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How Do Demographic Trends Change? The Onset of Birth Masculinization in Albania, Georgia and Vietnam in 1990–2005.

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Abstract:

While the rapid rise of the sex ratio at birth in Asia and Eastern Europe is well documented, the conditions surrounding its onset are poorly understood. Was the increase a response to factors determining prenatal sex selection or was it triggered by contingent events? In this paper, we examine the timing of the rise in the sex ratio at birth in Albania, Georgia, and Vietnam, three countries characterized by different social, political and economic conditions in 1990-2005. We take advantage of unique microdata to identify turning points in birth masculinity trends in each of these countries. Thus, the rise in the SRB appears to have clearly started in January 1992 in Georgia, during the first trimester of 1997 in Albania, and in August 2003 in Vietnam. We relate the onset of birth masculinization to various contextual events such as economic and political crisis, significant policy changes and fertility decline. The paper concludes with a discussion on the respective role of triggers of instant demographic change and of more structural factors affecting reproductive choices.

How Do Demographic Trends Change? The Onset of Birth Masculinization in Albania, Georgia and Vietnam in 1990–2005.

1. Introduction

The theory of demographic transition assumes the gradual move from a pretransitional equilibrium of birth and death rates to a new equilibrium resting on lower vital rates. While this model remains largely correct, research on more than two centuries of demographic change in various settings has pointed to a significant number of variants and departures from the model. For instance, the fertility transition proved to be a rather complex demographic transformation since the secular decline was often preceded by a short-term rise and started from different high-fertility levels (Dyson and Murphy 1985) and was at times followed by unexpected stalls and rebounds as in postwar Europe (Van Bavel and Reher 2013), Southeast Asia (Hull 2012), sub-Saharan Africa (Shapiro and Gebreselassie 2013), or Central Asia (Spoorenberg 2015).

In comparison, the evolution of the sex ratio at birth (SRB) appears less complicated. The SRB has remained stable over centuries, oscillating around 104–106 male births per 100 female births ever since it was first measured in 16th century England (Fellman 2015). The variations in birth masculinity by 1 or 2 percentage points are mostly inconsequential and due to random fluctuations or to lesser-known biological or compositional factors.[1] It is only in a few countries of Asia and Eastern Europe that a significant rise in birth masculinity has emerged since the 1980s as people increasingly resorted to prenatal sex selection. In countries ranging from Albania to Vietnam, SRB levels have risen over the last three decades above 110 or 115 male births per 100 female births, leading to a long-term process of demographic masculinization. In some regions, the SRB stabilized to a plateau level while in some other regions such as South Korea, it has come back to a normal level, pointing to a cyclical trend in SRB changes (Guilmoto 2009).

The increase of birth masculinity in affected countries appears therefore to be recent and well documented by census and birth registration series. Yet, changes in the SRB are still imperfectly

[1] Examples abound of countries with reliable birth registration statistics in which the sex ratio at birth has for instance crossed 108 in several years such as Bulgaria (1997) Estonia (2005, 2006), Greece (2001) or Slovenia (1998, 2001). Data used here are from Eurostat. On the natural sex ratio at birth and its variations, see Chahnazarian (1988) and James (2009).

understood and its future course difficult to predict. The basic issue of the onset of the masculinization of births remains particularly unclear, with two lingering questions: When did the sex ratio at birth start departing from natural levels, and what type of factors or events set the change into motion? These questions first relate to the dating of the rise of birth masculinity. As argued by Van Bavel and Reher (2013) about the baby boom in America, it is crucial to properly identify the date of the onset before examining its contextual factors. Unlike the onset of the fertility transition—commonly identified as the period when total fertility rates (TFR) fall lastingly by more than 10 percent—there is no recognized threshold for spotting a rise in the SRB. However, the examination of yearly trends in East Asian and Eastern European countries suggests that once destabilized, the SRB tends to increase steadily until it reaches a new equilibrium level, usually in a range of 110-125 male births per 100 female births. Since there is indeed a beginning to the observed rise, it seems therefore legitimate to explore its potential determinants. The overall impact of a late or early onset of birth masculinization in itself is not without consequences. Had for instance Vietnam's sex ratio at birth started to rise ten years earlier–a perfectly feasible event in view of its low fertility and entrenched son preference–, the country would have today 600,000 more surplus males.[3]

The issue of the onset of high birth masculinity touches on our understanding of the process of demographic change. We may first regard the rise in SRB as an adaptive response to changes in structural factors such as gender bias, normative fertility and available reproductive technologies. According to what Abbott (2001) once called a general linear reality, a view popularized by econometric modeling and rational choice theory, couples simply adjust their reproductive behavior to a new environment characterized by emerging signals, opportunities, and constraints. We then expect an almost imperceptible rise in birth masculinity generated by the gradual change in the causal factors. What we document in this paper, however, is a rather abrupt rise in sex-selective abortions that can be clearly dated. In addition to structural factors, the onset of the rise is therefore likely to have been sparked off by circumstantial factors that precipitated a transformation in reproductive practices—a scenario closer to the cases of sudden outbreaks followed by a gradual diffusion. In this examination of the causal and triggering factors behind demographic transformations, we consider that mechanisms of social change are "triggered under generally unknown conditions or with indeterminate consequences" following the conceptual perspective put forward by Elster (1998) and expanded by path-dependence theorists (Mahoney 2000). This debate on the causal mechanisms behind changes in demographic trends mirrors the discussion on the ultimate and intervening factors at the core of shifts in other demographic behaviors such as labor migration or fertility decline. In the case of the former, sustained migration may be ultimately caused by economic inequality, while the establishment of successful migratory networks represents a very common intervening factor predicating mass migration. As for fertility decline, the question about the respective role of demand and supply factors vs. diffusion mechanisms in explaining a sustained decrease in birth rates remains a matter of continuous discussion. The case of the skewed sex ratio at

[3] This figure is calculated as the additional number of excess male births if the SRB had started to increase in 1993 instead of 2003 and plateaued at 113 male births per 100 female births ten years later. Annual estimate of births are taken from United Nations (2015).

birth presented here is intended to enrich this debate by providing new materials on the historical determinants of demographic change.

In this paper, we take advantage of unique microdata to examine in depth the timing of the changes in the SRB in three different countries. The countries selected here, Albania, Georgia and Vietnam, are characterized by different social, political and economic conditions during the two decades under study. The paper starts with a brief synthesis of what we know of the determinants of rising sex ratios at birth. We then present our data and the methodology followed here to identify turning points in demographic trends. Based on our broken-lines model, we then locate the exact date of the SRB rise using quarterly or monthly figures from the three countries under study. Following this, we relate the change in trends to other events occurring in these countries at that period, and provide an interpretation for the specific onset of birth masculinization in each national setting. The paper concludes with a discussion on the role of triggers of instant demographic change and more structural factors affecting reproductive choices and the lessons learned for understanding the potential downturn of birth masculinity.

2. Explaining the masculinization of births

There are today more than a dozen countries in the world with elevated sex ratios at birth due to prenatal sex selection and many more where sex selection is practiced only by a minority of the population. According to official estimates, Azerbaijan, Armenia and China today record the highest levels of birth masculinity, but skewed SRB levels are observed in several other countries in Eastern Europe, South Asia, and Southeast Asia.[4] While every country is characterized by a specific contextual setting, such as the prevalence of dowry in India or the former one-child policy in China, the presence of prenatal sex selection can be linked ultimately to the existence of three concurring preconditions (Guilmoto 2009). The first condition is a staunch preference for sons in specific settings. To this demand factor, there is a corresponding supply factor: the emergence of affordable reproductive technologies allowing parents to detect the sex of children during pregnancy and abort fetuses of the unwanted sex. The third "squeeze" factor at the root of skewed sex ratios at birth is low TFR. Low fertility acts as a severe constraint to the reproductive goals of parents as more than 23 percent of parents of two children would, for instance, remain sonless in the absence of sex selection.

This explanatory framework suggests that the initial rise in the SRB in a given place and time would proceed from changes in initial conditions such as lower fertility, stronger gender bias or greater access to sex-selective abortions. Interestingly, son preference, which is the core factor in our model, may not have changed significantly in the expected direction since the 1970s. The preference for sons is ultimately rooted in patrilineal and patrilocal kinship systems that favor the presence of sons in the family for various socioeconomic or ritual purposes. There is no instance of suddenly worsening son preference that could lead to a rise in birth masculinity. The overall trend is rather one of loosening kinship constraints and increasing female autonomy through improved access to

[4] For an overview, see Guilmoto (2015) and UNFPA (2012).

education and employment among younger cohorts of women. When measured by surveys, the preference for sons tends in fact to decrease over time—even when sex selection gets worse (Kashyap and Villavicencio 2016). At first sight, an increased gender bias may not be a plausible explanation for the deterioration in the SRB observed since the 1980s.

The other two preconditions of prenatal sex selection may offer more room for explaining changes in birth masculinity trends. The landscape of reproductive choices has indeed vastly changed over the last fifty years in relation to gender preferences. Contraception has, for instance, allowed parents to avoid the birth of additional children after reaching the desired sex composition, leading notably to a vast majority of boys among last children in son-preferring settings (Bongaarts 2013). Prenatal sex testing emerged later during the 1970s in rich countries and since then, has gradually spread into poorer regions. Abortion is another prerequisite to modern sex selection and has become legalized in a growing number of countries over the last 40 years. The spread of ultrasound equipment has been specifically linked to deteriorating sex ratios in China and Vietnam (Chen et al. 2011; Guilmoto et al. 2009).

The introduction of sex selection technologies may therefore explain the rise in prenatal sex selection. Similarly, changes in TFR levels could also impinge directly upon reproductive choices of couples. For instance, a drop by one child in average family size doubles the probability of having no son at all and such fertility decrease in less than five years has been observed in a variety of countries such as Brazil, Iran, Zimbabwe, and China.[5] In fact, it has long been routinely asserted that the strict enforcement of the so-called one-child policy was responsible for the rise in sex-selective abortions in China, but the circumstances of the rise of SRB in China are obviously more complex (Goodkind 2015). Beyond the policy factors, we have already mentioned the potential impact of the diffusion of new technology, and a more formal analysis recently stressed the specific role of the land reforms introduced around 1980 (Almond et al. 2013). In theory, we might therefore have a combination of several factors that affect the propensity to sex select.

However, as stated in the introduction, changes in reproductive conditions may not have an instant effect on birth masculinity. It may take time for parents to recognize that they can and should directly influence the sex of their children to be born, in order to meet their gendered reproductive objectives. But this change in attitudes and behavior may be facilitated by triggering events that transform sex-selective abortions into a "consciously reflected upon alternative".[6] The delay between potential and actual behavior may be due both to the access to the information on new technology options and to the gradual acceptance of interfering with nature (Lesthaeghe and Vanderhoeft 2001). Some intervening factors may then play the role of specific triggers leading parents to envisage a change in their earlier reproductive practices based on the random distribution of births by sex. As such, the SRB onset corresponds to a sudden change in people's reproductive behavior, corresponding to a "critical juncture," which, according to Mahoney (2000), may determine long-

[5] Rates of fertility decline are computed here from the recent UN estimates (United Nations 2015).
[6] I borrow here from the analysis by Åberg (2009) of the micro-mechanisms leading to divorce.

term shifts in social institutions.[7] While not random in nature, these events are marked by contingency and cannot be explained by standard theory. We should expect therefore the date of the onset to shed light on the short-term mechanisms likely to have triggered irreversible changes in deeply rooted reproductive practices. The onset inaugurates an historical sequence characterized by an almost continuous rise in the SRB, but after a decade or so, this process invariably ends when the SRB plateaus at a skewed level corresponding to a new demographic regime in which a given proportion of girls are prevented from being born.

3. Data, methodology and findings

It has proved difficult to date the inception of a skewed sex ratio at birth due to the lack of adequate statistical data in several countries. India, for example, has no reliable birth registration data. In China, the only available series is a national estimate published by the National Bureau of Statistics, which may be affected by significant measurement issues (Goodkind 2011). In South Korea, random fluctuations caused by traditionally inauspicious years and birth registration quality tend to obscure the analysis of the earlier SRB trends, and it is not clear whether the rise in birth masculinity should be dated to 1981 or 1982. In this study, we take advantage of unique microdata from three different countries to examine in depth the timing of changes in sex ratio at birth by year, quarter, and month.

3.1. Data

The civil registration usually fails to provide disaggregated birth statistics by sex and month. Among the three countries under study, one never publishes birth statistics (Vietnam) and vital rates are usually computed from the annual demographic surveys based on limited samples. In the other two countries (Albania and Georgia), birth data are not available for individual months or quarters. In addition, the quality of birth registration is especially uncertain, as the 1990s were indeed a troubled decade for these countries, following the fall of their socialist regimes—in 1991 in Georgia and in 1992 in Albania. In addition to civil war conditions, the bureaucratic disorganization of the 1990s has severely reduced the quantity and quality of available birth registration figures.[8]

We exploit here an alternative source based on the census data by age and sex. Census samples usually include the detailed date of birth of the population and they can therefore be used for computing sex ratios by month and trimester of birth. For the relatively small populations of Albania and Georgia, we were able to access the entire census database of 2001 and 2002 respectively. For Vietnam, the statistical office released a large sample from the 2009 census and we also used the 2014 population survey of Vietnam for confirmation.

[7] Parents had earlier different options to shape the gender composition of their offspring, including the stopping rule, postnatal sex selection, or adoption. At a given period, a preference for prenatal sex selection emerges because of its specific advantages of preventing unwanted female births and it fast becomes a norm among a section of population.

[8] Several reports document the availability of statistical data needed for estimating birth masculinity in these three countries. See UNFPA (2012b, 2015) and GSO (2011).

Table 1: Characteristics of the datasets of birth cohorts of Albania, Georgia and Vietnam

Country	Source used	Sample size (in thousands)	Average birth cohort (in thousands)	
			Per month	**Per quarter**
Albania	2001 census	3,069	4.9	14.8
Georgia	2002 Census	4,405	5.1	15.4
Vietnam	2009 Census	14,178	19.3	57.9
Vietnam	2014 Inter-censal Survey	4,214	5.6	16.8

Notes: average size of birth cohorts computed over the 10 years preceding the surveys

The three census samples are described in Table 1. We computed the average size of birth cohorts per month and quarter during the fifteen years preceding the census. The SRB is affected by random variations when the monthly number of births is limited. For Albania and Georgia, the corresponding 95 percent confidence intervals by month—here computed for a baseline SRB of 105—ranges from 99.3 to 111. For quarterly data, the confidence interval narrows down to 101.7-108.4.

3.2. Method and findings

This research is based on the hypothesis of the presence of significant *breakpoints*.[9] These are dates when a significant change in SRB trends is observed—usually from a normal SRB level before the breakpoint to a continuous rise after it. We postulate the presence of a flat trend close to a normal SRB level followed by a positive slope after the breakpoint date measured in month or quarter. The method corresponds to a segmented regression in which each fitted segment reflects a distinct trend before and after the breakpoint (Muggeo 2003). If the rise in the SRB over the period studied was slow and progressive, following, for instance, a logistic curve typical of diffusion processes, there may not be any detectable breakpoint. The slope would be positive for the entire period, with no statistically significant change. Otherwise, it may be possible to spot any discontinuity in the rate of

[9] Breakpoints may alternately be designated as join-points, turning points, change points, transition points, or switch-points.

change of the SRB and to locate the breakpoint as the date with the statistically most pronounced discontinuity.

We used the sex ratio of birth cohorts to estimate monthly and quarterly variations in the original SRB. In these three countries, a vast majority of the population was literate, and age statement is of very good quality. We initially corrected the sex ratio of each birth cohort for mortality—by applying a survival sex ratio drawn from corresponding WHO life tables—and for seasonal variations. However, these corrections did not affect monthly trends and variations at all. We therefore decided to retain the original census-based sex ratios by date of birth as an indicator for the SRB, which means that our figures tend to underestimate the actual SRB because of the excess mortality of male children. As the illustration presented in the Appendix shows, monthly and quarterly SRB estimates are affected by important random variations, but this does not prevent the identification of different broken lines. In addition, we were able to apply a family reconstruction method to rank children within families and to identify children born after the birth of two or more girls. It provided a series of SRB estimates for children born in families with previously only female births, a population admittedly most vulnerable to sex selection. This subsample of births, however, is smaller.

In order to detect the change in the SRB, the series for the three countries were examined with the *Joinpoint* software[10] developed to identify breakpoints affecting trend data in mortality research (e.g. Goovaerts and Xiao 2011), but already applied to SRB trends in the United States (Mathews and Hamilton 2005). Joinpoint regression is a statistical modeling technique that fits a time series by means of a segmented linear regression and it requires no preliminary assumption about breakpoints.[11] Of particular importance are the dates where the slope of the regression function changes in a significant manner. The strength of the breakpoints and linear segments can be tested statistically in order to find the best parameters. The analysis was conducted for a period of ten years before the census, and we tested for the presence of 0, 1 or 2 breakpoints in the SRB trendline.

The results for the four samples are summarized in Table 2. This table includes the best cut-off dates for the change in SRB trendlines. The SRB trends before these dates were systematically flat, demonstrating no increase in birth masculinity at the national level. This average trend may, however, conceal increases in specific regions where son preference is stronger or among pioneer social groups with lower fertility and better access to sex selection technologies. After the respective breakpoints, the slope of the sex ratio trends is positive in each country for several years. We examine these results in greater detail in the next section, starting with Georgia, where the onset of birth masculinization is the earliest in our sample. [12]

[10] The regression analysis was conducted using the public-domain program (Joinpoint Regression Program, Version 4.3) developed at the National Cancer Institute: http://surveillance.cancer.gov/joinpoint. See also Kim et al. (2000).

[11] See also Ouelette et al. (2014) for a methodological discussion applied to the identification of mortality trends.

[12] A similar breakpoint analysis was also conducted with birth cohorts (not reported here). Georgia was the

Table 2: Breakpoints in the SRB trendlines computed on monthly and quarterly variations in birth masculinity in Albania, Georgia and Vietnam

Sample	Time unit	Date of the breakpoint	Slope of the trendlines	
			Before the breakpoint	After the breakpoint
Albania 2001	Month	March 1997*	.0000^{ns}	.0003***
	Quarter	Q1 1997***	.0000^{ns}	.0003***
Georgia 2002	Month	January 1992***	.0000^{ns}	.0002***
	Quarter	Q1 1992***	.0000^{ns}	.0002***
Vietnam 2009	Month	August 2003***	.0000^{ns}	.0002***
	Quarter	Q3 2003***	.0000^{ns}	.0002***
Vietnam 2014	Quarter	Q3 2003*	.0000^{ns}	.0001***

Note:

- **See Table 1 for sample size and characteristics**
- **Significance levels given for dates relate to the variations in slope coefficients.**
- **ns: not significant, * 5%, ** 1%, *** 0.1%**
- **Slopes are computed over proportions of male births (rather than SRB)**
- **Sex ratio not corrected for mortality differentials and seasonal variations**
- **The 2014 Vietnam sample does not provide significant monthly estimates.**

4. Three case studies: Georgia, Albania and Vietnam

In this section, we briefly sum up the findings on breakpoints in each country in relation to other demographic trends. We then provide a longer discussion of the contextual factors likely to have triggered this inception of rising sex ratios.

4.1. Georgia

Although fertility in Georgia declined relatively steadily between 1970 and 1990, in 1991 it took a

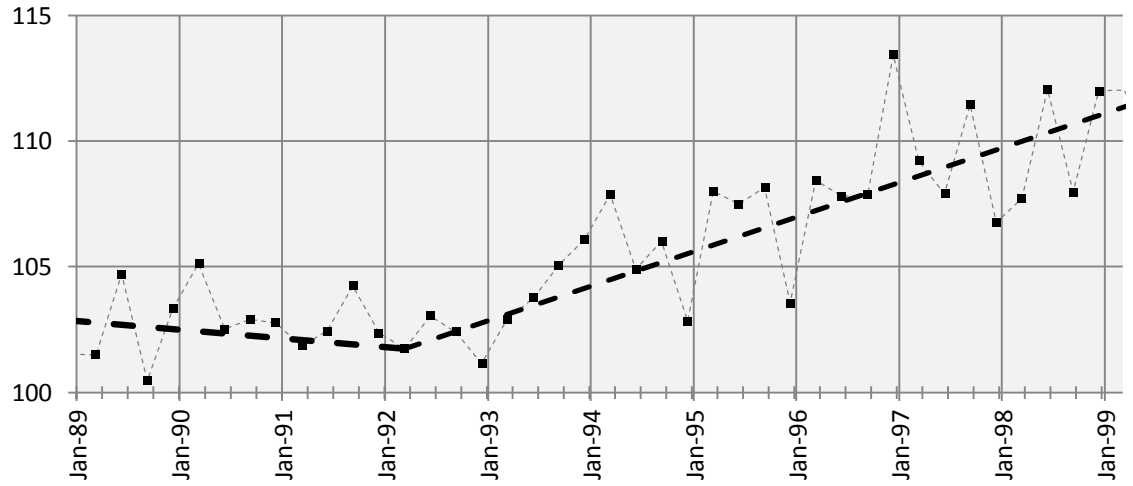
only country with a detectable change in fertility trends (see detail below).

nosedive, falling abruptly from 2.5 to 1.55 children per woman in 1993. As in Russia, this abrupt fertility decline paralleled that of the GDP. But the decline in TFR continued until the end of the 1990s in Russia, Ukraine and Belarus; fertility stabilized in Georgia after 1994, and remained at a level close to 1.6 for a decade.[13]

As fertility was dropping, the SRB, hitherto stable at 105 male births per 100 female births, began to increase during the first quarter of 1992. The onset of this decade-long increase can be identified in January 1992 (See Table 2 and Figure 1). This date corresponds to conceptions taking place nine months earlier, i.e. in April 1991, exactly when Georgia became independent. In families with no son, the rise is even detectable from November 1991 onwards.[14] From 1992 onwards, the sex ratio of Georgian cohorts increased at a yearly rate of 1.4 male births per 100 female births until 1999, when it peaked and stopped increasing. According to birth registration data, the SRB stabilized afterwards at a level close to 114 in 2009–2013. Incidentally, it has recorded a continuous decrease since that period, so that Georgia's SRB is now below that of its neighbors, Armenia and Azerbaijan (Duthé et al. 2012; UNFPA 2015).

The SRB-fertility comparison indicates that a new TFR equilibrium in Georgia was already attained by 1993, whereas the sex ratio at birth kept increasing until 1999. We should also stress that Russia and other former Soviet Republics north of the Caucasus—where fertility decline extended over the entire decade—observed no rise in birth masculinity after 1991.

Figure 1: Sex ratio of quarterly birth cohorts and estimated trendlines, Georgia 1989-1999



Given the instability of the political and economic environment in Georgia by 1990, it is not surprising

[13] A similar stabilization was also observed in Armenia and Azerbaijan. On fertility dynamics in Russia and other countries of Eastern Europe, see notably Kohler and Kohler (2002) and Billingsley (2010).

[14] This corresponds to pregnancies reaching three months—when fetal sex can be determined by ultrasonography—during the month of May 1991. The breakpoint for the whole of samples takes place two months later (data not shown in this paper).

that fertility dropped so sharply. For the most part, women resorted to abortions to terminate unwanted pregnancies, since abortions were the most commonly practiced method of family planning in Georgia at the time. Although restricted after the Second World War as part of Stalin's pro-natalist policy, Khrushchev's reforms eased access to abortion. In the absence of oral contraceptives, which doctors distrusted, as well as poor quality IUDs, condoms and cervical caps, abortion became the prevalent means of limiting fertility (Michael et al. 2013). It is clear that declining fertility was a response to the unprecedented political and economic instability in 1991: once a seemingly stable country, with a high employment rate, accessible education and healthcare, and an array of social supports, including pensions, the Soviet Union collapsed with surprising speed, and daily life in Georgia became harsh and unpredictable.

In 1989, Soviet troops killed 20 demonstrators in the capital of Soviet Georgia, providing huge impetus to the independence movement; by 1990, a Georgian nationalist party gained control of the parliament. In April 1991, Georgia declared independence, and the Soviet Union was dissolved in December of the same year. 1992 ended with armed conflict in central Tbilisi. Concurrent with the emergence of an independent Georgian state, two ethnic enclaves bordering Russia (Abkhazia and Ossetia) sought to separate themselves from Georgia, leading to conflicts that resulted in thousands of deaths and tens of thousands of displaced persons throughout Georgia (Slider 1994; Jones 1997). Concurrent with the political upheaval, the Georgian economy continued to spiral downhill until 1994. Industrial output, incomes and consumption dropped precipitously as a result of opposition strikes and transport disruptions after 1989. In 1990-91, responding to the Georgian restriction on exports, Russia subjected Georgia to a partial economic blockade; without energy from Russia, much of Georgian industry came to a standstill in 1991. The shortages were exacerbated by the harsh winter of 1991–1992. Enterprises were no longer able to pay wages, prices steadily rose and even basic items such as bread were in short supply. In 1990, prices approximately doubled and they rose tenfold in 1992. By the end of 1993, Georgians who had accumulated their earnings in the government savings bank, the *Sberkass*, had lost their lifetime savings (World Bank 1993; World Bank 1999; Slider 1994).

Although under-the-table fees for medical services were already a fact of life in Georgia, the unofficial price of delivering a child in the new environment was daunting. Given the many reasons *not* to have children, the question is—what changed during the spring of 1991 that resulted in an observable rise in the SRB in January 1992, rather than simply a decline in the number of births? Was it simply that ultrasound technology became more accessible, or also that the conditions people were living under increased the perceived value of sons?

Son preference in Georgia, as in other strongly patrilineal countries where it appears, has long historical roots. Sons carry on the family name and continue the lineage, as opposed to daughters, who marry into other families. At least one son is expected to remain with his parents after he marries, inheriting their property and supporting them in their old age. Daughters may continue to provide some moral support and day-to-day care, but their primary loyalties and labor belong to their husband's family. Having at least one son also affirms the father's masculinity and strengthens

the position of the mother, who is otherwise quite vulnerable after she leaves her natal family to join her husband. Particularly in rural areas, women often continued to have children until they could produce at least one son (Dudwick 2015; UNFPA 2015).

Throughout the Soviet period, sons remained pivotal to the strong lineage and reciprocity relations that ordered Georgian society and buttressed men's political power. In the Seventies and Eighties, these relationships of solidarity and trust had helped make the Georgian economy the "epitome of hidden economies in the Soviet Union" (Grossman 1977, cited in Mars and Altman 2008). These networks were critical for obtaining goods and resources in a command economy unable to meet its citizens' daily needs (Mars and Altman 2008) and for generally navigating the complex and unpredictable bureaucracy (Dragadze 1988).

Yet, until the late 1980s, the Soviet Union had no capacity to manufacture quality ultrasound equipment, and the West restricted exports of such equipment to the country because of its potential military use. Prenatal sex selection was therefore technically not feasible in Georgia. These restrictions on technology imports diminished in the late 1980s as *perestroika* and *glasnost* took hold. By the late 1980s, diagnostic ultrasound technology became more available, and Soviet Ministry of Health documents record the use of 3,000 Soviet machines and 1,000 imported machines, many of which were used in nationwide outpatient clinics providing reproductive health services for women (Michael et al. 2013). The first imported ultrasound machine capable of detecting fetal sex appeared in Tbilisi in 1987 and the first private clinic providing services to women opened in 1991.[15] Although it is now difficult to piece together how quickly these services spread outside Tbilisi, it can be assumed that once people learned of its availability in Tbilisi, they found the money to travel to Tbilisi. By 1995, ultrasonography was readily available in clinics throughout the country.

Despite the coincidence of timing, it is difficult to ascertain whether the SRB increased only because ultrasound made it possible for people to act on already existing gender bias in a context characterized by drastic fertility decline, or whether son preference actually increased during this period. This question arose during a study of current attitudes toward sex-selective abortion undertaken by the World Bank in 2015 (Dudwick 2015). Elderly respondents were unanimous that Georgians had always wanted at least one son in the family, but some noted that whereas people had previously accepted that they would have daughters along the way until they could deliver a boy, —now, as one woman put it, "they only need a boy." Another female respondent succinctly noted that if Georgian women had been able to learn the sex of the child they were carrying, there would have been fewer girls born during the Soviet period. Affirming the importance of a son, many respondents provided examples of women who were divorced by their husbands or otherwise punished for failing to give their husbands sons. They described the shame that men in particular felt when they were unable to pass their property on to a son.

Although sons were important to families throughout the Soviet period, as noted above, son preference may have been less acute than it became in the 1990s, for two reasons. First, Soviet

[15] Personal communication from Dr. Nicholas Kintraia and Sergo Matitashvili.

gender policies encouraged egalitarian gender relations, at least in terms of broader access to education and labor force participation for women; second, Soviet state provided basic health care and social protection, including pensions. In the late 1980s, however, the steady deterioration of economic conditions and related growth of nationalism in Georgia and elsewhere contributed to the "retraditionalization" of gender relations, including the patriarchal family, a trend also observed in Eastern Europe (Kaser 2008) and Central Asia (Commercio 2015). Disempowerment or the overwhelming sense of instability and insecurity may have convinced some families that having a son (capable of hard physical labor, able to migrate for work, and better positioned than a daughter to negotiate with authorities) was an important survival mechanism. Sons, more than daughters, would support elderly parents and offer physical protection in a conflict environment. In addition, Michael et al. (2013) have suggested that violent ethnic conflicts might diminish women's bargaining power, and indeed, recent research suggests that Georgian women often undergo repeated pregnancies or abortions under pressure from their husbands (see also Dudwick 2015).

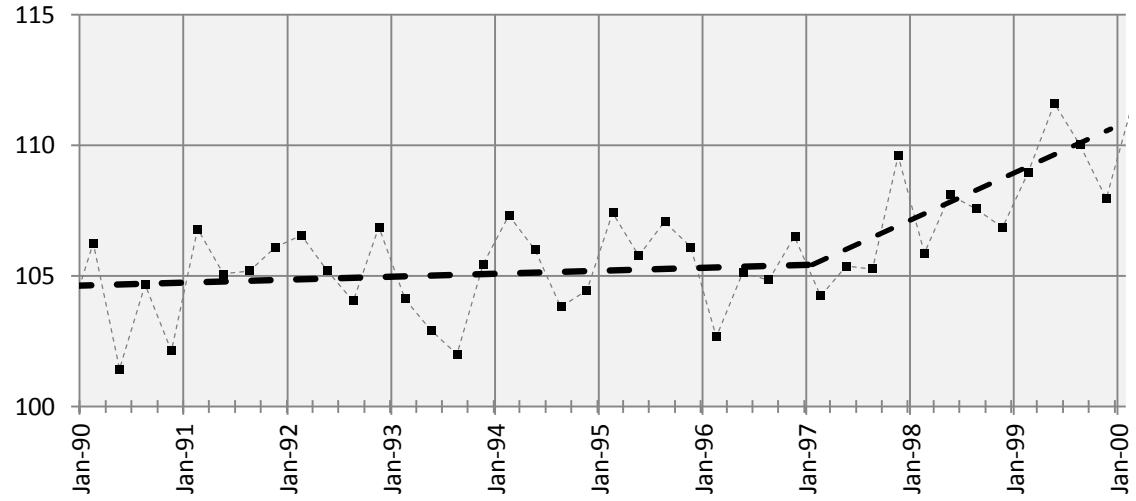
We may therefore conclude that the sudden reduction in TFR levels by one child during the early 1990s simply halved the likelihood to have a son.[17] This generated a new demand for ultrasound equipment to which emerging private clinics were gradually able to respond, thanks to import liberalization. Georgians responded immediately to the post-1991 crisis by reducing high-order births, but the impact of new ultrasound facilities over the next ten years was obviously slower. This cumulative progression conforms to a gradual diffusion of ideas and methods of prenatal sex discrimination across Georgian society (from cities to villages, from higher to lower socioeconomic strata, etc.).

4.2. Albania

The onset of the increase of SRB in Albania dates back to 1997 (see Table 2 and Figure 2). Prior to this year, birth masculinity was marginally increasing, though the measured slope is not significant.[18] The SRB trendline changed during the first quarter of 1997 and inaugurated a period of sustained annual increase of 1.8 male births per 100 female births. Birth registration data for the period following the 2001 census suggests that the SRB reached a peak in 2006 at a record level of 114 male births per 100 female births (UNFPA 2012b). Since then, the SRB has diminished, and has now stabilized at a plateau level of 109 in 2013-15. This level is almost identical to the SRB level observed in neighboring Kosovo and Montenegro (UNFPA 2016). Contrary to what is observed in Georgia after the fall of the Communist regime, there was no visible correspondence between regime change and fertility trends: Albania's TFR started to decline continuously during the 1960s, reaching 2.4 children per woman in 1997 and stabilizing only later at a level close to 1.7 after 2005 (Gjonca et al. 2008).

[17] The risk of not having a son can be computed as q^{TFR}, where q is the biological proportion of female births (48.8 percent) and TFR the total fertility rate. With Georgian fertility dropping from 2.5 children per woman to 1.5 in 1990-94, the proportion of couples with no son increased from 16.7 percent to 34.1 percent.

[18] Birth masculinity was, however, already on a small but gradual increase in Albania during the mid1990s among sonless families. Saying that, this increase is within biological norms of 104 to 106 male births per 100 female ones. The real jump in distorted SRBs starts in 1997.



Early on in this paper, we highlighted that the three factors that could explain the unexpected increases of SRB in different parts of the world were the unprecedented low levels of fertility, the existence of son preference enforced through patriarchal systems, and access to the new technology. Albania is no different in this regard (UNFPA, 2012b). By the end of the Second World War, Albania was a typical patrilineal and patrilocal society, governed by feudal laws and traditions. Sons usually remained in their parents' household after their own marriage in an extended household arrangement, while daughters joined their husband's families. Women's low status was notably enshrined by the Kanun of Lek Dukagjini, a set of traditional, orally transmitted laws from Northern Albania (Mangalova 2004). All property and civic rights were vested in men, with women occupying a marginal position in society. In the words of Swire (1937), "[Women] were betrothed by their fathers in infancy and sometimes before birth … their price was a heavy one for they were the drudges, the breeding stock, the beasts of burden." Communists began to dismantle the bricks of patriarchy and introduced an egalitarian system, effectively removing any alternative sources of authority or legitimacy to the party. Sex differentials in education and employment were reduced or vanished over the decades until 1990. But the collapse of the communist regime entailed dramatic consequences such as large-scale unemployment that first affected women, and a revival of the traditional collective norms and honor-oriented culture (Fischer et al. 1999). Surveys recorded a dramatic increase in reported violence (UNDP and INSTAT 2013), and the divorce rate also increased during the transition.

Another important change in Albania with some potential effect on gender is the very large migration over the 1990s and 2000, during which period a third of the population emigrated. The first migration wave was dominated by young male adults (Gjonca et al. 2008), and their remittances sent back home contributed to the financial crises. The year 1997, however, coincided with a new stream of family migration. More than 50,000 Albanians left within a few months to seek long-term security and higher wages in other European countries (Vullnetari 2007; Stecklov et al. 2010; King and Vullnetari 2012). As a majority of migrants were men in the initial stages of migration in the

1990s, it is hypothesized that this may have reinforced the demand for sons. While this relationship between male dominated migration and the increased demand for sons requires further investigations, the population age structure data from both censuses of 2001 and 2011 suggest that the Albanian migration has stabilized in terms of male-female ratios by age groups.

Historical mortality trends show a male advantage for infant and child mortality in Albania, but these disparities favoring male over female children disappeared over the 1970s and 1980s.[19] During the same period, Albania recorded one of the fastest demographic transitions; in a patriarchal society with a high demand for male heirs, this rapid reduction in family size combined with the disappearance of excess female mortality created the conditions for sex selection.

When we examine what could have triggered the immediate rise of SRBs in early 1997, two main reasons emerge for this relatively late date several years after the introduction of democracy. The first relates to abortion legislation rather than to fertility decline. One of the first changes in legislation introduced after communism collapsed was the legalization of abortion, which created the conditions for an upsurge in the number of abortions from close to zero to about 200 per thousand live births in 2002. The law has gone through a number of changes, but the most important ones were implemented only in 1995, contributing to a comprehensive legislation on abortion (MoH, 1995). Under the law, abortion could be performed through the first twelve weeks of pregnancy based on different grounds, be they medical, psychological or socioeconomic. The full legislation was only introduced in December 1995, about one year before the rise in birth masculinity. During this period, abortions were performed in public hospitals and only became available in private clinics with the start of the millennium. Women still needed a medical doctor's report stating the reasons for abortion. In addition, ultrasound equipment at that time was only accessible in hospitals.

It is almost impossible to state the exact number of abortions during this period, as the data during the transition are not reliable. The data on induced abortion differ from one source to the other. Thus, in two reproductive health surveys, the level of induced abortion was at 73 per 1000 live births in ARHS 2002, and in ADHS 2008 it was at about 90 abortions per 1000 live births as against official figures of 200 per 1000 in 2002 and 272 in 2007. The main reason for this is the fact that abortion was taking place illegally either outside the medical system or within the medical system but without the consent of the medical report as the law demanded.

Another reason for the rise in SRB in Albania relates to the collapse of economy and the increased political and public unrest, a context somewhat similar to that observed in Georgia after 1991. During the end of 1996 and start of 1997, the country experienced civil unrest triggered by the collapse of Ponzi financial schemes. The collapse caused the loss of large amounts of money and whole livelihoods for a large proportion of the population and it also precipitated the departure of thousands of Albanians abroad. The economic crisis and political strife did not convert into a distinct drop in TFR or a rise in mortality. Nevertheless, the GDP contracted temporarily by 10 percent in

[19] See Gjonça (2001). In contrast, it should be noted that no significant excess female mortality has ever been documented in Georgia and Viet Nam.

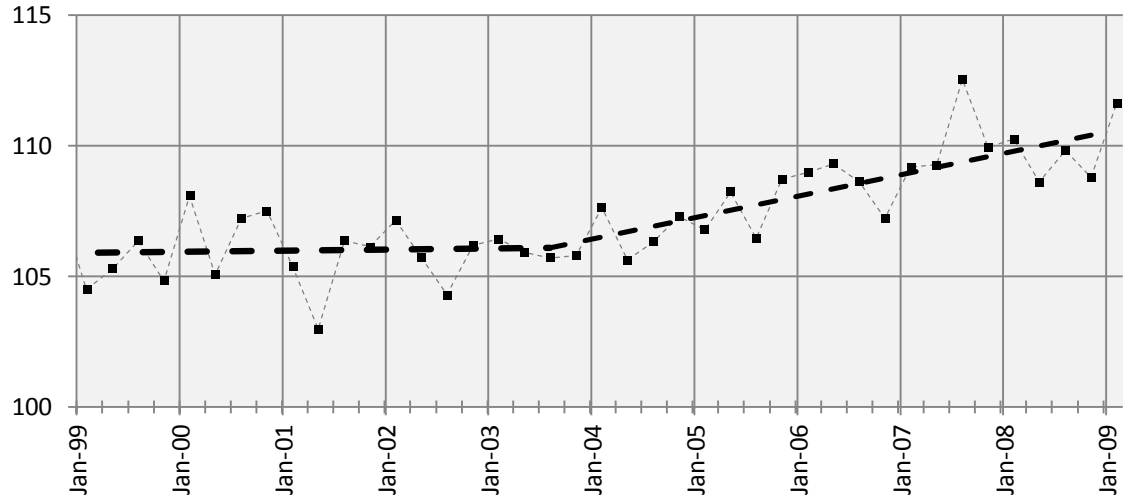
1997 (World Bank 2007). Lerch (2013) detected a sudden drop in third births during the same year. Yet, the rise in the SRB during the first quarter of 1997 seems to closely match the deteriorating situation in the country. The protests became increasingly violent in January 1997 and the country was suddenly gripped by political unrest, civil disorder and organized crime. This led to an increasing chaos culminating in March of that year, exactly when the proportion of male births started to rise.

Clearly, both the liberalization of abortion and, to a lesser extent, the 1997 crisis can be linked to the rise of the SRB in Albania. The impact on birth masculinity of changes in abortion legislation has already been observed in Taiwan and Nepal, two countries where easier access to pregnancy paved the way for a rise in the proportion of male births (Lin et al. 2008; Valente 2014), and Albania may be an additional case.

4.3. Vietnam

Of the three countries investigated, Vietnam has experienced the most recent rise in SRB. Despite a false positive in the early 1999 census data (Bélanger et al. 2003), it has been commonly assumed that the national onset of skewed SRB occurred in the 2004-2005 period (Guilmoto 2017; GSO 2011). The monthly data analyzed for the first time here proposes an earlier date since they clearly show that Vietnam's sex ratios at birth started to increase after August 2003 (see Table 2 and Figure 3).[21] Before that period, the sex ratio of birth cohorts oscillated around 106 with no distinct trend.

Figure 3: Sex ratio of quarterly birth cohorts and estimated trendlines, Vietnam 1999-2009



After 2003, the national SRB increased regularly at a yearly rate of 0.8 male births per 100 female births. Compared to Albania and Georgia, this slower tempo of SRB increase per year may be

[21] While this date is rather unexpected as the following analysis will show, we emphasize that both 2009 and 2014 datasets identify the third quarter of 2003 as the turning point in SRB trends (Table 2). Figure 3 is based on 2009 census data.

explained by the more heterogeneous population of Vietnam, where several regions and ethnic groups have not recorded any significant rise in birth masculinity so far (Guilmoto 2012). At the national level, SRB has continuously increased since 2003 and stabilized at 113 in 2015 (GSO 2016a and 2016b). Today, Vietnam has one of the highest SRBs in the world.

Like Albania and Georgia, Vietnam has a long history of son preference, closely related to its strong patrilineal and patrilocal heritage (Haughton and Haughton 1995; Guilmoto 2012). Sons are preferred for a variety of economic and cultural reasons, many of them linked to Confucian beliefs and ancestor worship (Croll 2000). Unlike Albania and Georgia, the rise of SRB in Vietnam cannot be associated with any fertility-related or economic shocks. Fertility decline has been long promoted by the Vietnamese government as a part of their socio-economic development plan (Pham et al. 2013), first in the form of a Two-Child Policy (1988) and later in the form of a One-to-Two-Child policy (1993). Vietnam's achievements in lowering the TFR—from 3.8 in 1989 to 2.3 within one decade—were awarded the 1999 United Nations Population Award (Pham et al. 2008, 178). Fertility control policies put certainly pressure on Vietnamese couples to produce a son with fewer births, but no dramatic change in birth masculinity occurred during this period of rapid decline. By 2003, TFR had declined to 2.1 children per women and has since then remained close to replacement level (GSO 2016a). Economically, Vietnam has experienced sustained and continuous growth since the 1990s. While SRB has been negatively affected by economic insecurities elsewhere (e.g. Georgia after 1991; South Korea in the aftermaths of the 1997 Asian financial crisis), this was not the case in Vietnam. Scholars have, however, argued that the economic liberalization in 1986 (*Doi Moi*) and the absence of a functioning social welfare system left families dependent on their male offspring for financial security in old age (Barbiéri and Bélanger 2009). If a shift in fertility or the economy did not trigger the SRB onset in Vietnam, other factors must have affected the reproductive choice landscape of Vietnamese couples.

Abortion up to 22 weeks of gestation has been legal in Vietnam since the 1960s and was practiced as a means of population control (Hoang, Phan, and Huynh 2008). Sex determination became possible only after Vietnam's economic opening, which generated an influx of modern reproductive technologies, a growing network of private healthcare providers and the "commercialization of childbearing" (Gammeltoft and Nguyen 2007: 165). In 1989, the Law on the Protection of Public Health was passed granting women legal access to abortion-on-demand (Article 44.1). The law also stressed the government's "duty to consolidate and expand the network of obstetric and neonatal health care to the grassroots level" (Article 44.2) (Harvard School of Public Health 2008). This access to medical services allowed for a rapid increase in abortions in the early 1990s (Goodkind 1994). In 1996, Vietnam recorded one of the highest abortion rates worldwide: 111 abortions per 1,000 women—about 2 million abortions in total—were estimated to be performed that year (Henshaw, Singh, and Haas 1999). Along with abortion services, affordable prenatal testing became widely available throughout Vietnam, being an important source of revenue for both public and private health providers (Gammeltoft and Nguyen 2007). By 2002, 86 percent of surveyed pregnant women received prenatal care from medically trained health workers, while 5 years prior, it was just 71 percent (GSO 2003). Women living in the Red River Delta—where sex selection is most prevalent—

had the highest prenatal care coverage in 2002 (i.e. 98%). Having access to high quality images and better diagnostic capabilities allowed couples to know the sex of the fetus at 13 weeks of gestation, well before the 22 week abortion limit. This new knowledge created pressure on couples, who no longer had the option to blame fate for remaining sonless (Becquet 2015).

The availability of abortion and routine use of ultrasound services in Vietnam were further accelerated by three major health reforms in the early 2000s. First, the Vietnamese government started to promote ultrasound as part of the National Population Strategy for the years 2001-2010 as a means of enhancing the "physical quality of the population" (Gammeltoft 2014: 52-53). This included screening for undesired traits and facilitating abortions in order to avoid fetal abnormalities. Soon it became evident that the same services could be used to avoid other undesired "qualities" such as the sex of the fetus (Bélanger et al. 2003). Second, the financial autonomization of hospitals was introduced in January 2002 (Government of Vietnam 2002). It encouraged public hospitals to become self-sufficient, mobilize private capital and invest in modern equipment. According to London (2013, 236), this reform led to "the rapid expansion of 'patient-requested services'." As such, ultrasound began to be highly requested for sex determination (Gammeltoft and Nguyen 2007). Third, the Vietnamese Ministry of Health issued the National Standards and Guidelines for Reproductive Health Care Services in 2002. Drafted under the technical assistance of the UNFPA (Bondurant, Henderson, and Nguyen 2003), these guidelines were designed to improve safe abortion services in Vietnam (Wolf et al. 2010). Subsequently new abortion methods were introduced that proved safer and more efficient than the old Kovacs method (Tran 2011). These three health reforms improved the supply and commercialization of technology, while paving the way for normative changes, which made sex-selective abortions increasingly socially and morally acceptable. However, the implementation of these reforms was spotty and continued well into the late 2000s.

As access to abortion and reproductive services improved, Vietnamese authorities were alert that sex selection was on the horizon. The 1999 Census did cause concern among national demographers and policy makers who recognized SRB fluctuations throughout a number of provinces and forecasted sex imbalances in Vietnam due to political and cultural similarities with China (Croll 2000).[22] A member of the drafting committee of the Population Ordinance at the National Assembly stated in an interview, "My committee started to think, why big countries like China and India are facing this problem, why not Vietnam?". Vietnamese legislators saw the writing on the wall. They were aware that other governments in the region (e.g. China, India, and South Korea) had already issued policies against sex selection when they drafted the Population Ordinance (Socialist Republic of Vietnam 2003). Sensitized by the ICPD Programme of Action and by policy experiences in other Asian countries, Vietnam introduced legislation against sex selection before it became widespread.[24] The Population Ordinance was issued in early January 2003. Nine months later, starting September 2003, SRB started to increase on a national level. The rise in SRB corresponds closely to the introduction of anti-sex selection legislation

[22] Our analysis differs here from the recent interpretations of Den Boer and Hudson (2017: 19).
[24] This section is based on fieldwork conducted in 2015. See Rahm (forthcoming).

The Population Ordinance officially recognized for the first time fundamental reproductive rights and gave couples the freedom to decide the timing, number, and spacing of births (Article 10), while at the same time prohibiting any form of prenatal sex selection (Article 7.2.). It urged the state to adopt policies to prevent sex selection (Article 14.1.) and "eliminate all forms of gender discrimination" (Article 24.1.). Paradoxically, this ordinance, intended to enable more liberal reproductive rights, directly coincides with the national onset of sex selection, suggesting a perverse effect of the ban on sex selection behavior. How can this be understood? Prior to this, sex selection was a "taboo issue" (Bélanger et al. 2003: 243). The Population Ordinance broke this taboo and increased both media and public attention on sex selection and its prohibition. Knowledge about sex selection was finally discussed openly. Thanks to the Population Ordinance, sex selection—as a novel reproductive strategy—became a national topic of conversation in 2003.

The parallel between policy change and SRB onset does not imply that previous developments in economics, fertility and medical services were not essential in creating the necessary conditions for the phenomenon to emerge. It merely notes that the actual onset begins in concert with the Population Ordinance and suggests that the new legislation was able to trigger the rise in SRB because of underlying factors already in place that produced an environment where sex selection suddenly became known, feasible, and desirable to a growing number of Vietnamese couples. As it stands, the 2003 Population Ordinance appears to be the strongest correlation to the rise in birth masculinity in Vietnam after August 2003. Whether it actually had the unintended effect of facilitating prenatal sex selection, when explicitly prohibiting it, remains difficult to prove due to the lack of counterfactuals. However, in this analysis we were able to exclude other potential triggering events that could explain the sudden change in SRB trends in Vietnam.

5. Conclusion and discussion

Our analysis aimed at a more fine grained analysis of sudden changes in SRB trends by using disaggregated data from Albania, Georgia and Vietnam. Our ultimate objective was to date the onset of birth masculinization and to reflect on the potential triggers of this long-term change in SRB trends in these three countries. Our analysis has shown that it was indeed possible to identify one singular breakpoint corresponding to the rise in the SRB in each country. These turning points can be precisely dated in quarters, and at times in months, when the sample data allow. Thus, the rise in the SRB appears to have clearly started in January 1992 in Georgia, during the first trimester of 1997 in Albania, and in August 2003 in Vietnam. From that period, the SRB increased steadily till it leveled off around 110-115 male births per 100 female births. In this new reproductive regime, a significant proportion of families had opted for selective pregnancy termination to avoid unwanted girls.[28]

The interpretation of these dates in their specific national contexts led to both expected and unexpected findings. In Georgia, the rise followed closely the declaration of independence of the

[28] A simulation suggests that only about 20 to 40 percent of parents resorted to sex selection when the sex ratio at birth reached its peak in the countries under study. If all families after the birth of two girls had opted for sex-selective abortions, the average sex ratio at birth would have risen to 129.

country, which inaugurated a period of turmoil for the Georgian society and economy. The brutal fertility fall most likely had the most direct consequences on the reproductive strategies of couples who were ready in the past to have additional children to ensure the presence of a son. In comparison, the transition from a socialist to a capitalist regime spanned several years in Albania and the SRB started increasing later. While the 1997 political unrest might have had some impact, the liberalization of abortion in a country where abortion had been severely prohibited during the communist era was probably the primary factor to encourage the diffusion of sex-selective abortions in a context characterized by a pent-up demand for sex selection. Vietnam is probably a more puzzling case. The country had long been under scrutiny because of its similarities with its northern neighbor China. Not only had son preference long been observed and measured, but also, the fertility decline had been strengthened by strict family planning policies and abortion was easily available. Earlier studies suggested that the missing link in this picture was the lack of quality ultrasound equipment in this country, but both population samples used here point to a distinct rise from 2003, closely associated with a major shift in population policy. It may sound paradoxical that a less restrictive policy specifically prohibiting targeted abortions set in motion a more active form of gender bias though prenatal sex selection.

In retrospect, the rise in the SRB appears primarily related to the effects of triggers that disrupted a previous reproductive system based on a stable family norm, inefficient sex selection services, and random birth masculinity. The three sequences of events we identified in this study – abortion legislation, population policy initiatives, and economic crisis – appear somewhat contingent. They obviously played an important role in the ensuing rise of the SRB and are intimately related to the supply and squeeze factors of the overall sex selection model. But they should be seen here only as triggers rather than causes. To illustrate the difference, the self-immolation of a street vendor in Tunisia in 2010 may be seen as a unique event sparking off the Arab spring, but of course not as its actual cause. Similarly, the new legislation in Albania and Vietnam did not cause the SRB in a few years to rise to levels above 110. They signaled the end of a previous reproductive regime in which families had to cope with a purely random distribution of girls and sons, followed by the acceptance of sex selection as an instrument of "calculated choice" in fertility (to follow Ansley Coale's vocabulary). The political and economic turmoil linked to the independence of Georgia (and its Caucasian neighbors) had even wider consequences far beyond the strict domain of reproduction.[30]

These events in the three countries studied here should be seen as powerful mechanisms that shook slow-changing reproductive institutions in an irreversible manner, forcing them to rapidly adapt to a broader environment in which the pressure from changes in fertility levels, economic security, reproductive technologies, and the role of families in society had built up over the years. Once destabilized, the reproductive regime in each country underwent a complete change in trajectory. The SRB then increased continuously for almost ten years until it reached a new equilibrium reflecting the couples' "optimal" response to their new reproductive priorities and opportunities.

[30] Civil unrest in Albania was less intense and shorter and it cannot therefore be equated with the regime change in Georgia.

From a path-dependent perspective, the different cases of onset of birth masculinization analyzed here correspond to typical cases of transformations in demographic behavior triggered by contingent occurrences, i.e. events that cannot be explained by initial conditions (Mahoney 2000). We do not mean that contingent occurrences are purely random factors unconnected to the main preconditions of sex selection since they are obviously linked to one of the three preconditions of skewed SRB. While the influence of the specific events identified here was at times unexpected, they triggered a predictable sequence of SRB increase. Once set into motion, the process seemed irreversible as sex selection spread across the concerned population, among whom the need for a son often overcame other practical or moral considerations. The diffusion mechanisms of prenatal discrimination are much more familiar to demographers as they echo, for instance, the dissemination of the small family norm during fertility decline. The main difference is that the rise in birth masculinity proceeded much faster and leveled off within a decade.

The current decline in the proportion of male births observed in some regions suggests that the high SRB equilibrium observed elsewhere may not last forever. It is, of course, too early to discuss the process of SRB transition in the countries studied here, especially as the SRB in Albania and Vietnam has not shown any sign of downturn. But the factors likely to cause this turnaround will probably be very different from those that initially engendered its rise. Greater gender equity is most likely to spur future change—rather than fertility trends or sex selection technologies. But in spite of the influence of structural factors such as female employment, broader social protection or weakening family solidarity, we may also expect some unpredictable contextual events—such as policy changes and interventions, family and gender reforms, media campaigns and advocacy, or political transformations—to trigger a return of the sex ratio at birth to normalcy as rapid as its initial disruption.

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7. Appendix: Illustration of the Method

We use data from the 2009 census of Vietnam to illustrate our methodology. The core dataset is the distribution of the population by date of birth computed by month and quarter for the fifteen years preceding the census. The raw sex ratio of these monthly and quarterly birth cohorts shown in Figure 4 display sizable variations. Monthly SRB estimates might be 6 points above or below the trendline. Quarterly figures fluctuate less (+/- 3 points) since they are computed on samples that are twice as big.

We added a smoothed series computed with moving averages over 11 months. This smoothed series is still affected by oscillations, especially before 2002. The most significant model drawn from the Joinpoint regression is also added in Figure 4. It divides the trendline into two different segments, with a breakpoint between the two series located in August or the third quarter of the year 2003. All model parameters are significant at 0.1 percent (see Table 2). The first part of the trendline on the left corresponds to the period prior to 2003, during which the slope of birth masculinity was flat. After 2003, the second line segment on the right corresponds to a sustained increase in sex ratio at a rate of .8 per year.

We have also included the smoothed series of sex ratio computed among children born in families with only daughters. Fluctuations are broader because of the smaller size of this subpopulation. Yet we can also distinguish a flat trend until 2003 and a sustained rise thereafter. The sex ratio of these children increases twice as fast as the overall sex ratio, and it exceeds 115 from 2007 onwards.

Figure 4: Sex ratio of monthly and quarterly birth cohorts and fitted trends, Vietnam 1995-2009