhang 1992).

By mid-1979, Guangdong, as China's "southern gate", and adjacent Fujian province had been granted authority to create Special Economic Zones, in accordance with the central government's new "open-door" policy, intended to attract foreign investment. This reform also gave Guangdong the flexibility to restructure and refocus the provincial economy from agriculture to industry (Johnson 2003). In 1985, the historical core of the Delta region was designated by the State Council as an "Open Economic Region", which was enlarged later to encompass adjacent areas, including some poorer rural counties in the Delta region. The aim was not only to ensure maximization of economic productivity and the attraction of foreign investment but also to promote economic development in the Delta region's vast rural hinterlands (Vogel 1989; Li 1998; Chan 1998).

As a result of these reforms, economic development accelerated, and since 1979 Guangdong has been the fastest-growing province in China. Between 1978 and 2000, Guangdong's annual gross domestic product (GDP) increased from 18.6 billion to 966.2 billion *yuan* (the latter figure equivalent to US$116 billion at an exchange rate of 8.3 *yuan* to the dollar), rising from sixth to first position among China's provinces on this measure. By 2005, provincial GDP had increased to 2,236.7 billion yuan (US$273 billion), again the highest among the 31 provinces. In 2000, Guangdong ranked fourth on average per capita GDP, behind the Shanghai, Beijing, and Tianjin centralized municipalities and Zhejiang province (NBS 2001; SBG 2001), and in 2005 it ranked fifth (at 24,435 yuan, slightly behind Jiangsu province at 24,560 yuan) (NBS 2006: 66). Figure 1 shows trends in per capita GDP for China and Guangdong between 1978 and 2005. Before 1980, Guangdong's per capita GDP was slightly below the national average, but between 1978 and 2005, Guangdong's per capita GDP increased from 370 to 24,435 *yuan*, well above the national average of 14,040 *yuan* (NBS 2006: 57, 66; GPBS and GSONB 2007: 74).

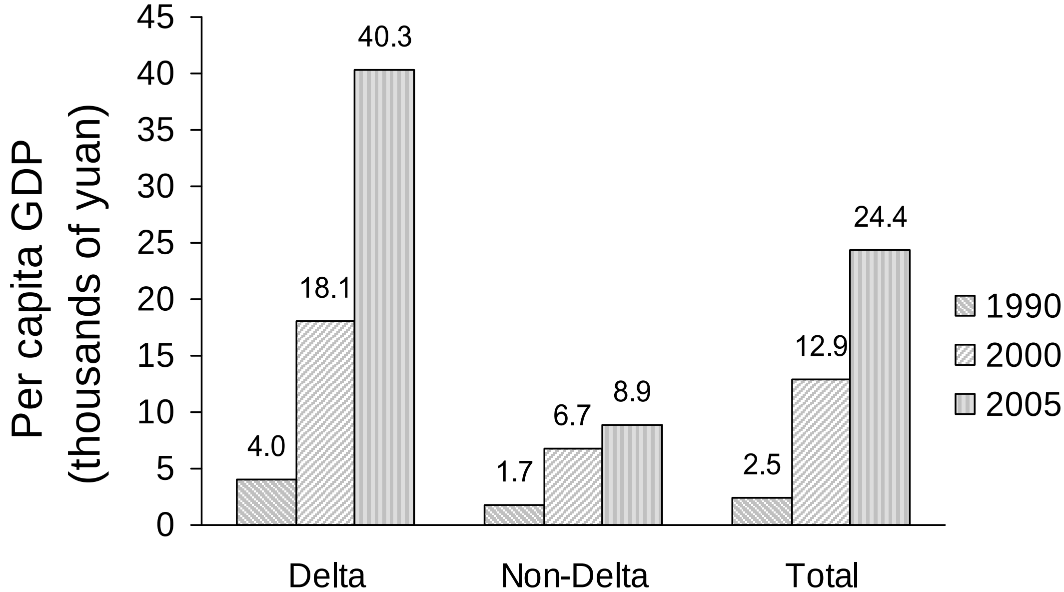
FIGURE 1 Trends in per capita GDP in China and Guangdong province, 1978-2005



Data sources: NBS 2006: 57; GPBS 2006: 105, 486. The exchange rate (yuan per U.S. dollar) was 1.7 in 1981, 8.3 in 2000 and 8.2 in 2005.

The economic growth estimates for Guangdong province mask large regional disparities within the province (Johnson 1995). Figure 2 shows that between 1990 and 2005, per capita GDP was initially much higher and grew faster in the Delta region than in the province as a whole. Per capita GDP increased from 4.0 to 40.3 thousand *yuan* in the Delta region, and from 1.7 to 8.9 thousand *yuan* in the non-Delta region (GPBS and GSONBS 2007). As of 2000, the non-Delta region was still primarily agricultural with numerous pockets of poverty (Johnson 2003). Large differences persist between the two regions, even when one restricts comparison to rural areas. In 2000, rural per capita net income was 5.4 thousand *yuan* in the Delta region and 3.7 thousand *yuan* or less in non-Delta areas (Bai 2004). An understanding of fertility trends in the province requires consideration of these regional differences in both level and pace of development.

FIGURE 2 Per capita GDP in Guangdong province by region, 1990, 2000, and 2005



Data sources: GPBS 2001: 89, 626; GPBS and GSONBS 2007: 77, 553; Ye et al. 2003. Values for the non-Delta region were calculated by the authors.

Fertility policy

During the "later-longer-fewer" (later marriage, longer birth intervals, fewer children) period between 1971 and 1979, Guangdong's government adopted a two-child policy for both urban and rural areas. Available evidence indicates that the population control campaign in the province during this period was no more lenient or harsh than in other provinces (Akkerman and He 1999).

After the announcement of the one-child policy in 1979, Guangdong was the first province to establish birth-planning regulations, which were approved by the Standing Committee of the Guangdong Provincial People's Congress in February 1980 (Yang 1994; Scharping 2003). The new regulations stressed the importance of reducing fertility to one child per couple, but they also allowed the provincial government to continue granting second-child permits to all citizens who applied for them after a minimum birth interval of four years (Tien 1991: Appendix, Family Planning Regulations, Guangdong Province 1980, p. 273). In effect, Guangdong's policy remained a two-child policy, more or less the same as it was under the later-longer-fewer policy.

Under pressure from the central government, the provincial government tightened up its fertility policies in 1981. Under revised regulations, departures from the one-child standard were rarely granted in urban areas—for example, when the first child was either dead or disabled. In rural areas, however, the policy did not change much. With some exceptions, only couples with an agricultural household registration could apply for a second-child permit after a birth interval of at least four years (Documents 1983; Scharping 2003: 97). Overall, the 1981 policy approximated a one-child policy in urban areas and a two-child policy in rural areas, and this situation lasted until 1998. Guangdong was able to pursue this relatively lenient variant of the one-child policy because, as an officially designated testing ground for the open-door policy, it enjoyed considerable autonomy and flexibility not only in economic matters but also in how it implemented the one-child policy (Potter and Potter 1990; Akkerman and He 1999; Schultz and Zeng 1999). Despite this relative leniency, Guangdong's policy was restrictive and played an important role in reducing fertility in both urban and rural areas (DRC of Guangdong Province 1999).

A major tightening of Guangdong's fertility policy was initiated on October 18, 1998, when the Standing Committee of the Guangdong Provincial People's Congress promulgated the new "Guangdong Provincial Family Planning Regulations" (PFPC of Guangdong Province 1998). The principal change was that in rural areas the policy changed from a two-child policy to what was, in effect, a one-and-a-half-child policy, whereby second-child permits were restricted to agricultural households in which the first child was a girl. The provincial government also set a goal of stricter enforcement of the policy, to be accomplished in steps over a four-year period. These steps aimed at tightening up the "one vote down" cadre-responsibility system and eliminating underreporting of out-of-quota births (DRC of Guangdong Province 2000). The "one vote down" system had been introduced throughout the country already in 1991. Under this system, a cadre's failure to perform adequately in any one of several areas (fertility targets being one of the most important) could result in a reduction in wages or even dismissal from one's job.

In order to motivate conformity with the stricter policy and also to mitigate its harshness, Guangdong's government provided a limited amount of social security pension support as a reward to each agricultural family having only one child or two daughters (but no more than two). Urban families are not entitled to this reward. Governments at various levels (province, city/county, township, and village) are required to make proportional contributions to a one-time lump-sum reward of at least 1,000 *yuan* per agricultural family that observes the new policy, to be used to purchase pension coverage (DRC of Guangdong Province 2000). Pension benefits are small, however, amounting to as little as 80 *yuan* per month at the legal retirement age of 55 for women and 60 for men (PFPC of Guangdong Province 2004). By contrast, the financial penalty for the first out-of-quota birth is substantial, consisting of a fine ranging from 30 to 50 percent of income in the previous year multiplied by seven, amounting to a total of between 2.1 and 3.5 years of annual income. The fine for a second out-of-quota birth is double that of the first, the fine for a third is triple that of the first, and so on (PFPC of Guangdong Province 1998).

Data

The fertility estimates for Guangdong in this study are derived from 1-percent samples from China's 1990 and 2000 censuses and a 20-percent systematic sample from China's 2005

National 1-percent Population Sample Survey, referred to here as the 2005 mini-census. The sample from the 2005 mini-census amounts to a 0.2-percent sample from China's total population. The 1-percent samples from the 1990 and 2000 censuses were obtained by selecting 10-percent systematic samples from the 10-percent samples containing long-form information on fertility, marriage (marital status and, in the 2000 census, age at first marriage), urban/rural residence, migration, education, and occupation. Information on age at first marriage is available in the 2000 census and 2005 mini-census but not in the 1990 census.

Characteristics by which fertility estimates and related measures are tabulated in this paper are region (Delta, non-Delta), residence (city, town, rural), education (elementary or lower, middle school, high school or higher), occupation (administrative/professional, service, farming, operator/laborer, homemaker, unemployed, other), and migration status (migrant, non-migrant).

"Elementary or lower" in our analysis is defined as less than elementary or some or completed elementary, "middle school" as some or completed middle school, and "high school or higher" as at least some high school or higher education. Typically in China the number of years of schooling for completing each of the lower levels of education is six for elementary, three for middle school, and three for high school.

In the 1990 census, occupation is defined as current occupation, and in the 2000 census, it is defined as occupation in the week before the census. Despite this difference in definition, occupational categories are roughly comparable between the two censuses. In the 1990 census, occupations of seasonal workers and other workers with multiple jobs were defined based on their major or longest job during the year before the census. Persons who had a regular job but were temporarily not working at the time of census for reasons of illness, injury, maternity leave, seasonal layoff, or interruptions due to bad weather or technical problems were still classified by their regular occupations (Population Census Office Under the State Council 1990). In the 2000 census, persons who did not work during the week preceding the census because of illness, injury, maternity or vacation leave, training, seasonal work, or temporary layoffs due to power failures or raw materials shortages were still classified as working in the industry and occupation they were in before they left. In both censuses the unemployed category includes persons who were not working but looking for work. And in both censuses the "other" category includes persons who were not working and not looking for work for various reasons, including but not limited to persons with income from investments, patents, rental income, pensions, or other non-wage sources (Population Census Office Under the State Council 2000). The definition of occupation in the 2005 mini-census is similar to that in the 2000 census (National 1% Population Sample Survey Office Under the State Council 2005).

Because occupation can change over time and because occupation is specified only at the time of the census, our fertility estimates by occupation are presented only for the year before each census. It is assumed that a woman's occupation did not change during the year before the census. Occasional violations of this assumption introduce slight errors in the fertility estimates by occupation. Students, among whom births are very rare, are excluded from the occupational classification.

Measuring migration status is more complicated, because the questions relating to migration were not the same in the 1990 and 2000 censuses and the 2005 mini-census. Information on birth place is not available in the 1990 census or the 2005 mini-census. Because of the lack of adequate information on birth place, we could not use birth place in our definition of migration status. Instead, we use two definitions of migration status that are applicable to both the 1990 and 2000 censuses and the 2005 mini-census. We refer to these two definitions as provincial-level migration status and regional-level migration status.

In the provincial-level definition of migration status, non-migrants are registered persons (i.e., registered in the household registration system) who already lived in Guangdong five years ago, but not necessarily at the address at which they were living at the time of the census. Non-migrants include persons who migrated within the province within the last five years before the census, regardless of whether they changed their place of registration within Guangdong. All other persons are defined as migrants, with the following exception: Persons who are currently living in Guangdong, are registered in another province, and have been living away from the place of household registration within that province for less than one year (in the 1990 census) or less than six months (in the 2000 census or the 2005 mini-census) were not enumerated in Guangdong's censuses or mini-census. Instead they were enumerated in their place of household registration in their province of origin.

In the regional-level definition of migration status, non-migrants are persons in either the Delta region or the non-Delta region who were registered at the time of the census in the county where they were currently living at the time of the census. To be classified as non-migrants they must also have been living in the same county five years ago (if enumerated in the 1990 or 2000 census) or anywhere in Guangdong province five years ago (if enumerated in the 2005 mini-census). (The question on whether the respondent was living in the same county five years ago was not asked in the 2005 mini-census.) All other persons are defined as migrants, with the following exceptions: The first exception is the same as the exception described for provincial-level migrants in the preceding paragraph. These persons were enumerated in their place of household registration in their province of origin, not in Guangdong. The second exception is persons who are currently living in Guangdong, who are registered in another county of Guangdong, and have been living away from their place of household registration for less than one year (in the 1990 census) or less than six months (in the 2000 census or the 2005 mini-census). They were not enumerated where they were living at the time of the census but instead at their place of household registration and therefore are defined as non-migrants in their place of household registration.

Migrants, as we define them, are not the same as the "floating population." In the 2000 census (but not in the 1990 census) a person was classified as floating if he or she was not registered in the place where he or she was currently living at the time of the census and had been living away from his or her place of household registration for more than six months. In 2000, Guangdong accounted for 27 percent of China's floating population (Liang and Ma 2004). Within Guangdong in 2000, the floating population accounted for 36 percent of women age 15–49, whereas migrants by our provincial definition accounted for 28 percent, and migrants by our regional-level definition accounted for 38 percent. Among provincial-level migrants, 98 percent were floating, and among regional-level migrants, 93 percent were floating.

Methods

Fertility estimates are calculated using the birth history reconstruction (BHR) method, which is an extension of the own-children method (Cho et al. 1986). The BHR method starts with incomplete birth histories corresponding to "own children", defined as children matched to a mother within the same household. Children are matched by means of a computer algorithm that uses information on each woman's age, sex, marital status, relation to household head, and (if available) number of children ever born and number of children still living. (Questions on children ever born and children still living were both asked in China's 1990 and 2000 censuses and 2005 mini-census and were used for matching.) The year of birth of each own child is derived from the child's age at the time of the census, yielding an "own children" birth history for the mother that may be incomplete, due to missing information on dead children or children living in some other household. In an own-children birth history, own children age 0 were born in the first year before the census, own children age 1 were born in the second year before the census, and so on.

The difference between a woman's number of children ever born (an essential piece of information for application of the BHR method) and the number of own children matched to her equals the number of missing births corresponding to dead children and children living in other households. These missing births are imputed into the incomplete birth history using probabilistic procedures developed by Luther (Cho et al. 1986; Luther and Cho 1988; Luther et al. 1990; Luther and Pejaranonda 1991; Retherford and Luther 1996), yielding a complete reconstructed birth history. For any particular woman, the complete reconstructed birth history is in general only approximately accurate in terms of the year of birth assigned to an imputed birth. But when the birth histories are aggregated in the process of calculating fertility estimates, individual-level errors tend to cancel out, so that the fertility estimates are quite accurate when derived from large samples — unless, of course, other sources of error, such as undercount, under-reporting of children ever born, or age misreporting are also present. Fertility estimates are calculated from the reconstructed birth histories using methods developed by Feeney (1991).

The reconstructed birth histories allow computation of both age-specific fertility rates (ASFRs) and period parity progression ratios (PPPRs) for each of the 15 years prior to the census. Normally (and in this study in particular) one does not go back more than 15 years, because a large fraction of children age 15 or older at the time of the census no longer live in mother's household and therefore cannot be matched to mothers.

A woman's parity is defined as the number of children that she has ever borne. In the analysis, parity zero is sometimes subdivided into two states, one for never-married women with no children and one for ever-married women with no children. Parity transitions are then from a woman's own birth to her first marriage (B–M), from first marriage to first birth (M–1), from first birth to second birth (1–2), and so on. For any given parity transition, a parity progression ratio is simply the fraction of women at the starting parity who eventually progress to the next parity. In the computation of parity progression ratios, a first-marriage event is treated like a birth event. If marital status is ignored, the B–M and M–1 transitions are combined into a single B–1 transition.

A period parity progression ratio (PPPR) is a PPR that is calculated from period data, which in this paper are data for a particular calendar year. A PPPR pertains to the experience of a hypothetical "synthetic" cohort that lives through its reproductive age span experiencing the duration-in-parity-specific birth (or first marriage) rates pertaining to the particular calendar year. PPPRs are calculated by the life table method from these duration-in-parity-specific rates, which are calculated from the reconstructed birth histories and information on age at first marriage. In the case of a birth-to-first-marriage life table, duration in parity is simply the age of the woman. Life tables are truncated at age 40 in the case of the B–M transition and the combined B–1 transition, and at 10 years of duration in parity in the case of higher-order transitions. The justification for these cut-offs is that, in China, first marriages and first births after age 40 and next births after 10 years of duration in parity are rare and have a negligible impact on estimated PPPRs. A PPPR is calculated from a life table as one minus the proportion "surviving" (i.e., still never-married or not yet having had a next birth) at the end of the life table.

We denote the PPPRs and the transitions to which they pertain as

p_M Woman's own birth to her first marriage (B–M)
p_0 First marriage to parity 1 (M–1)
p_1 Parity 1 to parity 2 (1–2)
p_2 Parity 2 to parity 3 (2–3)
p_3 Parity 3 to parity 4 (3–4)
etc.

If marital status is not taken into account, then p_M and p_0 are replaced with

p_B Parity 0, regardless of marital status, to parity 1 (B–1)

A total fertility rate (births per woman over the entire reproductive age span 15–49) can be calculated from either ASFRs or PPPRs. TFR_{asfr} is calculated in the usual way as five times the sum of the ASFRs in 5-year age groups. TFR_{pppr} is calculated from PPPRs using the formula

$$TFR_{pppr} = p_B + p_B\, p_1 + p_B\, p_1\, p_2 + p_B\, p_1\, p_2\, p_3 + p_B\, p_1\, p_2\, p_3\, p_4 + \ldots \qquad (1)$$

In this paper, TFR_{pppr} is always calculated using p_B in place of p_M and p_0. When using equation (1), PPPRs are specified out to the highest parity observed.

TFR_{asfr} and TFR_{pppr} are usually but not always close to each other. In the previously-mentioned province-level report (Li et al. 2008), TFR_{asfr} and TFR_{pppr} are found to differ by as much as 0.7 child but usually much less than this.

The life tables of parity progression also allow calculation of "mean failure time," where a "failure" is either a first marriage (in the case of the B–M transition) or a next birth (in the case of higher-order transitions). In the case of the B–M transition, mean failure time is mean age at first marriage (A_m), and in the case of the B–1 transition, mean failure time is mean age at first birth (A_1). In the case of the M–1 and higher-order transitions, mean failure time is mean closed birth interval. The mean failure times so calculated are also period measures, because they are derived from period life tables of parity progression.

The mean age at first marriage, A_m, calculated in this way is conceptually superior to the singulate mean age at marriage (SMAM), which is also calculated by the life table method. The reason is that A_m is a pure period measure whereas SMAM is not. A_m is derived from a life table that is calculated from age-specific first-marriage rates that pertain strictly to the time period of interest (in our analysis, a one-year time period). SMAM, on the other hand, is derived from a life table calculated from age-specific proportions single (never-married), which, especially at the older ages, reflect first marriages that occurred a number of years in the past as well as in the year before the census. A_m is also conceptually superior to the mean age at marriage (MAM) calculated as the arithmetic mean of ages at marriage for marriages that actually occurred in a particular calendar year. The reason is that MAM is affected by the composition of the population by age and marital status, whereas A_m is not (Feeney and Wang 1993).

In the analysis, years of time (as opposed to years of age) are always "years before the census", which run from 1 July to 30 June for estimates derived from the 1990 census and from 1 November to 31 October 2000 for estimates derived from the 2000 census and the 2005 mini-census. The two censuses and the mini-census were each enumerated in a single day: 1 July for the 1990 census and 1 November for the 2000 census and the 2005 mini-census. The year before the 2000 census falls mainly in 2000 and is therefore labeled as 2000. Years before the 2000 census are accordingly labeled 2000, 1999, and so on. Similarly, years before the 2005 mini-census are labeled 2005, 2004, and so on. The 1990 census was taken at mid-year on 1 July, so the labeling of years before the census is more arbitrary. We have chosen to label years before the 1990 census as 1990, 1989, and so on. For some years, fertility estimates can be derived from more than one census or mini-census. In the case of estimates for 1990, for example, fertility estimates can be derived alternatively from the 1990 census or the 2000 census. The correspondence is not exact, however. Estimates for 1990 derived from the 1990 census correspond to the period 1 July 1989 to 31 June 1990, whereas estimates for 1990 derived from the 2000 census correspond to the period 1 November 1989 to 31 October 1990. We make no adjustments for this lack of perfect correspondence.

Findings

Changes in population composition

Table 1 shows how the three census samples of women age 15–49 are distributed on the characteristics by which fertility trends are estimated. Regarding age distribution, population proportions mostly declined at the younger reproductive ages and increased at the older ages. This population aging trend was much more marked in the non-Delta region than in the Delta region, because of heavy migratory flows of young adults into the Delta region. Proportions currently married fell dramatically at the younger reproductive ages and by 2005 were especially low in the Delta region. Proportions married declined steeply between 1990 and 2000 but changed little between 2000 and 2005. The proportion living in cities or towns, the proportion with high education, and the proportion in non-farm occupations were much higher in the Delta region than in the non-Delta region in all three censuses and increased greatly from one census to the next. Between 1990 and 2005, the proportion of the population working as farmers fell from 51 to 21 percent. A curious finding is that the proportions who were students in 2000 and 2005 were higher in the non-Delta region than in the Delta region. The explanation is migration of non-students from the non-Delta region to the Delta region for work in factories. If one repeats the tabulation in Table 1 for non-migrants alone (not shown), the proportions who were students in 2000 and 2005 are approximately the same in the Delta and non-Delta regions.

The migration flows between 1990 and 2000 were enormous. As shown in Table 1, between 1990 and 2000 the proportion of the population who were provincial-level migrants increased from 4 to 27 percent, the proportion who were regional-level migrants increased from 11 to 36 percent, and the ratio of provincial-level to regional-level migrants increased from 34 to 75 percent. The bulk of the migration was to the Delta region. The proportion who were migrants leveled off between 2000 and 2005, but this does not mean that the volume of migration declined to low levels. Because the vast majority of migrants migrated within the last five years and are floating, the leveling off of the proportion who were migrants implies that the bulk of persons who were migrants in 2000 were replaced by a new wave of migrants in 2005. For the proportion who were migrants to have remained approximately the same, the new 5-year wave of migrants between 2000 and 2005 actually had to be somewhat larger than the previous 5-year wave of migrants between 1995 and 2000, because Guangdong's population grew between 2000 and 2005.

Trend in TFR_{asfr}

Figure 3 shows trends in TFR_{asfr} for all women in China and for non-migrant women in Guangdong province. Two trends are shown for non-migrant women, corresponding to the regional-level and provincial-level definitions of migration status discussed earlier. The figure focuses on non-migrant women rather than all women in Guangdong, because many migrants come from other provinces and because we wish to link Guangdong's fertility more clearly to influences within the province. In Figure 3 and subsequent figures, it should be borne in mind that some of the women classified as non-migrant at the time of the census were migrants more than five years ago, and some resided outside Guangdong province more than five years ago.

Figure 3 shows that TFR_{asfr} for non-migrant women in Guangdong declined from 3.8 in 1975 to 3.0 in 1978, on the eve of economic reform. The value of 3.0 in 1978 was the same as the national average in that year. Guangdong's TFR_{asfr} then rose sharply in 1979 and slightly more in 1980. This fertility increase likely occurred because, as mentioned earlier, Guangdong's two-child policy did not change until 1981, and because Guangdong shifted rapidly, starting in early 1979, from the commune system to the household responsibility system in rural areas. The shift to the household responsibility system apparently increased the economic benefit of child labor on what was now the family's land, thereby increasing the desire for children (Ku 2003).

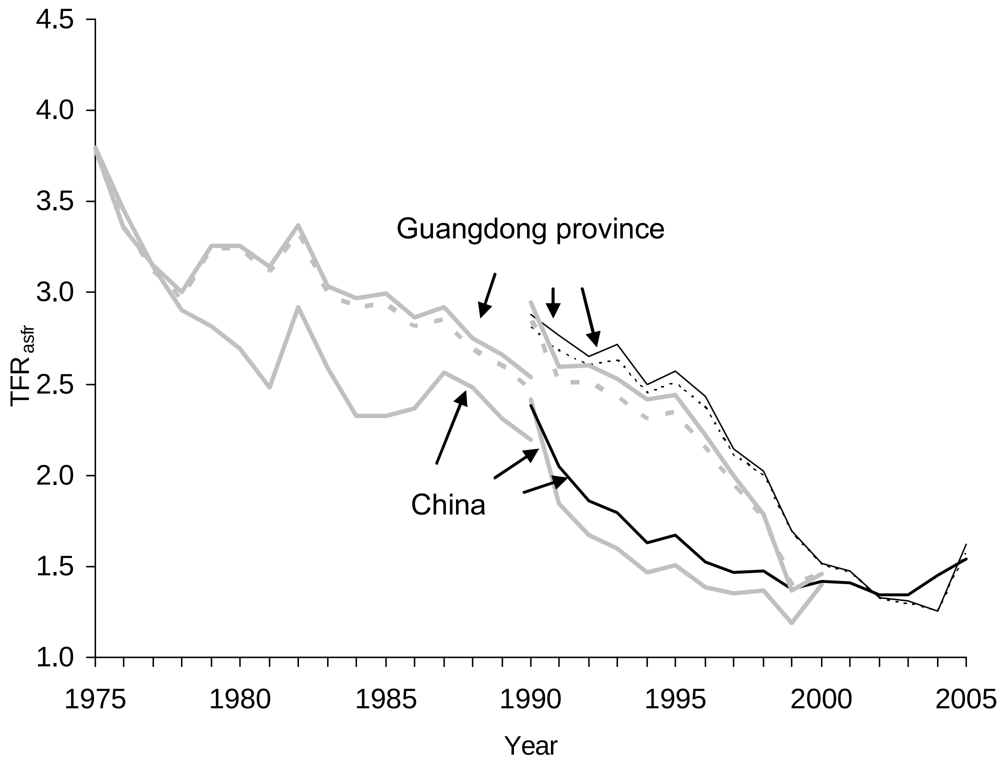
The change in the one-child policy in Guangdong in 1981, which ceased to allow (with minor exceptions) second-child permits in urban areas, probably explains the downward turn in TFR_{asfr} in Guangdong in that year. This was followed by an upward spike in TFR_{asfr} in 1982 in both China and Guangdong, probably due mainly to the delayed effect of the new marriage law of 1980 on fertility. Just prior to 1980, the later-longer-fewer policy specified a minimum age at

Table 1 Distribution of women aged 15-49 by characteristics, Guangdong province, derived from the 1990 and 2000 censuses and the 2005 mini-census (percent)

	Delta			Non-Delta			Total		
Variable	1990	2000	2005	1990	2000	2005	1990	2000	2005
Current age									
15-19	20.7	19.8	16.8	19.2	16.1	18.0	19.8	18.2	17.4
20-24	21.9	24.2	22.6	19.8	10.7	10.8	20.6	18.4	17.3
25-29	16.1	19.1	15.7	17.5	15.1	11.2	17.0	17.4	13.7
30-34	13.6	14.2	16.2	14.5	17.5	14.4	14.2	15.6	15.4
35-39	12.4	10.2	12.9	12.9	16.0	16.9	12.7	12.6	14.7
40-44	9.2	6.5	9.6	8.8	12.8	16.1	9.0	9.2	12.5
45-49	6.1	6.1	6.2	7.3	11.8	12.7	6.8	8.5	9.1
Percent currently married									
15-19	1.4	0.5	0.6	5.5	1.0	0.5	3.9	0.7	0.6
20-24	26.3	16.9	18.3	52.3	35.9	29.7	41.7	21.6	21.5
25-29	80.6	72.6	70.6	90.6	83.7	76.4	86.9	76.7	72.7
30-34	95.6	91.8	92.0	98.3	95.7	94.6	97.3	93.7	93.1
35-39	97.3	95.1	95.3	98.3	97.4	96.7	98.0	96.3	96.0
40-44	96.9	95.6	95.1	97.1	97.1	96.5	97.0	96.5	95.9
45-49	94.3	94.9	94.4	94.2	95.5	95.3	94.2	95.2	94.9
Region									
Delta	--	--	--	--	--	--	38.4	57.2	55.4
Non-Delta	--	--	--	--	--	--	61.6	42.8	44.6
Residence									
City	47.1	52.2	67.7	15.8	23.0	31.1	27.8	39.7	51.4
Town	12.5	22.2	14.2	13.3	21.8	19.6	13.0	22.0	16.7
Rural	40.4	25.6	18.0	70.9	55.2	49.3	59.2	38.2	32.0
Migration status (provincial level)									
Non-migrant	92.3	54.2	52.9	98.6	96.5	97.2	96.2	72.3	72.7
Migrant	7.7	45.8	47.1	1.4	3.5	2.8	3.8	27.7	27.3
Migration status (regional level)									
Non-migrant	76.8	38.5	38.5	96.2	92.8	94.8	88.8	61.7	64.5
Migrant	23.2	61.5	61.5	3.8	7.3	5.2	11.2	38.3	35.5
Education									
Elementary or lower	41.1	19.2	15.4	62.9	42.2	32.1	54.5	29.0	22.9
Middle school	40.2	55.9	53.1	28.2	43.2	50.6	32.8	50.5	52.0
High school or higher	18.7	24.9	31.4	9.0	14.6	17.3	12.7	20.5	25.1
Occupation									
Administrative/professional	9.2	10.6	11.3	3.7	6.1	7.6	5.8	8.7	9.7
Service	11.5	16.4	19.1	4.8	7.9	8.9	7.4	12.8	14.5
Operator/laborer	30.8	43.3	38.5	12.9	12.0	15.4	19.8	29.9	28.2
Farmer	34.6	11.2	8.4	61.5	47.0	35.7	51.2	26.5	20.6
Unemployed	2.1	3.7	3.7	1.4	3.5	3.2	1.7	3.6	3.5
Homemaker	4.4	8.1	10.1	9.6	12.7	12.7	7.6	10.1	11.3
Student	6.5	5.1	6.6	5.4	9.3	14.3	5.8	6.9	10.0
Other	0.9	1.6	2.3	0.7	1.5	2.3	0.8	1.6	2.3
Sample size (n)	62,468	138,383	40,435	100,071	103,587	32,603	162,539	241,970	73,038

Notes: Figures shown for the 2005 mini-census are based on the weighted sample. For definitions of migration status, see text.
Source: Computed from sample data from the 1990 and 2000 censuses and the 2005 mini-census.

FIGURE 3 Trends in TFR_{asfr} for all women in China and non-migrant women in Guangdong province, derived from the 1990 and 2000 censuses and 2005 mini-census



Note: Gray lines (solid or dashed) indicate trends derived from the 1990 and 2000 censuses, and black lines (solid or dashed) indicate trends derived from the 2005 mini-census. In the case of Guangdong, solid lines (gray or black) indicate trends for regional-level non-migrants, and dashed lines (gray or black) indicate trends for provincial-level non-migrants. Trends based on the 2000 census go back only 10 years instead of 15 years, because the question on children ever born was asked only of ever-married women below age 50 (rather than 65, as in the 1990 census and the 2005 mini-census).

marriage for women of 23 years in rural areas and 25 years in urban areas, whereas the 1980 law specified a legal minimum age of 20 years for women and 22 for men throughout the country (Choe et al. 1996). In 1983 TFR_{asfr} fell sharply in both Guangdong and China, probably because of the tightening-up of the one-child policy that occurred in 1981 in urban areas and 1982 in rural areas in reaction to the sharp increase in births in 1982 (Greenhalgh 1986; Short and Zhai 1998). A second upward spike occurred in 1985–87, because of a relaxation of the one-child policy following the "open a small hole" policy shift in 1984 (Scharping 2003; Luther et al. 1990). This spike was smaller for Guangdong than for China, probably because Guangdong's implementation of the one-child policy was already relatively lenient, inasmuch as second-child permits were still routine in rural Guangdong. Enforcement of the one-child policy was tightened up again around 1990 throughout China but less so in Guangdong (Scharping 2003), resulting in an acceleration of fertility decline during 1990–91 that was more pronounced in China as a whole than in Guangdong.

Already in 1996, before Guangdong's 1998 policy shift from what was, in effect, a two-child policy to a 1.5-child policy in rural areas, TFR_{asfr} started declining faster in Guangdong than in China, and it declined faster yet in Guangdong after the 1998 policy shift. The downturn in fertility that commenced in 1996 suggests that there may have been some additional tightening-up of the existing policy in the lead-up to the 1998 policy shift. The downward spike in 1999 and the upward spike in 2000 may have occurred because of births deferred to 2000, which was an unusually propitious year to have a birth, since it was not only the year of the dragon (generally considered to be a propitious year) but also the first year of the new millennium. The new millennium may have been a more important factor, because there was no upward spike in the previous year of the dragon in 1988. (A downward spike in 1999 and an upward spike in 2000 also occurred in Taiwan under a very different set of circumstances (H. N. Chen 2005)). For reasons that are not clear, the TFR_{asfr} estimates derived from the 2005 mini-census do not show a downward spike in 1999 and an upward spike in 2000 for Guangdong.

Figure 3 also shows that Guangdong's rapidly falling TFR_{asfr} reached the same level as China's TFR_{asfr} in 2002, after which TFR_{asfr} rose slightly in both Guangdong and China. This slight rise may have resulted, at least in part, from a short-term income effect associated with extremely rapid growth in per capita GDP after 2002, especially in Guangdong (Figure 1). Steeply rising per capita income appears to have been a contributing cause of a concomitant decline in mean age at first marriage and mean age at first birth in Guangdong (discussed in more detail later), resulting in a temporary bunching of births in calendar time. It is likely this timing effect or "tempo effect," as it is often referred to by demographers, is part of the mechanism by which steeply rising income contributed to the slight rise in TFR_{asfr} after 2002. Another noteworthy feature of Figure 3 is that, regardless of which of the two definitions of migration status is used, the estimated trend in TFR_{asfr} for non-migrants in Guangdong is close to the same.

In Figure 3, the estimate of TFR_{asfr} for 1990 based on the 2000 census and the estimate of TFR_{asfr} for 1990 based on the 2005 mini-census are both higher than the estimate of TFR_{asfr} for 1990 based on the 1990 census, and this true for both China and Guangdong. The estimates based on the 1990 census are almost certainly too low, for the following two related reasons: (1) Births in 1990 derived from the 1990 census are estimated by reverse-surviving 0-year-olds enumerated in the 1990 census, whereas births in 1990 derived from the 2000 census are estimated by reverse-surviving 10-year-olds in the 2000 census, and births in 1990 derived from the 2005 mini-census are estimated by reverse-surviving 15-year-olds in the 2005 mini-census; and (2) 0-year-olds in the 1990 census whose births were out-of-quota were more likely to be underreported than 10-year-olds in the 2000 census whose births were out-of-quota or 15-year-olds in the 2005 mini-census whose births were out-of-quota, because a couple newly discovered to have had an out-of-quota birth in the last year were more likely to be punished than a couple newly discovered to have had an out-of-quota birth 10 or 15 years ago.

Comparison of the trend in TFR_{asfr} between 1990 and 2000 estimated alternatively from the 2000 census and the 2005 mini-census shows systematic discrepancies between the two trends for both Guangdong and China, as also shown in Figure 3. Except for 1990, the estimates of TFR_{asfr} derived from the 2005 mini-census are always higher than the estimates of TFR_{asfr} derived from the 2000 census. The likely reasons are similar to the two reasons given in the preceding paragraph. The births that underlie a TFR_{asfr} estimate for any given year in the 1990s are calculated by reverse-surviving children who are five years older at time of enumeration in the 2005 mini-census than they are at time of enumeration in the 2000 census and therefore less likely to go unreported in the 2005 mini-census than in the 2000 census. It is also possible, but by no means clear, that coverage of single women, many of whom were temporary migrants working in factories, may have been less complete in the 2005 mini-census, which was a sample census, than in the 2000 census, which covered the entire population. Undercoverage of single women would have the effect of biasing upwardly the estimates of ASFRs and TFR_{asfr}.

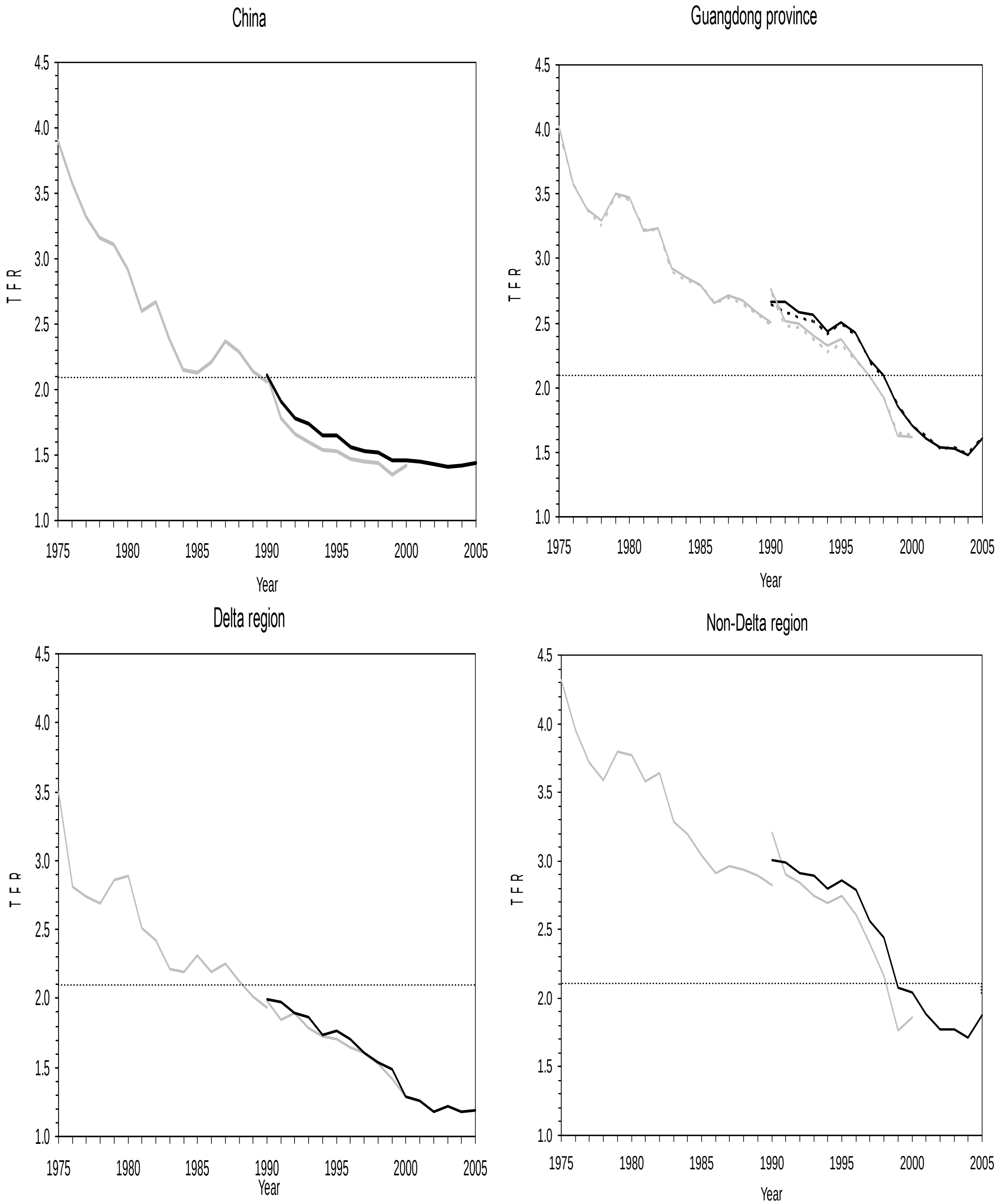
Trends in TFR_{pppr} and PPPRs

The analysis in the remainder of this paper focuses on TFR_{pppr} and its components (PPPRs, mean age at first marriage A_m, mean age at first birth A_1, and mean closed birth intervals) rather than TFR_{asfr} and ASFRs — the main reason being that PPPRs (especially the PPPR for the 1–2 transition) are more useful than ASFRs for analyzing the effects of the one-child policy on fertility. Figure 4 shows trends in TFR_{pppr} for all women in China and non-migrant women in Guangdong and regions of Guangdong. The trends in TFR_{pppr} in Figure 4 and TFR_{asfr} in Figure 3 are broadly the same, differing by as much as 0.2 child but usually less. Again it is noteworthy that, in Figure 4 as in Figure 3, which of the two definitions of migration status is used makes almost no difference in the fertility estimates.

In Guongdong, the decline in TFR_{pppr}, like the decline in TFR_{asfr}, accelerated after 1996. Below-replacement fertility was achieved at the national level in 1990 but only in the late 1990s in Guangdong province. As shown in the lower half of Figure 4, the lagged decline and acceleration was confined mainly to the non-Delta region, where fertility was much higher than in the Delta region. TFR_{pppr} in the Delta region not only declined just as rapidly as the national average after 1975, but also fell below replacement in 1989, one year before the national average fell to that level. TFR_{pppr} in the non-Delta region was much higher than the national average and reached replacement level only in the late 1990s. The slight recovery of TFR_{pppr} after 2002 was also confined mainly to the non-Delta region. The trend overlaps between 1990 and 2000 are very close for the Delta region but not for the non-Delta region, indicating that the problem of underreporting of out-of-quota births was largely confined to the non-Delta region during this period.

The apparently accurate TFR_{pppr} trends for the Delta region at least since 1990 indicate that TFR_{pppr} for non-migrant women in this region fell to about 1.6 births per woman even before Guangdong implemented more restrictive fertility regulations in 1998. Apparently in response to the new regulations, TFR_{pppr} for non-migrants in the Delta region fell even faster after 1998, reaching 1.3 in 2000. These findings for non-migrant women in the Delta region do not support the speculation (e.g., Shi 2003; W. Chen 2005) that Guangdong's low fertility since 2000 is explained partly by a large influx of inter-provincial migrants with relatively low fertility.

FIGURE 4 Trends in TFR_{pppr} for all women in China and non-migrant women in Guangdong and regions of Guangdong, derived from the 1990 and 2000 censuses and 2005 mini-census



Note: Gray lines (solid or dashed) indicate trends derived from the 1990 and 2000 censuses, and black lines (solid or dashed) indicate trends derived from the 2005 mini-census. In the case of Guangdong, solid lines (gray or black) indicate trends for regional-level non-migrants, and dashed lines (gray or black) indicate trends for provincial-level non-migrants.

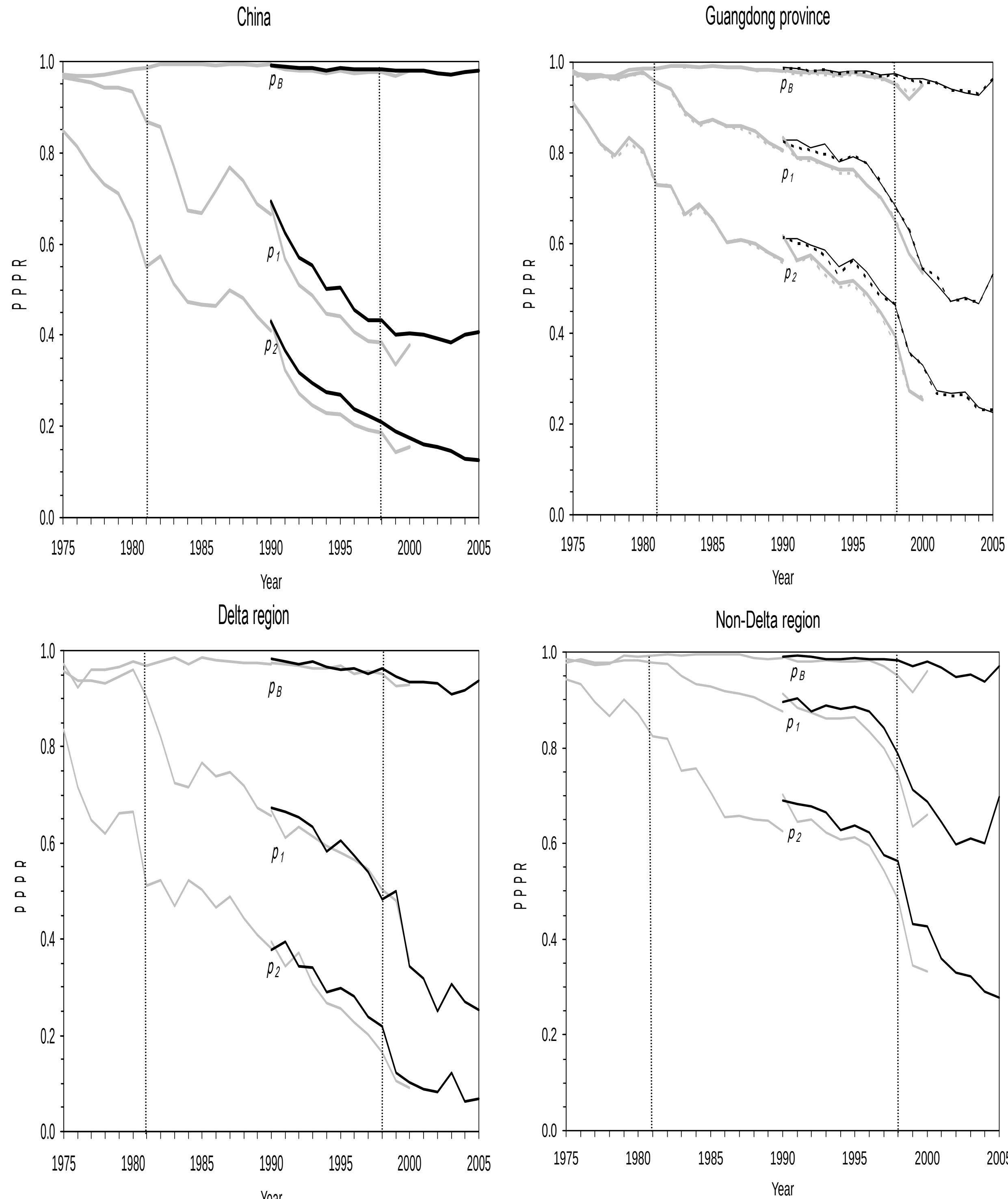
Additional evidence in support of this conclusion is that in every year since 1995 in the Delta region, TFR_{pppr} has been higher for all women than for non-migrant women (estimates not shown), indicating higher fertility of recent migrants than of non-migrants. These findings for non-migrant women in the Delta region are especially important for understanding the contribution of inter-provincial migration to Guangdong's fertility decline, because the vast bulk of inter-provincial migration has been to the Delta region. The fertility of migrants and non-migrants will be examined in more detail in a later section.

Figure 5 elaborates Figure 4 by showing estimated trends in the PPPRs p_B, p_1, and p_2 for all women in China and for non-migrant women in Guangdong and regions of Guangdong. The upper two graphs in Figure 5 show that PPPRs in Guangdong and China were quite similar in 1975. By 2000, however, p_B had fallen more in Guangdong than in China. Indeed, in China as a whole, p_B actually rose slightly between 1975 and 2000. After 1995 p_1 and p_2 fell more sharply in Guangdong than in China until approximately 2002. In Guangdong p_2 fell especially sharply after 1998, when the provincial government increased its efforts to reduce out-of-quota births. Again, which definition of migration status is used makes hardly any difference in the fertility estimates.

All four of the graphs in Figure 5 show trend overlaps between 1990 and 2000. The upper-left graph for China shows a close overlap for p_B, a poor overlap for p_1, and a somewhat closer overlap for p_2. The close overlap for p_B is not surprising, because first births were permissible under the one-child policy, so that the first-born children from whom first births are estimated were not underreported in the censuses (or at least not noticeably so). The poor overlap for p_1 is also not surprising, because the second-born children from whom second-order births are estimated were often impermissible under the one-child policy and were therefore underreported to some extent, resulting in underestimation of p_1. The underestimation of p_1 in any given year was smaller when estimated from the 2005 mini-census than when estimated from the 2000 census, because the estimate from the 2005 census was based on children five years older, whose existence was less likely to be concealed. The somewhat closer overlap for p_2, compared with p_1, is also not surprising, because not only third births but also most second births were impermissible, so that there was motivation to conceal many second-born as well as virtually all third-born children. The concealment of second-born as well as third-born children reduces the downward bias in the estimate of p_2. (There would be no downward bias at all if the percentage concealed were the same for second-born children and third-born children.)

By contrast, in the case of Guangdong, the upper-right graph in Figure 5 shows a closer overlap for p_1 than for p_2. The reason is that in Guangdong (but not in most other parts of China), second births for agricultural households were mostly legal until 1998, when Guangdong's policy changed to what was, in effect, a 1.5-child policy in rural areas. Thus motivation to underreport second-born children was much less in Guangdong than in China as a whole, at least until 1998. Third births, on the other hand, were impermissible both before and after 1998 in rural Guangdong, so that third-born children were much more likely than second-born children to be underreported. In Guangdong, the overlapping trends for p_2 diverge after 1998, suggesting that enforcement of the ban on third births was much stricter after 1998, leading to increased motivation to conceal third-born children age 0–2 in the 2000 census.

FIGURE 5 Trends in period parity progression ratios for all women in China and non-migrant women in Guangdong and regions of Guangdong, derived from the 1990 and 2000 censuses and 2005 mini-census



Note: Gray lines (solid or dashed) indicate trends derived from the 1990 and 2000 censuses, and black lines (solid or dashed) indicate trends derived from the 2005 mini-census. In the case of Guangdong, solid lines (gray or black) indicate trends for regional-level non-migrants, and dashed lines (gray or black) indicate trends for provincial-level non-migrants.

The two graphs in the lower half of Figure 5 show much poorer overlaps for non-Delta than for Delta, especially after 1998, again indicating that concealment of out-of-quota children was confined mainly to the non-Delta region. The dip in p_B in 1999 and recovery in 2000, which shows up in the estimates derived from the 2000 census but hardly at all in the estimates derived from the 2005 census, was confined mainly to the non-Delta region. Why the dip in p_B shows up in one set of estimates but not the other is again unclear. In the year or two before 2005, p_B rose in both the Delta and non-Delta regions. The striking leveling off and upturn in p_1 (progression from first to second birth) after 2002 in Guangdong was confined to the non-Delta region. The leveling off and upturns in p_B and p_1 between 2000 and 2005 in Guangdong as a whole are the main proximate causes of the leveling off and slight upturn in TFR_{pppr} in Guangdong, seen earlier in Figure 4.

The upturn in p_B in Figure 5 appears to reflect, at least in part, tempo effects associated with declines in age at first marriage and age at first birth, as discussed in more detail in the next section. By contrast, the leveling off and slight upturn in p_1 after 2002 in the non-Delta region appear to reflect changes in the implementation of fertility policy. The 1998 policy specified not only a shift from what was, in effect, a two-child policy to a 1.5-child policy in rural areas, but also a shift to stricter enforcement of the policy in order to eliminate out-of-quota births. The tightening up of enforcement was to be accomplished over a four-year period between 1998 and 2002. The leveling off and upturn in p_1 in the non-Delta region suggests that after 2002 enforcement was relaxed a bit, but only in the poorer non-Delta region where the economic value of a second child, especially in farm households, was greater than in the Delta region. In the case of progression to third birth, however, there was no significant relaxation of enforcement in either the Delta region or the non-Delta region. In both of these regions, p_2 declined more or less continuously between 1998 and 2005.

Trends in p_M and mean age at first marriage A_m

As mentioned earlier in the discussion of equation (1), we use p_B in place of the product $p_M p_0$ when calculating TFR_{pppr}, where p_M pertains to the B–M transition, p_0 pertains to the M–1 transition, and p_B pertains to the overall B–1 transition. We use p_B because the census data on age at first marriage are somewhat problematic, resulting in biased estimates of p_M and p_0. It is nevertheless of interest to examine the estimated trends in p_M and p_0, because a considerable amount of useful information can still be extracted from them, as will be seen shortly. The trend in p_M is of particular interest, because it can have a major effect on p_B and consequently on TFR_{pppr}, especially if age at marriage is rising rapidly.

Our estimates of trends in p_M and p_0 are derived from the 2000 census and 2005 mini-census. They cannot be derived from the 1990 census, because the 1990 census did not ask a question on age at first marriage or a question on year and month of first marriage. Both of these questions were asked of all ever-married women in the 2000 census and the 2005 mini-census. The graphs of p_M extend back to 1975, which is possible because the first-marriage questions were asked of all ever-married women, regardless of their age at the time of the census. Our life tables for first marriage terminate at age 40, however, and the women who were age 40 in 1975 were age 65 in the 2000 census and age 70 in the 2005 mini-census. This means that the period life table for transition to first marriage for 1975 utilizes information on age at first marriage for women as old as 65 at the time of the 2000 census and age 70 in the 2005 mini-census.

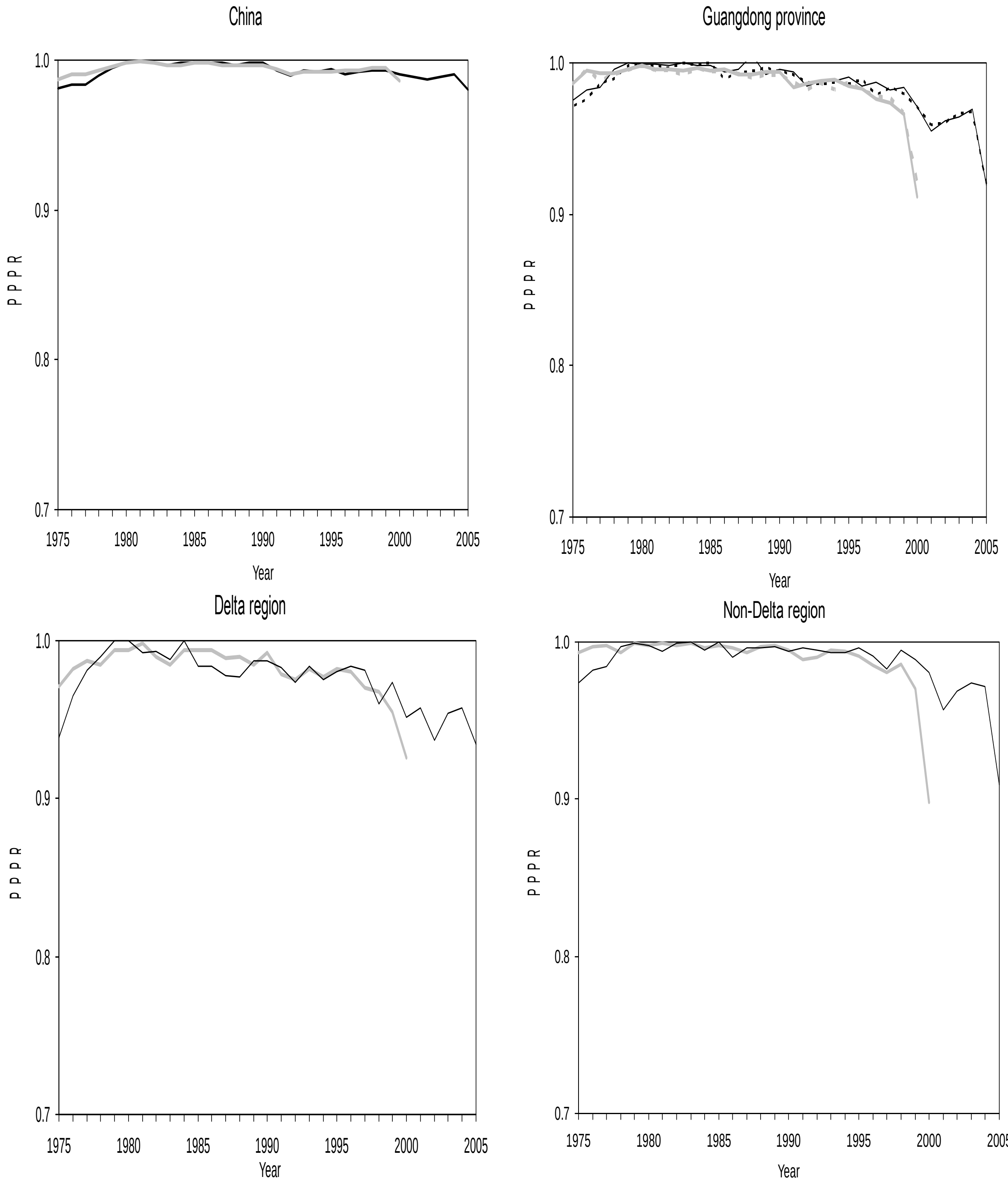
The estimated trends in p_M in Figure 6 again pertain to all women in China and non-migrant women in Guangdong and regions of Guangdong. In the case of China, p_M rose between 1975 and 1981, then declined gradually, with minor fluctuations, to a level in 2005 that was about the same as it was in 1975. The two trends based on the 2000 census and 2005 mini-census overlap closely, although the small dip in p_M in the year before each of the two censuses is somewhat suspect. Guangdong shows a pattern rather similar to that of China until approximately 1995. The overlapping trends in p_M agree closely until that time, indicating that the trends are reasonably accurate up to 1995. During the three years or so before the census, however, the estimated trend from each census shows an accelerating decline in p_M. The two trends after 1995 do not overlap closely, indicating that the steep decline in p_M in the three years or so before each census is at least partly spurious. The trend between 1995 and 2000 derived from the 2005 mini-census, however, can be regarded as reasonably accurate. The 2005 mini-census indicates a p_M value of 0.97 in 2000 for non-migrant women in Guangdong, which is close to the value of 0.99 in 2000 for all women in China. Figure 6 also shows that, regardless of which definition of migration status is used, the estimates of p_M for non-migrant women in Guangdong are close to the same.

The question remains as to the cause of the spurious decline in p_M in Guangdong during the three years or so before each census. Previous research has shown that, in the case of estimates derived from the 2000 census, Guangdong and Hainan (which used to be part of Guangdong) are the only two provinces in China that show this spurious decline (Li et al. 2008). This explains why a similar spurious decline is not seen in China as a whole, except for a small downward blip in the year before the census.

The cause of the unusual pattern in Guangdong, and presumably also Hainan, seems to have something to do with the way that lunar age at first marriage was converted to solar age at first marriage in those two provinces. Enumerators in China's censuses are provided with a conversion table, included in the enumerator's manual, for converting lunar age to solar age, and this conversion requires accurate information on animal year of birth. All Chinese who do not know their solar year of birth do know their animal year of birth, so the conversion table works well for age. But many persons who do not know their solar year of first marriage also do not know their animal year of first marriage. In such cases, the conversion table for age cannot be used to convert lunar age at first marriage to solar age at first marriage, and the enumerator's manual contains no instruction on what to do. It appears that some kind of *ad hoc* procedure was used, and that the procedure used in Guangdong and Hainan differed somehow from that used in other provinces.

Although the details of Guangdong's conversion procedure are not clear, it had the effect of pushing many first marriages back in calendar time. Our detailed analysis for Guangdong (not shown) indicates that a substantial number of first marriages were erroneously pushed out of the first year before the census into the second year before the census. Because of this, the numerator of each age-specific probability of first marriage for the first year before the census is underestimated while the denominator (never-married women at the specified age) is not

FIGURE 6 Trends in period parity progression ratios from birth to first marriage, p_M, for all women in China and non-migrant women in Guangdong and regions of Guangdong, derived from the 2000 census and 2005 mini-census



Note: Gray lines (solid or dashed) indicate trends derived from the 2000 census, and black lines (solid or dashed) indicate trends derived from the 2005 mini-census. In the case of Guangdong, solid lines (gray or black) indicate trends for regional-level non-migrants, and dashed lines (gray or black) indicate trends for provincial-level non-migrants.

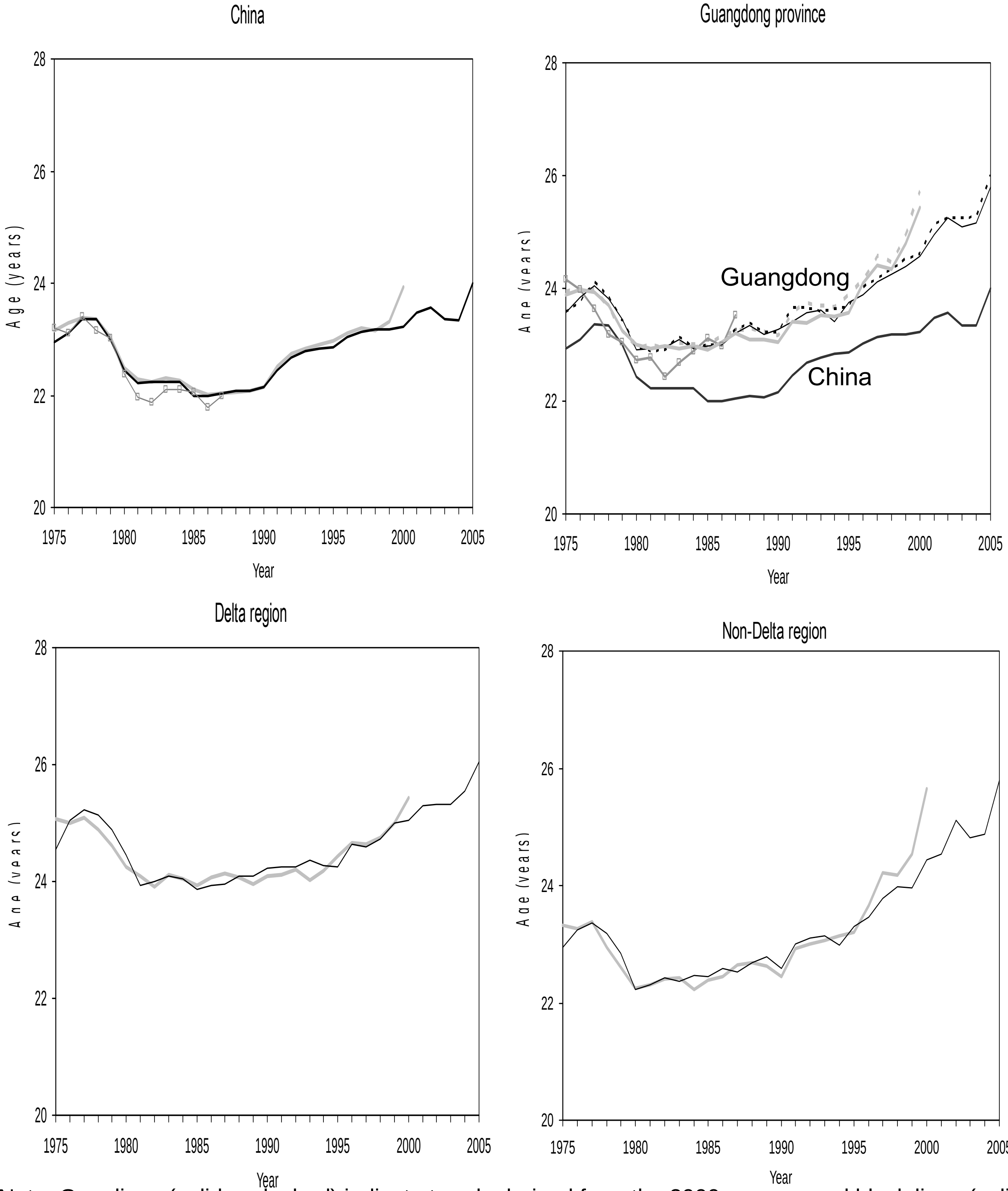
underestimated, the result being that each age-specific probability of first marriage for the year before the census is also underestimated. Based on the underestimated age-specific probabilities of first marriage, the period life table estimate of p_M for the first year before the census is underestimated, and the period life table estimate of mean age at marriage A_m, discussed later, is overestimated. In the second year before the census, some marriages are pushed into that year from the first year before the census, and some marriages are pushed out of the second year before the census into the third year before the census; but it appears that more are pushed out than are pushed in, so that p_M for the second year before the census is also underestimated and A_m overestimated, but not as much as in the first year before the census. Figure 6 indicates that by the fourth year before the census, the numbers of marriages pushed in and out of the year are about the same, so that the biases in p_M and A_m are minimal for the fourth and earlier years before the census.

The graphs for Delta and non-Delta in the lower half of Figure 6 show that the errors of conversion of lunar age at first marriage to solar age at first marriage are confined mainly to the non-Delta region. This is probably because the solar calendar is more commonly used in the more modernized Delta region, with its export-oriented industries, than in the less modernized non-Delta region, and because, in the non-Delta region, relatively more household respondents are elderly persons who are more likely to use the lunar calendar than the solar calendar and who are more likely than elderly persons in the Delta region to be reporting on behalf of young adults who are temporarily (less than six months) working somewhere else, often in the Delta region. The graph for the Delta region shows a clear downward trend in p_M commencing around 1985. In the Delta region, p_M fell to approximately 0.93 in 2005.

Figure 7 shows estimated trends in mean age at first marriage, A_m, calculated from the same period life tables from which the estimates of p_M in Figure 6 were calculated. The upper two graphs in Figure 7 show estimated trends in A_m derived alternatively from the 2000 census and 2005 mini-census for all women in China and non-migrant women in Guangdong. They also show previously reported trends in A_m for China and Guangdong during the period 1975–1987 estimated by Feeney and Wang (1993), based on data from China's two-per-thousand National Fertility and Birth Control Survey of 1988. Estimates from this latter survey are distinguished by small squares at the nodes of the piecewise-linear trends. Feeney and Wang's estimates are similar to the overlapping trends derived from the 2000 census and 2005 mini-census. Their estimates are, however, for all women instead of non-migrant women and therefore are not strictly comparable to the other trends shown in the upper two graphs.

The overlapping trends in A_m derived from the 2000 census and 2005 mini-census agree closely for all women in China and for non-migrant women in Guangdong as a whole, except for the last year or two before the census from which the trend is estimated. The upward spike in the year before the census is spurious, for reasons already mentioned in the discussion of Figure 6. Figure 7, like Figure 6, shows that the spike is confined mainly to the non-Delta region, again for reasons mentioned in the discussion of Figure 6. Regardless of which definition of migration status is used, the estimates of A_m are about the same.

FIGURE 7 Trends in mean age at first marriage, A_m, for all women in China and non-migrant women in Guangdong and regions of Guangdong, derived from the 2000 census and 2005 mini-census



Note: Gray lines (solid or dashed) indicate trends derived from the 2000 census, and black lines (solid or dashed) indicate trends derived from the 2005 mini-census. In the case of Guangdong, solid lines (gray or black) indicate trends for regional-level non-migrants, and dashed lines (gray or black) indicate trends for provincial-level non-migrants. Trends with small squares at the nodes of piecewise-linear segments are from Feeney and Wang (1993).

Figure 7 shows that in 1975, A_m was almost one year later in Guangdong than in China as a whole. A_m then fell by about one year both in Guangdong between 1977 and 1980 and in China as a whole between 1978 and 1981, even before the 1980 marriage law lowered the minimum age at marriage from what it was under the later-longer-fewer policy. As in the case of the pre-1980 rise in p_M in Figure 6, the pre-1980 fall in A_m in Figure 7 probably occurred mainly because, starting in late 1978, China shifted rapidly—and Guangdong even more rapidly—from the commune system to the household responsibility system in rural areas, leading to a surge in marriages and new households in order to qualify for land allocations under the new system. During 1981–82 A_m declined slightly in China but rose slightly in Guangdong, where the transition to the household responsibility system was completed sooner. During the rest of the 1980s, age at marriage did not change much in Guangdong, although it did fall some in China between 1984 and 1985.

A_m then rose steeply in 1991 in both China and Guangdong. The rise in A_m appears to have occurred as a by-product of the tightening-up of the one-child policy, following the fertility increase that occurred in the late 1980s after the "open a small hole" policy shift in 1984. The fertility increase after 1984 alarmed the government, leading to the tightening-up that commenced in 1988. The government's main concerns at that time were that young marriages and second births had increased (Hardee-Cleveland and Banister 1988).

Figure 7, however, does not completely support the government's concerns. Age at first marriage did indeed fall some during the second half of the 1980s in China as a whole, but it did not fall for non-migrant women in Guangdong. Figure 5, discussed earlier, likewise shows that progression from first to second birth increased substantially (but only briefly) in China after the "open a small hole" policy shift, but did not increase in Guangdong, where the policy on second births was already relatively lenient. In any case, the tightening-up that commenced in 1988 reflected the government's perceptions. Initial efforts to tighten up on early marriage focused on preventing cohabitation and premarital births and on preventing marriages below the legal minimum age of 20 for women and 22 for men. Somewhat later—apparently around 1990, judging from Figure 7—later marriage well beyond the legal minimum was often urged or even enforced, along with increases in the minimum age at first birth in at least some and perhaps many parts of the country (Scharping 2003: 91–93). The marriage law of 1980 was not amended to raise the minimum age at marriage, however, although this was advocated by some.

Figure 7 also shows that the rise in A_m accelerated in Guangdong after 1995, for reasons that do not seem to be related at all to fertility or marriage policy, inasmuch as the 1998 policy revisions came later and did not target age at marriage, which by that time was, on average, far above the legal minimum. The further increase in A_m between 1995 and 1998 in Guangdong, and perhaps in the rest of China as well, appears to have been caused mainly by rapid economic development (involving, for example, increasing education and factory employment of single women), not by population policy. This interpretation is strengthened by the finding that A_m was consistently much higher in the more developed Delta region than in the less developed non-Delta region, as shown in the graphs in the lower half of Figure 7.

Judging from the pattern of overlapping trends in Figure 7, the trends in A_m for China and Guangdong based on the 2005 mini-census appear to be fairly accurate up to about 2002.

Between 1990 and 2002, A_m rose from 22.2 to 23.6 years in China (all women) and from 23.3 to 25.3 years in Guangdong (regional-level non-migrant women), indicating that A_m rose 0.6 year more in Guangdong than in China. As a consequence, A_m was 1.7 years higher in Guangdong than in China in 2002, compared with 1.1 years higher in 1990. By region, the difference in A_m between Delta and non-Delta has diminished over time. In 1990 A_m was 1.6 years higher in the Delta region than in the non-Delta region, but by 2002 it was only 0.19 year higher. The more rapid rise in A_m in the non-Delta region may reflect increases in temporary migration of young single women either within the region or to the Delta region. Many of these women postponed marriage in order first to make some money by working in factories.

Although the trend in A_m after 2002 is suspect in Figure 7, it is noteworthy that A_m declined in all graphs, except for the Delta region, between 2002 and 2004 in Figure 7, but more so in Guangdong than in China. Although the estimates of A_m for these years appear to be upwardly biased, the declines after 2002 may be real, and they may have persisted into 2005, inasmuch as the upward spike in 2005 is probably completely spurious. The declines in A_m between 2002 and 2004 are paralleled by increases in p_M during the same years in all four panels of Figure 6. The question of whether the declines in A_m and increases in p_M between 2002 and 2004 are real is pursued further in the next section.

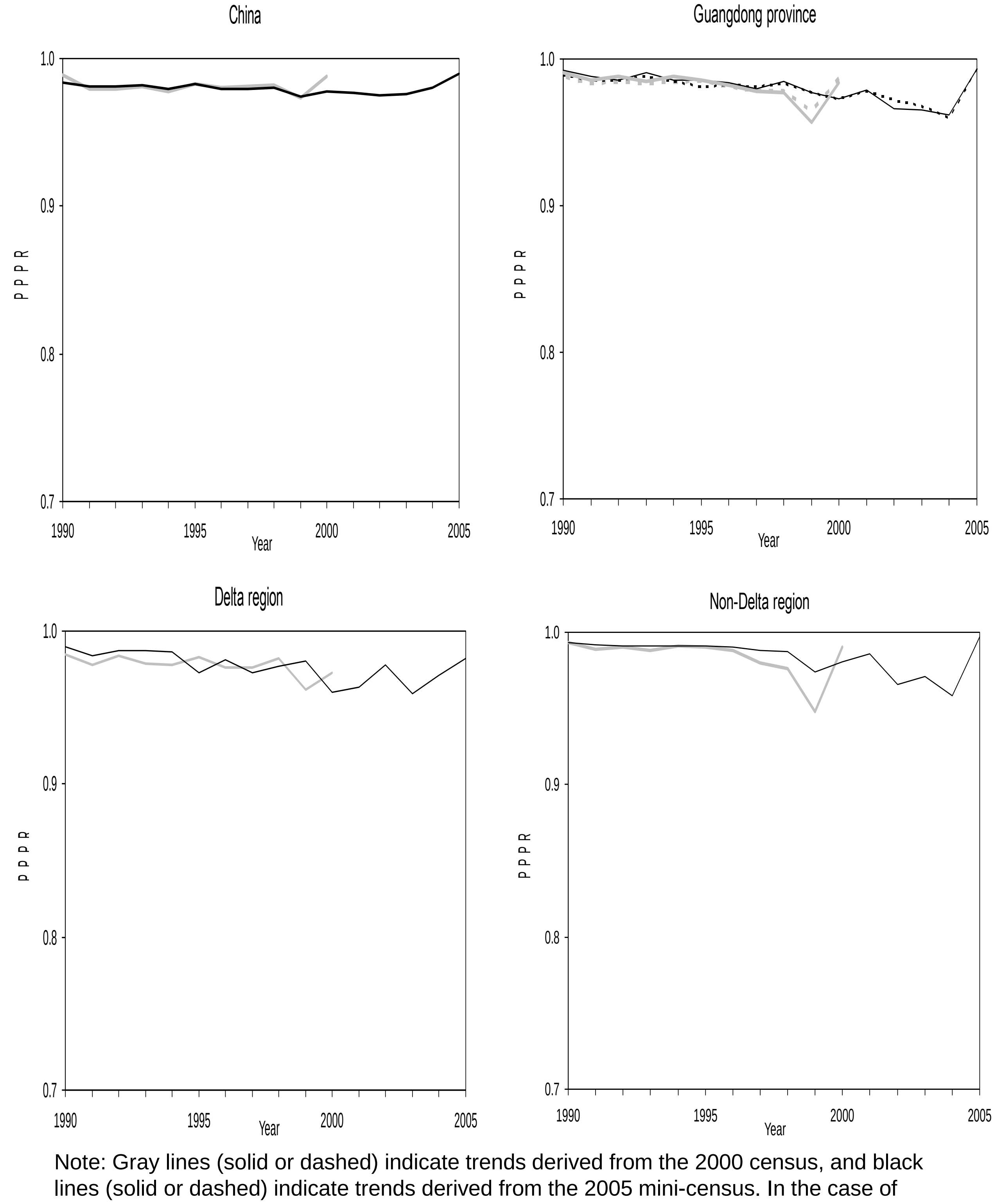
Trends in p_0 and mean age at first birth A_1

The graphs of trends in p_0 (M–1 transition) in Figure 8 extend back only to 1990, because the census question on children ever born, which is necessary for applying the BHR fertility estimation method, was asked only of women up to age 50 in the 2000 census. The women age 50 in 2000 were age 40 in 1990. Truncation at age 40 in the period life tables of progression from first marriage to first birth is justifiable, because very few first births in Guangdong in 1990 occurred after age 40.

Whereas the trend in p_M in Figure 6 shows a spurious downward spike in the year before each census, the trend in p_0 in Figure 8 shows a spurious upward spike in the year before each census. The reason for these spikes in opposite directions is the same, namely the tendency of estimated marriages to be moved backward in time. The numerator of p_0 is first births, and the denominator of p_0 is first marriages. In the year before the census, the numerator is estimated reasonably accurately, but the denominator is underestimated, resulting in an overestimate of p_0.

In the case of China in Figure 8, the overlapping trends in p_0 estimated from the 2005 mini-census and the 2000 census are very close, except for the last year or two before the census from which the trend is estimated. Overall, p_0 appears to have risen slightly for all women in China and declined slightly for non-migrant women in Guangdong. Again the estimates derived from the 2000 census, but not the estimates derived from the 2005 census, show a downward spike in 1999 followed by an upward spike in 2000, which is confined mainly to the non-Delta region. And once again the estimated trends in fertility, measured this time by p_0, are about the same, regardless of which definition of migration status is used.

FIGURE 8 Trends in period parity progression ratios from marriage to first birth (p_0) for all women in China and non-migrant women in Guangdong and regions of Guangdong, derived from the 2000 census and 2005 mini-census



Note: Gray lines (solid or dashed) indicate trends derived from the 2000 census, and black lines (solid or dashed) indicate trends derived from the 2005 mini-census. In the case of Guangdong, solid lines (gray or black) indicate trends for regional-level non-migrants, and dashed lines (gray or black) indicate trends for provincial-level non-migrants.

Figure 9 shows trends in mean age at first birth, A_1. Given the problems with reported age at marriage, we computed trends in A_1 from period life tables for the B–1 transition, which does not take marriage explicitly into account. Thus the estimates in Figure 9 can be viewed as reasonably accurate right up to and including 2005. The figure shows trends in A_1 not only for non-migrant women in Guangdong province as a whole but also for subgroups defined by level of woman's education, in order to illustrate the effects of development as well as policy on mean age at first birth.

In each of the four graphs in Figure 9, the trends overlap fairly closely, indicating that the estimates of mean age at first birth are fairly accurate. Not surprisingly, the overlaps are less close and the estimates therefore less accurate for those with an elementary or less education. The shapes of the four curves (i.e., the ups and downs) are fairly similar, indicating that the various policy shifts described earlier have had rather similar effects on all three education groups. The figure also shows that the higher the education, the higher the mean age at first birth. What is very striking is how high mean age at first birth was in 2002–2003 — in the neighborhood of 28 years — for those with at least a high school education. The level of 28 years is far above the legal minimum age at first marriage for women (20 years) and therefore constitutes clear evidence that economic and social development are having a profound influence on mean age at first birth, over and above the influence of the one-child policy.

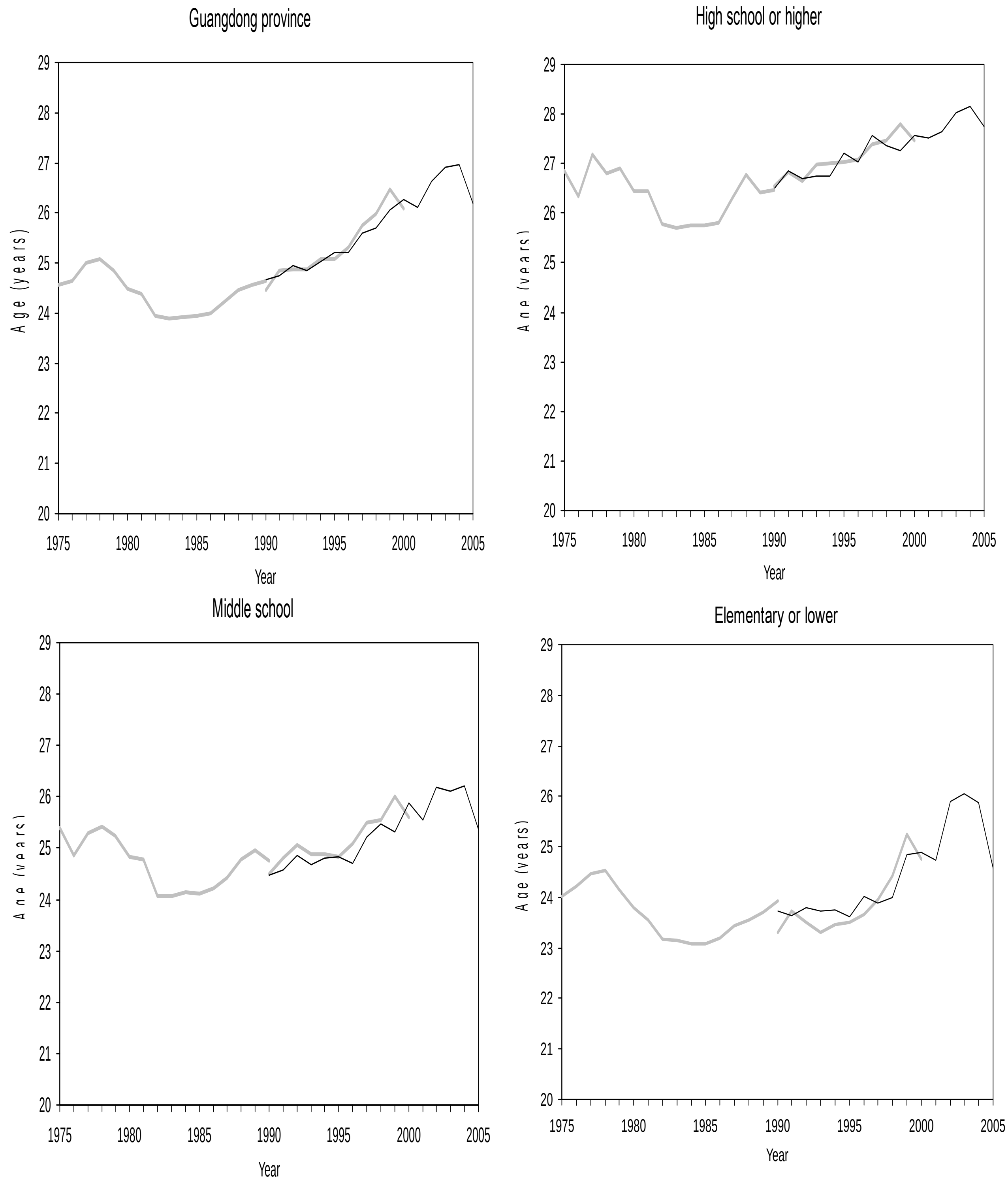
Interestingly, all three education groups, especially the elementary and middle school groups, show a downturn in A_1 after 2002 or 2003, indicating that the increases in p_M and decreases in A_m between 2002 and 2004 in Figures 6 and 7, discussed earlier, are partly real, even though the estimates of p_M are downwardly biased and the estimates of A_m are upwardly biased. The downturn in A_1 for Guangdong as a whole occurs only after 2004, the delay of the downturn being caused by compositional change, namely the rapid decline in the proportion of women with an elementary or less education and the rapid increase in the proportion of women with at least a high school education (Table 1).

The downturns in mean age at first birth in Figure 9 suggest that the leveling off of TFR_{pppr} after 2002 in Figure 4, which was earlier traced to a leveling off and increases in p_B and p_1 in Figure 5, indeed resulted in part from a tempo effect — i.e., to a bunching of first births over calendar time that occurred because of a leveling off and decline in A_1, as shown in Figure 9. As mentioned earlier, it seems likely that the downturns in A_m and A_1 resulted at least in part from pure income effects stemming from the very rapid and accelerating growth of per capita GDP after 2000 (Figure 1). It appears that many couples who had been saving money and delaying marriage considered that it was finally time to get married and start a family. If so, the declines in A_m and A_1 were part of a catch-up process stimulated by a long period of rapidly increasing prosperity.

Fertility trends by characteristics

Until now, migration status has entered the analysis in the form of trends in fertility and nuptiality for non-migrants, but not for migrants. Table 2 compares directly TFR_{pppr} for migrants and non-migrants. The estimates of TFR_{pppr} are for the year before each census. The estimates for 1990 are derived from the 1990 census, the estimates for 2000 are derived from the 2000

FIGURE 9 Trends in mean age at first birth, A_1, for non-migrant women in Guangdong by education, derived from the 1990 and 2000 censuses and the 2005 mini-census



Note: Gray lines indicate trends derived from the 1990 and 2000 censuses, and black lines indicate trends derived from the 2005 mini-census.

Table 2 Estimates of TFR_{pppr} by region, urban-rural residence, and migration status, Guangdong province, 1990, 2000, and 2005

	Regional-level definition of migration									Provincial-level definition of migration		
	Delta			Non-Delta			Total			Total		
Variable	1990	2000	2005	1990	2000	2005	1990	2000	2005	1990	2000	2005
City												
Migrant	1.61	1.61	1.65	1.92	1.64	1.65	1.68	1.61	1.62	1.23	1.57	1.58
Non-migrant	1.56	1.09	1.09	2.31	1.48	1.75	1.87	1.22	1.32	1.85	1.34	1.39
Total	1.57	1.37	1.42	2.30	1.52	1.68	1.83	1.41	1.48	1.83	1.41	1.48
Town												
Migrant	1.14	1.70	1.68	1.63	2.08	1.67	1.45	1.81	1.73	0.97	1.75	1.75
Non-migrant	1.56	1.41	1.33	1.99	1.66	1.60	1.85	1.59	1.49	1.84	1.63	1.57
Total	1.53	1.63	1.60	1.97	1.71	1.58	1.82	1.65	1.61	1.82	1.65	1.61
Rural												
Migrant	2.67	1.84	1.65	3.42	2.25	2.16	3.14	1.97	1.59	2.89	1.91	1.62
Non-migrant	2.43	1.70	1.47	3.11	2.20	2.17	2.93	2.02	2.03	2.93	2.06	2.01
Total	2.44	1.73	1.60	3.10	2.23	2.19	2.93	2.02	1.93	2.93	2.02	1.93
Total												
Migrant	1.87	1.66	1.61	2.80	2.01	1.71	2.19	1.73	1.61	2.14	1.69	1.61
Non-migrant	1.93	1.29	1.19	2.82	1.86	1.88	2.51	1.62	1.61	2.49	1.64	1.62
Total	1.92	1.48	1.44	2.82	1.90	1.88	2.49	1.65	1.60	2.49	1.65	1.60

Note: Estimates for 1990 are derived from the 1990 census, estimates for 2000 are derived from the 2000 census, and estimates for 2005 are derived from the 2005 mini-census.

census, and the estimates for 2005 are derived from the 2005 mini-census. Since the estimates are for the year before the census, they are probably downwardly biased to some extent, for reasons explained earlier.

The estimates of TFR_{pppr} for migrants are shown only for the year before each census because it is not known precisely when the migrants migrated. We assume that a woman's migration status at the time of the census was the same as her migration status throughout the year before the census, and that violations of this assumption are rare enough that they introduce only small errors in the TFR_{pppr} estimates for migrants for that year. The situation is quite different for non-migrants. Only some of the persons classified as non-migrants ever migrated, and the migration, if it occurred, occurred more than five years ago. That is why it was possible in Figures 3–9 to present fertility estimates for non-migrants as far back as 15 years before the census, while keeping in mind that the estimates for more than five years ago are somewhat contaminated by migration. This could not be done for migrants.

Table 2 shows TFR_{pppr} estimates for migrants and non-migrants for the year before the census not only for the province as a whole but also by region and urban/rural residence. In the province as a whole, TFR_{pppr} fell from 2.49 to 1.60 between 1990 and 2005, and almost all of the decline occurred between 1990 and 2000. TFR_{pppr} fell for both migrants and non-migrants, but more for non-migrants. TFR_{pppr} for non-migrants exceeded that of migrants by about 0.35 child in 1990 but by only 0.01 child or less in 2005, depending which of the two definitions of migration status is used.

The decline in TFR_{pppr} was smaller for migrants than for non-migrants partly because the nature of migration into Guangdong changed during the 1990s. During the 1980s, inter-provincial migration had more of an elite character, not only in Guangdong but also throughout the rest of China, because persons of higher socioeconomic status stood a much better chance of securing official permission to move to another province or to move from a rural to an urban area within the same province. Because of their higher socioeconomic status, these migrants tended to have relatively low fertility, rarely deviating from policy guidelines. There was, moreover, relatively little migration that was not officially approved. By contrast, the 1990s saw the emergence of large floating population who were working mainly in urban areas on temporary work permits and who originated mainly in poorer areas where fertility was higher. It therefore seems likely that the post-1990 influx of migrants from poorer areas with higher fertility slowed the decline in TFR_{pppr} for migrants. These inferences are supported by the percentages with at least a high school education among inter-provincial migrant and non-migrant women age 15−49 in Guangdong's 1990 and 2000 censuses (not shown in the table). In the 1990 census, the percentage with at least a high school education was 15 percent for migrants and 13 percent for non-migrants, whereas in the 2000 census this differential by migration status was reversed, the percentage with at least a high school education being 16 percent for migrants and 22 percent for non-migrants.

In the case of urban/rural residence, Table 2 shows that in 1990 TFR_{pppr} was about the same in cities and towns, at 1.83 and 1.82 children per woman, and about one child higher in rural areas, at 2.93. By 2005, it had fallen to 1.48 in cities, 1.61 in towns, and 1.93 in rural areas. The extent of the decline was 0.35 child in cities, 0.21 child in towns, and 1.00 child in rural areas. The smallest decline occurred in towns, and by far the largest decline occurred in rural areas. The especially large decline in rural areas occurred partly because of the 1998 fertility policy shift, which fell most heavily on rural agricultural couples, who after 1998 could no longer have a second child routinely but only if the first child was a girl; and partly because of the tightening-up of enforcement of fertility policy, which before 1998 was especially lax in rural areas, where the rural TFR_{pppr} of 2.93 in 1990 was almost one child higher than the maximum of two that, until 1998, was allowed by the two-child policy for agricultural households. It seems likely that the smaller declines in cities and towns than in rural areas occurred also because TFR_{pppr} was already quite low in cities and towns in 1990, and because of the major influx of higher-fertility rural migrants into cities and towns between 1990 and 2005.

Guangdong's rapid economic development no doubt also played an important role in the rural fertility decline. The historical experience of other countries has been that rural fertility falls especially rapidly when rural couples come to perceive that the future of their children no longer lies in farming but instead in cities, which grew very rapidly in Guangdong between 2000 and 2005 (Table 1). This likely shift in perception by rural couples probably accelerated an on-going substitution of quality for quantity of children, because children need education and training in order to get good jobs in cities.

The story for the Delta and non-Delta regions (last three rows of Table 2) resembles somewhat the story for urban and rural, which is not surprising, given the more urban character of the Delta region and the more rural character of the non-Delta region. Between 1990 and 2005, the decline in TFR_{pppr} was greater in the non-Delta region than in the Delta region, paralleling the greater decline in rural areas than in urban areas. TFR_{pppr} fell by 0.5 child in the Delta region (from 1.9 to 1.4) and by 0.9 child in the non-Delta region (from 2.8 to 1.9). In the Delta region, which was the main destination for migrants, TFR_{pppr} was 1.9 for both migrants and non-migrants in 1990, but by 2005 TFR_{pppr} had fallen more for non-migrants than for migrants, to 1.2 for non-migrants and 1.6 for migrants. By contrast, in the non-Delta region TFR_{pppr} was 2.8 in 1990 for both migrants and non-migrants, but by 2005 had fallen more for migrants than for non-migrants, to 1.7 for migrants and 1.9 for non-migrants. We speculate that the reversal occurred because migration into the non-Delta region came mainly from the lower-fertility Delta region, reflecting the expansion of enterprises from Delta to non-Delta, where labor was cheaper. This expansion probably occurred mainly in the cities of the non-Delta region, where in 2005 TFR_{pppr} was indeed lower for migrants than for non-migrants, as shown in the table. By contrast, TFR_{pppr} was slightly higher for migrants than for non-migrants in the towns of the non-Delta region, probably because migration into the towns came mainly from adjacent farming areas where fertility was relatively high. TFR_{pppr} was almost the same for migrants (who were few in number and probably included many landless farm laborers) and non-migrants in rural areas of the non-Delta region in 2005. The value of 2.2 for rural non-Delta in 2005 was still about 0.7 child higher than the maximum average value of 1.5 mandated for agricultural households by the 1998 revision of Guangdong's fertility policy (not a precise comparison, however, because TFR_{pppr} is a period measure, whereas the mandate of 1.5 pertains to an average of individual fertilities).

Tables 3 and 4 bear more directly on the effect of economic and social development on fertility. In these tables level of development is measured by woman's education and woman's occupation. Table 3 shows estimates of TFR_{pppr}, mean age at first birth, and mean closed birth interval between first and second birth by education and region for Guangdong (including migrants as well as non-migrants) in 1990, 2000 and 2005. In each of these three years, TFR_{pppr} was lower among women with more education. Over time, TFR_{pppr} fell sharply in all education categories but more among women with less education. As a result, fertility differentials by education narrowed somewhat over the 15-year period. Within each education category, the fall in TFR_{pppr} was greater in the non-Delta region than in the Delta region.

In each of the three education categories, virtually all of the decline in TFR_{pppr} occurred between 1990 and 2000. It then leveled off between 2000 and 2005, as did the trend in A_1. (The similar values of A_1 for 2000 and 2005 conceal the rise and fall in A_1 for non-migrant women between 2000 and 2005, seen earlier in Figure 9.) The finding in Table 3 that the leveling off of TFR_{pppr}, A_m, and A_1 occurred in every education group suggests a common cause. As already mentioned, the most likely common cause is the very rapid growth of per capita GDP in Guangdong, which accelerated between 2000 and 2005 (Figure 1).

The large fertility differentials by education in Table 3, together with the substantial changes in population composition by education in Table 1, imply that changes in population composition by education also contributed to the fall of fertility in Guangdong between 1990 and 2005. To the extent that the changes in population composition by education were stimulated by economic development, the contribution of this compositional change to fertility decline (which appears to be sizeable but difficult to measure) is another indicator of how economic development has contributed to fertility decline, over and above the effects of Guangdong's fertility policy. Of course, as already discussed, fertility fell substantially in every education

Table 3 Estimates of TFR_{pppr}, mean age at first birth, and mean closed birth intervals (in years) by woman's education and region, Guangdong province, 1990, 2000, and 2005

	Delta			Non-Delta			Total		
Variable	1990	2000	2005	1990	2000	2005	1990	2000	2005
TFR_{pppr} (births per woman)									
Elementary or lower	2.30	1.84	1.77	3.09	2.16	2.15	2.84	2.01	1.94
Middle school	2.04	1.54	1.56	2.69	1.96	1.97	2.44	1.68	1.72
High school or higher	1.21	1.12	1.08	1.74	1.18	1.24	1.48	1.12	1.12
Total	1.92	1.48	1.44	2.82	1.90	1.88	2.49	1.65	1.60
Mean age at first birth									
Elementary or lower	25.1	25.3	25.2	23.5	24.5	24.4	23.9	24.9	24.8
Middle school	25.8	26.8	26.1	23.9	25.0	24.7	24.9	26.4	25.7
High school or higher	27.0	28.1	28.1	25.6	26.8	27.3	26.5	27.8	27.8
Total	25.8	27.0	26.8	23.9	25.3	25.2	24.7	26.6	26.4
Interval between 1st and 2nd birth									
Elementary or lower	3.0	4.3	4.5	2.5	3.5	3.4	2.6	3.9	3.9
Middle school	3.3	4.5	4.6	2.7	3.7	3.7	2.9	4.3	4.2
High school or higher	3.6	4.2	4.3	3.6	3.9	3.7	3.8	4.1	4.3
Total	3.3	4.4	4.6	2.7	3.6	3.8	2.8	4.1	4.2

Notes: Estimates for 1990 are derived from the 1990 census, estimates for 2000 are derived from the 2000 census, and estimates for 2005 are derived from the 2005 mini census. Mean age at first birth and mean closed birth intervals are calculated from the same life tables from which p_B, p_1, p_2, and p_3 are calculated.

category, indicating that changes in the educational composition of the population account for only part of the overall decline in TFR_{pppr}. If compositional changes were all that mattered, TFR_{pppr} in each education category would have remained constant over time.

Table 3 also shows that, in both 1990 and 2005, mean age at first birth, A_1, was higher for women with more education, the difference between the high and low education categories being in the range of approximately 2–3 years. A_1 increased substantially in most education categories in both the Delta and non-Delta regions between 1990 and 2000 and then leveled off in most education categories between 2000 and 2005. Mean closed birth interval between first and second birth increased with education in each of the three years considered separately, and in most cases it also increased over time in each education category, but more so between 1990 and 2000 than between 2000 and 2005.

Table 4 shows estimates of TFR_{pppr}, mean age at first birth, and mean closed birth interval between first and second birth by occupation and region for Guangdong in 1990, 2000, and 2005. Because a person's occupation can change over time, estimates are again shown only for the year before the census from which the estimate is derived, under the assumption that a woman's occupation did not change during that year. In 1990, 2000, and 2005, TFR_{pppr} was almost always higher in the non-Delta region than in the Delta region, regardless of occupation. In both regions, administrative/professional had by far the lowest TFR_{pppr} of any occupational group, and farmer and homemaker had the highest TFR_{pppr}. In the Delta region, TFR_{pppr} fell substantially only for farmer and homemaker and changed little for administrative/professional, service, and operator/laborer. In the non-Delta region, TFR_{pppr} fell sharply for farmer and homemaker and moderately for administrative/professional, service, operator/laborer, and unemployed between 1990 and 2000. Between 2000 and 2005 TFR_{pppr} continued to fall, but only slightly, for service, farmer, and homemaker while rising moderately for administrative/professional and operator/laborer.[1] The reasons for the rise in TFR_{pppr} for administrative/professional and operator/laborer are unclear.

Table 4 also shows that age at first birth, A_1, was highest for administrative/professional and lowest for homemaker in most years. The difference in A_1 between these two categories increased from 6.2 years in 1990 to 7.7 years in 2005. After homemaker, farmer had the next lowest age at first birth, which was about four years lower than that for administrative/professional in each of the three calendar years. A_1 increased over time for most occupations, homemaker being the exception. A_1 was higher in the Delta region than in the non-Delta region for almost all occupations in almost all calendar years. Mean closed birth interval between first and second birth was also higher in the Delta region than in the non-Delta region for almost all occupations in almost all calendar years. This interval increased over time for the major occupational categories, the main exception being administrative/professional, for which the interval decreased over time in both the Delta and non-Delta regions. The decrease for administrative/professional may have occurred partly because of a 1998 policy provision that allowed couples in which both husband and wife were only children to have two children instead of one, and because couples in which the wife is administrative/professional are more likely than other couples to be only children of parents of higher socioeconomic status. Without this 1998 policy provision, couples in which the wife was administrative/professional who wanted a second child might have had to wait longer because of the necessity of paying a substantial fine. Overall, the large occupational differentials in fertility in Table 4 and the major changes in population composition by occupation in Table 1 also indicate that fertility trends in Guangdong have been influenced strongly by economic and social development and not just by fertility policy.

Conclusion

The analysis of Guangdong's fertility trend since 1975 has shown clearly the influence of fertility policy on the fertility trend, inasmuch as fluctuations in the trend correlate in expected ways with changes over time in the way that China's one-child policy has been implemented in

[1] It may seem odd, in the case of service workers, that in 2000 the value of TFR_{pppr} for "total" is lower than the value of TFR_{pppr} for both Delta and non-Delta. This can happen because TFR_{pppr} is calculated from PPPRs, each of which is calculated by the life table method from a set of duration-specific progression probabilities for Delta or non-Delta that are standardized in the sense that these duration-specific progression probabilities do not take into account differences between Delta and non-Delta in the number of women on which each duration-specific progression probability is based. When Delta and non-Delta are combined into a "total" category, however, each duration-specific progression probability for "total" is calculated, in effect, as a weighted average of the two separate duration-specific probabilities for Delta and non-Delta, where the weights are the numbers of women in the denominators of the duration-specific progression probabilities for Delta and non-Delta. Depending on the configuration of the weights at the various durations in parity at each parity, one can arrive at an estimate of TFR_{pppr} for "total" that is either lower than or higher than both of the two values of TFR_{pppr} for Delta and non-Delta.

Table 4 Estimates of TFR_{pppr}, mean age at first birth, and mean birth intervals (in years) by woman's occupation and region, Guangdong, 1990, 2000, and 2005

	Delta			Non-Delta			Total		
Variable	1990	2000	2005	1990	2000	2005	1990	2000	2005
TFR_{pppr} (births per woman)									
Administrative/professional	1.10	1.07	1.00	1.27	1.12	1.35	1.16	1.09	1.14
Service	1.34	1.42	1.26	1.63	1.40	1.17	1.44	1.39	1.24
Operator/laborer	1.35	1.52	1.57	1.90	1.46	1.60	1.61	1.53	1.57
Farmer	2.52	1.84	1.45	3.13	2.25	2.13	2.96	2.09	1.99
Unemployed	1.40	1.27	1.15	1.76	1.31	1.41	1.49	1.29	1.26
Homemaker	2.79	1.68	1.69	3.16	2.18	2.13	3.08	1.89	1.85
Other	1.46	1.51	1.35	2.00	2.13	2.07	2.13	1.70	1.76
Age at first birth									
Administrative/professional	27.3	28.5	28.5	26.1	26.9	26.7	26.9	28.0	28.0
Service	26.3	27.3	28.3	24.7	27.2	27.1	25.7	27.3	28.1
Operator/laborer	27.5	27.6	26.9	25.9	26.9	26.9	26.9	27.4	26.9
Farmer	23.6	24.2	25.5	23.2	24.3	24.0	23.2	24.2	24.3
Unemployed	24.6	26.0	26.8	25.2	26.9	27.3	25.0	26.4	27.4
Homemaker	21.5	21.0	20.2	20.5	21.3	20.3	20.7	21.2	20.3
Other	23.7	24.8	24.2	24.0	25.2	23.1	24.2	25.0	23.7
Interval between 1st and 2nd birth									
Administrative/professional	5.2	4.4	4.0	4.5	4.2	3.7	4.9	4.3	4.1
Service	4.0	4.6	4.6	3.6	4.0	4.7	3.9	4.5	4.6
Operator/laborer	4.6	4.8	4.7	3.2	3.4	3.4	3.7	4.5	4.4
Farmer	2.7	4.6	4.2	2.6	3.7	3.7	2.6	3.8	3.9
Unemployed	5.3	4.6	4.6	4.1	4.0	2.8	4.8	4.5	4.0
Homemaker	3.4	4.4	4.1	2.7	3.4	3.8	2.9	4.0	4.0
Other	5.2	4.2	4.0	2.3	4.3	2.9	3.6	4.1	3.5

Notes: Students are excluded from the "other" category. Estimates for 1990 are derived from the 1990 census, estimates for 2000 are derived from the 2000 census, and estimates for 2005 are derived from the 2005 mini-census.

the province. The trend in fertility differences between Guangdong and China as a whole also correlate in expected ways with differences between Guangdong and most of the rest of China in the way that the one-child policy has been implemented. The analysis also indicates that Guangdong's fertility policy, though not as strict as in most of the rest of China prior to 1998, has contributed substantially to Guangdong's fertility decline.

Economic development has also contributed to Guangdong's fertility decline, much as it has in other countries that have undergone fertility transition. The analysis has shown, for example, that economic development has brought about large changes in population composition by education and occupation, which, together with the emergence of large fertility differentials by education and occupation, has contributed substantially to Guangdong's fertility decline. Fertility has also declined within educational and occupational categories, not only because of fertility policy but also because parents increasingly have substituted quality for quantity of children as the structure of economic opportunity has changed, requiring more education and training for their children in order for their children to succeed in the modern economy. This is reflected in Guangdong's rapidly increasing levels of education and rapidly increasing percentages in occupations that require education and training.

Guangdong's rapid economic development cannot explain, however, why fertility was higher in Guangdong than in China between 1980, shortly after the one-child policy was announced, and 1998, when Guangdong's fertility policy tightened up. Were it true that Guangdong's fertility was higher because its people were richer, as some have speculated, then one should observe higher fertility in the Delta region, where Guangdong's economic development has been concentrated, than in China. But this is not observed. On the contrary, the Delta region's fertility was about the same as China's fertility between 1980 and 1998, despite Guangdong's less strict fertility policy prior to 1998, and was progressively lower than China's fertility after 1998, when Guangdong tightened up its policy to be consistent with policy in the rest of China. These findings indicate that, in the Delta region, the effect of economic development was to lower fertility, not to raise it.

Part of the explanation of why fertility was higher in Guangdong than in China between 1980 and 1998 is that fertility was much higher in the non-Delta region than in either the Delta region or China. Fertility was much higher in the non-Delta region because the non-Delta region was (and continues to be) much poorer than the Delta region, and because the implementation of Guangdong's fertility policy was more lenient and less strictly enforced in the non-Delta region than in the Delta region. Because of these large regional differences, an adequate explanation of fertility differences between Guangdong and China requires disaggregation of the province into its two major regions. Comparison of the two regions, although somewhat muddied by differences in fertility policy implementation, supports the conclusion that economic development tends to lower fertility, not to raise it, and to the conclusion that Guangdong's fertility excess, relative to China, would have been even greater if Guangdong's economic development had been slower. A further conclusion is that Guangdong's fertility excess, relative to China, between 1980 and 1998 occurred primarily because Guangdong's implementation of the one-child policy was much less strict than in most other provinces of China prior to 1998.

Since approximately 1980, Guangdong's rapid economic development has attracted a high level of migration from other provinces, as well as a high level of migration within the province from the less-developed non-Delta region into the more-developed Delta region. Prior to 1990, when opportunities for migration were highly restricted by the government, migrants tended to have an elite character and therefore lower fertility than that of non-migrants. The 1990s, however, saw the emergence of large floating population who worked mainly in factories on temporary work permits and who originated mainly in poorer areas where fertility was higher. The effect of inter-provincial migration was therefore to lower Guangdong's fertility prior to 1990 and to increase it (i.e., to slow down the fertility decline) between 1990 and 2000. These effects of inter-provincial migration were greater in the Delta region than in the non-Delta region, because most inter-provincial migration was into the Delta region. Migration slowed considerably between 2000 and 2005, even as the growth rate of per capita GDP accelerated, and by 2005 fertility differences between migrants and non-migrants had greatly diminished.

During the period 2000–2005 Guangdong's total fertility rate leveled off at about 1.6. Mean age at first marriage and mean age at first birth continued to rise during the first half of this period and then started to fall during the second half. It is likely that these falls occurred in large part because of pure income effects stemming from a long period of rapid and accelerating increase in per capita GDP, leading many couples who had been saving money and delaying marriage to decide that the time had finally come to get married and start a family. The declines in mean age first marriage and mean age at first birth resulted in tempo effects, consisting of a temporary bunching of marriages and births, that at least partly account for the leveling off of the total fertility rate. Whether Guangdong's total fertility rate will resume declining after these tempo effects dissipate remains to be seen.

Acknowledgment

The authors are grateful to Gayle Yamashita for computer programming assistance.

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