Gender preference at birth

A new measure for son preference based on stated preferences and observed measures of parents' fertility decisions

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Abstract: Investigating preference for sons is a continuing focal area of development economics and demographic research. Son preference presents a challenge in achieving the United Nations Sustainable Development Goals of 'no poverty', 'good health and wellbeing', and 'gender equality' by 2030. It is thus important to investigate son preference to inform policy-makers of the potential challenges in achieving these goals. Inaccurate interpretation of the mechanisms of son preference could misinform policy analysis and result in unintended consequences. Existing measures including sex ratios and gender composition of children do not reflect the true extent of son preference in high fertility countries such as Pakistan, where the success of policy action is limited and significant barriers to sex-selective technologies exist. Given the likely impact of son preference on fertility behaviour in Pakistan, accurate measurement of the forms this gender bias can take is necessary to appropriately gauge the influence of son preference on the fertility outcomes. The limited capacity of existing measures to accurately depict son preference in countries with high fertility combined with limited demarcation between pre- and post-birth son preference warrants development of a new measure for son preference to evaluate its effects. In this paper, a new measure of son preference called 'gender preferences at birth' (GPB) is presented. GPB combines stated fertility preferences and observed fertility outcomes to acknowledge that households in countries with high fertility and low contraception usage have less control over their fertility decisions.

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1   Introduction

Investigating preference for sons is a continuing focal area of development economics and demographic research. Son preference has long been associated with higher fertility levels, abnormally higher numbers of males than females in the total population and higher female mortality (e.g., Bongaarts and Guilmoto 2015; Das Gupta et al. 2003; Sen 1990). Owing to these associations, interest in son preference has increased recently since it presents a challenge in achieving the United Nations Sustainable Development Goals of 'no poverty', 'good health and wellbeing' and 'gender equality' by 2030. It is thus important to investigate son preference to inform policymakers of the potential challenges in achieving these goals.

The diversity of different countries where preference for sons is present indicates that, despite the prevalence, no single historical, cultural or theoretical foundation can comprehensively explain the phenomenon. Son preference is particularly common in parts of South Asia, East Asia, North Africa, and the Middle East (Arnold 1997; Bongaarts and Guilmoto 2015; Das Gupta et al. 2009; Sen 1990). In South Asia, more extreme son preference is found in India and Bangladesh, and a distinct preference for sons is also evident in Pakistan (Jayaraman et al. 2009; Zaidi and Morgan 2016). Hence, it is important to consider country-specific contexts when investigating son preference to avoid misinterpretation.

Inaccurate interpretation of the mechanisms and effects of son preference could misinform policy analysis and result in unintended consequences. According to the national Action Plan (Ministry of National Health Services, Regulations and Coordination 2018) of Pakistan, policy-makers aim to reduce the fertility rate from 3.6 children per woman (NIPS and ICF 2019: 83) to 2.2 children by 2030. To achieve this goal, it is recommended in the national plan that the contraception prevalence rate increase from 34 per cent (NIPS and ICF 2019: 114) to 60 per cent. However, son preference may act as a challenge in achieving these goals. There is evidence that son preference may result in larger family sizes (Zaidi and Morgan 2016). For instance, parents may avoid using contraception to continue childbearing until a son (or several sons) are born (Channon 2017). Thus, one unintended consequence may be that girls are born in larger households while boys are born in smaller households (Arnold 1992; Jayaraman et al. 2009). There is further evidence that the current estimates of son preference may be under-reporting actual trends as research suggests that there is a latent demand[1] for sons in Pakistan (Bongaarts 2013). Hence, without considering son preference in population policy, it may be challenging to achieve set goals and may give rise to further problems.

This reverberates with the experience of other countries where son preference was not included as an important consideration in population policy and subsequently resulted in unintended outcomes. Demographers have estimated that 60–100 million women are 'missing', mostly in South and East Asia, as a result of son preference (Bongaarts and Guilmoto 2015; Jayachandran 2017). The absence of these women has resulted in unnaturally high male-to-female sex ratios,[2] predominantly in India and China. In recognition of the adverse effects of son preference on population composition and female mortality, India banned sex-selective abortions in 2001 and China abolished the 'one child policy' in 2015 (Attané 2016).

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[1] Latent demand for sons signifies that there is a potential for future increase in sex ratios if the obstacles that currently prevent sex selection are removed and no policy action is undertaken to increase gender equality.

[2] Total number of males/total number of females × 100.

Are prevalent measures of son preference appropriate for countries with high fertility? Rapid decline in fertility rates in parts of Asia with known preference for sons has led to higher than normal sex ratios becoming a common and convenient measure for identifying son preference across groups. However, researchers soon pointed out that sex ratio is not a suitable measure for countries with high fertility where, although the ratio may be close to average, discrimination against girls is common. The high *desired* sex ratios in these countries signal a suppressed demand for sons indicating the importance of including stated preference alongside observed behaviour when investigating son preference.

In the Pakistani context, owing to the constraints to sex-selective technologies and low contraception usage, households reconcile their son preference by having many children to increase the likelihood of having sons (Zaidi and Morgan 2016). Higher than normal sex ratios at *last* birth in these countries indicate that parents may use 'stopping rules' — that is, they continue childbearing until their desired number of sons are born and then stop (Yamaguchi 1989). Stopping rules are limited in their identification of households with son preference because they do not account for households that may prefer sons, but these son targets remain unmet. Use of observed outcomes thus provides a limited understanding of son preference in countries with high fertility and indicates the need to incorporate stated preference when measuring son preference.

Existing measures such as sex ratios and gender composition of children do not reflect the true extent of son preference in high fertility countries such as Pakistan, where the success of policy action is limited and significant barriers to sex-selective technologies exist. Given the likely impact of son preference on fertility behaviour in Pakistan, accurate measurement of the forms this gender bias can take is necessary to appropriately gauge the influence of son preference on the fertility gap.

The limited capacity of existing measures to accurately depict son preference in countries with high fertility combined with limited demarcation between pre- and post-birth son preference warrants development of a new measure for son preference to evaluate its effects on fertility.

In this paper, a new measure of son preference 'gender preferences at birth' (GPB) is presented. GPB combines stated fertility preferences and observed fertility outcomes to acknowledge that households in countries with high fertility and low contraception usage have less control over their fertility decisions. This measure is better suited than existing measures of son preference in Pakistan, which are determined only from observed behaviours (Arnold 1997; Barcellos et al. 2014; Pande 2003). For example, sex ratios indicate son preference in China and India, which have sex ratios of 111 and 115 males for every 100 females, respectively.[3] These are considerably higher than the world expected sex ratio of 105 males for every female. In contrast, the sex ratio in Pakistan is 109 males for every 100 females, which is less convincing at portraying prevalence of son preference[4] even though discrimination against girls is common. This indicates that while preference for sons may exist in Pakistan, households may not be able to act on it because of constraints such as unavailable sex-selective technologies.

The measurement of son preference was examined by investigating the following research question: *How can observed behaviours and stated preference be combined to derive a measure of son preference that is suitable for countries with high fertility?*

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[3] United Nations Population Division (2019).

[4] Ritchie and Roser (2019).

This research makes the following contributions to the existing body of knowledge on son preference and fertility. GPB, the new measure created, is more suitable for countries with high fertility and low contraception such as Pakistan. Existing measures of son preference rely on only observed outcomes because they have usually been developed in the context of countries where sex-selective technologies are readily available. In the present study, by incorporating parent-stated preference and observed outcomes, it is acknowledged that couples do not have considerable control over fertility decisions. By incorporating both stated preferences and observed outcomes of couples, this research makes the contribution of acknowledging the constraints of couples in developing countries in achieving their desired family outcomes.

The remainder of the paper proceeds as follows. In Section 2 a background of the limitations of sex-selective technologies in Pakistan and a rationale for a new measure for son preference is provided. In Section 3, the limited appropriateness of current measures of son preference in high-fertility and low-contraception usage settings is evaluated to highlight the need for a more appropriate measure. In Section 4 GPB is introduced, developed by utilising parents' stated preferences and observed behaviours. The construction of the GPB measure, data description and descriptive statistics are also provided in this section. In Section 5, comparison of prevalence of son preference as measured by GPB measure and existing measures of son preference is provided. In Section 6, a conclusion and policy suggestion considering the findings of this paper are provided. Noting that son preference continues to be an existing issue in many countries, scope for future research is provided in Section 7.

2 Background

At face value it may appear that the pre-requisites for sex-selective abortion are present in Pakistan. Family sizes are large but declining, technology to determine the sex of an unborn child is available (National Institute of Population Studies 2019), there is evidence that abortions are taking place albeit unsafely and illegally, and there is strong preference for boys. However, when the legal, religious, medical, economic and practical constraints for sex-selective abortion are considered, there is no evidence that sex-selective abortions are practised in Pakistan.

According to two national studies conducted by the Population Council of Pakistan, one in seven pregnancies in Pakistan ends in induced abortion.[5] Even though the incidence of abortion is high in Pakistan, evidence of sex-selective abortion is scarce. Access to safe and affordable abortion is limited in Pakistan, where only a quarter of public health facilities provide abortion services (Singh et al. 2020). Therefore, almost all abortions are performed outside the public sector, half of these are illegal and only 14 per cent of women receive post-abortion care (Singh et al. 2020). Unsafe and illegal abortions contribute to 5.7 per cent of all maternal deaths (Jafarey 2002). For rural women, where son preference may be more prevalent, accessing abortion is even more difficult, as only one-third of abortion facilities are in rural areas where two-thirds of the women live (Singh et al. 2020). All these factors contribute to the view that induced abortion is more costly and more difficult to access than contraception (**Guttmacher** Institute 2009; Tsui et al. 2011).

For women who seek abortions despite the health risks and monetary costs, evidence of sex-selective abortion is rare for two reasons (Zaidi and Morgan 2016). First, the purpose of abortion

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[5] The annual abortion rate in Pakistan was 50 per 1,000 women in 2012 (Sathar et al. 2014; Tsui et al. 2011). This is relatively high when compared with neighbouring India's 47 per 1,000 women (Singh et al. 2018) and Muslim-majority Bangladesh's 39 per 1,000 (Singh et al. 2017).

does not seem to be influenced by sex of the foetus. According to Tsui et al. (2011), abortion is considered a backup when contraception fails as one in four pregnancies in Pakistan are unintentional, but contraception prevalence rate remains low. Half of women who have an abortion state the reason as having too many children, while one-quarter cite the reason as being too soon to have another child (Guttmacher Institute 2009). Second, hospitals have informal rules that forbid revealing the sex of a foetus at the first ultrasound (i.e. 12 weeks) because is it extremely difficult to determine that early (Sathar et al 2014; Zaidi and Morgan 2016). However, abortions after the 14-week mark are not common practise, with 82 per cent occurring before 14 weeks of pregnancy (Guttmacher Institute 2009). Thus, the timing of abortions indicates that sex of the foetus is not a deciding factor.

In addition to these significant logistical, cost and risk issues, there are also significant medico-legal barriers to accessing abortion in Pakistan. Sex-selective abortion is a crime in Pakistan punishable by law. Further, as in other Muslim countries, inducing an abortion is legal only under the condition that there is a threat to the health or life of the mother, and sex-selective abortions do not fulfil this criterion (Rahman et al. 1998).[6] This law is driven by religious beliefs of the larger population — 96.6 per cent of the population of Pakistan identifies as Muslim (Pakistan Bureau of Statistics 2017). Islamic beliefs prohibit abortion unless to save the life or preserve the health of the mother. Even in dire circumstances such as foetal impairment, rape, incest or social and economic reasons, there is considerable reluctance among scholars on the provision of abortion (Azmat et al. 2012; Yacoub 2001).

Any person who performs an abortion for reasons other than protecting the life or health of the mother is also punishable by law. Pakistan's restrictive abortion laws and religious sensitivities create reluctance among the medico-legal community to provide abortion services and post-abortion care to avoid punishment. In 1996, by presidential order, restrictive abortion laws came into effect and punishment for illegal abortion was harsher by stage of pregnancy, hence a higher reluctance to perform abortions at later stages (Rahman et al. 1998). Despite amendment to the laws under the Women's Protection Bill (2006), the negative perceptions among the legal community with regards to abortion remain. This acts as a constraint to women seeking abortions even for legitimate purposes, let alone for seeking sex selection (Azmat et al. 2012).

3   Literature review

In this section, common measures of son preference and their appropriateness for countries with high fertility and low contraception usage are discussed. See Table 1 for a summary of son preference measures applied in the literature. Population control policies and access to pre-natal sex selection were important considerations for the development of existing measures.

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[6] Section 338-A and 338-B, respectively, of the Pakistan Penal Code (1860): 'Whoever causes a woman with child whose organs have not been formed, to miscarry, if such miscarriage is not caused in good faith for the purpose of saving the life of the woman, or providing necessary treatment to her, is said to cause *sqat-i-haml* (termination of pregnancy).' And: 'Whoever causes a woman with child some of whose limbs or organs have been formed to miscarry, if such miscarriage is not caused in good faith for the purpose of saving the life of the woman, is said to cause *isqat-i-janin* (termination of foetus).'

Table 1: A review of popular measures of son preference in the literature

Study	Measures	Sample	Year/s	Findings
Sen (1990)	SRB, Missing women	Projections	1990	Discriminatory practices against girls led to 100 million missing women in China and India.
Park and Cho (1995)	SRB, SRB by family size and birth order, SRB by preceding sex sequence	Census Report Korea	1985–90	Son preference affects SRB at the population level and sex composition within households when fertility is low but not when fertility is high. Household level analysis is necessary.
Arnold (1997)	SRB, Desire for sex of additional child	57 DHS surveys, 244 countries	1986–95	SRB skewed towards males in Pakistan. Country-specific studies needed to understand gender preference by background characteristics.
Arnold (1997)	SRB, Existing gender composition of children	57 DHS surveys, 244 countries	1986–95	Female children more likely to grow up in larger families. That is, couples continue childbearing if first few children are girls.
Clark (2000)	Differential stopping behaviour	National Fertility and Health Survey, India	1992	Smaller families have a significantly higher proportion of sons than larger families.
Dalla Zuanna and Leone (2001)	SRLB, SRLB by family size	National Fertility and Health Survey, India 1992–1993	1992–93	Deviation of SRLB from biological constant of SRB indicates son preference. Measure can be applied to groups but not individuals.
Basu and Gupta (2001: 85-350)	SRB, Gender preference by sex composition of living children	National Fertility and Health Survey, India	2001	SRB higher (i.e. more males) when fertility levels are low and son preference is prevalent. In countries with high fertility SRB stronger at higher birth orders. Indicates need for household level analysis.
Bose and South (2003)	Sex composition of living children	National Fertility and Health Survey, India	1993 and 1998	Existence of some sons reduces risk of divorce. Requires more direct measures of son preference.
Retherford and Roy (2003)	SRB	National Family Health Surveys	1992 and 1998	SRB strongly affected by birth order and sex of existing children. Indicates need for household analysis.
Chung and Gupta (2007)	SRB	Korea National Fertility and Family Health Surveys	1991 and 2003	SRB only captures actual behaviour manifestation. Important to include stated preferences.
Jayaraman, Mishra, and Arnold (2009)	Sex composition of living children	Demographic and Health Surveys for India, Nepal and Bangladesh	2004–06	Having sons increases use of contraception and reduces desire for more children. Self-reported measures of fertility may suffer from rationalisation and should be compared with observed outcomes.
Goodkind (2011)	SRB	Census projections, China	1982–2000	Harsh state policies may result in parents under-reporting births and deaths of girls resulting in under-interpreting the effects of son preference.
Guilmoto (2012)	SRB	United Nations Population Division	2005–100 (simulations)	Projections from SRB very sensitive to variations in fertility levels.
Bongaarts (2013)	SRB, desired sex ratios at birth	DHS for 61 countries	2010	Gap between desired and actual sex ratios indicates that there is 'pent-up demand' for sons, which sex ratios are not able to identify.

Study	Measures	Sample	Year/s	Findings
Gupta (2014)	SRB	Census of India	1931, 1961, 1971, 1981, 2001	Son preference effects result in a marriage squeeze where some men remain unmarried. Acknowledging cultural norms can be challenging but individual preferences can play an important role in fertility behaviour.
Bongaarts and Guilmoto (2015)	SRB, Missing women	Projections	2015	Estimates for missing women based on SRB can range from 60 to 100 million. Special attention needs to be paid to pre-natal and post-natal discrimination against girls given the availability of sex-selective technologies.
Adebowale and Palamuleni (2015)	Gender preference Sex composition of living children	Malawi Demographic and Health Surveys	2015	Gender preference increases intention to have more children but is limited in capturing manifestation effects unless observed outcomes are included. SCLC is an observed outcome for son preference affects but does not capture true essence when SCLC is not extreme.
Makino (2018)	Birth order and sibling sex composition	India Demographic and Health Surveys	2004–05	There is a trade-off between pre-birth and post-birth gender discrimination

Note: SRB = sex ratio at birth; SRLB = sex ratio at last birth.

Source: authors' construction.

Hence, despite the use of stated preferences and observed outcomes in developing these measures, there is a need for a measure which adequately captures the context of son preferences in countries where success of population control policies has been limited and considerable obstacles to safe and affordable prenatal sex selection exist. The development of the measure of son preference in this thesis aims to address this current gap in knowledge.

Son preference has been measured pre-birth and post-birth. Examples of pre-birth measures of son preference include pre-natal sex selection such as sex-selective abortions or stopping behaviours (measured via sex ratios and GCC (gender composition of children)). Post-birth measures of son preference include female infanticide and preferential treatment of boys at the expense or neglect of girls.

'Stopping rules' describe a class of measures commonly referred to as sex ratios.[7] By construction, measures of sex ratios are aggregated, typically at regional or national levels (Echávarri and Ezcurra 2010; Goodkind 2011). More recently, sex ratios have been calculated by birth order, with findings indicating that sex ratios tend to be higher at later births, particularly last birth. Using sex ratio as a proxy for son preference implies that couples stop producing children only after their son preference is met. Limitations of these measures include that they do not consider previous births and, in accordance with the data, can only be applied to cohorts. However, they are a popular measure because they are easy to calculate utilising existing datasets such as the Demographic and Health Surveys, which are relatively widely accessible. Furthermore, the ratios enable a relatively simple measure to aid cross-nation analysis, which also makes them popular.

'Gender composition of children' may not be an adequate measure to gauge son preference because it does not discriminate between a preference for children and a preference for sons. Nor does the measure consider the sequence of births. This introduces a confounding effect, that is, wanting more children may be mistaken for wanting more sons. Consider these two examples, in which gender composition measures would not differentiate between a household with no preference and one with a strong preference for sons:

> *Ali and Maryam want four children, two of whom they want to be sons. Despite their first two children being sons, they have another two children. If both are daughters, the composition is 50:50.*

> *Similarly, Imran and Jemima want four children and have no preference for sons. The first two are sons and the second two are daughters, again the split is 50:50.*

4   New measure of son preference: GPB

4.1   Construction of GPB

In this section, an alternative measure for son preference, called GPB, is developed by considering the stated preferences and observed outcomes of mothers in a society where discrimination against females is common[8]. To ensure completeness of answers, mothers who want no more children

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[7] Sex ratio = number of males/number of female × 100.

[8] Focusing on mothers who want no more children is standard in studies on gender preference as it indicates completeness of fertility intention (e.g., Dyson and Moore 1983)).

are considered in the analysis. Based on the existing literature, it is assumed that in countries where there is evidence of discrimination against girls, son preference exists under two conditions:

1. After son preference is met, households do not have additional children even though they have not realised their preferred number of daughters or family size (Arnold 1997; Arnold et al. 2002; Arokiasamy 2002; Basu 1999; Basu and De Jong 2010).

2. Actual number of daughters exceeds desired number, resulting in more children −smaller households with a higher proportion of sons and larger households with a higher proportion of daughters (Ahmed 1981; Arnold et al. 1998; Bairagi 2001).

These conditions are formally presented in Table 2.

C(A) denotes the actual number of children, C(D) denotes desired number of children, S(A) denotes actual number of sons, S(D) denotes desired number of sons, D(A) denotes actual number of daughters and D(D) denotes desired number of daughters. The two sides of the table demonstrate how stated preferences and observed outcomes can be used to identify son preference effects while addressing the limitations of existing measures. The shortcomings of using sex ratios to inform fertility behaviour are demonstrated by the condition: C(A) < C(D). Specifically, the child need not be male for gender preference to be observable. The limitations of the gender composition variable may also provide misleading values, especially if the number of daughters dominates higher birth ranks.

Table 2: Measuring son preference using preferred and observed fertility outcomes

Actual family size is less than (or equal to)[A] desired	Actual family size is larger than desired
C(A) ≤ C(D)	C(A) > C(D)
S(A) ≥ S(D)	S(A) = S(D) [B]
D(A) < D(D)	D(A) ≥ D(D)
Met or exceeded ideal number of sons but not satisfied the preferred number of daughters.	Met or exceeded ideal number of sons but exceeded desired total number of children.
This condition does not necessarily imply the last birth was a boy.	E.g., five children were desired (C(D)), three sons (S(D)) and two daughters (D(D)) were desired. Of the five children, three were daughters (D(A)) and two were sons. Even though D(A) > D(D), the household has an additional child in the hopes of having a son as S(A) < S(D).
E.g., five children were desired (C(D)) and the three desired sons (S(D)) were realised in the first three births. The fourth child was a daughter, production ceased at that point to avoid having another girl. C(A) < C(D)	
[A] special (weaker) form of potential bias is this case is where S(A) + D(A) = C(D) = C(A)	Note: in this case the last birth is a son.
Recalling that S(A) ≥ S(D) and D(A) < D(D)	[B] A special (weaker) form of potential bias is when S(A) < S(D), D(A) ≥ D(D) and S(A) + D(A) ≥ C(D).
That is the number of desired sons is exceeded but daughters are not, but the C(D) = C(A) becomes the binding constraint.	In this case, the household exceeded or reached desired number of children, but son preference remained unmet.
E.g., five children were desired (C(D)), three sons (S(D)) and two daughters (D(D)). The first four births were sons and the fifth was a daughter. As C(A) = C(D) and S(A) ≥ S(D) the household does not have any additional children, even though D(A) < D(D).	

Note: C(A) actual number of children, C(D) desired number of children, S(A) actual number of sons, S(D) desired number of sons, D(A) actual number of daughters and D(D) desired number of daughters.

Source: authors' construction.

The underlying assumption in using sex ratios as a measure for son preference is that the higher proportion of males indicates a preference for boys. Consider the left-hand side of Table 2 and the following examples:

Example 1: Household A, where five children were desired (C(D)) and three sons were desired (S(D)). The three sons were realised in the first three births. The fourth child was a daughter at which point C(A) < C(D) but production ceased. SRLB would under-report preference for sons by not including this household in calculations.

Example 2: Household B, where five children were desired (C(D)) including three sons (S(D)) and two daughters (C(D)). The three sons were realised in the first three births. The fourth child was also a son and the fifth was a daughter, at which point C(A) = C(D) and production ceased, even though actual number of daughters was less than desired number of daughters (D(A) < D(D)). Sex ratio measures would over-report preference for sons, as the fourth male birth was not because of son preference but because of fertility preference.

Consider the right-hand side of Table 2 and the following examples:

Example 3: Household C, where five children were desired (C(D)), three sons (S(D)) and two daughters (D(D)). Of the five children born, three were daughters (D(A)) and two were sons. Even though D(A) > D(D), as S(A) < S(D) the household has an additional child who is a son. Sex ratios would under-report son preference in this case, as the additional daughters are due to a preference for sons.

Example 4: Household D, where five children were desired (C(D)), three sons (S(D)) were desired and two daughters (D(D)). Of the five children, three were daughters (D(A)) and two were sons (S(A)). Even though D(A) > D(D), given S(A) < S(D), the household has an additional child, who is a daughter. Sex ratio at last birth measures would under-report son preference in this case, as the additional daughters were due to a preference for sons.

The GCC (i.e. ratio of daughters) is sensitive to family size. In examples 1 and 2, where family sizes are below or equal to desired, ratio of daughters is low, whereas when family size is more than desired, as in examples 3 and 4, ratio of daughters is higher.

In Figure 1, a preference tree for households is provided. Households that do not want any more children were considered, denoted in the first column of Figure 1 by the box 'no more children'. These households are classified into three types, depending on whether the actual number of children in each household, C_A, is equal to, less than or more than the desired number of children C_D. This is illustrated in the second column of the diagram in the three boxes $C_A < C_D$, $C_A = C_D$ and $C_A > C_D$. The third column demonstrates whether actual number of sons (S(A)) is less than or at least equal to desired number of sons S(D). The fourth column repeats this exercise for actual number of daughters D(A) and desired number of daughters D(D).

The numbers on the branches in the fourth column (see Figure 1) denote the 12 outcomes. For example, branch 1, in the fourth column, represents a household where actual number of children is lower than desired number of children, but actual number of sons is greater than desired number of sons and the same for daughters. (Consider a household that wanted five children of which at least one was a son and one was a daughter. The first two births were daughters, and the third birth was a son, after which the household did not want any more children.) Note that branches 8 and 12 are not possible by construction.

The remaining 10 branches were utilised to generate GPB, the measure of son preference in this research. The odd number branches represent households that exceeded daughter targets to attempt to realise son targets. Branches 2, 6 and 10 represented households that stopped having children as soon as son targets were realised even if daughter targets remained unmet. Branch 4

9

represents households that did not meet son or daughter targets and did not want any more children (i.e. perhaps for reasons other than gender preference, such as health of mother).

Figure 1: Preference tree for households
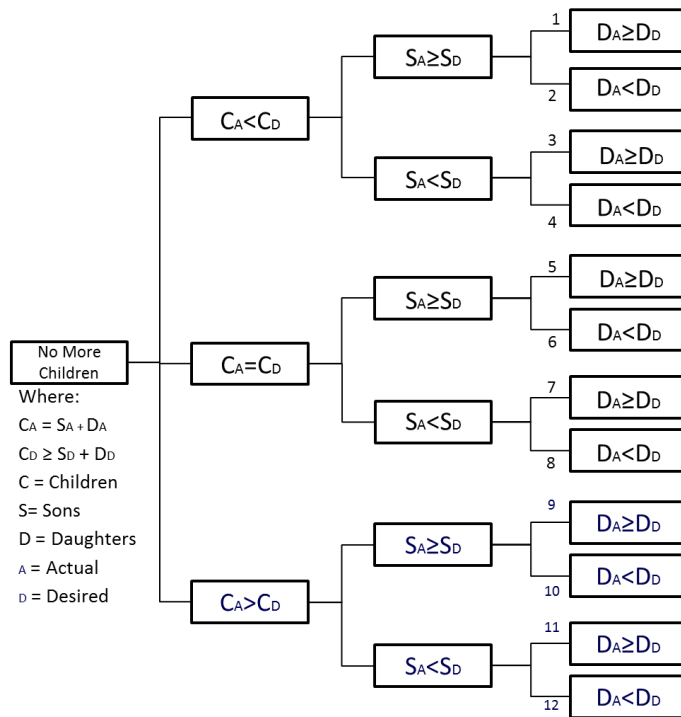
Source: authors' Illustration.[9]

4.2 Numerical illustration

Son preference may have two implications for households. First, to meet son preference, households may have more children (Ahmed 1981). Second, households with son preference who have sons earlier may have smaller families with higher proportions of sons than larger families (Clark 2000).

A numerical example is provided in Figure 2 to show the impact of GPB on fertility levels. For simplicity, let us assume the following:

- the household will keep having children until a son is born,
- after a son is born, the household will stop having any children,[10]
- the gender of a child at birth is random, and
- households will try a maximum of five times for a son then stop.[11]

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[9] While it is appreciated that daughter preferences may exist in many countries, as the focus of this thesis is on Pakistan (a country which ranks low in Gender Development Index), capturing daughter preferences is beyond the scope of this thesis.

[10] If the total number of children in a household is n, then the proportion of daughters is n-1/n and proportion of sons is 1/n; e.g., in a family of four children, the proportion of daughters is 0.75.
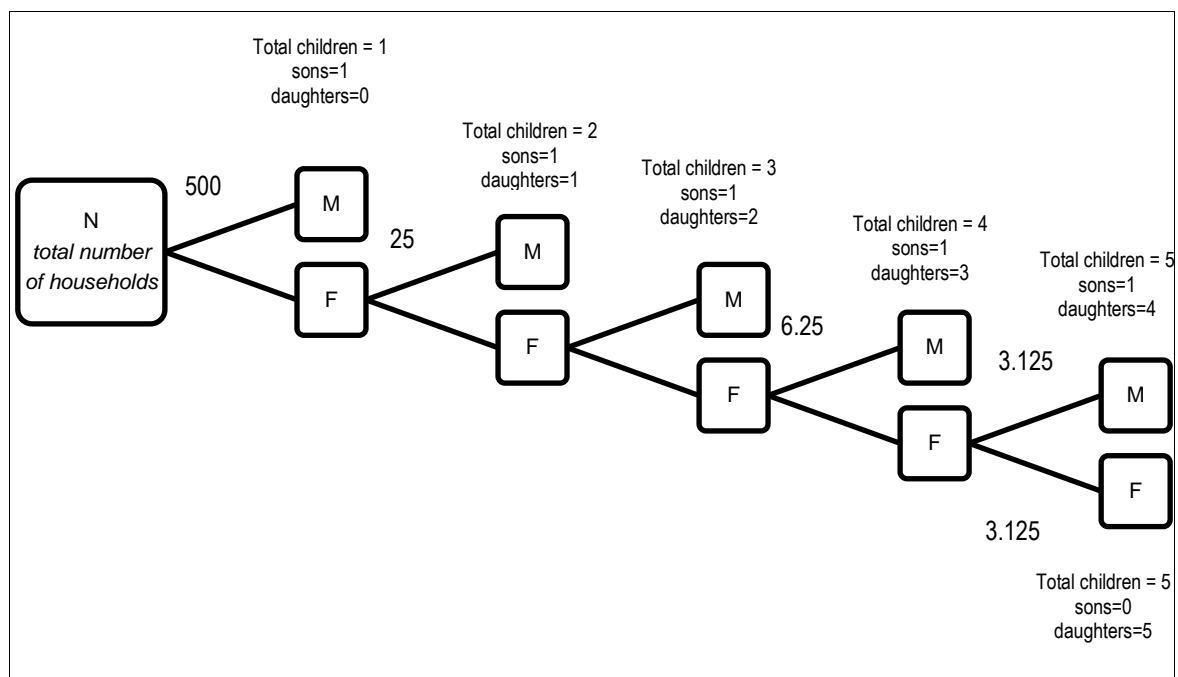
[11] This can be replaced by the total fertility rate for women in a particular area.

Suppose that there are N households in an area. The probability at birth of a child being male or female is 0.5 each. On the first try, half of households have a son and stop having any more children, while the other half have a daughter and try again. This continues until the remaining households have five children after which they stop. As is shown in Figure 2, for households trying to meet son preference fertility increases. Note that as fertility increases, number of daughters also increases.

Analytically, the example above has the following implications:

1. Households with unmet GPB may have a higher family size (Ahmed 1981).
2. Smaller families may have a significantly higher proportion of sons than larger families (Clark 2000).

Figure 2: Effect of son preference on fertility outcomes

Source: authors' Illustration.

4.3 Data description

To construct the GPB measure, the Pakistan Demographic and Health Survey (PDHS) 2012–13[12] was used. The PDHS is a household-level survey and information is collected from national and subnational representative samples of households. All ever-married women and a subsample of ever-married men aged 15–49 years old in households are eligible for individual interviews. The survey design is a stratified, clustered, and systematic sample of Pakistani households.

The Demographic and Health Survey (DHS) is funded by the United States Agency for International Development (USAID) and run by the National Institute of Population Studies (NIPS), Government of Pakistan Ministry of National Health Services, Regulations and Coordination. The survey is designed to provide information for family planning programmes for

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[12] Pakistan Demographic and Health Survey 2012–2013 (datasets).

evidence-based planning to assist programme managers and policy-makers to effectively plan and implement interventions (NIPS and ICF 2013).

The PDHS uses four questionnaires: Household Questionnaire, Woman's Questionnaire, Man's Questionnaire and Community Questionnaire. The survey covers topics of marriage, fertility, fertility preferences, family planning, infant and child mortality, nutrition and health, mother's reproductive health and nutrition, female empowerment and domestic violence. The main sections of the survey considered for the present study were those on reproduction, contraception, fertility preferences and women's autonomy.

4.4 GPB measure

In this section, descriptive statistics of households demonstrating son preference as per GBP measure is provided. The variables used for the construction of the GPB measure along with more information about household types is provided below. Using variable v605 'Fertility Preference' all women that want no more children are identified as respondents who answered 'No more' 'Sterilized (respondent or partner)' or 'Declared infecund' were classified as wanting no more children. By comparing the number of living children (v218) with ideal number of children (v613) households who have fulfilled their fertility preferences are identified where $v218 > v613$ or $v218 = v613$ means household has achieved desired number of children while $v218 < v613$ means households have fewer children than desired. By comparing number of living sons, at home or elsewhere ($v202 + v204$) with ideal number of sons (v627), households are identified as having achieved ideal number of sons if ($v202 + v204 > v627$ or $v202 + v204 = v627$) or falling short of having achieved ideal number of sons $v202 + v204 < v627$). Next, by comparing number of living daughters, at home and elsewhere ($v203 + v205$) with desired number of daughters (v628), households are identified as having fulfilled daughter preferences if $v203 + v205 > v628$ or $v203 + v205 = v628$ and falling short of having achieved daughter preferences if $v203 + v205 < v628$

GPB is constructed as a dummy variable where 1 means households are assumed to have son preferences if:

1. households do not have additional children when $v202 + v204 > v627$ or $v202 + v204 = v627$ even though they have not realised their preferred number of daughters or family size, i.e. $v203 + v205 < v628$ or $v218 < v613$.

2. Actual number of daughters exceeds desired number; i.e. $v203 + v205 > v628$ (assuming to meet son preferences)

And zero otherwise.

In Table 3, Table 4 and Table 5, information on households with son preference by household characteristics, couple characteristics and family size is provided.

As shown in Table 3 out of the total 6,186 mothers who want no more children, 41 were identified as having son preference, as per GPB. The prevalence of son preference is similar in rural and urban areas.

Prevalence of son preference is highest amongst poorest households (48.2) and poorer households (42). The prevalence of son preferences is slightly higher in the richest households as compared to middle or richer households. There may be many interconnected factors for including women in richer households having more control over their reproductive rights; e.g., having access to

contraception, richest households wanting to transfer wealth within the family to male heirs as well as richest households having fewer children but still wanting to have some sons.

Regionally, prevalence of son preference is highest in the provinces of Gilgit Baltistan, Baluchistan and Sindh respectively. In these provinces, prevalence of son preference is also higher in rural areas. This resonates with earlier findings that prevalence of son preferences is high in Pakistan. For example, using the 2006–07 Pakistan and Demographic Health Surveys (Saeed 2015) finds that a higher percentage of households have a strong preference for having only sons or then having more sons than daughters. As noted by (Guilmoto 2009), in developing countries, sons are desired by families due to their potential contributions to household earnings from agricultural work. As mentioned earlier, 39 per cent of the workforce is employed in the agriculture sector (Food and Agricultural Organisation of the United Nations 2021), which is predominantly in rural areas. Having sons ensures that there are more workers available for farm work and that there is a succession of land ownership after the head of the household, also usually a male, passes away. In urban areas, boys are still expected to be the breadwinners, so a desire for sons is still rooted in economic stability.

Table 3: GPB by household characteristics

		National, %	Rural, %	Urban,	Total no. of observations
Demonstrate GPB		41.3	41.2	41.4	6,186
Wealth quintile	Poorest	48.2	47.9	50.9	975
	Poorer	42.0	41.3	44.1	1,127
	Middle	39.1	35.3	44.7	1,207
	Richer	38.0	37.0	38.7	1,251
	Richest	40.9	43.2	40.5	1,626
Region	Punjab	36.7	36.9	36.5	2398
	Sindh	44.0	46.7	42.4	1313
	KPK[A]	37.6	37.0	38.6	1286
	Baluchistan	47.2	45.7	48.6	574
	Gilgit Baltistan	55.9	58.5	53.7	615

Note: Percentage distribution of ever-married women ages 15–49 who want no more children. [A]KPK 'Khyber Pakhtunkhwa'

Source: PDHS 2012–13.

In Table 4 background characteristics for mothers who have GPB are provided. Prevalence of GPB is higher in older women (ages 30 years and above). This trend may indicate a change in generational experience, as previous generations may prefer sons, but younger generations prefer fewer children, partly owing to the higher opportunity cost of having many kids. Interestingly, GPB is not vastly different across education level, indicating that more educated women may have greater capacity to practise son preference via access and awareness to sex-selective technologies. As expected, son preference is highest for households involved in agricultural work.

Table 4: GPB by mother's background characteristics

	Distribution	Total Observations
Respondent's age group		
15–19	20.00	15
20–24	32.60	221
25–29	37.50	752
30–34	43.30	1193
35–39	41.90	1464
40–44	40.50	1312
45–49	43.60	1229
49+	–	–
Respondent's education		
None	42.50	3574
Primary	38.40	883
Secondary	40.20	989
Higher	40.70	740
Respondent's type of work		
Not working	40.80	4248
Agriculture	43.70	309
Non-agriculture	41.20	952
Husband's age group		
15–19	–	–
20–24	34.10	44
25–29	35.30	272
30–34	40.80	659
35–39	40.50	1102
40–44	41.90	1307
45–49	41.80	1346
49+	42.50	1455
Husband's education level		
None	43.60	2003
Primary	39.80	820
Secondary	39.80	1891
Higher	41.40	1463
Husband's type of work		
Not working	51.20	172
Agriculture	43.50	639
Non-agriculture	40.30	4696

Note: Percentage distribution of ever-married women ages 15–49 who want no more children who are identified as having son preference according to GPB

Source: PDHS 2012–13.

The literature suggests that son preference may result in larger family sizes. In Table 5, information on GPB by actual and ideal number of children is provided. As shown, son preference is concentrated in households that have more children than desired, and those that have relatively larger households. However, diminishing returns on having children may be seen after five children, after which the percentage of households with son preference drops. Households with son preference who exceed fertility are more common than households with son preference who stop fertility. Owing to high fertility levels, low use of contraception, lack of feasibility and access to abortion facilities as well as religious, moral and legal hurdles in Pakistan, unmet son preference may manifest as households exceeding fertility. This suggests the importance of cultural influence on how son preference is met. Thus, unlike the currently used sex ratio at birth and SRLB measures based on stopping rules to gauge son preference, GPB considers households that practise exceeding rules.

Table 5: GPB by ideal number of children and number of living children

Ideal number of children	Number of living children						
	1[A]	2	3	4	5	5+	Total
0	2	1	0	9	12	0	24
1	2	4	1	2	0	0	9
2	36	67	87	53	18	12	273
3	3	48	110	95	59	31	346
4	0	29	207	308	258	240	1,042
5	0	1	9	46	112	144	312
5+	1	0	7	38	82	164	292
Total	44	150	421	551	541	591	2,298

Note: Percentage distribution of ever-married women who want no more children by ideal number of children and number of living children. [A] No observation for living children zero.

Source: PDHS 2012–13.

5   Comparing GPB with other measures of son preference

In Table 6, sex ratios at birth and SRLB are provided by birth order and family size. SRB is calculated as the total male births/total female births x 100 and SRLB is calculated the same way except only for last birth. Looking at first births, the sex ratio at birth is 109[13] for first two births. The sex ratio at last birth is higher at 144[14] and 159 for first two births. Both SRB and SRLB are higher as family size and birth orders increase. These findings resonate with earlier findings that:

(1) households may be using stopping rules when sons are born (Arnold et al. 2002; Hull 1990; Sahni et al. 2008);

(2) higher SRLB in households with fewer children may indicate stopping rules leading to reduced fertility (Das Gupta and Mari Bhat 1997; Guilmoto 2009; Hudson and Boer 2002; Park and Cho 1995);

(3) stopping rules may result in higher proportions of sons in smaller families.

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[13] The World Bank estimate for Sex Ratios at Birth is 1.087 (World Bank 2013).

[14] Similar to estimates of SRLB for Pakistan by Bongaarts (2013: 194)

Table 6: Sex ratios at birth and last birth by birth order and family size

	Birth order					
	1	2	3	4	5	5+
SRB	109.6	109.1	99.0	106.4	111.1	107.7
SRLB	144.9	159.4	138.5	133.7	135.8	111.5
Family size						
SRB[1]						
1	109.0					
2	119.0	117.3				
3	123.9	116.6	114.6			
4	109.8	113.3	97.2	119.6		
5	107.1	105.4	108.0	110.7	126.1	
5+	88.6	91.8	80.8	92.6	101.9	107.7
SRLB[2]						
1	144.9					
2	158.0	159.4				
3	148.7	132.2	138.5			
4	124.9	125.9	102.0	133.7		
5	109.1	107.4	112.0	115.1	135.8	
5+	87.7	90.7	81.2	94.0	101.8	111.5

Note: Ever-married women aged 15–49 by fertility gap and according to background characteristics, Pakistan 2012–13 SRB = sex ratio at birth (M/F*100); SRLB = sex ratio at last birth (i.e. for mothers who do not want any more children). [1]Whole sample. [2]Mothers who do not want any more children.

Source: PDHS 2012–13.

Indeed, the proportion of sons declines as family size increases and proportion of daughters increases (see Table 7). On average, those who do not want any more children have more sons than daughters (i.e. 2.4 sons versus 2.2 daughters). This resonates with the earlier result of sex ratios being skewed towards males in earlier births; however, it does not imply that all households have more sons than daughters.

In Table 7, a comparison of GPB to GCC and SRLB is conducted. SRLB measure is converted to a household level measure, where SRLB is a dummy variable equal to 1 if the last birth in the household is male and zero if it is female. GCC is a dummy variable that equals 1 if a household has more daughters than sons and zero if opposite. Only households that do not want any more children are included.

Table 7: Gender composition of living children by family size

Number of living children	Observations	Average number of sons	Average number of daughters	Proportion of sons	Proportion of daughters
All households	6,186	2.477	2.238	0.541	0.460
0	3	–	–	–	–
1	145	0.614	0.386	0.614	0.386
2	602	1.201	0.799	0.600	0.400
3	1,106	1.728	1.272	0.576	0.424
4	1,313	2.193	1.807	0.548	0.452
5	1,100	2.680	2.320	0.536	0.464
5+	1,917	4.596	5.404	0.468	0.532

Note: Ever-married women aged 15–49 by fertility gap and according to background characteristics, Pakistan 2012–13.

Source: PDHS 2012–13.

Table 8: Son preference and family size

Number of living children (1)	Observations (2)	GPB (3)		SRLB (4)		Gender composition (5)	
		Mean	SD	Mean	SD	Mean	SD
All households	6,186	41	0.49	40	0.49	34	0.47
1	145	29	0.46	48	0.50	39	0.49
2	602	25	0.43	51	0.50	10	0.31
3	1,106	38	0.49	45	0.50	36	0.48
4	1,313	41	0.49	42	0.49	22	0.41
5	1,100	48	0.5	37	0.48	43	0.50
More than 5	1,917	46	0.5	32	0.47	43	0.49

Note: Percentage of ever-married women ages 15–49 who want no more children.

Source: PDHSs 2012–13.

The relationship of each variable to family size implies that each measure, at least partially, identifies different households. GPB and SRLB each have the opposite relation to family size, while GCC follows no pattern (see Table 8). As previously discussed, research has found that son preference has a positive association with family size in Pakistan (Zaidi and Morgan 2016). This relationship is captured by GPB; i.e. as family size increases so does the proportion of households identify as preferring sons. SRLB on the other hand has an inverse relationship with family size; i.e. as family size grows, the proportion of households identified as preferring sons, as captured by SRLB, declines. This relationship seems counterintuitive indicating that SRLB may not be capturing the son preference in some households. For example, parents with only daughters may continue childbearing to achieve sons hence their family size would be larger at last birth. On the other hand, households where sons are born earlier may have fewer children at last birth. Finally, these measures do not account for households where son preferences remained unmet, but family sizes were large. The relationship between sex ratios and family sizes have been clearer in countries closer to completing the fertility transition but where son preferences prevail (Bongaarts 2013).

Figure 3: GPB: a comparative analysis of existing measures
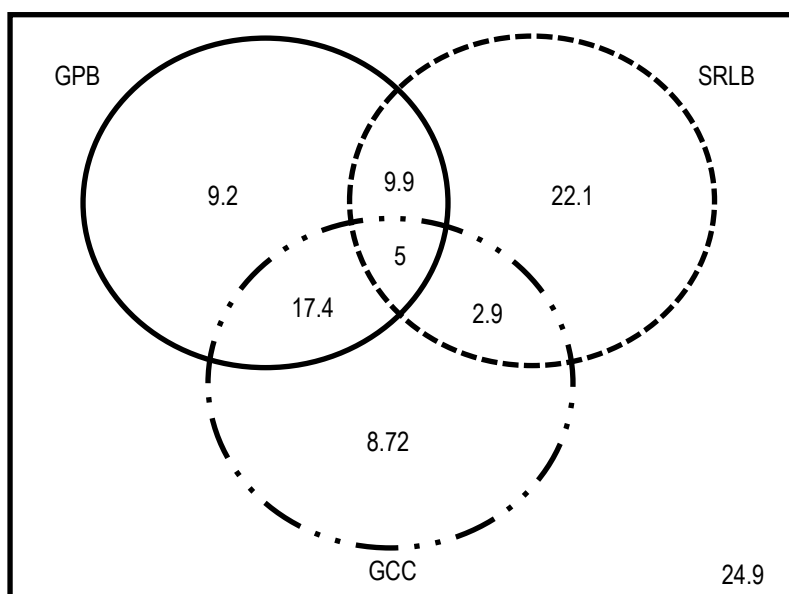
Note: number of ever-married women aged 15–49 who want no more children; N = 6,186.

Source: PDHSs 2012–13.

In Figure 3, a comparison of households identified as having son preference is illustrated for the three measures. GPB exclusively identifies 9.2 of households as having a son preference, which SRLB and GCC are unable to capture. All three measures identify at least 5 of the same households as preferring sons.

On closer inspection of the GPB and SRLB measures, both identify at least 14.9 of the same households. However, GPB categorises 26.6 of households that are not classified by the SRLB measure. For example, both GPB and SRLB would identify a household as having son preference when the last birth is male but only GPB would identify households where earlier births are male even if the last birth is female, the household stops when number of sons is complete even if number of daughters is not complete. SRLB does not capture when son preference is practised but last birth is not male.

GPB and GCC identify 22.4 of the same households as having a son preference. GPB identifies 19.1 of households as having a son preference that are not classified by GCC. For example, both GPB and GCC will identify a household as having son preference if it has more daughters than desired in the hopes of having a son, but only GPB will identify households that had son preference that was met earlier, hence they stopped having children despite daughter preferences not being met. GCC only considers whether households have many daughters to fulfil son preference but will not consider whether households stop having children as soon as son preference is met even if daughter preference is unmet.

18

6 Conclusion and policy suggestions

The results of the investigation suggest that GPB is a more appropriate measure for Pakistan, which has high fertility and low use of contraception.

GPB allows for identification of households with son preference that may be un-identified by existing measures such as sex ratios and GCC. Using GPB, it is possible to identify son preference in households where there is an unexpressed demand for sons. These households would be categorically un-identified if sex ratios, even at last birth, were used. Using GPB, even those households where last birth is not male can be identified as using stopping rules by identifying that when the preference for sons is met, households may stop childbearing even if total number of daughters is less than desired. Conversely, to meet son targets, households may continue to have children (i.e. daughters). Both GPB and GCC measures identify a household as having son preference if they have more daughters than desired in the hopes of having a son. Only GPB identifies households that have son preference that was met earlier, and hence they stopped having children despite daughter preferences not being met.

This reverberates with earlier findings by Bongaarts (2013) that Pakistan has one of the highest desired sex ratios in the world despite having observed sex ratio between 107 and 109. The excess of desired over observed sex ratio indicates an unexpressed demand for sons, which sex ratios are unable to capture because of cultural, legal, religious, ethical and moral obstacles to sex-selective abortions in Pakistan.

Findings also shed useful insights on characteristics of mothers with son preference. Son preference was found to be higher in older age groups, indicating a change in attitudes over time as previous generations may prefer sons, whereas younger generations may have fewer children and a higher opportunity cost of having many kids. Prevalence of son preference was found to be similar in the poorest and richest households, but the poorest households may have a desire for sons to ensure farm work, whereas the richest households may have a desire for sons to transfer wealth.

To summarise, the existing measures of sex ratio at birth, SRLB and GCC have been useful in gauging son preference in countries where stopping rules are predominantly used. GPB allows for gauging son preference in countries where households are willing to have more children to meet those preferences by using exceeding rules.

Based on the findings in this research, the Pakistan government and international development agencies should continue to promote gender equality to control population growth and reduce poverty. The national Action Plan (Ministry of National Health Services, Regulations and Coordination 2018) proposes several relevant initiatives in this regard. While devising population control policies, son preference should be an important consideration for policy-makers. It is recommended that promotion of initiatives be undertaken that lead to more balanced preference of offspring gender. The motivation behind son preference is rooted in socio-economic, cultural, religion and traditional beliefs. Policy initiatives should continue that:

- Increase the access and continuation of education of females. This includes increased safety and mobility for females and an increase in age of marriage for females. The child marriage restraint ACT 1929 (Act XIX of 1929) currently places the legal age for marriage for girls at 16 years of age. The UN Convention on the Rights of the Child also suggests the minimum age for marriage should be 18 years of age. According to UNICEF (2020), 18 of women aged 20–24 years are married before the age of 18 years and 4 are married before the age of

15 years (UNICEF global databases 2021, based on Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys and other nationally-representative surveys.)

- Increase the access and continuation of paid market activities for females, particularly in the formal sector, which leads to accumulation of retirement savings and hence reduces perceived dependence on sons as old age insurance. In Pakistan, retirement savings are like a superannuation fund. The government pays retirement benefits to public sector employees and in the event of death of beneficiary to next of kin. In the private sector retirement benefits are known as the Provident Fund. There are no retirement benefits in the informal sector.

- Reduce the transfer of wealth in the marriage market from the bride's family to the groom's family either in the form of wedding expenses or dowry. In 2016, the province of Punjab passed The Punjab Marriage Functions Act 2016 (XXIX of 2016) for the 'Prohibition of ostentatious celebrations' in marriages (Pakistan 2016). In 2018, it was proposed to apply the same regulation nationwide but has not passed in senate yet.

- Reduce gender gaps in inheritance, so daughters are eligible to receive similar inheritance as sons, who currently receive more.

6.1 Scope for future research

It should be noted that since the PDHS data only asks the questions of fertility preferences, i.e. ideal number of total children, sons and daughters retroactively - the responses are only recorded at a point in time. This means that the GPB measure cannot be extended to include birth orders as the question is not asked at each birth and respondents are not followed over a period, i.e. PDHS is not a panel dataset. However, when panel data are available which cover this question for countries such as Pakistan, this analysis would be very valuable.

This study primarily focuses on cross-sectional analysis of son preference for mothers who want no more children to ensure that fertility intentions and outcomes are complete. Research on lifecycle theory suggests that fertility intentions and outcomes may change over time. The Pakistan Demographic and Health Surveys are not a panel dataset, and thus it is not possible to study the changing nature of son preference over time. If panel data that include desired and actual fertility and GCC were to become available, it would be an interesting exercise to study the transition of son preference over time.

The GPB measure is constructed using the mother's fertility preferences. However, male preference may also be important in constructing GPB. At present, this information is only collected for a subset of husbands of respondents. While husband's fertility preference is beyond the scope of this study, future studies can consider both preferences when creating a GPB measure.

From 2019, the world suffered from the Coronavirus pandemic resulting in loss of life, health and an increase in poverty worldwide. According to the World Health Organization, between January 2020 and April 2021, Pakistan reported 692,231 confirmed cases of COVID-19 and 14,821 deaths, and as of April 2021, 894,327 vaccine doses had been administered (WHO 2021). The next round of the Pakistan and Demographic Health Survey can be expected in 2022–23. Study of the impact of son preference on gender gaps in poverty in the wake of COVID-19 in Pakistan would make a useful contribution to the existing literature.

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