A Multilevel Analysis of Spatial Variation in Sex Ratio at Birth in China
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Abstract:

While it is well known that sex ratio at birth (SRB) in China is high and varies across space, research that analyzes such spatial variations is overly general, often at the provincial level. Furthermore, previous debates over the causes of spatial variation in SRB were less focused on the regional effect of different family planning policies and their interactions with local socio-economic and demographic conditions in differentiating SRBs at individual units of analysis. Combining data from three different sources, this paper uses multilevel models to analyze the spatial variations in SRB within and across different provinces. A special focus lies on the impacts of institutional factors at the provincial level on SRBs of different sub-county population groups in China. We also explore the spatial correlation patterns of SRBs in neighboring locations. Considering spatial dependency effects in a multilevel model creates valuable insights into the unexplained variations in SRB across sub-county population groups in China.

Background:

Over the last few decades, China's SRB has shown a steady increase. Though extensive literature on gender imbalance in China focus on particular regions or the entire country in general, a small body of work has emerged on the regional disparities in SRB and factors accounting for variations between different regions in China (Liu, 2002; Coale, 1991; Hull, 1990). However, few studies have systematically studied causal factors for the high spatial variation in SRB. Three categories of factors account for variations in SRB across regions in China. First, individual-level unit characteristics such as educational attainment, ethnic status, and socio-economic status are widely found to be associated with SRB levels (Xie, 1989; Anderson and Romani, 1997; Terrell, 2005).

Second, more and more studies have recognized the significant role of regional disparities in economic development, medical services, and most importantly, family planning policies in differentiating SRBs (Tang et al, 2011,). The family planning policies on SRB reduction are mainly formulated by provincial and prefectural governments in China and executed by governments in smaller geographically-embedded administrative units. In light of their varied economic and social conditions, different provinces vary in their regulations and rewards on SRB reduction. However, only a few studies including

Yang (2006) and Hung (2004) have made attempts to measure the regional effects of policy instruments on SRBs. Therefore, little can be determined on whether there is a causal relationship between the family planning program or, in particular, the one-child policy, and SRB. Moreover, almost no attention has been paid to the interactions between regional factors and individual level factors. For example, family planning policies in each province affect mediate the impacts of individual characteristics, such as being a minority or living in a rural community, on SRBs within a province.

Finally, due to the way that SRB data are collected from neighboring regions, spatial dependencies in SRB values of different basic units of analysis across space may exist. This spatial factor of variations in SRB has only recently gained academic interests in the study of SRBs in China (Tang et al., 2011; Zhang, 2011; Guilmoto and Oliveau, 2007). Yet, the underlying theory that explains the spatial autocorrelation among SRB values in China has widely been acknowledged, ie., the preference for sons due to social and cultural pressures diffused across neighboring regions in China (Yi, 1993;Yang, 2009). Despite their consensus on a very obvious pattern of spatial autocorrelation in SRBs across county and province, existing studies use very rough models to estimate the SRBs, thereby reducing their power of prediction.

Research Question:

Based on previous research, this paper asks three research questions.

1) What are the spatial variation patterns of SRBs among sub-county groups within and across province?

2) After controlling for individual-unit level characteristics, how do regional policy factors affect SRBs and interact with individual-unit level factors?

3) Does neighborhood effect of SRBs exist among more proximate regions? Will consideration of spatial dependency effects in a multilevel model provide better results in model estimation?

Data and Measures:

Considering the spatial/neighborhood effects, we perform a multilevel analysis to systematically examine the spatial variations of SRB values across sub-county population groups in China and the effects of individual unit level, regional/hierarchical level, and

neighborhood level factors on the spatial pattern of SRB in China.

For the first stage of analysis, individual-unit level information mainly comes from China Census 2000 Assembly Data. We define the basic unit of analysis as a sub-county level population group. Census 2000 covers aggregated information on population living in any county-level administrative units, they are further divided into sub-county groups by current place of residence in city, town, and county (rural areas outside town).

In the second stage, policy data are included. Analyzing documents on family planning regulations and rewards to reduce SRB, we develop a simple scheme to measure family planning policies at the provincial level and incorporate them into the multilevel model. In China, 31 provincial level administrative units (province, autonomous regions, and major municipalities) are major political entity to draw up the family planning policies. Although, prefectural- and county-level governments literally participate in the formulation of family planning policies, they usually choose to follow the published provincial level policies, only matching regulations and rewards to local socio-economic and demographic conditions. Lastly, exploratory spatial data analysis is conducted and a multilevel model will be adjusted to account for spatial correlation.

Preliminary Results:

Results from preliminary analyses suggest that wide variations lie in SRB values across sub-county groups by all places of residence. Although Table 1 agrees with previous findings that SRB in Western provinces are more balanced, the relative standard deviation of SRB within these provinces, such as Tibet and Inner Mongolia, are extremely high.   In comparing SRBs across sub-county groups by their types of residence in China, the average SRB is the highest in rural areas outside of town, and lowest in cities. Sub-county population living in towns has the highest variations in SRB levels. In Jiangsu, Tianjin and Chongqing, a big contrast lies between the relatively low SRBs in cities and the relatively high SRBs in rural areas.

Table 1. Mean and Variance of SRB by place of residence in each province

Region	Mean city	RSD city	Mean town	RSD town	Mean county	RSD county	Mean total	RSD total
ANHUI	114.468	10.243	121.838	13.872	126.959	15.656	122.124	14.516
BEIJING	112.161	3.659	109.498	8.004	104.916	4.754	109.159	6.093
CHONGQING	109.021	7.372	111.515	9.101	118.013	11.471	113.586	10.357
FUJIAN	116.006	7.451	113.735	12.491	119.145	10.473	116.350	10.920
GANSU	113.642	8.978	122.155	19.662	118.323	15.525	119.400	17.068
GUANGDONG	127.264	13.905	137.363	16.737	133.711	12.995	133.105	15.015
GUANGXI	120.434	14.170	125.334	16.988	124.984	12.318	124.347	14.747
GUIZHOU	109.289	10.052	112.763	11.499	116.790	16.470	114.232	14.085
HAINAN	145.622	9.688	135.238	14.227	129.729	13.009	135.433	13.286
HEBEI	110.140	8.234	116.048	18.028	114.270	9.527	114.345	13.780
HEILONGJIANG	109.204	7.855	108.230	12.270	108.535	13.739	108.644	11.606
HENAN	113.925	7.507	122.799	10.938	120.487	6.971	119.932	9.260
HUBEI	123.895	16.961	125.323	20.122	131.537	20.700	127.298	19.749
HUNAN	117.470	9.427	122.316	16.914	130.190	14.715	124.582	15.367
INNER MONGOLIA	106.519	8.404	107.127	12.389	116.822	47.584	111.249	34.147
JIANGSU	111.993	8.013	121.388	28.265	117.751	16.534	117.002	20.058
JIANGXI	117.375	10.329	113.838	15.049	120.620	7.825	117.249	11.870
JILING	110.846	5.802	108.665	13.953	110.078	7.755	109.757	10.058
LIAONING	110.297	8.134	118.986	19.261	111.908	9.039	113.614	13.695
NINGXIA	107.317	7.580	103.081	11.348	110.854	7.059	107.289	9.222
QINGHAI	107.182	5.607	102.327	16.175	107.250	10.579	105.627	12.323
SHAANXI	115.915	8.116	120.579	17.244	125.583	12.746	122.314	14.730
SHANDONG	109.477	6.835	112.646	14.340	112.793	7.701	111.932	10.638
SHANGHAI	111.027	5.234	110.083	5.622	109.954	6.310	110.572	5.394
SHANXI	111.977	11.395	115.251	11.578	113.622	7.910	114.088	10.129
SICHUAN	109.304	6.649	111.358	17.050	113.438	10.733	111.974	13.484
TIANJIN	107.221	5.621	116.609	10.644	126.004	20.533	115.270	14.492
Tibet	89.792	36.094	120.109	65.448	103.362	10.208	110.674	48.567
XINJIANG	105.009	10.714	106.178	16.366	106.232	7.334	106.034	12.257
YUNNAN	104.813	3.608	107.158	11.390	109.361	8.993	108.021	9.992
ZHEJIANG	109.855	7.631	113.769	10.426	112.787	9.403	112.424	9.490
TOTAL	113.512	11.275	116.480	19.991	117.324	16.356	116.239	17.173

Next, I will demonstrate the spatial variations in SRB on maps. We have finished constructing the main database for first level analysis. Currently, we are conducting content analysis of policy factors for stage-two analysis in the multilevel model. After that, we will move on to exploratory spatial statistic analysis and discuss more about the

issues raised by complex spatial modeling of geographically distributed SRB data. We plan to have a full paper ready for presentation at the PAA 2013 meetings next spring.

Conclusion:

Gender preference in China has always been strong. Surprisingly, SRB has progressed even more rapidly since China's family planning regulations including the one-child policy became more lenient since the late 1980s. In addition, levels of SRB vary across China and "hot spots" of demographic masculinity tend to concentrate in inland East regions. Yet prior work has not paid adequate attention to the spatial pattern of SRB in China. Little work has explicitly measured the association between family planning policy and SRBs. Findings from this work shed light on the effect of family planning policy on spatial variations of SRBs in China, with a focus on its interaction with individual-unit level factors in shaping local SRB differentials. By incorporating spatial statistical analysis into the multilevel regression model, we also control the effects of spatial dependencies between SRBs.

References:

Coale, Ansley J. and Judith Banister. 1994. Five Decades of Missing Females in China. *Demography* **31**(3): 459-479.

Liu, Shuang. 2002. Change in Sex Composition of Children during Fertility Transition. *Market and Demographic Analysis* **8**(5): 1-11.

Hull, Terence H. 1990. Recent Trends in Sex Ratios at Birth in China. *Population and Development Review* **16**(1): 63-83.

Tang et al. 2011. Regional Disparity of the Sex Ratio at Birth in China: A Spatial Analysis

Xie, Yu. 1989. *"Measuring Regional Variation in Sex Preference in China: A Cautionary Note." Social Science Research*, 18(3): 291-305.

Anderson, Barbara and John H. Romani. 1997. Socio-economic Characteristics and Excess Female Infant Mortality in Jilin Province, China. *Population Studies Center – University of Michigan Research Report* . **97**: 409.

Terrell, Heather K.M. 2005. *"Fertility in China in 2000: a county-level analysis,"* unpublished M.S. thesis.

Yang, Juhua 2009. An analysis on "One and Half" Policy and its social implication, Collection of Women's Studies. 93(3):16-25.(in Chinese)

Zeng Yi,Tu Ping, Gu Baochang, Xu Yi, Li Bohua, Li Yongping, 1993 Causes and Implications of the Recent Increase in the Reported Sex Ratio at Birth in China. *Population and Development Review*, 19(2) 283-302.

Yang, Juhua (2006) On the Relationship between Family Planning Policy and Sex Ratio of Children in China. *Population and Society*, 30(3):30-41. (in Chinese)

Hung, Yvonne (2004). China's One-Child Policy: Regional Regulation Variation & the Sex Ratio at Birth. http://www-econ.stanford.edu/academics/Honors_Theses/ Theses_2004/Hung.pdf

Songlin Zhang, "Spatial filtering analysis of sex ratios at birth in China," *Geoinformatics, 2011 19th International Conference on* , vol., no., pp.1-5, 24-26 June 2011 doi: 10.1109/GeoInformatics.2011.5980876

Guilmoto, Christophe Z. and Sébastien Oliveau. 2007. "Sex Ratio Imbalances Among Children At Micro-Level: China And India Compared." Published in Population Association of America 2007 Annual Meeting, New York, USA.