Title: "The 'Martha Effect': The Compounding Female Advantage in South African Higher Education"

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Abstract

In this paper we use population-wide panel data to follow every South African student from the 2008 cohort as they enter into and progress through university, following them for six years (N=112,402). We find indisputable evidence of a large female advantage that continues to grow at each hurdle of the higher education process. To be specific, relative to their male counterparts we find 27% more females who qualified for university, 34% more who enroll in university, 56% more who complete any undergraduate qualification and 66% more who attain a bachelor's degree. This despite there being roughly equal numbers of boys and girls at the start of school. We show that this female advantage remains after controlling for school-level performance, and exists for all subgroups of race, age, socioeconomic status, province of origin or institution attended. We examine 19 fields of study and find that females are significantly *more* likely to get a degree in 12 of the 19 fields (often by substantial margins), and are significantly *less* likely to get a degree in five of the 19 fields. However, this is almost entirely because they do not access these traditionally 'male' programs rather than due to lower completion rates. Irrespective of field of study, race, age, socioeconomic status, location or institution, females are always and everywhere 20% less likely to dropout than their male counterparts (including in traditionally 'male' fields like Engineering and Computer Science). Building on the idea of the 'Matthew Effect' in reading (the rich get richer), we present evidence of a gendered version of this phenomenon in higher education; what we call the 'Martha Effect'.

JEL codes: I21, I23, I24, J16

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1 Introduction and high-level evidence for the female advantage

> "*For whosoever hath, to him shall be given, and he shall have more abundance; but whosoever hath not, from him shall be taken away even that that he hath. (13:12).*"
>
> (The Gospel according to Matthew)

Internationally there is a large and growing literature on the female advantage in higher education. Across the 35 OECD countries, 58% of bachelor's degrees were awarded to women in 2014, with slightly higher figures in the European Union (60%), and South Africa (61%) (OECD, 2016: 71). Vincent-Lancrin (2008) shows that the percentage of women in higher education in these countries rose by 20% over the 20-year period 1985-2005, increasing from 46% to 55%. Numerous explanations have been put forward as to why this is the case, but it is still not entirely clear what the underlying causes are. In the United States, Goldin et al. (2006) argue that, historically, changing gender norms and rising female expectations of labor force participation explain the increase in female participation in higher education (see also Diprete & Buchmann, 2006; Goldin, 2006). However, this does not explain why female participation has continued to rise significantly beyond the 50-50 mark – as it has in almost all OECD countries - or why females do better than males at school where there have not been as many barriers to entry historically as there have been in the labor-market. Explanations for this typically fall into one of four categories (1) higher female post-secondary expectations (Fortin et al., 2014; OECD 2015), (2) superior pre-university achievement (Conger & Long, 2010; Ewert, 2010), and (3) different choices in fields of study between men and women (Charles & Bradley, 2002; Alon & Gelbgiser, 2011). However, the leading current explanation for both phenomena is that (4) females have more and/or better non-cognitive skills and thus have lower 'total costs' for education, elsewhere referred to as 'psychic costs' (Becker et al, 2010). Put simply, schooling and education is more suited to females than it is to males, or alternatively, females have more traits and behaviors that are favorable for schooling in its current form. While 'non-cognitive skills' is a relatively amorphous term, it typically refers to concepts such as self-control, self-motivation, dependability, sociability, perceptions of self-worth, locus of control, time-preference and delayed gratification (see Heckman et al., 2006: 420; Jacob, 2002; Duckworth & Seligman, 2005).

While understanding the determinants of the female advantage at school and at university is an important strand of research, it is not what we focus on in this paper. Secondly, although there is no lack of empirical evidence showing a female advantage at a country-level using cross-sectional data for most countries, there is a dearth of panel-data research on this topic for countries other than the United States or those in Europe. Our contribution to this literature

is to construct and analyze a population-wide unit-record panel dataset that allows us to control for background covariates, prior achievement, field of study and institution of access for an entire country (South Africa) for one full cohort (2008). We aim to (1) show that there is a large female advantage in higher education, which we quantify and describe, (2) to document where this advantage is concentrated – for sub-groups as well as by field of study and institution of access, and (3) to show that there is some additional female advantage in higher education that is not explained by superior school-level achievement among females. We argue that there is a version of the "Matthew Effect" at play, where there is a growing educational advantage accruing to female students. It is not simply an effect of levels where female students are some way above male students and remain ahead by that consistent margin. At each stage in the higher education process females succeed in higher and higher numbers, pointing to not only a large, but a growing, advantage that cannot be explained by prior achievement. This is what we call the "Martha Effect."

A brief outline of the paper and its high-level findings are included below:

Section 2 below begins with an overview of pre-university differences in academic achievement by gender, surveying the international evidence and also summarizing the South African results from ten rounds of nationally representative surveys (TIMSS, PIRLS and SACMEQ). We also look at the local evidence for gender differences in repetition and drop-out at the school level, as well as achievement in the school-leaving exam ('matric').

Section 3 provides an overview of the data and methodology employed in the paper. In Section 4 we present our findings. We define six higher education outcomes relating to access, retention and completion and use these metrics to compare the performance of male and female students for the following sub-groups: age, race, school socioeconomic status, province of origin, and institution of access. We then determine if the female advantage emerging in these regressions remains once we control for prior academic achievement and school-level subject choice. Given that females are under-represented in STEM subjects we repeat the analysis – both with and without controls – for each of 19 fields of study. In Section 5 we present conclusions.

In short, we find that in cross-national assessments South African female learners outperform their male counterparts at every grade of assessment (grades 4, 5, 6 and 9) and in every subject assessed (mathematics, science and reading). Fewer females repeat a grade or drop out of school resulting in more females reaching and passing the school-leaving exam (matric). We show that females attend university in higher numbers, are more likely to

graduate and are always and everywhere less likely to dropout – even in traditionally male dominated fields like Engineering and Computer Science. Of 19 fields of study we analyze there are only five where females are less likely to enroll given their school-level performance: (1) Engineering, (2) Computer Sciences, (3) Architectural Sciences, (4) Mathematical Sciences, and (5) Agricultural Sciences. However, once females have enrolled in these degrees a pro-male completion advantage only remains for Engineering and Computer Science, and it is much diminished. We find that prior academic achievement explains half of the university level Using rich population-wide longitudinal data we can say unequivocally that there is a large female advantage in higher education which grows at every hurdle in the process. These high-level findings can be seen in Figure 1 below:

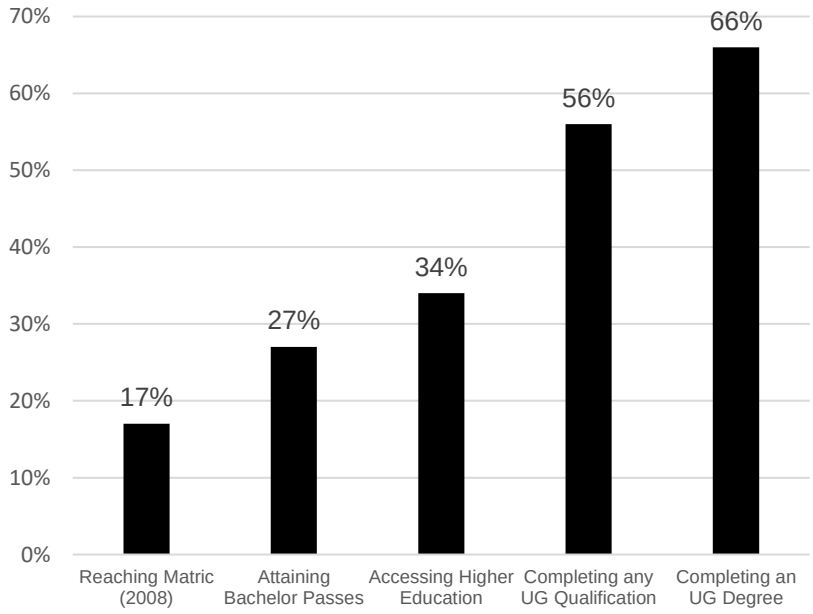

Figure 1: The percentage more females than males from the 2008 NSC Cohort (N=112,402) attaining higher education outcomes (2009-2014) (For corresponding figures see Table 1)

2 Pre-university differences in achievement by gender

One of the explanations for the superior performance of females in higher education is the superior performance of females at school. This is both in terms of academic achievement and likelihood of dropout. Using longitudinal data Ewert (2010) shows that high school academic performance accounts for part of the pro-female gap in college throughput in the United States (see also Riegle-Crumb, 2010). Similarly, Conger & Long (2010: 184) find that "males earn lower GPAs and credits in their first semester of college largely because they arrive with lower high school grades." They go on to explain that this effect is exacerbated after the first semester as males fall further behind their female counterparts. One helpful data source for analyzing school-level gender differences are the now ubiquitous cross-national

assessments of educational achievement. An overview of school-level gender-inequalities in these cross-national assessments is included below.

2.1.2 Gender differences in primary and secondary school achievement

Reading Results Globally. Both the Program for International Student Assessment (PISA) and the Progress in International Reading and Literacy Study (PIRLS) have found that on average girls always outperform boys in reading. Of the 45 countries that participated in PIRLS 2011 at the fourth-grade level, 40 had large pro-girl differences in reading achievement, with the remaining five countries showing no difference by gender (Mullis et al., 2012a: p7). In all rounds of the PISA assessment 15-year-old girls outperform 15-year-old boys in reading, however this gap has narrowed somewhat between 2009 and 2015 (OECD, 2016: 169, 38). Similar results have been found for reading in Latin American countries at the primary school level. The SERCE[1] 2007 data show that girls significantly outperformed boys in all 17 Latin American countries at the grade 3 level and in 9 countries at the grade 6 level (LLECE 2008 in Saito 2011). In sub-Saharan Africa, the SACMEQ data shows that nine of the 14 countries had higher average scores for girls than boys, with the difference being statistically significant in five countries. Of the six countries with pro-boy reading scores (all of which are much poorer low-income countries), the difference is only statistically significant in two countries (Zimbabwe and Tanzania) (Saito, 2011: p18).

Mathematics and Science Results Globally: In the PISA 2015 Science assessment boys scored marginally higher than their female counterparts (4 points), with significant pro-boy differences in only 24 of the 72 countries. The PISA 2015 Mathematics assessment showed that boys outperform girls by 8 score points on average, but that the difference is only statistically significant in 28 of the 72 countries/economies (OECD, 2016: p.196), down from 38 points in PISA 2012 (OECD, 2015:20). Of the 49 countries participating in TIMSS 2015 at the grade 4 level, about half exhibit no achievement difference between boys and girls in mathematics (23 countries) and science (25 countries). At the grade 8 level this rises to 26 of the 39 countries in mathematics and 20 of the 39 countries in science. Contrary to popular belief at the eighth-grade level for mathematics and science there are more countries where girls outperform boys (7 countries for mathematics and 14 for science) than where boys outperform girls (6 countries for mathematics and 5 countries for science) (Mullis et al., 2016: p15). It is worth noting that all of the above statistics are country averages. Disaggregating results shows that there is considerably more variation in boys' achievement, meaning that

[1] SERCE stands for the Segundo studio regional comparative y explicativo

boys are more likely than girls to be at the very top and the very bottom of the distribution (OECD, 2015). Turning to Africa, Dickerson et al. (2015: 13) uses data from SACMEQ and PASEC[2] (francophone West Africa) and shows that of 19 African countries included in their sample, boys significantly outperform girls in mathematics in 10 countries, while girls significantly outperform boys in 3 countries (see also Saito, 2013). These results are all correlated with income such that wealthier countries exhibit pro-girl differences and poorer countries exhibit pro-boy differences.

To summarize the above, girls significantly outperform boys in reading irrespective of assessment or grade. Boys typically outperform girls in mathematics and science (particularly in PISA) although to a smaller extent and one that seems to be declining over time in some assessments (Mullis et al., 2016: p15).

School-Level Gender Gaps in South Africa: Table 1 below reports the average scores for boys and girls in each of the cross-national assessments that South Africa has participated in over the last two decades. All these surveys are nationally representative. Since 2011 all cross-national assessments in South Africa show that girls outperform boys, irrespective of grade or subject. At the primary school level these differences are large and statistically significant in both reading and mathematics.

Reading results in South Africa: The gender gap in reading at the primary school level in South Africa is one of the largest in the world. Of the 40 countries that participated in PIRLS 2006, South Africa had the third largest (pro-girl) gender gap of 36 points, amounting to one grade-level of learning (Mullis et al., 2007). The SACMEQ results point to similarly large and statistically significant gender gaps in reading (Zuze & Reddy, 2013). Interestingly, the gender gap in reading can already be seen on the first day of grade 1. In a sample of 230 schools, Mohohlwane (2016, p.104) finds a clear and statistically significant female advantage in baseline learner performance in home language (Setswana) at the very start of Grade 1 in the North West province.

Mathematics and Science Results in South Africa: In the 2000 and 2007 rounds of SACMEQ, South African grade 6 girls outperformed their male counterparts, but this difference was not statistically significant. However, in the more recently conducted TIMSS-Numeracy assessment of 2015, grade 5 girls outperformed grade 5 boys by a statistically

[2] SACMEQ stands for the Southern and Eastern African Consortium for Monitoring Educational Quality, and PASEC stands for the Programme d'Analyse des Systèmes Educatifs des Pays de la Confèrences des Ministres de l'Education des Pays Francophones.

significant margin of 16 points. This was the fourth largest (pro-girl) gender gap in mathematics of the 49 countries that participated (Mullis et al, 2016). At the high-school level South Africa only participates in TIMSS, but this is also the assessment that spans the longest time period (1995-2015). In earlier rounds of TIMSS (1995, 1999 and 2003) boys outperformed girls in both mathematics and science at the grade 8 level, although these differences were not statistically significant (see Table 1). In the more recent rounds of TIMSS (2011 and 2015), girls now outperform boys in both mathematics and science at the grade 9 level, although again these differences are not statistically significant.

Table 1: South African learning outcomes by gender

Survey	Year	Subject & grade	Boys	SE	Girls	SE	Diff	SE of diff.	Stat. sig.?	Source & page number
TIMSS	1995	Math Gr8	360	*6,3*	349	*4,1*	-11	*7,5*	N	Beaton et al, 1996; p34
		Sci Gr8	337	*9,5*	315	*6*	-22	*11,2*	N	
	1999	Math Gr8	283	*7,4*	267	*7,5*	-16	*10,5*	N	Reddy 2006 p54
		Sci Gr8	253	*7,7*	234	*9,2*	-19	*12,0*	N	O'Martin et al. 2000 p50
	2003	Math Gr8	264	*6,4*	262	*6,2*	-2	*8,9*	N	Reddy 2006 p54
		Sci Gr8	244	*7,7*	242	*7,2*	-2	*10,5*	N	O'Martin et al. 2004 p51
	2011	Math Gr9	350	*3,4*	354	*3*	4	*4,5*	N	Mullis et al 2012b p71
		Sci Gr9	328	*4,5*	335	*4,1*	7	*6,1*	N	Mullis et al 2012b p.69
	2015	Math Gr9	369	*4,6*	376	*5,3*	7	*7,0*	N	Mullis et al., 2015
		Sci Gr9	353	*5,5*	362	*6,7*	9	*8,7*	N	
TIMSS-N	2015	Math Gr5	368	*4,4*	384	*3,8*	16	*5,8*	Y	Reddy et al., 2015; p6
SACMEQ	2000	Read Gr6	478	*7,9*	505	*10,1*	27	*12,8*	Y	Moloi & Chetty, 2011: p51
		Math Gr6	482	*6,7*	490	*8*	8	*10,4*	N	
	2007	Read Gr6	484	*4,7*	506	*4,8*	22	*6,7*	Y	
		Math Gr6	491	*4,1*	498	*3,9*	7	*5,7*	N	
PIRLS	2006	Read Gr4	235	*5*	271	*5*	36	*7,1*	Y	Howie et al 2006, p20
	2006	Read Gr5	283	*5,5*	319	*6,3*	36	*8,4*	Y	
prePIRLS	2011	Read Gr4	446	*4,2*	475	*3,9*	29	*5,7*	Y	Howie et al, 2011; p28

*Note: **g**reen = pro-**g**irl difference; **b**lue = pro-**b**oy difference*

2.1.3 Gender differences in grade repetition and dropout in South Africa

In addition to superior academic achievement, girls in South Africa are also significantly less likely to repeat a grade or drop out of school (Branson et al., 2014; Fleisch & Shindler, 2009). Two important contributions to the South African literature on throughput and dropout are those of Lam et al (2010) and Van Wyk et al (2017), both of which focus on one province; the Western Cape. Using survey data Lam et al (2010: 3) find that "girls move through school faster than boys, with female schooling exceeding male schooling by about one full grade among recent African cohorts who have finished schooling." Van Wyk et al (2017: 20) use

administrative data and follow all grade six learners in the Western Cape (N=77,633) over the period 2007-2013. They find that males are 29% more likely to have dropped out of school by 2013 compared to their female counterparts (male dropout rate: 47,8%, female dropout rate: 36,7%).

Given the above findings, it is only logical that there would be more female learners than male learners writing the grade 12 school-leaving exam known as the National Senior Certificate (NSC), or 'matric'. Of the 2008 NSC cohort, 54% of learners were female (303,406), and 46% were male (258,261)[3]. Similarly, in our 2008 cohort females accounted for 56% of bachelor passes (62,386), while males accounted for 44% of bachelor passes (48,289).

2.1.4 Gender differences in performance in the school-leaving exam (matric)

Given that dropout and repetition are strongly correlated both with each other and with performance (Lewin & Little, 2011), there is clear evidence of a gendered sample selection process. Since weaker performing males are more likely to dropout than weaker performing females, there will be a larger number of weaker-performing females in matric, lowering average female achievement (see Perry, 2003 for a full discussion). This is in addition to the generally high levels of dropout that are characteristic of South African education. Although there were 561,667 matric students in 2008, in Grade 3 this cohort had 1,194,425 learners in it (DBE, 1999). While some of these grade 3 learners would be repeating learners, it is generally accepted that are approximately one million learners per grade. The important point here is that only about 50% of the cohort actually made it to matric and are included in our 2008 NSC dataset. This should be keep in mind as a caveat throughout the interpretation of the results. When interpreting the results presented throughout this paper, if one wants to move from the statistics being relative to 2008 NSC cohort and instead from the original cohort (of roughly one million), one can halve the figures given that there were roughly equal numbers of boys and girls in this cohort at the start of school (49% girls, 51% boys) (DBE, 2010).

Figure 1 below shows the distributions of performance in the largest subjects[4] for males and females in the 2008 NSC cohort. Of the 18 subjects, boys outperform girls in five subjects (Agricultural Sciences, Geography, History, Mathematics and Mathematics Literacy) while

[3] This gap between male and female learners making it to matric has grown slightly over time such that in 2016 females made up 55% of matriculants (369,013) while males made up the remaining 45% (305,639) (DBE, 2017a: 32). In 2016 the bachelor-pass gap had declined somewhat with 54% of bachelor passes awarded to females (87,974) and 46% awarded to males (74,400) (DBE, 2017a: 43).

[4] These are the 18 subjects with the highest enrolment, all of which have more than 50,000 learners enrolled in that subject.

girls outperform boys in the remaining 13 subjects. Focusing on the interquartile range one can see that girls significantly outperform boys in all language subjects (Afrikaans, English, isiXhosa, isiZulu, and Sepedi), while boys significantly outperform girls in mathematics.

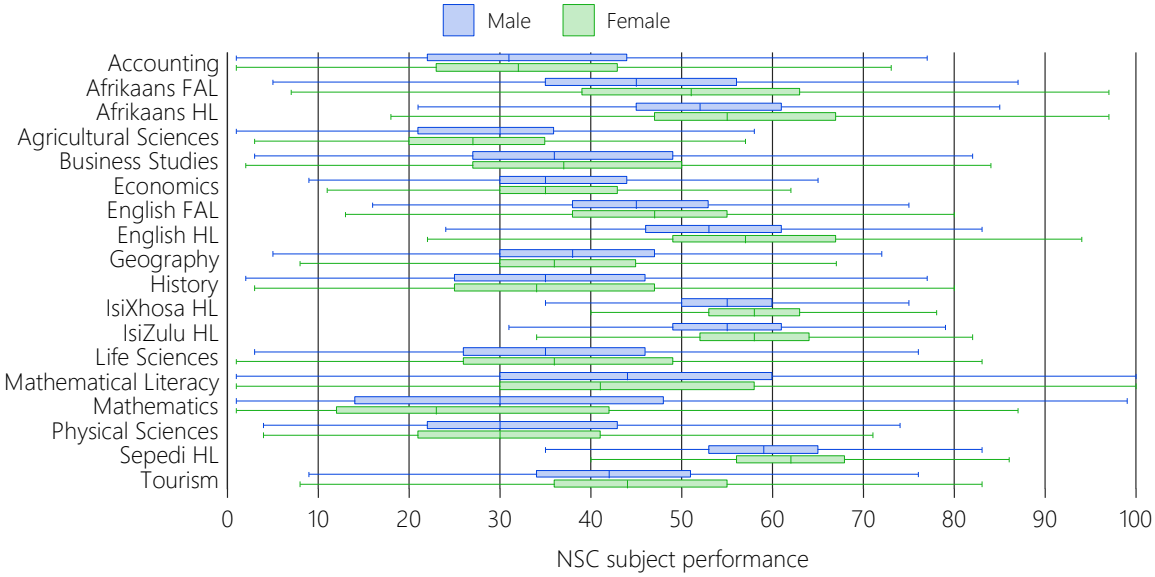

Figure 1: Box plots of subject performance by gender in the 2008 National Senior Certificate

3 Data and methodology

The data used for the present analysis comes from two sources: (1) The 2008 National Senior Certificate (NSC) examinations data from the Department of Basic Education South Africa. This contains learner-level unit-record information for all grade 12 learners in South Africa who wrote the matric exam in 2008 (561,667 learners); and (2) Data on university outcomes for all learners who then accessed any type of higher education between 2009 and 2014 (112,402 learners), sourced from the Higher Education Management Information System (HEMIS) of the Department of Higher Education and Training South Africa (DHET). Both datasets were sourced from DBE and DHET as part of the Labour Market Intelligence Project (LMIP) research program. The HEMIS data contains rich student-level unit-record data on all enrolments and graduations in South Africa's public higher education or university system. All 112,402 learners could be matched using their unique South African identity number. Given that both datasets contain the universe of learners in the school-leaving exam and in the higher education system it is possible to track learners even if they change their field of study or institution.

For ease of reference youth enrolled at school are referred to as 'learners' and youth enrolled at university are referred to as 'students.'

4 Findings

Following the 2008 NSC cohort into and though the higher education system reveals a large and growing female advantage. Table 1 below reports the numbers of male and female students from this cohort that wrote the matric exam, entered the university sector, and graduated within a 6-year period. Focusing on the school-leaving exam (matric), there are 17% more female learners than male learners writing matric, and 15% more female learners passing matric. Given that there are roughly equal numbers of boys and girls at the start of school (49% girls, 51% boys[5]) this is clearly the outcome of the school-level female advantage documented above – both in terms of retention and achievement. Since there are 17% more females in the cohort than there are males, one might expect that females would make up 17% more matric passes, bachelor passes, university entrants and degree awards. This is indeed what we see for matric passes, with 15% more matric passes for females. However, it is at this point that the female advantage begins to grow and accelerate. Relative to their male counterparts in this cohort, there are many more females achieving bachelor passes (27% more), more females accessing university (34% more), and considerably more females completing any undergraduate qualification (56% more) or an undergraduate degree (66% more) (Table 1).

Table 1: Higher education outcomes for the 2008 NSC cohort and the percentage more females at each stage in the higher education process

	Male	Female	% more females (female advantage)	Total
2008 NSC Learners	258 261	303 406	17%	561 667
Passed Matric	163 233	187 603	15%	350 836
- Diploma passes	63 897	66 719	4%	130 616
- Bachelor passes	49 289	62 386	27%	111 675
Accessed HE (2009 - 2014)	48 003	64 399	34%	112 402
- Immediate access (2009)	30 662	42 098	37%	72 760
- Delayed access (2010 -2014)	17 341	22 301	29%	39 642
Completed UG qualification	21 792	33 929	56%	55 721
- Completed UG degree	14 373	23 856	66%	38 229

These high-level findings show an undeniable female advantage in higher education. Before exploring whether this advantage can be explained by earlier matric performance or differentials in field of study – as we do further on in the paper – we first document the extent

[5] According to the Department of Basic Education's (DBE's) Education Statistics at a Glance for 1999 (the earliest publicly available data on gender and enrolments), there were 579,833 girls and 614,592 boys in grade 3 in 1999 (DBE, 1999). Note the NSC 2008 cohort would have been in grade 3 in 1999.

of the female advantage for different racial and socioeconomic sub-groups. For ease of reference these are presented as population pyramids and all figures can be interpreted relative to 100 female learners in the 2008 NSC cohort[6]. To illustrate, Figure 1 below illustrates the same results as Table 1. What is striking from this graph are the exceedingly small numbers of students – both males and females - that graduate with an undergraduate qualification within six years of matriculating from school. For every 100 females in matric in 2008, there were only 11 females that earned any undergraduate qualification by the end of 2014, and only 7 males.

From both Table 1 and Figure 1 we can see that females are also more likely to access higher education immediately after matric (i.e. in 2009) than their male counterparts.

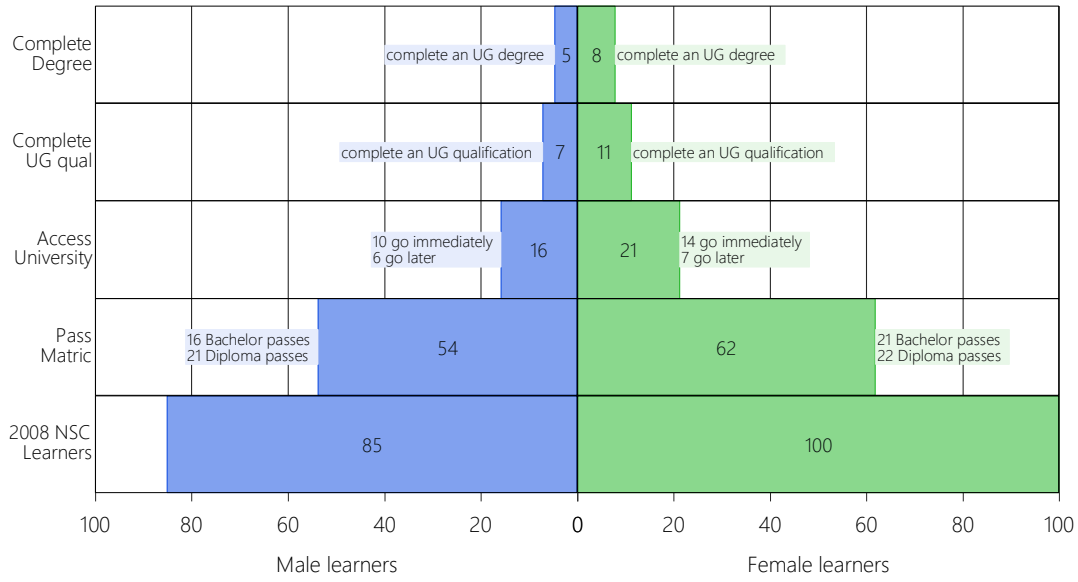

Figure 1: National higher education outcomes by gender (2008 NSC Cohort)

4.1 Higher education outcomes by gender and race

Figure 2 and 3 below present the same information but for the two largest race groups in the 2008 NSC group: Black African and White matriculants (Figure A1 and A2 in the appendix provide the same figures for Indian and Coloured learners). Given that Black African students make up 82,4% of the total number of matriculants in 2008, it is unsurprising that Figure 2 is almost identical to Figure 1, albeit with even fewer students completing any undergraduate qualification or a degree. It is alarming that for every 100 black female learners in matric in

[6] The reason we have not chosen to use a base of 100 for males and a base of 100 for females – which would mean we could interpret all figures as simple percentages – is to show that part of the female advantage is already present in the numbers of females in matric (i.e. a school-level advantage). Thus all figures are relative to 100 females in matric.

2008, only five will gain an undergraduate degree within six years of graduating, and only three males will do likewise. Comparing Figure 2 (Black African) and Figure 3 (White) highlights the extraordinary racial inequalities that remain two decades after the dawn of democracy. Of 100 White female learners in matric in 2008, all pass, half access university, and every third White female (33/100) graduates with a degree within six years. Thus, in comparison, only 5% of Black female matrics will graduate with a degree within 6 years compared to 33% of White female matrics.

The outcomes for Coloured matriculants are very similar to those of Black matriculants, with the exception that the female advantage is even larger for Coloured females. For every Coloured male matriculant who obtains a degree within 6 years there are twice as many Coloured female matriculants who do so. The outcomes for Indian matriculants are similar to that of White matriculants but shows a larger female advantage than among White matriculants. The exact numbers of matriculants by race and gender can be found in Table A1 in the appendix.

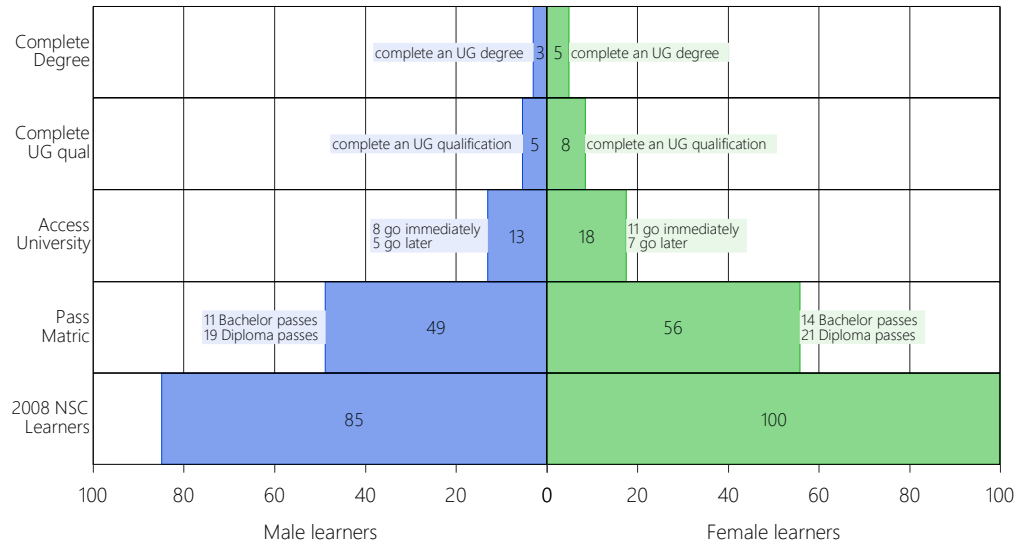

Figure 2: Black African learners' higher education outcomes by gender (2008 NSC Cohort)

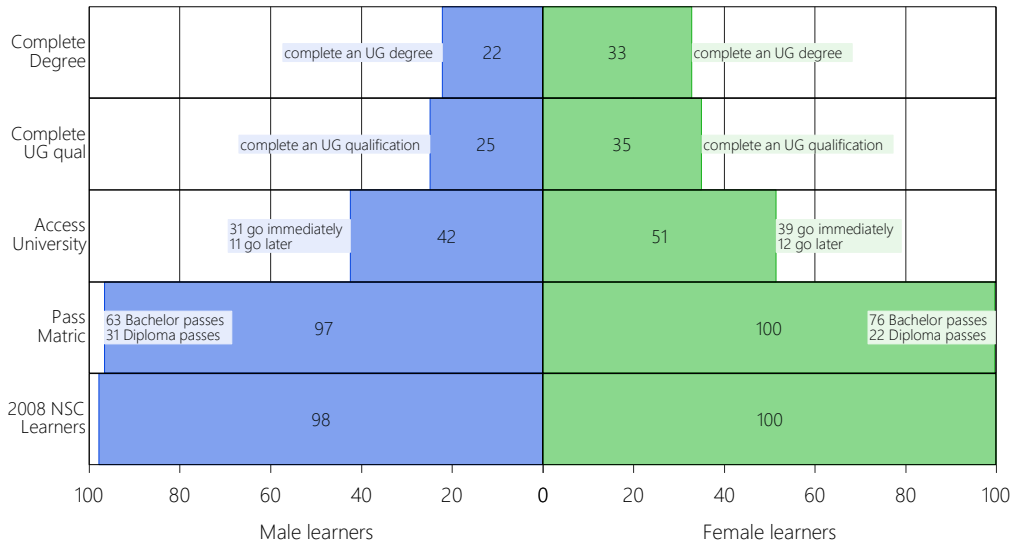

Figure 3: White learners' higher education outcomes by gender (2008 NSC Cohort)

4.2 Higher education outcomes by gender and school socioeconomic status

Figures 6 and 7 below provide the same information but for poverty school Quintile 1 (poorest) and Quintile 5 (richest) respectively. In South Africa school poverty quintiles are calculated using census data to determine the poverty rankings of schools based on the income and literacy rates of the school's catchment area (Hall & Giese, 2009). Given that there is a pro-poor allocation of funding based on these quintiles, there are in fact less than 20% (a true quintile) of students in Quintile 5, and more than 20% in Quintile 1. Hall & Giese (2009) report that in 2008 there were 26% of students (34% of schools) in Quintile 1 and only 14% of students (9% of schools) in Quintile 5 (2008: 37). The fact that by 2008 there were nearly equal numbers of matriculants in Quintile 1 (107,453) and Quintile 5 (96,059) speaks to the higher rates of drop-out in Quintile 1 than in Quintile 5. For example, using longitudinal data between 2007 and 2013, Van Wyk et al (2017) find that between Grade 6 and Grade 12 there were much higher rates of dropout in Quintile 1 (53%) than Quintile 5 (29%) in the Western Cape.

Household survey data from 2009 shows that 47% of learners paid no school fees and a further 27% paid minimal fees (R200/$15) or less per year (DBE, 2017b :52). Generally speaking Quintile 1-3 schools are regarded as no-fee schools, Quintile 4 schools charge low-fees and Quintile 5 schools charge considerably higher school fees[7]. The distinction between Quintile 1-3 schools on the one hand, and Quintile 5 schools on the other, is one that has been

[7] For example, Van der Berg et al (2017) report that in 2014 the wealthiest 10% of secondary schools in South Africa charge R11,500+ per year.

made numerous times in the South African literature, emphasizing the bimodal nature of schooling in the country (Van der Berg, 2007, Fleisch, 2008; Spaull, 2013).

Turning to our results, Figure 6 and 7 below show that in Quintile 1 schools only 2 of every 100 female matriculants will go to university and graduate with a degree, compared to 24 of 100 female matriculants from Quintile 5 schools. (For males this is 2 males and 13 males for every 100 females in matric). That there are such strong parallels between school poverty quintiles (Figure 6 and 7) and race (Figures 2 and 3) is the starkest indication of the ongoing legacy of apartheid and the consequent correlation between wealth and race in South Africa.

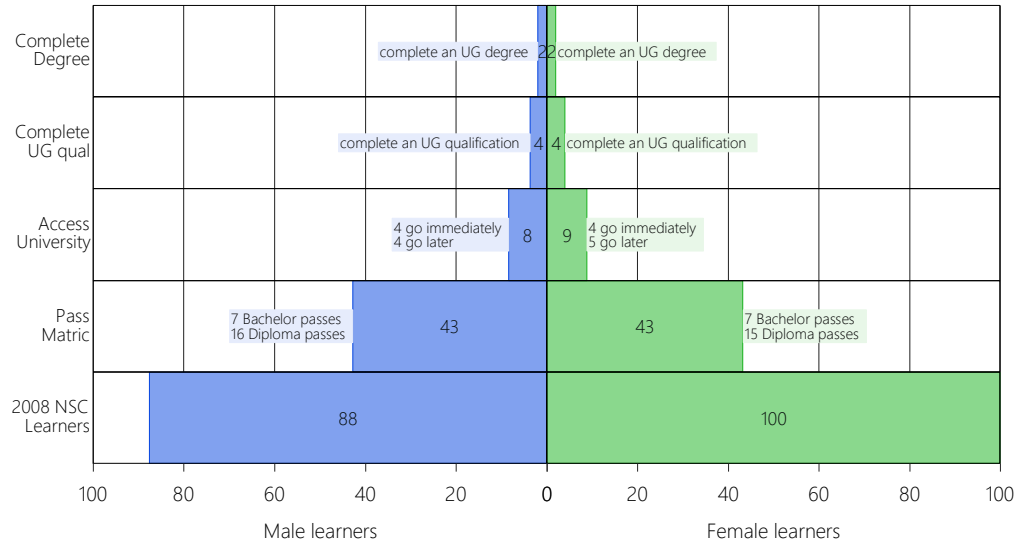

Figure 6: Quintile 1 Learners' Higher education outcomes by gender (2008 NSC Cohort)

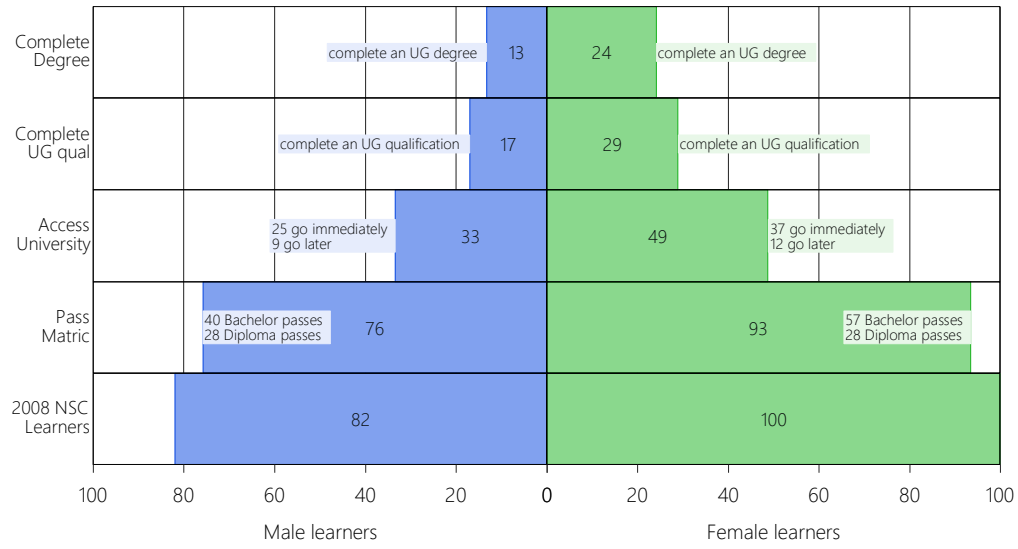

Figure 7: Quintile 5 Learners' Higher education outcomes by gender (2008 NSC Cohort)

5 Quantifying the female advantage

In this section we examine how the female advantage observed above differs across sub-groups of age, race, socioeconomic status and province of origin. We report a variety of higher education outcomes and discuss whether the advantage is equally present and equally large for each of these sub-groups, including sub-estimates for undergraduate degrees on the one hand and undergraduate diplomas/certificates on the other. In each case we report both the unconditional differences between male and female students (Table 2), as well as the conditional estimates – that is after controlling for prior school-level achievement (Table 3). This allows us to determine the extent to which the advantage seen in higher education is driven by superior academic achievement at school. We also explore whether the results hold within each of 19 fields of study, reporting the unconditional (Table 4) and conditional results (Table 5).

The unconditional results (Table 2 and Table 4) do not control for prior performance and are simply the percentage[8] difference in the higher education outcome between males and females for each sub-group seen in isolation. The difference is always calculated as the female rate minus male rate as a percentage of the male rate and thus a positive number shows a pro-female advantage while a negative number shows a pro-male advantage. For dropout rates the opposite is true. Sub-groups are reported in the row and the outcome of interest is reported in the column.

The conditional results (Table 3 and Table 5) control for five variables: (1) matric pass type[9], (2) matric average[10] (similar to the American Grade Point Average), (3) whether one took mathematics or mathematics literacy, (4) whether one took English Home Language or English First Additional Language, and (5) whether one took Physical Science or not. Because we are now controlling for prior achievement, it is difficult to calculate simple averages of higher education outcomes for males and females. Therefore we calculate the predicted probability of the higher education outcomes for the given sub-group and report the percentage difference between the predicted probability for females and the predicted

[8] Note this is *not* the percentage-point difference.

[9] The five pass types in increasing order of achievement are (1) not achieved, (2) Pass National Senior Certificate (NSC), (3) Pass NSC with Higher Certificate endorsement, (4) Pass NSC with Diploma endorsement, and (5) Pass NSC with Bachelor endorsement. These are traditionally referred to as "diploma passes" "bachelor passes" etc.

[10] In this paper, the matric average refers to the average across the six highest marks that a learner achieved among the subjects that they took in the NSC exam, provided that those subjects collectively satisfy the requirements for the NSC as described by the Department of Basic Education (DBE, 2010: 3 – 5).

probability for females (again female minus male). Thus one would interpret a positive number x as "After controlling for prior academic achievement females in sub-group A are x% more likely to achieve higher education outcome y than are males in sub-group A." Given that there are separate regressions for each higher education outcome (there are six), for qualification type (there are three categories) and for all subgroups (there are 22 subgroups) these aggregates to 396 regressions. For the field of study regressions there are 342 regressions (19 fields of study, three qualification types and six outcomes). It is therefore not possible to display all the results or even the actual predicted probabilities. We choose to focus and report only the *differences* between males and females given that this is our object of interest[11].

For ease of reference we have used gradient conditional formatting in all tables. All **g**reen cells show a statistically significant pro-**g**irl advantage and **b**lue cells show a statistically significant pro-**b**oy advantage. Blank cells indicate that the difference between females and males is not statistically significantly difference from zero.

Included below are the full titles, abbreviations and definitions of the six higher education outcomes we use to examine the size and scope of the female advantage. For illustrative purposes we include an example interpretation for the full group ('All') for 'All Undergraduate Qualification' in italics and square brackets after each description (figures from Table 2).

a) **One-year access rate (Access-1):** the percentage of learners from the 2008 NSC cohort who accessed university immediately (2009) after finishing school (2008). *[The average female matric learner in 2008 was 17 percent more likely to access university immediately after school than the average male matric learner.]*

a) **Six-year access rate (Access-6):** the cumulative percentage of learners from the 2008 NSC cohort who accessed university at any time within the six-year period following matriculation in 2008, i.e. during 2009-2014. *[The average female matric learner in 2008 was 14 percent more likely to access university within six years of finishing school than the average male matric learner.]*

b) **Six-year conversion rate (Conversion-6):** The percentage of learners from the 2008 NSC cohort who enrolled in and completed an undergraduate university programme within six years (2009-2014). *[The average female matric learner in 2008 is 33 percent more likely to access university and complete an undergraduate qualification within six years compared to the average male matric learner.]*

b) **Four-year completion rate (Completion-4):** The percentage of students who accessed university in 2009 who complete their undergraduate programme within four years (2009-2012). *[The average female university entrant in 2009 from the 2008 NSC cohort was 26% more likely to complete an undergraduate qualification within four years compared to the average male university entrant in 2009 from the 2008 NSC cohort.]*

[11] Our STATA log files are available on request.

c) **Six-year completion rate (Completion-6):** The percentage of students who accessed university in 2009 who complete their undergraduate programme within six years (2009-2014). *[The average female university entrant in 2009 from the 2008 NSC cohort was 16% more likely to complete an undergraduate qualification within six years compared to the average male university entrant in 2009 from the 2008 NSC cohort.]*

c) **Five-year dropout rate (Dropout-5):** The percentage of students who accessed university in 2009 who drop out of the higher education system at some point in the subsequent five years (20010-2014). *[The average female university entrant in 2009 from the 2008 NSC cohort was 20% less likely to dropout of university during the 2010-2014 period compared to the average male university entrant in 2009 from the 2008 NSC cohort.]*

It is important to note that of the above (a), (b) and (c) are all relative to the 2008 NSC cohort while (d), (e) and (f) are all relative to *those who access university in 2009,* i.e. there is a difference base category for (a), (b) and (c) compared to (d), (e), and (f).

By comparing the gender differentials across these six metrics for each sub-group we limit the sample to only that sub-group and compare males and females in that sub-group. For example, the row "Black African" in Table 2 is reporting the percentage difference between Black females and Black males only for each of the six outcomes. The row "Quintile 1" is reporting the percentage difference between females who attended a Quintile 1 school and males who attended a Quintile 1 school, and so on. By comparing the unconditional gender differences (Table 2) and the gender differences conditional on matric achievement (Table 3) we are able to see to what extent the female advantage is simply the continuation of a school-level advantage, or whether there is an additional university-specific advantage that cannot be explained by prior achievement. When one compares the gender differentials across sub-groups and qualification types, and with and without controls, the following findings are most striking:

<u>Socioeconomic status:</u>

1. **The poorest females are the only group not to exhibit an advantage in accessing degrees:** If one looks at Table 2, female students who attended the poorest schools (Quintile 1) were 8-16% less likely to access undergraduate qualifications as compared to male students who attended the poorest schools. Smaller and less significant results can be seen for female students from Quintile 2 schools. There is some South African evidence to support this finding. In a perception survey of 12,204 Grade 12 students, Cosser & Du Toit (2002: 73) find that "The only factor likely to influence female learners more than males to enter higher education is obtaining a bank loan to finance higher education study" with similar results for parental financial support (p.66). However,

once we control for prior academic achievement this access disadvantage for poor females is not longer significant and is actually now positive for Quintile 2 females. That is to say that almost all of the reason why poorer females access university at lower rates has to do with their lower matric achievement as compared to their Quintile 1 male counterparts.

2. **Female access and completion advantages are largest for wealthiest students**: If one looks at school socioeconomic status, the largest unconditional access advantage can be found among female learners from the wealthiest schools (Quintile 4 and 5). If one looks at degrees, while the poorest females (Q1) are 16% *less* likely than the poorest males to access a degree immediately, the richest females (Q5) are 35% *more* likely than the richest males to access a degree immediately (Table 2). Much of this advantage can actually be explained by prior academic achievement and once this is controlled for the access advantage, while considerably lower is still largest among the wealthy. While the female access advantage can largely be explained by higher matric achievement, the female completion advantage remains almost unchanged whether or not one controls for matric achievement. For example, looking at undergraduate degrees and controlling for matric achievement (Table 3), the wealthiest females (Q4-5) are 26-29% more likely to complete an undergraduate degree in four years than are their wealthiest male counterparts (Q4-5). By contrast the poorest females (Q1-2) are no more likely to complete a degree in *four* years than are the poorest males (Q1-2). That being said, they are 13-14% more likely to complete a degree in *six* years. Using 70 years of data for the United States, Bailey & Dynarski (2011: 1) find that "the female advantage in educational attainment is largest in the top quartile of the income distribution." Also in the United States Deming et al. (2014: 1010) show that "girls are more responsive to than boys to gains in school quality." Similar findings have emerged at the school-level in South Africa where Zuze & Reddy (2013: 6) find that the pro-girl "gender gap was also more apparent in resource-rich schools."

<u>Access</u>:

3. **Half of the female access advantage is explained by prior-achievement:** In one looks at access to university for the entire cohort, and compares the results before and after controlling for prior academic achievement, the female advantage drops from about 16% to about 8% for all qualifications, and from 23-28% to 9-10% for undergraduate degrees. In other words about half of the female access advantage we see in Table 2 can be explained by prior academic achievement (Table 3). This result holds for Black African and Coloured learners, and for White and Indian learners the large female access advantage for degrees (29-42%) practically disappears (0-7%) after accounting for prior academic achievement (Table 3). It is also worth noting that

even after accounting for matric achievement, Coloured females are 23-25% more likely to access undergraduate degrees than their Coloured male counterparts (Table 3).

4. **Racial differences in accessing Diplomas/Certificates**: Coloured, Indian and White female matriculants are 20-30% less likely to access Diplomas or Certificates than their male counterparts (Table 2), and this holds even after accounting for matric performance (Table 3). Because this trend does not exist for Black Africans, who make up the vast majority of the cohort (80%+), the overall trend is that – as a whole – females are 3-5% more likely to access undergraduate certificates or diplomas after accounting for matric performance (Table 3). While there appears to be some association with age and accessing undergraduate statistics (Table 2), this drops away when controlling for matric achievement (Table 3).
5. **Provincial differences in accessing degrees**: If one looks at Table 3 it is clear that there are large provincial gender differentials in who accesses higher education and that this cannot be explained by the difference in matric achievement between provinces. Females in the Limpopo and the Northern Cape, for example are 20-25% more likely to access university immediately after school than their male counterparts in these provinces.

Completion:

1. **The female completion advantage cannot be explained by prior achievement**: While much of the female access advantage can be explained by prior academic achievement, this is not the case for the female completion advantage. If one looks at all undergraduate qualifications females are 16-26% more likely to complete their degree than are males. These figures hardly change once prior academic achievement is controlled for, dropping marginally to 15-21% more likely than males. The same can be seen for undergraduate degrees where the female completion advantage drops from 17-27% to 17-23% after controlling for prior academic achievement. This is true across race groups and school socioeconomic status.
2. **Females are considerably more likely to complete their qualification in four years rather than six years**: In all cases the female advantage is largest for Completion-4 and decreases substantially for Completion-6. That is to say that females are considerably more likely to complete their qualification in four years rather than six years and therefore that the female advantage is smaller if one allows for a longer period during which more males will graduate. For all students entering university, females were 26% more likely to complete their qualification in four years but only 16% more likely to complete their qualification in six years than their male counterparts (Table 2). Importantly, this result does not hold for the Black African group were males

and females are equally likely to complete in four or six years. Among the wealthiest students (Q5) the completion advantage for any qualification within *six* years (16%) is half as large as the completion advantage for any qualification in *four* years (32%) (Table 2).

Conversion:

The Conversion-6 rate is perhaps the best of the six metrics to compare males and females because it takes into account both access and completion. The Completion-6 rate is the percentage of matric learners who access university *and* complete an undergraduate qualification within six years.

1. **A third of the overall female advantage can be explained by prior academic achievement and most of the female advantage (76-78%) among top-achieving females can be explained by school-level achievement**: If one looks at all undergraduate qualifications, females are 33% more likely to access university and attain an undergraduate qualification in six years (Table 2). This decreases to 20% once prior academic achievement is controlled for (Table 3). Among degrees this drops from 41% to 20%. Again the largest declines in the female advantage are among White and Indian learners and among students coming from Quintile 4 and 5 schools. White and Indian female learners are 45-63% more likely to access university and attain a degree in six years than their White and Indian male counterparts. However once prior academic achievement is controlled for they are only 11-14% more likely than their White and Indian male counterparts. This is an important finding since White and Indian females are the two best performing sub-groups in this analysis. Figure 8 below reports the percentage of male and female matriculants attaining an undergraduate qualification by race. We will return to Figure 8 in our concluding discussion about the relative size of the gender difference compared to race (arguably the more salient dimension of inequality in South Africa). For now, the important thing to note is that the lion's share of the explanation for superior performance among the best performing females (White and Indian) is their superior performance at school. Indian females are 63% more likely to enrol and get a degree than Indian males, with White females 45% more likely to enrol and get a degree than white males (Table 2). This decreases to 14% and 11% respectively once prior academic achievement is taken into account (Table 3).

Dropout:

Females are always considerably less likely to dropout and this cannot be explained by prior achievement: One of the most striking findings from Tables 2 and 3 is the large and

consistent female advantage in retention – they are considerably less likely to dropout. Across almost all sub-groups females are about 20% less likely to drop out of their higher education program, and this virtually unchanged after controlling for prior academic achievement. The uniform size of this pro-female difference – about 20% - and that it is robust to controls for prior-achievement suggests that this is picking up something inherent to females irrespective of sub-group.

Figure 8: Percentage of male and female matriculants attaining an undergraduate degree within six years by race (see Table A1 for exact figures)

Table 2: The **unconditional** percentage difference in higher education outcomes by sub-group and gender (female percentage minus male percentage). [**G**reen cells show statistically significant pro-**g**irl results while **b**lue cells show statistically significant pro-**b**oy results. White cells indicate that the difference was not statistically significantly different from zero].

E.G. the figure '29' for Access-1 for "Black African' and 'Undergraduate degree' is interpreted as: "The average Black African female in matric was 29 percent more likely to access an undergraduate degree immediately compared to the average Black African male in matric"

	All Undergraduate Qualifications						Undergraduate Diplomas/Certificates						Undergraduate Degrees					
Should be interpreted…	*Relative to matric cohort*			*Relative to university-entering cohort*			*Relative to matric cohort*			*Relative to university-entering cohort*			*Relative to matric cohort*			*Relative to university-entering cohort*		
Sub-group	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**
All	17	14	33	26	16	-20			16	23	14	-13	28	23	41	27	17	-23
Appropriate age		-2	11	24	14	-19	-13	-13		21	12	-12	5	3	16	25	15	-21
Underaged																	17	
Overaged	-17	-14	-7	18	10	-7	-18	-14	-8	9			-15	-15	-6	27	16	-17
Black African	17	14	33	19	17	-18	7	7	22	17	11	-10	29	21	43	21	21	-25
Coloured	23	20	43	31	16	-18	-18	-17		47	21	-18	47	43	65	28	15	-11
Asian/Indian	26	26	52	44	20	-32	-25	-25		101	42	-33	41	42	63	33	15	-23
White	22	19	38	36	16	-33	-35	-39	-21	63	35	-36	32	29	45	35	15	-28
Quintile 1	-13	-8		10	11	-12	-10	-7		12	10	-10	-16	-12			12	-17
Quintile 2			7	8	9	-11			10	12	8	-8		-7			10	-18
Quintile 3	9	9	27	21	16	-13	7	8	23	19	11	-7	11	8	31	22	23	-23
Quintile 4	19	20	40	22	18	-18		8	23	14	11	-9	31	30	51	29	22	-24
Quintile 5	23	20	40	32	16	-25	-7	-11	9	41	23	-23	35	32	49	29	15	-20
Western Cape	5	3	16	22	11	-21	-21	-22		33	22	-24	17	15	23	19	8	-12
Eastern Cape			15	21	14	-20	-8	-5	8	21	15	-17	15	8	20	21	12	-19
Northern Cape	31	30	50	23	13	-19				37			49	39	62		13	
Free State	12	11	43	41	30	-31		-10	23	56	34	-22	29	27	57	33	27	-33
KwaZulu-Natal	26	32	45	19	13	-18	8	21	33	23	13	-14	39	39	52	16	13	-17
North West	27	17	41	22	19	-23	14		28				34	22	46	23	18	-30
Gauteng	23	19	45	37	20	-21	11	5	22	18	12	-7	29	25	53	43	24	-28
Mpumalanga	14	5	22	35	17	-21		-6	11	33	16	-15	25	13	29	38	18	-24
Limpopo		-5	10	15	15	-16	-8	-13					12		21	18	20	-25

Table3: The **conditional** percentage difference in the predicted probabilities of higher education outcomes by sub-group and gender (female percentage minus male percentage), controlling for matric average, and subject choice (English, Mathematics and Physical Science).
[**G**reen cells show statistically significant pro-**g**irl results while **b**lue cells show statistically significant pro-**b**oy results. White cells indicate that the difference was not statistically significantly different from zero]. *E.G. the figure '5' for Access-1 for "Black African' for 'Undergraduate Diplomas/Certificates' is interpreted as: "The average Black African female in matric was 5 percent more likely to access an undergraduate Diploma/Certificate immediately after school compared to the average Black African male, controlling for matric-level achievement"*

	All Undergraduate Qualifications						**Undergraduate Diplomas/Certificates**						**Undergraduate Degrees**					
Should be interpreted…	*Relative to matric cohort*			*Relative to university-entering cohort*			*Relative to matric cohort*			*Relative to university-entering cohort*			*Relative to matric cohort*			*Relative to university-entering cohort*		
Sub-group	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**
All	7	9	20	21	15	-21	3	5	17	22	16	-17	9	10	20	23	17	-24
Appropriate age	6	7	19	21	15	-22		-2	10	23	16	-19	11	10	22	23	16	-25
Underaged		8	20		13			17							19		17	
Overaged	9	13	24	21	15	-13	6	11	20	15	14	-9	14	14	26	29	19	-21
Black African	9	11	24	18	17	-19	5	8	20	16	14	-14	13	12	28	22	22	-26
Coloured	9	8	25	26	15	-17	-20	-19		41	22	-19	25	23	38	30	19	-16
Asian/Indian			10	32	14	-26	-23	-23		86	37	-32		7	14	27	13	-22
White			7	24	10	-24	-31	-33	-23	30	15	-17	5	5	11	27	12	-25
Quintile 1		8	13	11	14	-17		8	16	13	14	-16			9		14	-20
Quintile 2	7	9	20	10	13	-18	6	8	21	14	11	-14	9	6	14		13	-23
Quintile 3	8	11	26	21	18	-17	9	11	24	19	14	-11	7	9	28	23	24	-25
Quintile 4	5	10	24	20	19	-22		7	18	14	15	-15	9	13	26	29	24	-29
Quintile 5	8	8	19	25	14	-24		-6	11	37	23	-24	12	12	21	26	14	-23
Western Cape	9	7	18	20	13	-26	-13	-13		33	28	-32	18	16	22	20	11	-22
Eastern Cape		3	13	18	13	-20			11	20	16	-19	9	6	14	20	13	-21
Northern Cape	17	19	32	19	12	-17				37			25	21	38		14	
Free State		6	30	31	26	-27	-8	-9	21	48	33	-22	13	16	37	27	24	-31
KwaZulu-Natal	2	14	17	16	13	-19		16	23	23	16	-19		11	12	14	14	-20
North West	8	6	19	16	16	-21	11		24		17	-15	7	5	16	17	15	-27
Gauteng	8	9	23	30	18	-20	12	9	23	16	13	-9	6	7	22	37	22	-28
Mpumalanga	14	10	24	30	17	-22	10		19	34	21	-21	17	12	24	34	17	-24
Limpopo	14	8	22	12	14	-15	7		10			-9	20	12	32	18	19	-24

5.1 Do female advantages persist within all fields of study?

While the evidence presented in the above tables points to what seems like a clear female advantage in most metrics – access, throughput, completion – there is the possibility that this can be explained by the fact that male and female students choose different fields of study. If males are more likely to enroll in more difficult fields (ones with higher failure rates) this could explain part of the difference found in Tables 2 and 3.

We repeat the analysis above and limit the sample to specific fields of study. This allows us to compare if females or males are more or less likely to enroll, remain and graduate in certain fields and not in others. This is in fact what we find. Table 4 shows a clear distinction between the male-dominant fields of Engineering, Computer Sciences, Architectural Sciences, Mathematical Sciences and Agricultural Sciences, and the female-dominant fields of Consumer Sciences, Psychology, Social Sciences, Communication, Education, Health Sciences, Linguistics, Arts, Public Management, Natural Sciences, Law and Business Sciences. Military Sciences and Philosophical Sciences show no real advantage one way or the other. In most instances, these gendered differences are large and robust to including controls for prior academic achievement (Table 5). It is only Law which becomes a gender-neutral field of study after controlling for prior academic achievement. The field with the largest pro-male access advantage is Engineering where males are 62% more likely to enroll than females. This difference is unaffected by controlling for school-level achievement (Table 5).

Focusing on undergraduate degrees, in Table 5 it becomes clear that in six of the 18 fields of study, the gender differences in access seen across fields of study do not reappear as completion differences. There are only two fields of study – Engineering and Computer Sciences – where male students are significantly more likely to complete their degree in four or six years. It is worth emphasizing the large change in the gender differential between Completion-4 and Completion-6 for Engineering. While male students are 52% more likely to complete an Engineering degree in four years, they are only 16% more likely to complete one in six years, as compared to their female counterparts. It would seem that females simply take longer to complete Engineering degrees. The same trend is true for Health Sciences but with reversed genders. Females are 100% more likely to complete a Health Sciences degree in four years, but only 12% more likely to complete a Health Sciences degree in six years, than their male counterparts in Health Sciences. The same 'it-just-takes-a-little-longer-for-the-other-gender' trend is not true for Computer Sciences where the male advantage in completion (36%) remains whether one looks at four-year completion or six-year completion. Similarly, in Education, Communication, Social Sciences and Psychology the female completion advantage remains largely unchanged whether one looks at four- or six-year completion rates. Most interestingly, in Mathematical Sciences, while females are 45% *less* likely to enroll in a degree in this field, once they have enrolled they are 53% *more* likely to graduate in four or six years than their male counterparts in Mathematics. This is partly because females are 32% less likely to dropout than their male counterparts in this field.

Gender determines access more than it does 'success' in the degree: It is quite clear from Table 5 that most of the fields of study have strong gendered patterns with regards to entry (13 of the 18 fields of study are either 20% more pro-male or 20% more pro-female in Access-1). However, once students are already enrolled there is a much smaller gender gap in completion, with only seven of the 18 fields of study exhibiting strong (20%+) gender patterns in six-year completion rates for degrees (and only one of which is pro-male). One can

therefore think of the gender 'story' with regards to fields of study as one of determining who-studies-what rather than who-succeeds-at-what. This is also evident if one decomposes the Conversion-6 gender differential and looks at the Access-1 and Completion-6 differentials that are its two sub-components. In most instances, when we see large differences in the percentages of students getting different types of degrees (Completion-6), this is because they choose to enroll in different fields (Access-6) rather than due to differential success rates (Completion-6).

A visual summary of the results in Table 4 and 5 is provided in Figure 9 below which shows the female share of undergraduate degree enrolments and graduations by field of study. For those interested in the actual numbers of enrolments and graduations by field of study please see Table A3 in the appendix.

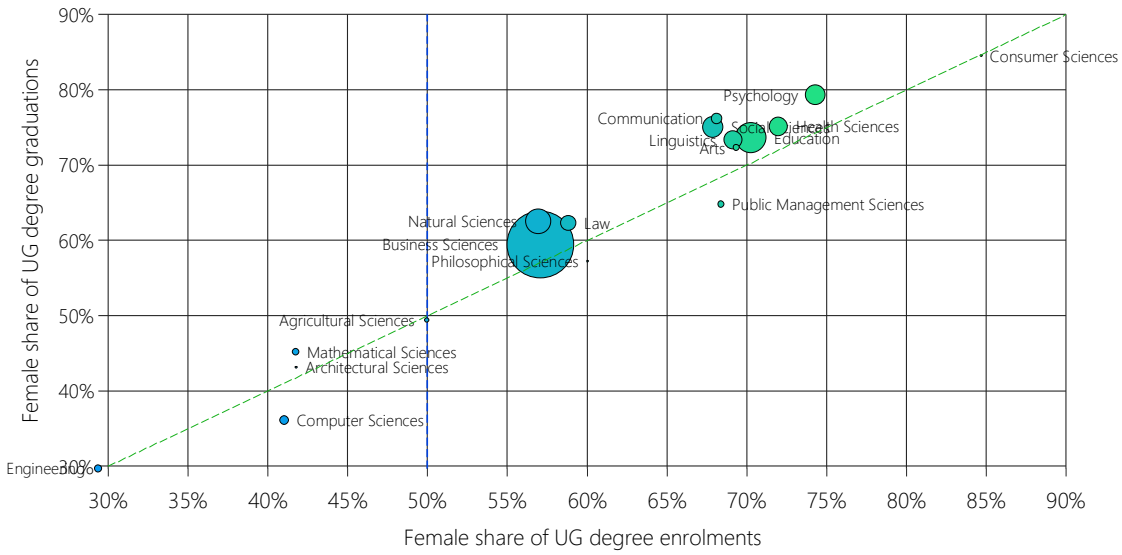

Figure 9: Female share of undergraduate degree enrolments and graduations by field of study

Table 4: The **unconditional** percentage difference in higher education outcomes by field of study and gender (female percentage minus male percentage). [**G**reen cells show statistically significant pro-**g**irl results while **b**lue cells show statistically significant pro-**b**oy results. White cells indicate that the difference was not statistically significantly different from zero].

	All Undergraduate Qualifications						Undergraduate Diplomas/Certificates						Undergraduate Degrees					
Should be interpreted…	*Relative to matric cohort*			*Relative to university-entering cohort*			*Relative to matric cohort*			*Relative to university-entering cohort*			*Relative to matric cohort*			*Relative to university-entering cohort*		
Field of Study	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**
Engineering	-62	-62	-63	-20		-24	-60	-61	-61	-16		-22	-64	-65	-64	-31		-34
Computer Sciences	-46	-44	-42			-28	-53	-47	-34	19	22	-26	-32	-41	-52	-38	-42	-26
Architectural Sciences	-32	-43	-37	15		-26	-42	-48	-43				-19	-39	-35			
Mathematical Sciences	-48	-40	-30	55	51	-33	-65	-57					-47	-39	-30	49	47	-31
Agricultural Sciences	-21	-16	-17	-15		-23	-30	-18	-14			-16		-15	-17			
Philosophical Sciences		27			-40									28			-37	
Military Sciences																		
Business Sciences	28	21	32	8	8	-11	40	32	44	8	8	-10	17	13	25	10	9	-21
Law	21	19	40	24	14	-21			35				23	22	41	26	14	-23
Natural Sciences	19	12	46	36	37	-37		10	66	36	67	-31	22	13	42	35	31	-39
Public Management Sciences	76	41	35	-18	-17	-26	43	18	28			-18	150	84	57			-36
Arts	65	46	72			-29			32	21	23	-23	133	93	122			-28
Linguistics	114	89	122			-28		75	90				117	91	134			-28
Health Sciences	126	116	158	58	18	-33	97	107	141	33	31	-53	135	119	157	88	13	
Education	128	115	147	50	29	-38		193	211				129	101	137	50	29	-38
Communication	91	87	146	33	32	-19	100	97	120	20	19	-21	85	82	172	52	51	-19
Social Sciences	62	90	155	52	36	-10	143	146	152				45	80	156	72	54	-21
Psychology	137	146	228	112	74	-25		666	na				137	146	227	112	74	-25
Consumer Sciences	281	224	300	151	129	-46	163	150	223				na	370	364	198	225	-82

Table 5: The **conditional** percentage difference in the predicted probabilities of higher education outcomes by field of study and gender (female percentage minus male percentage), controlling for matric average, and subject choice (English, Mathematics and Physical Science).
[**G**reen cells show statistically significant pro-**g**irl results while **b**lue cells show statistically significant pro-**b**oy results. White cells indicate that the difference was not statistically significantly different from zero].

	All Undergraduate Qualifications						Undergraduate Diplomas/Certificates						Undergraduate Degrees					
Should be interpreted…	*Relative to matric cohort*			*Relative to university-entering cohort*			*Relative to matric cohort*			*Relative to university-entering cohort*			*Relative to matric cohort*			*Relative to university-entering cohort*		
Field of Study	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**
Engineering	-63	-62	-67	-23		-21	-56	-56	-59	-20		-20	-72	-71	-73	-52	-16	-23
Computer Sciences	-44	-41	-40			-27	-48	-41	-27		19	-24	-35	-42	-56	-36	-39	-31
Architectural Sciences	-39	-47	-43				-45	-47	-42				-33	-47	-46			
Mathematical Sciences	-56	-45	-38	55	56	-32	-57	-48					-56	-45	-38	53	53	-32
Agricultural Sciences	-19	-9	-13	-19	-15		-25							-14	-17			
Philosophical Sciences																		
Military Sciences																		
Business Sciences	10	10	12	8	8	-12	36	30	37		6	-8	-9	-5		0	5	-17
Law		6	15					16	47						13			
Natural Sciences	18	13	41	13	22	-27	21	26	90		37	-23	17	11	33	12	16	-28
Public Management Sciences	76	45	40			-20	51	27	36			-16	125	79	55			-32
Arts	34	26	40						19				67	52	60			
Linguistics	95	76	94			-21	54	97	113				96	75	95			-22
Health Sciences	98	100	130	64	14	-26	112	127	160		15	-40	93	93	115	100	12	
Education	109	108	131	27	21	-30		221	243			-53	110	90	115	27	20	-29
Communication	81	80	128	26	26	-18	109	111	129	17	17	-18	63	64	130	35	37	
Social Sciences	43	77	138	55	41	-12	131	154	186				26	64	130	64	49	-18
Psychology	106	118	181	67	45	-19		na	na				106	118	179	67	45	-19
Consumer Sciences	248	202	223			-28	171	161	197				553	266	249		143	

Table 6: The **conditional** percentage difference in the predicted probabilities of higher education outcomes by institution of access, controlling for matric average, and subject choice (English, Mathematics and Physical Science).
[**G**reen cells show statistically significant pro-**g**irl results while **b**lue cells show statistically significant pro-**b**oy results. White cells indicate that the difference was not statistically significantly different from zero].

Should be interpreted…	*Relative to matric*			Relative to university-entering cohort			*Relative to matric*			Relative to university-entering cohort			*Relative to matric*			Relative to university-entering cohort		
Institution	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**	**Access 1**	**Access 6**	**Conversion 6**	**Completion 4**	**Completion 6**	**Dropout 5**
UCT	-27	-27	-21		8	-26							-27	-27	-21		8	-26
US	-25	-27	-20	12	4	-21							-25	-27	-20	12	4	-21
CUT	-16	-18		32	25	-23	-16	-18		32	25	-23			3			-23
NMMU				17	12	-22		-3		17	12	-22	3	-3	8	17	12	-22
TUT	7		12	12	11	-12			12	12	11	-12	7		12	12	11	
CPUT			17	25	23	-32	6	-1		25	23	-32	6	-1	17			
UKZN	9	7	18	12	9	-22							9	7	18	12	9	-22
UP			20	41	21	-35	3	-3	20						20	41	21	-35
UL	17	12	23		8								17	12	23		8	
UJ	13	4	24	31	23	-20	13		24	31	23	-20	13	4	24	31	23	-20
VUT			25	23	16	-17			25	23	16	-17		0	25			
WITS			25	36	25	-27	3	-3	25						25	36	25	-27
NWU	11	11	26	27	17	-31	11			27	17		11	11	26	27	17	-31
UFS	17	23	36		16	-31	17	23					17	23	36	9	16	-31
UFH			43	36	29	-39									43	36	29	-39
UZ	52	46	53				52	46	53				52	46	53			
UWC	54	40	65	25	18	-20							54	40	65	25	18	-20
UNISA	27	33	93	16	18	-12	27	33	93	16	18	-12	27	33	93		18	-12
DUT	-14	-12		31	21	-24	-14	-12		31	21	-24						
RHODES	30	19											30	19				
UNIVEN					18		-11	-9	5				-11	-9			18	
WSU	13	22	31	19	14	-16	13	22	31	19	14	-16						

5.2 Is the female advantage larger at some universities than at others?

In addition to understanding the extent of the female advantage in different sub-groups and within different fields of study, it is interesting to see whether or not there are differences by institution attended. Due to space concerns, for institution attended we only provide the table for conditional gender differentials (Table 6) not unconditional differentials. At the institution level, after controlling for prior institutions females are more likely to complete undergraduate qualifications (degrees/diplomas/certificates). However, when looking at access there are three distinct groups of institutions: (1) *Pro-male enrolments*: The University of Stellenbosch and the University of Cape Town are the only universities with large pro-male differences (20%+) in enrolments. (2) *Pro-female enrolments*: There are four universities with large pro-female differences in enrolments; University of Zululand, University of the Western Cape, University of South Africa and Rhodes University., (3) *No large difference in enrolments:* The majority of the remaining universities have smaller (<20%) pro-female access rates. Given that the University of Cape Town and the University of Stellenbosch are the only universities with large pro-male access rates, it is interesting to note that they are also two of the top ranked universities in South Africa[12]. The reasons for this are not clear and cannot be explained by formal or publicly-available admissions policies.

Figure 10 below shows the female share of undergraduate enrolments and graduations by institution of study. The fact that all institutions lie to the left of the diagonal line shows that there is a larger percentage of female graduations than female enrolments showing that females are more likely to complete their degrees across academic institutions. Furthermore, this advantage is relatively uniform across institutions where the female share of graduations is usually about 3-5 percentage points higher than the female share of enrolments. It would appear that there are three groupings of university (1) those with 55-65% female share of undergraduate degree enrolments (University of Stellenbosch, University o (2) those with 60-65% and those with 65%-70%. Figure 11 provides the same information as Figure 10 but only for non-degree qualifications (diplomas/certificates). The most notable finding is how much of an outlier UNISA is, UNISA is also the only exclusively distance university, and also South Africa's largest university. The data-bubbles in Figures 10 and 11 are weighted by female enrolments and it clear that part of the overall pro-female enrolment and graduation trend in South Africa is driven by UNISA.

[12] https://www.topuniversities.com/university-rankings-articles/brics-rankings/top-universities-south-africa

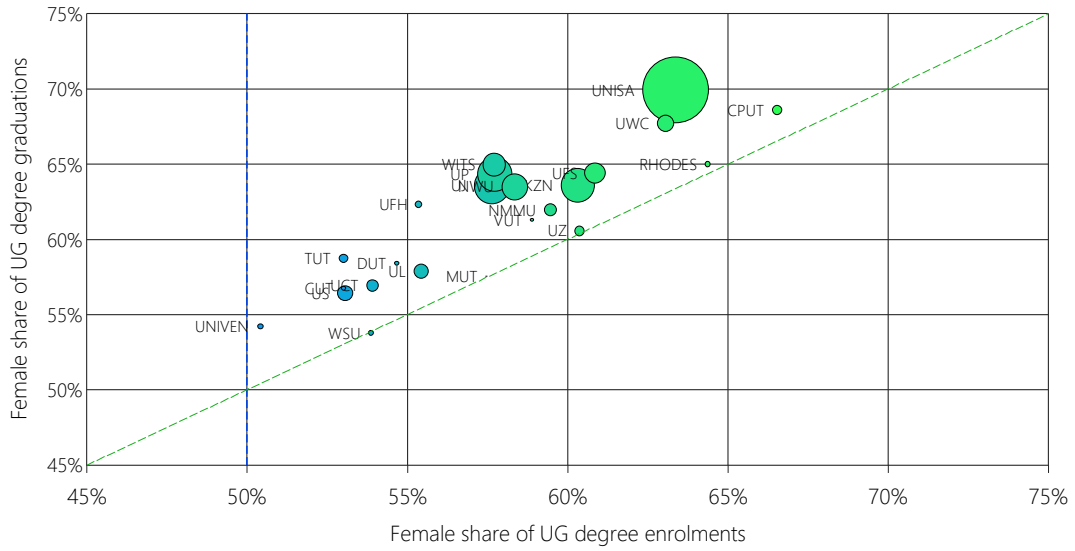

Figure 10: Female share of undergraduate degree enrolments and graduations by institution

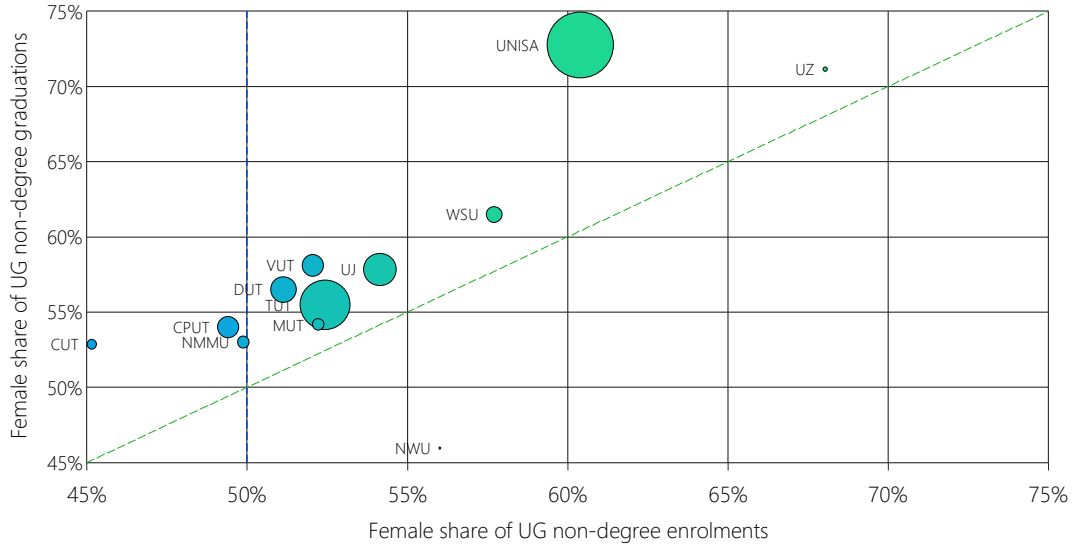

Figure 11: Female share of undergraduate non-degree (Diploma/.Certificate) enrolments and graduations by institution

6 Discussion & conclusion

The aim of the present analysis has been to construct a country-wide panel dataset and use it to examine the higher education outcomes of a single cohort (NSC 2008) by gender. Given that we only have six years of panel data, the one main limitation of the present study is that the completion rates reported are only for those who access university immediately after school. That is to say that if we want to follow a cohort for the full period (six years), we have to select those who leave school in 2008 and enroll in university in 2009. This is obviously a selective group of students compared to those that delay entry into university. That being said, by reporting both Acess-1 and Access-6 we show that there is only a small decline in the female access advantage if one looks at six-year access rather than four-year access, and thus that the results presented here are unlikely to change significantly.

The six most important findings of the analysis are listed below:

1) **Overall**: After controlling for pre-university achievement females are 20% more likely to access university and graduate with an undergraduate degree in six years than are their male counterparts.
2) **Gendered access**: We find much stronger evidence of gendered access effects rather than gendered completion effects. This is both for sub-groups and for fields of study.
3) **Dropout**: Relative to their male counterparts, females are always and everywhere 20% less likely to drop out of university programmes. This is not affected by pre-university achievement.
4) **Socioeconomic status**: Among the quintiles of socioeconomic school socioeconomic status, only females from the poorest 20-30% of schools do not exhibit an advantage in accessing university. Most pro-female advantages are largest among the wealthiest groups.
5) **Pre-university achievement:** A third of the overall female advantage (Conversion-6) can be explained by school-level achievement. However, among the best-performing sub-groups the female advantage is almost entirely (77%) explained by superior school-level achievement.
6) **Gendered fields of study:** While it is true that fewer females graduate with a degree in traditionally male fields of study (Engineering, Computer Sciences, Architectural Sciences, Mathematical Sciences and Agricultural Sciences) this is largely because females do not enter these fields, not because they do not do well in them once enrolled.

We would encourage other scholars – particularly those in political science and sociology – to expound the various ramifications of the pro-female advantages identified above. Perhaps the most obvious implication being the impact of this situation on the labour-market in South Africa. Using labor-force data from QLFS 2011, Van der Berg & Van Broekhuizen (2012: 29) find that the broad unemployment rate for those with degrees in South Africa was 5% in 2011 compared to 33% among non-graduates. Interestingly they also find evidence that this graduate premium is rising over time in South Africa.

Looking more broadly, the long-term impacts of the global female advantage in school and in higher education are likely to only become more acute over time. The premium on higher education in the labor-market is likely to grow as the world moves toward a knowledge-based economy. This is in addition to the effects of liberalizing gender norms globally and declining fertility rates.

We echo the words of Vincent-Lancrin (2008: 1) that in “promoting equal opportunities for men and women the focus can no longer be solely on women.” Understanding how and why females outperform males at school and at university is an important ongoing strand of research, and one that is likely to have significant impacts on the way that curriculum and pedagogy are structured and implemented. Yet while this topic is being addressed universities in South Africa and throughout middle-income and developed countries will continue to produce significantly more female graduates than male graduates which will, in all likelihood, have large impacts on society more generally. As Esping-Anderson (2009: 1) concludes:

“The quiet revolution of women’s roles, as Claudia Goldin (2006) calls it, is arguably a close rival to new technologies in terms of its seismic aftershocks touching, directly and indirectly, all major social institutions. And like its rivals, it has not yet come to full maturation. Incomplete revolutions tend to be associated with major disequilibria.”

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Appendices

Table A1: Higher education outcomes for the 2008 NSC cohort by race

	Black African		Coloured		Indian		White	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
2008 NSC Learners	212 396	250 284	16 259	22 140	7 791	8 649	21 458	21 944
Passed Matric	122 115	139 704	12 712	17 817	6 872	7 841	21 206	21 876
- Diploma passes	48 536	52 443	6 099	7 490	2 339	1 920	6 788	4 777
- Bachelor passes	28 264	34 475	3 472	5 680	3 651	5 224	13 732	16 755
Accessed HE (2009 - 2014)	32 711	44 056	2 898	4 718	2 965	4 155	9 300	11 289
- Immediate access (2009)	19 233	26 588	1 997	3 346	2 486	3 469	6 856	8 562
- Delayed access (2010 -2014)	13 478	17 468	901	1 372	479	686	2 444	2 727
Completed undergraduate qualification	13 572	21 245	1 217	2 378	1 489	2 505	5 445	7 685
- Completed undergraduate degree	7 392	12 419	831	1 864	1 232	2 236	4 863	7 233

Table A2: Higher education outcomes for the 2008 NSC cohort by DBE school quintile (Q1=poorest, Q5=richest)

	Quintile 1		Quintile 2		Quintile 3		Quintile 4		Quintile 5	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
2008 NSC Learners	50 180	57 273	59 017	67 845	62 629	73 298	32 201	38 986	43 269	52 790
Passed Matric	24 482	24 778	31 318	33 334	36 419	41 525	22 982	28 678	39 999	49 334
- Diploma passes	9 379	8 843	11 981	12 256	14 548	16 046	9 958	11 416	15 028	14 871
- Bachelor passes	4 180	3 869	6 045	5 764	7 852	8 650	6 700	9 213	21 090	30 017
Accessed HE (2009 - 2014)	4 823	5 059	6 699	7 478	8 738	11 179	6 833	9 894	17 657	25 796
- Immediate access (2009)	2 448	2 433	3 455	3 818	5 015	6 372	4 388	6 326	13 077	19 625
- Delayed access (2010 -2014)	2 375	2 626	3 244	3 660	3 723	4 807	2 445	3 568	4 580	6 171
Completed UG qualification	2 139	2 357	2 892	3 560	3 553	5 262	2 854	4 853	8 938	15 298
- Completed UG degree	1 136	1 199	1 585	1 852	1 936	2 972	1 700	3 111	6 996	12 753

Table A3: Full Time Equivalent Numbers, Enrolments and Graduations for Undergraduate Qualifications by Gender for the 2008 NSC Cohort

	All Undergraduate Qualifications						Undergraduate Diplomas/Certificates						Undergraduate Degrees					
	FTEN		ENROLMENTS		GRADUATIONS		FTEN		ENROLMENTS		GRADUATIONS		FTEN		ENROLMENTS		GRADUATIONS	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Agricultural Sciences	1397	1279	1932	1916	824	805	1078	971	1207	1160	411	417	557	529	921	919	482	471
Architectural Sciences	1185	844	1532	1021	712	526	783	494	912	559	370	249	647	503	798	573	464	352
Arts	832	1361	1244	2132	519	1049	587	702	739	906	330	510	408	888	624	1413	262	683
Business Sciences	15456	22280	18932	26969	7550	11723	8691	13416	9390	14516	3202	5418	8511	11408	10988	14608	4965	7282
Communication	1292	2674	1841	4034	530	1533	619	1436	749	1733	256	661	772	1485	1149	2457	302	966
Computer Sciences	4479	2797	5981	3907	1673	1149	3255	1852	3686	2275	1049	815	1710	1246	2651	1845	735	416
Education	2571	6772	3392	8552	1338	3885	534	1860	602	2074	185	675	2251	5427	2865	6768	1153	3215
Engineering	7402	3203	8761	3897	3363	1450	5760	2552	6119	2821	2002	928	3174	1338	3841	1600	1662	702
Health Sciences	1601	3964	2062	5221	1022	3098	519	1198	580	1409	306	868	1273	3229	1606	4126	784	2369
Consumer Sciences	171	697	243	926	64	301	136	413	159	467	24	91	40	317	86	475	40	218
Linguistics	1332	3101	1889	4202	277	724	111	250	148	305	52	116	1274	2952	1757	3937	229	630
Law	1633	2173	2663	3737	772	1271	320	386	389	481	73	116	1394	1880	2296	3281	699	1155
Natural Sciences	3496	4569	5031	6606	1487	2557	847	1020	1015	1316	245	479	2901	3863	4160	5502	1294	2157
Mathematical Sciences	1438	903	2236	1574	326	270	76	34	127	64	7	7	1416	891	2109	1511	319	263
Military Sciences	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philosophical Sciences	167	235	383	571	95	124	4	6	7	6	3	1	170	242	376	565	92	123
Psychology	717	1894	1447	4189	362	1396	1	2	1	9	0	0	749	1967	1446	4180	362	1390
Public Management Sciences	1272	2103	1707	2818	590	936	1034	1460	1213	1682	478	720	389	880	609	1318	181	334
Social Sciences	1881	3942	2590	5768	483	1449	392	1168	461	1334	85	252	1558	3015	2143	4527	402	1209

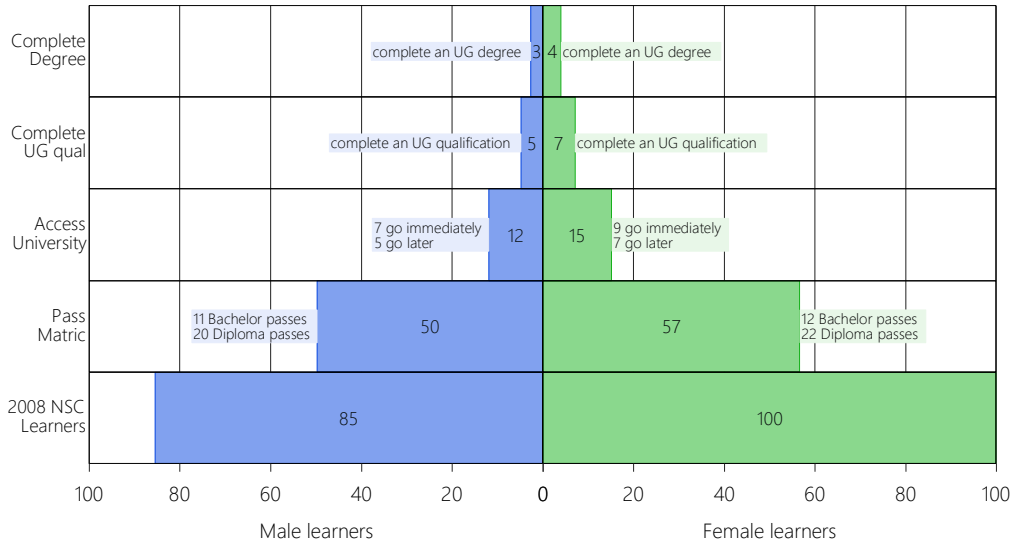

Figure A1: Quintile 3 Learners' Higher education outcomes by gender (2008 NSC Cohort)

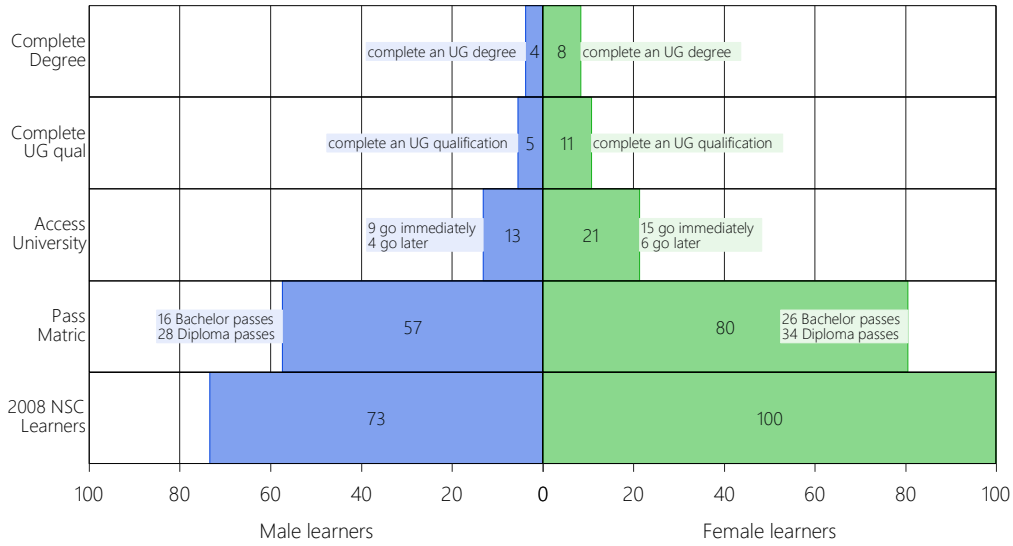

Figure A2: Coloured learners' higher education outcomes by gender (2008 NSC Cohort)

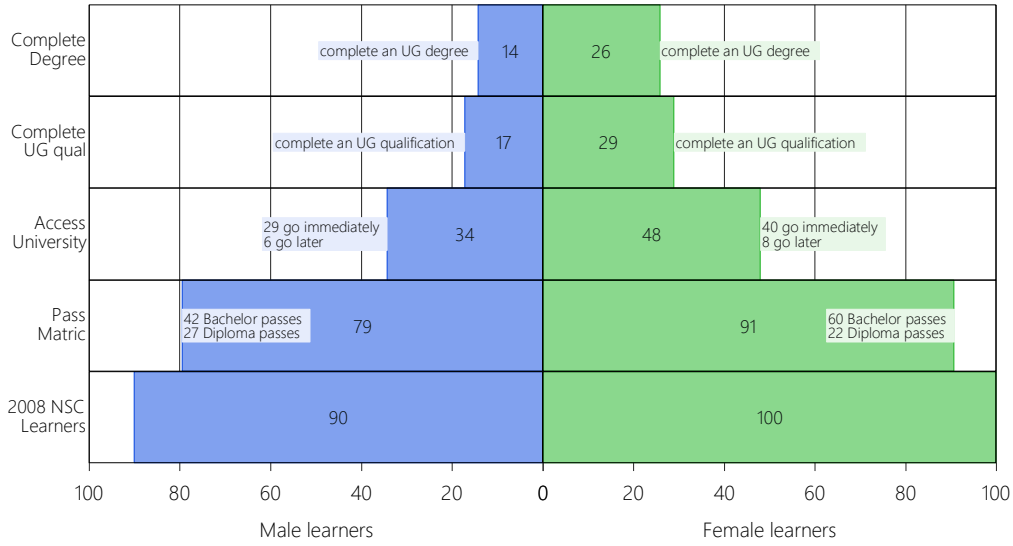

Figure A3: Indian learners' higher education outcomes by gender for the 2008 NSC Cohort