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Three-generation educational mobility in six African countries

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Abstract

Using nationally representative survey data, we provide estimates of three generation educational mobility for six African countries: Ethiopia, Gambia, Ghana, Liberia, Nigeria and Tanzania. We ask whether the extent of educational mobility across three generations differ by gender and whether the impact of grandparents differ depending on their residence status. We find that grandparents matter and the intergenerational effects can persist beyond two generations. These effects are however one fifth of those between two generations. They are generally higher for daughters than sons and stronger if grandparents live with their grandchildren than if they do not.

Keywords: multigenerational social mobility; education; gender; methods

JEL codes: J62, I24, J16

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1 Introduction

Grandparents play an increasingly important role in the upbringing and wellbeing of children in many ways, in both developed and developing countries. Indeed, demographic changes have resulted in ageing populations: more specifically, mortality and fertility declines have resulted, in many societies, in life expectancy of 80 years for women and slightly less for men.[1] The demographic balance between young and old has changed, resulting in families where the links between grandparents and grandchildren have become more durable. While these are more pronounced in the developed World, they have also been key demographic patterns in Africa. The latest World Population Ageing report by UNDESA shows that sub-Saharan Africa is amongst the regions that are expected to witness the largest relative increase (+220 percent) in the number of older people by 2050 (UNDESA, 2019).

The way grandparents affect grandchildren's educational outcomes are not the same everywhere and in every context; a first helpful categorisation distinguishes between direct and indirect channels of transmissions. In the direct one, the transfer of advantages goes to children's generation (G1) directly from the grandparents' generation (G3), while in the second one, the advantage goes from G3 to G1 through the intermediate parents' generation (G2). Grandparents can directly transfer resources, such as money and time, but also social contacts and cultural capital. They may also have a role in the formation of preferences and attitudes, for instance in terms of risk aversion and time preferences (Coall and Hertwig, 2011).

The strength of this inter-generational association, and, in particular, of some of the mechanisms, will differ depending on whether grandparents are geographically proximate or not, whether they reside with grandchildren in extended households and whether they are healthy or not. The health mechanism points to the possibility that the influence of grandparents on children's outcomes might be negative, if grandparents are net receivers of resources and particularly if they co-reside in the same household (Kreidl and Hubatkova, 2014). The effects could also be less direct and more culturally and socially framed, in the way that grandparents shape, through family histories, the educational or occupational choices made by grandchildren. Moreover, there might be structural mechanisms by which the association between grandparents and grandchildren's educational outcomes is maintained. Think for instance of societies and economies that dispel a strong hierarchical structure, in which opportunities for those at the bottom are not open, while individuals at the top expend substantial effort and resources in preserving their own opportunity sets. Or, even more dramatically, think of societies that discriminate on skin colour, which is genetically transmitted across generations. All these mechanisms are not exclusive. But, in various ways, they feed on each other, thus making it difficult to disentangle them empirically.

In *A Treatise on the Family*, Becker (1981) generalised the endowment transmission model beyond the first order autoregressive process AR(1) specification, typical of the links between parents

[1] Life expectancy has generally increased from less than 60 years for both sexes in 1970 to 73 years in 2020 on average for all countries (United Nations Department of Economic and Social Affairs, Population Division (POP/DB/PD/WPA/2019)

(G2) and children (G1), to more complex specifications that could incorporate influences from other relatives, including grandparents (G3). Indeed, theories of the transmission of resources across more than two generations have adopted a 'Markovian' approach: this establishes that the association between grandparents' resources (G3) and grandchildren's outcomes (G1) occurs only via the parent generation (G2), with the transfer of resources directly from one generation to the next.[2] However, the increased availability of survey and administrative data across multiple generations of family members has meant that researchers have been able to interrogate whether there are other potential ways in which grandparents may influence the outcomes of their grandchildren (Mare, 2011; Solon, 2014).

The main purpose of this paper is to provide an answer to the following question: are there significant grandparent effects on children's educational outcomes in Africa? We do this by asking three related questions: (i) what is the extent of multigenerational educational mobility? (ii) are there any differences by gender? and (iii) to what extent does the relationship depend on the residency status of grandparents, meaning whether they live in the same house with the grandchildren or not?

In order to address these questions, we draw on nationally representative survey data from six African countries: Ethiopia, Gambia, Ghana, Liberia, Nigeria and Tanzania, all carried out at very similar points in time, between 2014-15 and 2016-17, and all containing information on educational attainment for three generations. We rely on the reported information on the relationship to the head of household to identify the linked three generations of grandparents, parents and children, the latter aged between 18 and 40 at the time of the survey.

We find a positive and significant net effect of the grandparents' educational status on the educational outcome of their grandchildren, over and above that of their parents. We also find some differences between the six countries we have data for, with higher levels of three generational links experienced in Liberia, Ethiopia, Ghana and Gambia compared to Nigeria and Tanzania. We find that the influence of grandparents is smaller, approximately one-fifth that of parents. We also find that the association between grandparents and children's educational outcomes is more pronounced for female than male children in all countries but Nigeria. Finally, we find that the extent of the relationship positively depends on whether grandparents live in the same household with their grandchildren, pointing to the importance of more direct and continuous interactions between the generations.

2 Related Literature

While the empirical evidence on social mobility between two generations is extensive, much less attention has been devoted to mobility between three generations. This is not due to a lack of interest but to limitations of the data available to assess the links in socio-economic outcomes

[2] A Markovian transmission process is measured through repeated multiplication of elasticities or correlations of two-generational estimates; it therefore implies that grandparents cannot influence their grandchildren's outcomes over and above their influence through the parents.

between more than two generations. In fact, it is well established that the assessment of social mobility is not free of controversies. Whether there is high or low social mobility is difficult to measure precisely for two generations, let alone for more than two. One of the difficulties arises from the need to have detailed information on parental circumstances when individuals are growing up. Another is that the links between generations relate to a long period of time; in the case of the link between parents and children this is a whole generation, in the case between grandparents and children this is two generations: by the time we know what the association is between grandparents' education and that of their grandchildren, 40 or more years will have passed. This lack of suitable data is particularly pronounced in developing countries, which do not have the privilege of well developed data collection infrastructures or ecosystems in place.

The evidence on three-generation mobility, although limited, is however developing.[3] For the purpose of this paper, it will help to categorise the literature according to whether studies find a significant effect of grandparents on grandchildren's educational outcomes over and above that of their parents or, on the contrary, whether they find no such effect. Some studies in fact conclude that there is no departure from a first order AR (1) process that is common to estimates of social mobility between two generations. However, some other studies find that multigenerational links exist over and above the two generational ones and could, theoretically, be represented by both a positive and a negative coefficient, indicating that the auto correlations increase or decline, respectively, at a faster or slower rate than at the geometric rate typical of AR(1) processes (Solon, 2014, 2018).

Studies that have found no, or very little evidence of grandparents' influence on children's outcomes [4] include Clark et al. (2015); Lucas and Kerr (2013); Stuhler (2012); Erola and Moisio (2007); Warren and Hauser (1997); Peters (1992); Becker and Tomes (1986); Behrman and Taubman (1985). For instance, Becker and Tomes (1986) suggest that the endowments from ancestors tend to disappear in only three generations and that, in open societies, grandparents have little effect on the earnings of grandchildren and successive descendants. Stuhler (2012) discusses the role of market luck and indirect transmission, the multiplicity of skills, the role of grandparents, and the causal effect of parental income as possibly affecting the transmission process. He concludes that long-run mobility will likely be lower, possibly much lower, than the predictions from intergenerational evidence suggest, and that the assumptions that the process implies perpetual regression is a statistical fallacy. Other studies have also reached similar results while estimating multigenerational regressions based on years of education, individual earnings or occupation. Clark et al. (2015), for example, using data gathered from many countries over many centuries, on various socioeconomic outcomes for individuals with rare surnames, maintains that, in all societies and in all eras, mobility across generations follows an AR (1) process, with a high autoregressive coefficient between 0.7 and 0.8, and not the AR (2) process for estimating

[3] See, amongst others, Chan and Boliver (2013), Modin et al. (2013), Lindahl et al. (2015), Zeng and Xie (2014), Warren and Hauser (1997) and Wild and Gaibie (2014). A relevant review and assessment of the research agenda is in Pfeffer (2014).

[4] In this review, we also refer to studies of multigenerational mobility for outcomes other than education, such as earnings and occupation.

mobility across three generations. Hodge (1966), in his pioneering study of transitions among occupational categories across three generations in the United States, found that, although there was some relation between grandfather and grandson's occupations, this is not direct, but only indirect, and induced by its influence upon the father's occupation.

Furthermore, Behrman and Taubman (1985) focused precisely on educational status and found that the estimated coefficients of grandparents schooling were close to zero and statistically insignificant. Similarly, Peters (1992) used U.S. National Longitudinal Surveys data to estimate regressions of offspring's log income on parental log income and grandparental education; Warren and Hauser (1997) used the U.S. Wisconsin Longitudinal Study to estimate regressions of offspring's occupational prestige or education on the earnings, occupational prestige and education of both parents and grandparents; Ridge (1974) used British data on education and occupational prestige in three generations and Lucas and Kerr (2013) used Finnish data to estimate regressions of offspring's log earnings on parents and grandparents log earnings: they all found that the transmission of social status between parents and offspring is *not assisted* by grandparents.

While the above mentioned studies concluded that the child's educational attainment is associated with the educational attainment of the parent and that, if any, grandparents would only have an indirect influence through the child's parents, the generally more recent studies we review below report a significant direct influence of grandparents.

It is worth starting with the recent comprehensive systematic review from Anderson et al. (2018), which found that 58 percent of 69 studies report that grandparents' socioeconomic characteristics are associated with children's educational outcomes, independently of the characteristics of parents. They also found that, on average, grandparents matter around a quarter as much as parents, but this influence could be as much as a half. In particular, grandparents appear to be especially important where parents' socioeconomic resources are low. Overall, they strongly suggest that "grandparental characteristics often contribute information beyond that captured by parental characteristics and should be included in measurements of social origin". However, they also report consistent null results for the hypothesis that the association should be stronger where there is more contact with grandparents. The role of proximity in living arrangements is reported by Zeng and Xie (2014) for rural China: more precisely, they found that the education of absent (non-resident or deceased) grandparents has little or no effect on grandchildren's educational outcomes, while the effect of co-resident grandparents was significant. They conclude that the causal effect of tri-generational impacts happens within the household through daily interaction. Similarly, Solon (2014), while summarizing the research findings by Zeng and Xie (2014), concludes that grandparents' influence varies across different cultures and societies and might be different by race and ethnicity. This is particularly relevant to our context and indeed informs one of our research questions.

Another interesting study is that of Kroeger and Thompson (2016), which analyses educational transmission across three generations of American women in the 20th century. They report that multigenerational transmission strength exceeds the predictions of AR(1) models, and that processes like marriage, immigration and mortality often vary by education - and other measures

of socio-economic status - and very likely affect three-generation persistence. Their findings indicate that the largest educational achievements happen more often than not among women whose parents and grandparents had educational achievements. This is again relevant to our analysis and informs another of the questions we aim to address here on the possible gender differences in the grandparents' transmission of advantage or disadvantage. Other studies that find a positive and significant grandparents' effect, over and above that of parents, on children's outcomes are from Braun and Stuhler (2018) for Germany, Ferrie et al. (2016) for the US, Modalsli (2015) for Norway, Mare and Song (2014) for China, Dribe and Helgertz (2016) for Sweden and Hancock et al. (2016) for Australia.

3 Model and Data

3.1 Model specification

The model to estimate the extent to which grandparents' educational attainments (G3) affect the educational outcomes of grandchildren (G1) simply adds the educational attainment of a third generation to models of two-generation mobility. Following Solon (2014), we start from the first order autoregressive process used to estimate the association between the two generations of parents (G2) and children (G1):

$$Ed_i^{G_1} = \alpha + \beta Ed_i^{G_2} + \varepsilon_i \tag{1}$$

where ε_i is a white-noise error term, the heritability coefficient β lies between 0 and 1 and $Ed_i^{G_t}$ is educational attainment of individual i of generation G, with $i \in (1, ...N)$; t represents the three generations $t = G_1$, $t-1 = G_2$ and $t-2 = G_3$. In this model, the child's inheritance comes only from the parents. Grandparents' contribution could be incorporated into this model by considering a second-order autoregression of child's educational outcomes on the status of both parents and grandparents, but this will involve a negative coefficient for grandparental status, meaning that the intergenerational auto-correlations decline at a faster than geometric rate. However, as the empirical evidence we have reviewed in Section 2 suggests, the grandparent's contribution is in some cases positive and, therefore, autocorrelations decline more slowly than at the geometric rate. Therefore, as suggested by Solon (2014), the positive contributions from grandparents beyond the contributions mediated through the parents, are added to the right-hand side of equation 1:

$$Ed_i^{G_1} = \alpha + \beta_2 Ed_i^{G_2} + \beta_3 Ed_i^{G_3} + \varepsilon_i \tag{2}$$

where $0 \leq \beta_2 \leq \beta_3 \leq 1$.

The educational attainment variable is years of schooling for G_1, while for parents and grandparents we use the average years of schooling of both parents and grandparents. β_2 and β_3

represent the OLS estimates of intergenerational persistence, or the strength of the links, between the educational attainment of the generations: more precisely, between G_1 and G_2 and between G_1 and G_3 respectively.

As pointed out in the introductory section, we aim to estimate: (i) the effects both at the aggregate level with pooled data and specifically for the six countries; (ii) the differences by gender and, finally, (iii) whether grandparents' residency status has a differential impact on grandchildren's education. We therefore introduce a dummy variable for whether grandparents are living in the same household with their grandchildren at the time of the survey. We therefore expand equation 1 as follows:

$$Ed_i^{G_1} = \alpha + \beta_2 Ed_i^{G_2} + \beta_3 Ed_i^{G_3} + \rho P_i + \gamma C_i + \phi Z_i + \varepsilon_i \tag{3}$$

where P captures whether the grandparent has been living with the grandchildren or not, C are country fixed effects for the pooled data specification and are also related to the year the survey data are observed for each country, Z is a vector of variables, including age and age squared.

3.2 Data

We make use of the latest nationally representative survey data from six countries where individual information for three generations is available: Ethiopia 2015, Gambia 2015, Ghana 2016/17, Liberia 2016, Nigeria 2015, and Tanzania 2014.[5] The data contain information on individuals' demographic characteristics, including marital status, relationship to the household head, education, health, occupation, industry, ethnicity and geographical information. Importantly for our purposes, the surveys collect information on educational attainment, including retrospective information on non-resident parents. In order to analyse three generational links, we identify G_1 through the reported relationship to the household head, their parent (G_2) and their grandparent (G_3). Similarly, we link the household head and spouses to their parents based on the retrospective information provided. Having complete information on the individual's relationship to the household head, the data allow for matching of grandparent, parent and child. Those aged between 18 and 40 are matched with their parents and grandparents who are either co-residents or non-residents.[6] Family members who have moved out, particularly those who have married and established their own families, are regarded as non residents. We limit G_1 to individuals aged between 18 and 40, which is the age range within which we can maximize grandparent and grandchildren linkages in our sample. Table 1 summarises some key characteristics of the data sets we use, including the total number of households and individuals covered in each of the surveys.

[5] These surveys are multi-topic in nature, designed by the national agencies together with development partners with the sole purpose of improving the understanding of the links between agriculture, socioeconomic status, and non-farm income activities.

[6] Individuals are selected if they have completed education, if they are not enrolled at school at the time of the survey and have been out of school over the previous 12 months. Generally, students are not out of school for more than 12 months.

TABLE 1: Surveys Summary

Country	Year	Type	National pop. (millions)	Households	Individuals
Ethiopia	2015-16	ESS	102.4	30,229	125,098
Gambia	2015-16	IHS	1.9	13,281	50,215
Ghana	2017	GLSS7	26.3	16,722	72,372
Liberia	2016	HIES	4.6	8,346	36,303
Nigeria	2015-16	GHSP	181.2	4,594	26,176
Tanzania	2014	TZNPS	49.1	10,186	46,593

Notes: Year refers to the year the Survey was conducted. The population estimates are from World Development Indicators (WDI) mid-year population estimates at the respective year of the survey.

The educational variable "number of years of education completed" is standardised using the ISCED 2011 classification.[7] More precisely, given the surveys contain information on actual grades of schooling,[8] we can make use of a continuous variable rather than using levels of schooling completed, thus avoiding the discontinuities in schooling distribution that are possible when relying on categorical variables (Azam and Bhatt, 2015). This is collected for each family members in the sample. For parents' and grandparents' educational attainment we use the average years of schooling of both parents and grandparents.

Table 2 reports information on age and educational attainment of the three generations, also by gender for G_1 and G_2, for the pooled sample and the six countries separately. Educational attainment has increased over the generations, with grandparents completing on average less years of schooling than their children, who completed less than their children. The table also shows that women's educational attainment has overtaken men's: while G_2 women completed on average less schooling than G_2 men, for G_1 this is reversed. The reported average age for grandparents is almost 66, for G_2 is 46.5 for men and 37.5 for women and for G_3 is 24.1 for men and 23.5 for women. Table 2 also shows the differences between countries.[9] Ghana and Nigeria report the highest average years of schooling, while Ethiopia, Gambia, Liberia and Tanzania report relatively lower years of schooling. There are also differences in educational attainment by gender, particularly for G_2. The large gender gap in educational attainment for G_2 is in Ghana and Gambia (respectively, 1.4 and 1.3 years more of schooling completed by men than women) and slightly less in Nigeria (0.9). For G_1, the gap has mostly reverted in Ethiopia, Tanzania and Nigeria, where women complete on average 0.6 years of schooling more than men.

[7]The International Standard Classification of Education (ISCED) provides a comprehensive framework for organising and comparing educational attainment across countries, which is helpful given countries have different educational systems. This standardisation however does not adjust for the quality of education across schools or countries, information that we unfortunately do not have for the selected countries.

[8]For example, the completed years of education is 0 for pre-school, 1 for grade 1, 2 for grade 2 and so on.

[9]In considering differences between countries, note that the data are based on sightly different survey years, as shown in Table 1.

TABLE 2: Educational attainment and age across three generations

	Ethiopia	Ghana	Tanzania	Nigeria	Liberia	Gambia	Pooled
G1 Daughter							
Average age	23.5	23.8	24.1	23.8	22.7	23.4	23.5
*Education**	8.8	10.6	8.0	11.4	7.4	8.7	9.5
G1 Son							
Average age	23.7	23.3	23.6	23.6	22.4	25.2	24.1
Education	8.2	10.6	7.4	10.9	7.6	8.9	9.4
G2 Mother							
Average age	37.4	39.4	36.2	34.4	35.9	36.7	37.5
Education	7.5	8.6	5.8	7.9	5.5	6.6	7.6
G2 Father							
Average age	46.4	46.3	44.4	52.9	42.2	48.0	46.5
Education	8.4	10.0	5.9	8.8	6.1	7.9	9.0
G3 Grandparent†							
Average age	65.7	70.9	74.3	65.2	69.4	63.1	65.9
Education	6.6	8.0	1.4	3.4	4.8	4.9	5.5

* Average years of education. † Average of grandparents.

Sample selection bias in estimates of intergenerational elasticities have been extensively documented.[10] In particular, downward bias might result when relying on information from co-resident members only. Our data covers information for most of the children even when they are not residing with the family at the time of the survey. The respondent, mostly the head of the household, is asked about the educational attainment of all household members, including children that are away for work or at a boarding school. However, some non residents, for instance G_1 children who get married and form another household, might not be captured: if those who leave are systematically different from those who stay in the household and are captured by the survey, then the estimate from co-residents are biased. The younger adults in their 20s are therefore over represented in the sample while the other adults are under represented, due to the exclusion of non resident who are not captured at the time of the survey. Here, however, we make use of the educational attainment of the parents of household heads, who are the G_3 co-resident grandparents at the time of the interview.

Another source of bias in educational mobility might arise from the so-called ceiling effect: children (G_1) whose parents (G_2) have already attained the highest possible educational attainment would not possibly attain a higher educational attainment themselves and, therefore, cannot be shown to be moving up the educational ladder. In these cases, immobility is the only option. In order to avoid the ceiling effect, we only consider children (G_1) whose parents have completed secondary or lower educational qualifications.

[10] For instance, see Francesconi and Nicoletti (2006).

4 Analysis and Results

We estimate equation 3 for the pooled dataset and its version without country fixed effects for country-specific estimates. In Table 3 we show the results for the pooled data: the association between parent (G_2) and children's (G_1) educational attainment is strong, with an intergenerational elasticity estimate β_2 of 0.625. This is comparable with other estimates in the literature, for instance by Azomahou and Yitbarek (2016) for nine African countries and smaller than others, such as those from Hertz et al. (2007) for four African countries. The estimate is also higher than those generally found for developed economies in Western Europe and the United States and for Eastern Europe (Hertz et al., 2007). It is important to note, however, that our model specification includes other variables for demographic characteristics and grandparents' (G_3) educational attainment. The association between the latter and the educational attainment of grandchildren (G_1) is estimated to be positive, with an elasticity β_3 of 0.139, significantly different from zero, as hypothesised by AR(1) specifications. Although smaller than two-generation estimates, we do report a significant three-generation elasticity, suggesting that for the pooled sample overall there is a strong relationship between grandparents' educational attainment and that of their grandchildren, independently of its transmission through the intermediate parental education. Therefore the influence of grandparents is evident but is around one-fifth smaller than that of parents. This is again consistent with other findings, such as from Anderson et al. (2018), who report that grandparents' educational status is around one-fourth smaller than parent's educational status.

Table 3 also shows that this relationship differs by gender. While estimates of β_2 are larger for sons than for daughters, those of β_3 are larger for daughters than for sons. This result - when considered alongside the result for the variable that captures whether the grandparent resides in the same households with grandchildren, which is substantially larger for daughters than for sons - suggests that the grandparents' effects are more pronounced on granddaughters than grandsons' educational attainment. This might be because grandparents may end up having more interaction with granddaughters than with grandsons: granddaughters might be more present in the daily activities of the household where grandparents are also present or there might be some other gender dynamics at play which we are not able to capture with our data. Overall, the presence of grandparents in the same households does have a significant effect on grandchildren's educational attainment.

Overall estimates from pooled datasets are of limited interest when considering that countries may well differ in their educational systems and in other socio-economic contexts. Table 4 and Table 5 report country-specific estimates, including gender differences. The estimates of the association between G_3 and G_1 are all positive and significant for all six countries we analyse here.[11] Moreover, the results show that there are differences between countries: higher direct effects from G_3 to G_1 are found in the data for Liberia, Ethiopia and Ghana and relatively lower

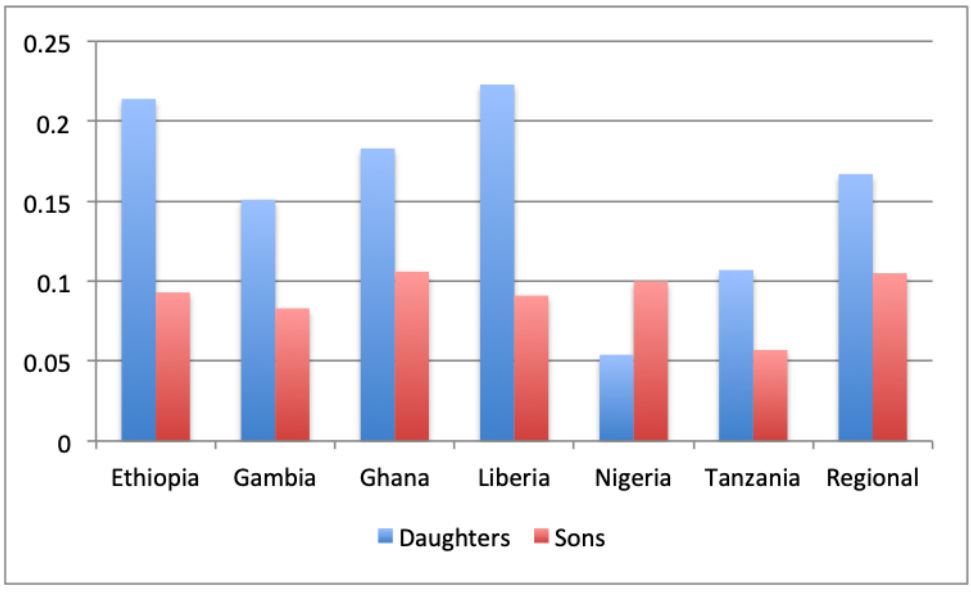
[11] The β_2 estimates are even larger when excluding the demographic controls from the regressions, suggesting bias if omitted.

effects are reported for Nigeria and Tanzania.[12] As for the pooled sample, in order to shed light on the possible social and cultural mechanisms at play in the association between grandparents' and grandchildren's educational attainment, we introduce a dummy variable to capture the joint residency of grandparents and grandchildren at the time of the survey. The results show a positive and significant effect (but for Tanzania): they are relatively more pronounced in Nigeria and less in Ghana.[13]

Table 5 shows the results by gender and the stronger association between G_3 and G_1 for daughters than for sons for five out of the six countries. Figure 1 graphically reproduces the gender differences in the β_2 estimates of intergenerational persistence. The more pronounced gender differences, above the average for the pooled sample, are to be found in Liberia, Ethiopia and Ghana. In Nigeria, on the contrary, the association between grandparents and grandchildren's education is stronger for sons than for daughters, but the coefficient for daughters is not statistically significant. The grandparents co-residency effect is also strong and significant in all countries and for both sons and daughters but relatively stronger in the case of daughters than sons, and particularly so in Nigeria and Liberia.

It is indeed the case that grandparents (G_3) do matter in the educational attainment of grandchildren (G_1) over and above the intermediate effects though parents (G_2). This is more so for daughters than for sons and if the grandparents reside within the same household, therefore possibly having a more persistent interaction with the co-residing grandchildren.

FIGURE 1: Three generational persistence, by gender



[12] Results of regressions of grandchildren's years of schooling directly on grandparents, without controlling for G_2 effects, show higher three generational persistence. These are not shown here but available upon request.

[13] While this specification shows the effect of grandparents' residency on the educational outcomes of grandchildren, in Appendix A we add interactions between grandparents'residency and the educational outcome of G1 and G2 to assess the effect on mobility.

TABLE 3: Three generational educational mobility, pooled dataset

	All	**Sons**	**Daughters**
G2 Years of schooling $\widehat{\beta_2}$	0.625***	0.690***	0.565***
	(0.004)	(0.005)	(0.005)
G3 Years of schooling $\widehat{\beta_3}$	0.139***	0.105***	0.167***
	(0.004)	(0.006)	(0.006)
G3 dummy	2.088***	1.786***	2.264***
	(0.081)	(0.113)	(0.109)
Country (Ethiopia=1)			
Ghana	0.715***	0.411***	1.030***
	(0.057)	(0.083)	(0.073)
Gambia	-0.861***	-0.951***	-0.645***
	(0.055)	(0.081)	(0.070)
Liberia	-1.317***	-1.041***	-1.491***
	(0.062)	(0.091)	(0.078)
Nigeria	1.599***	1.638***	1.688***
	(0.069)	(0.101)	(0.088)
Tanzania	-0.240***	-0.992***	0.430***
	(0.075)	(0.110)	(0.095)
G1 age	-0.144***	0.323***	-0.343***
	(0.022)	(0.032)	(0.028)
G1 age squared	0.0003	-0.007	0.003***
	(0.0004)	(0.001)	(0.001)
G2 average age	-0.118***	0.010	-0.151***
	(0.005)	(0.007)	(0.007)
G2 average age squared	0.002***	0.0002***	0.002***
	(0.0001)	(0.0001)	(0.0001)
G3 average age	-0.111***	-0.099***	-0.125
	(0.004)	(0.006)	(0.006)
G3 average age squared	0.001***	0.001***	0.001***
	(0.0001)	(0.0001)	(0.0001)
Constant	7.475***	-0.899***	10.532***
	(0.325)	(0.502)	(0.406)
Adj.R^2	0.472	0.483	0.492
Obs.	71,528	32,132	39,395

*** significant at 1 percent; Robust standard errors in parenthesis, clustered at household level.

5 Concluding Discussion

There is no clear consensus on the direct impact of grandparents' educational status on that of their grandchildren over and above the transmission that happens through the intermediate parental generation. The first and older studies generally reported no substantial effect over and above that passing through parents, while more recent evidence does suggest that multigenerational educational links are solid and grandparents' educational status, in various ways, is directly

TABLE 4: Three generational educational mobility, country estimates

	Ethiopia	**Gambia**	**Ghana**	**Liberia**	**Nigeria**	**Tanzania**
G2 Years of schooling $\widehat{\beta_2}$	0.712***	0.538***	0.671***	0.653***	0.616***	0.630***
	(0.012)	(0.007)	(0.007)	(0.008)	(0.010)	(0.014)
G3 Years of schooling $\widehat{\beta_3}$	**0.156*****	**0.125*****	**0.144*****	**0.169*****	**0.090****	**0.089****
	(0.014)	(0.009)	(0.007)	(0.011)	(0.040)	(0.016)
G3 dummy	**2.720*****	**2.158*****	**1.365*****	**3.024*****	**3.346*****	**1.408**
	(0.304)	(0.124)	(0.170)	(0.256)	(0.298)	(0.296)
G1 age	-0.202**	-0.262***	-0.190***	0.016	-0.006	-0.082***
	(0.069)	(0.036)	(0.047)	(0.053)	(0.070)	(0.076)
G1 age squared	0.001	0.002***	0.0004	-0.001	-0.003**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
G2 average age	-0.142***	-0.160***	-0.049***	-0.175***	-0.160***	-0.037***
	(0.017)	(0.009)	(0.010)	(0.013)	(0.019)	(0.018)
G2 average age squared	0.002***	0.0002***	0.001***	0.002***	0.0002***	0.001***
	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
G3 average age	-0.118***	-0.116***	-0.095***	-0.118***	-0.205***	-0.061*
	(0.020)	(0.006)	(0.011)	(0.017)	(0.018)	(0.016)
G3 average age squared	0.001***	0.001***	0.001***	0.001***	0.002***	0.001*
	(0.0003)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
Constant	8.223***	9.829***	7.690***	3.726***	8.391***	1.796***
	(1.031)	(0.542)	(0.690)	(0.769)	(1.084)	(1.110)
Adj.R^2	0.495	0.320	0.470	0.459	0.384	0.324
Obs.	7,017	24,602	17,388	10,349	7,053	5,119

*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Robust standard errors in parenthesis, clustered at household level.

and positively associated with that of grandchildren. Moreover, what has become evident, as Bol and Kalmijn (2016) observe, is that the variability in types of models, mobility measures, data, and national or historical/cultural contexts will likely contribute to these inconsistencies. For example, when the controls for the middle generation (parents) become more stringent in the estimation models, the remaining effect of grandparent's educational status becomes weaker. This pattern might be expected, given that higher educational attainment among grandparents will provide more than just improved educational attainment in parents, (including improvements in occupational class, earnings, housing stability, cultural influences and norms that higher education alone can't provide), which in turn are beneficial for the educational trajectories of their grandchildren.

Within this context, we set out to provide estimates of three generation educational mobility for six African countries for which we have consistent and harmonised data: Ethiopia, Gambia, Ghana, Liberia, Nigeria and Tanzania. Informed by the existing evidence, we asked three relevant questions. The first question aimed to measure the extent of three generational educational mobility; the second question aimed to understand whether the extent of educational mobility

across three generations differed by gender and the final question aimed to shed light on whether the impact of grandparents differed depending on their residency status.

We conclude that grandparents' matter and that the intergenerational effects can persist beyond two generations. We find that the grandparent's educational status directly influences their grandchildren's educational attainment, over and above the effect transmitted through parents: children's educational attainment is correlated not only with the education of their parents, but also with the educational status of their grandparents.
In each of the six countries, we find positive and significant net effects of the grandparent's educational status on the educational attainment of their grandchildren, conditional on their parent's educational status. There are however differences between the countries. We find that direct effects of grandparent's years of schooling on grandchildren's educational attainment, net of parent's influence, are higher in Liberia, Ethiopia, Ghana and Gambia, compared to Nigeria and Tanzania. The grandparents' influence is, however, much smaller than that of the parent. The results also indicate that the influence on children reduces after the second generation. We find that the direct effect of grandparent's influence as measured by the three-generational persistence is one-fifth of the two-generational persistence. Overall, our estimates of three-generational persistence do not follow the simple geometric extrapolation of the two generational transmission that has been assumed in some of the literature.

Regarding the second question, we find that the degree of grandparents' influence is higher for daughters than for sons at the regional level and across the countries, except in Nigeria, where the impact is higher for grandsons than granddaughters. Nigeria is also one of the most populated countries in the continent and the richest in terms of GDP per capita. The assessment of the underlying reasons as to why these differences exist between the countries we analyse here is beyond the scope of this research. Some speculation is however possible when looking at the results we found in addressing the third question, which looked at the impact from co-resident grandparents. Indeed, we found that the coefficients from co-resident grandparents are significant and positive and particularly so for daughters: grandparents have an important influence on grandchildren's educational outcomes, and this is particularly the case if they live in the same households. To the extent that we can proxy the residency status to a more direct interaction and, therefore, to transmission of social and cultural capital as well as resources of other kinds, we do find for our African countries similar results to those of Mare (2011), Solon (2014) and Zeng and Xie (2014). The daily interaction between grandparents and grandchildren in African societies is important. Social and cultural factors contribute to the multi generational transmission of social status: this can be through social norms for knowledge transfer, traditional resource allocation practices, as well as other cultural practises that enhance interactions across multiple generations.

Two main implications emerge from our analysis. First, the net effect of grandparents on grandchildren's educational outcomes indicates that that the two-generational specifications often

used are likely to overestimate the extent of educational mobility between children and parents. If, due to cultural, social and other economic factors, there are grounds to believe that grandparents have solid direct or indirect interactions with grandchildren, which is now much more likely in many parts of the World than it used to be a few decades ago, also because of demographic changes and ageing populations, then consideration of three generational estimates of mobility could well be revealing and helpful. Second, in those contexts where three generational mobility is found to be relevant, interventions that aim to address poor educational outcomes might well include focus on poorer grandparents as well as parents.

TABLE 5: Three generational educational mobility, country estimates, by gender

	Ethiopia	**Gambia**	**Ghana**	**Liberia**	**Nigeria**	**Tanzania**
Daughters						
G2 Years of schooling $\widehat{\beta}_2$	0.612***	0.436***	0.633***	0.520***	0.695***	0.609***
	(0.016)	(0.008)	(0.010)	(0.011)	(0.014)	(0.019)
G3 Years of schooling $\widehat{\beta}_3$	**0.214*****	**0.151*****	**0.183*****	**0.223*****	**0.054**	**0.107*****
	(0.019)	(0.010)	(0.010)	(0.014)	(0.056)	(0.020)
G3 dummy	**2.875*****	**2.143*****	**1.724*****	**3.514*****	**5.010*****	**1.016****
	(0.417)	(0.158)	(0.233)	(0.350)	(0.445)	(0.408)
G1 age	-0.321**	-0.446***	-0.433***	-0.111	-0.422***	0.032
	(0.092)	(0.042)	(0.063)	(0.068)	(0.095)	(0.100)
G1 age squared	0.003	0.005***	0.004***	0.0002	0.005**	-0.002
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
G2 average age	-0.217***	-0.144***	-0.091***	-0.238***	-0.192***	-0.054*
	(0.022)	(0.012)	(0.014)	(0.017)	(0.029)	(0.024)
G2 average age squared	0.003***	0.002***	0.002***	0.003***	0.003***	0.001**
	(0.0003)	(0.0001)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
G3 average age	-0.149***	-0.124***	-0.101***	-0.121***	-0.254***	-0.046*
	(0.028)	(0.008)	(0.015)	(0.023)	(0.025)	(0.022)
G3 average age squared	0.001***	0.001***	0.001***	0.001**	0.002***	0.001*
	(0.0003)	(0.0001)	(0.0002)	(0.0003)	(0.0003)	(0.0002)
Constant	10.887***	12.096***	11.536***	6.737***	13.134***	2.980*
	(1.344)	(0.618)	(0.917)	(0.971)	(1.473)	(1.414)
Adj.R^2	0.501	0.354	0.483	0.425	0.460	0.343
Obs.	3,741	14,128	9,153	5,756	3,821	2,796
Sons						
G2 Years of schooling $\widehat{\beta}_2$	0.827***	0.675***	0.700***	0.797***	0.524***	0.653***
	(0.018)	(0.012)	(0.010)	(0.008)	(0.014)	(0.023)
G3 Years of schooling $\widehat{\beta}_3$	**0.093*****	**0.083*****	**0.106*****	**0.091*****	**0.100***	**0.057****
	(0.021)	(0.014)	(0.010)	(0.011)	(0.051)	(0.024)
G3 dummy	**2.526*****	**2.075*****	**0.940*****	**2.140*****	**1.769*****	**1.766*****
	(0.410)	(0.185)	(0.240)	(0.256)	(0.361)	(0.429)
G1 age	0.192**	0.224***	0.252***	0.376	0.977	0.206
	(0.097)	(0.060)	(0.068)	(0.053)	(0.096)	(0.117)
G1 age squared	-0.006**	-0.006***	-0.007***	-0.006***	-0.019***	-0.00
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
G2 average age	0.006	-0.019	0.054***	-0.031*	0.013	-0.003
	(0.026)	(0.015)	(0.013)	(0.013)	(0.024)	(0.029)
G2 average age squared	0.0004	0.0004**	-0.0001	0.0003	0.0001	0.0004
	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0004)
G3 average age	-0.191**	-0.115***	-0.089***	-0.096***	-0.148***	-0.073**
	(0.027)	(0.010)	(0.015)	(0.017)	(0.024)	(0.023)
G3 average age squared	0.006	0.001***	0.0009***	0.001***	0.001***	0.001**
	(0.0003)	(0.0001)	(0.0002)	(0.0002)	(0.0003)	(0.0002)
Constant	0.729	0.447	0.138	-3.356**	-6.694***	-0.665
	(1.502)	(0.942)	(1.016)	(0.769)	(1.477)	(1.794)
Adj.R^2	0.539	0.324	0.468	0.605	0.337	0.308
Obs.	3,275	10,474	8,235	4,593	3,232	2,323

*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Robust standard errors in parenthesis.

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Three-generation educational mobility in six African countries

Online Appendix

September 2020

Appendix A. Grandparents' residency status and intergenerational mobility: further interaction

To provide more depth to the analysis of multigenerational mobility, we adapt the specification of equation 3 with the objective of understanding whether the residency status of the grandparent affect mobility outcomes. We, therefore, interact grandparents' residency status with the education levels of the other two generations, G1 and G2, as well as having it as a dummy as per equation 3. The results, reported in Tables A1-A3, show no change of note when compared to the original coefficients estimates from Tables 3-5 in Section 4. The effects remain stronger for daughters than for sons. The coefficients for the interaction between grandparents' residency and the education of G2 and G3 on grandchildren's educational outcomes, have negligible strength.

TABLE A1: Three generational educational mobility, pooled dataset

	All	**Sons**	**Daughters**
G2 Years of schooling $\widehat{\beta_2}$	0.638***	0.696***	0.585***
	(0.004)	(0.006)	(0.005)
G3 Years of schooling $\widehat{\beta_3}$	0.135***	0.104***	0.160***
	(0.004)	(0.007)	(0.006)
G3 dummy	2.320***	1.919***	2.567***
	(0.093)	(0.131)	(0.126)
G3 dummy * G2 Education	-0.098***	-0.045***	-0.146***
	(0.010)	(0.015)	(0.013)
G3 dummy * G3 Education	0.026**	0.006	0.050***
	(0.012)	(0.017)	(0.015)
Country (Ethiopia=1)			
Ghana	0.702***	0.402***	1.013***
	(0.057)	(0.083)	(0.073)
Gambia	-0.872***	-0.958***	-0.655***
	(0.055)	(0.081)	(0.070)
Liberia	-1.326***	-1.045***	-1.504***
	(0.062)	(0.091)	(0.078)
Nigeria	1.578***	1.631***	1.651***
	(0.069)	(0.101)	(0.088)
Tanzania	-0.237**	-0.991***	0.439***
	(0.075)	(0.110)	(0.095)
G1 age	-0.147***	0.323***	-0.350***
	(0.022)	(0.032)	(0.028)
G1 age squared	0.0003	-0.007***	0.003***
	(0.0004)	(0.001)	(0.001)
G2 average age	-0.118***	0.010	-0.151***
	(0.005)	(0.007)	(0.007)
G2 average age squared	0.002***	0.0002*	0.002***
	(0.0001)	(0.0001)	(0.0001)
G3 average age	-0.105***	-0.096***	-0.116
	(0.004)	(0.007)	(0.006)
G3 average age squared	0.001***	0.001***	0.001***
	(0.0001)	(0.0001)	(0.0001)
Constant	7.465***	-0.924***	10.557***
	(0.325)	(0.502)	(0.406)
Adj.R^2	0.473	0.483	0.494
Obs.	71,528	32,132	39,395

*** significant at 1 percent; Robust standard errors in parenthesis, clustered at household level.

TABLE A2: Three generational educational mobility, country estimates

	Ethiopia	**Gambia**	**Ghana**	**Liberia**	**Nigeria**	**Tanzania**
G2 Years of schooling $\widehat{\beta_2}$	0.720***	0.534***	0.687***	0.657***	0.619***	0.667***
	(0.012)	(0.008)	(0.007)	(0.009)	(0.011)	(0.014)
G3 Years of schooling $\widehat{\beta_3}$	**0.158****	**0.107****	**0.145****	**0.180****	**0.187****	**0.040****
	(0.015)	(0.010)	(0.008)	(0.011)	(0.054)	(0.016)
G3 dummy	**3.029****	**1.881****	**2.090****	**3.994****	**3.831****	**2.280**
	(0.345)	(0.134)	(0.210)	(0.315)	(0.352)	(0.296)
G3 dummy * G2 Education	**-0.153****	**0.033****	**-0.143****	**-0.040**	**-0.027**	**-0.373****
	(0.052)	(0.017)	(0.023)	(0.035)	(0.039)	(0.296)
G3 dummy * G3 Education	**0.021**	**0.075****	**-0.001**	**-0.175****	**-0.199****	**0.201****
	(0.054)	(0.019)	(0.024)	(0.046)	(0.083)	(0.296)
G1 age	-0.200**	-0.263***	-0.195***	0.021	-0.009	-0.061
	(0.069)	(0.036)	(0.047)	(0.053)	(0.070)	(0.076)
G1 age squared	0.001	0.002***	0.0004	-0.001	-0.003**	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
G2 average age	-0.142***	-0.160***	-0.049***	-0.176***	-0.163***	-0.043**
	(0.017)	(0.009)	(0.010)	(0.013)	(0.019)	(0.018)
G2 average age squared	0.002***	0.0002***	0.001***	0.002***	0.0002***	0.001***
	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
G3 average age	-0.104***	-0.115***	-0.086***	-0.115***	-0.206***	-0.052***
	(0.021)	(0.006)	(0.011)	(0.017)	(0.018)	(0.016)
G3 average age squared	0.001***	0.001***	0.001***	0.001***	0.002***	0.001**
	(0.0003)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
Constant	8.143***	9.893***	7.624***	3.584***	8.337***	1.521
	(1.031)	(0.542)	(0.689)	(0.769)	(1.084)	(1.110)
Adj.R^2	0.495	0.321	0.471	0.460	0.384	0.344
Obs.	7,017	24,602	17,388	10,349	7,053	5,119

*** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Robust standard errors in parenthesis, clustered at household level.

TABLE A3: Three generational educational mobility, country estimates, by gender

	Ethiopia	**Gambia**	**Ghana**	**Liberia**	**Nigeria**	**Tanzania**
Daughters						
G2 Years of schooling $\widehat{\beta}_2$	0.626***	0.445***	0.655***	0.523***	0.707***	0.743***
	(0.016)	(0.010)	(0.010)	(0.011)	(0.014)	(0.023)
G3 Years of schooling $\widehat{\beta}_3$	**0.211*** **	**0.140*** **	**0.176*** **	**0.231*** **	**0.093**	**0.056****
	(0.019)	(0.012)	(0.010)	(0.014)	(0.077)	(0.022)
G3 dummy	**3.129*** **	**2.082*** **	**2.259*** **	**4.216*** **	**5.574*** **	**1.712*** **
	(0.470)	(0.170)	(0.287)	(0.432)	(0.516)	(0.522)
G3 dummy * G2 Education	**-0.239*** **	**-0.029**	**-0.205*** **	**-0.017**	**-0.150*** **	**-0.366*** **
	(0.069)	(0.020)	(0.031)	(0.045)	(0.052)	(0.039)
G3 dummy * G3 Education	**0.090**	**0.042****	**0.079****	**-0.138****	**-0.008**	**0.217*** **
	(0.070)	(0.023)	(0.032)	(0.061)	(0.116)	(0.049)
G1 age	-0.329***	-0.449***	-0.446***	-0.107	-0.423***	0.035
	(0.092)	(0.042)	(0.063)	(0.068)	(0.095)	(0.098)
G1 age squared	0.003*	0.005***	0.004***	0.0002	0.005****	-0.002
	(0.002)	(0.007)	(0.001)	(0.001)	(0.002)	(0.002)
G2 average age	-0.216***	-0.144***	-0.091***	-0.239***	-0.195***	-0.060****
	(0.022)	(0.012)	(0.014)	(0.017)	(0.029)	(0.023)
G2 average age squared	0.003***	0.002***	0.002***	0.003***	0.003***	0.001****
	(0.0003)	(0.0001)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
G3 average age	-0.126***	-0.121***	-0.086***	-0.119***	-0.248***	-0.036*
	(0.029)	(0.008)	(0.015)	(0.024)	(0.025)	(0.022)
G3 average age squared	0.001***	0.001***	0.001***	0.001****	0.002***	0.004*
	(0.0004)	(0.0001)	(0.0002)	(0.0003)	(0.0003)	(0.0002)
Constant	10.915***	12.138***	11.606***	6.643***	13.076***	2.423*
	(1.343)	(0.618)	(0.915)	(0.971)	(1.473)	(1.395)
Adj.R^2	0.503	0.354	0.486	0.426	0.461	0.363
Obs.	3,741	14,128	9,153	5,756	3,821	2,796
Sons						
G2 Years of schooling $\widehat{\beta}_2$	0.831***	0.658***	0.710***	0.805***	0.520***	0.788***
	(0.018)	(0.014)	(0.011)	(0.011)	(0.015)	(0.028)
G3 Years of schooling $\widehat{\beta}_3$	**0.097*** **	**0.054*** **	**0.117*** **	**0.109*** **	**0.200****	**0.006**
	(0.022)	(0.017)	(0.011)	(0.014)	(0.068)	(0.027)
G3 dummy	**2.824*** **	**1.523*** **	**1.832*** **	**3.547*** **	**1.954*** **	**2.599*** **
	(0.470)	(0.202)	(0.297)	(0.376)	(0.436)	(0.521)
G3 dummy * G2 Education	**-0.066**	**0.112*** **	**-0.074****	**-0.077***	**0.083**	**-0.369*** **
	(0.074)	(0.028)	(0.033)	(0.044)	(0.053)	(0.047)
G3 dummy * G3 Education	**-0.037**	**0.123*** **	**-0.094****	**-0.234*** **	**0.261****	**0.207*** **
	(0.078)	(0.031)	(0.035)	(0.056)	(0.105)	(0.054)
G1 age	0.198****	0.222***	0.253***	0.384***	0.972***	0.157
	(0.097)	(0.060)	(0.068)	(0.068)	(0.096)	(0.116)
G1 age squared	-0.006***	-0.006***	-0.007***	-0.007***	-0.019***	-0.003
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
G2 average age	0.006	-0.019	0.056***	-0.033*	0.013	-0.011
	(0.026)	(0.015)	(0.013)	(0.018)	(0.024)	(0.029)
G2 average age squared	0.0004	0.0004****	-0.0002	0.0003	0.0001	0.0005
	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0004)
G3 average age	-0.084****	-0.122***	-0.090***	-0.092***	-0.156***	-0.067****
	(0.029)	(0.010)	(0.015)	(0.021)	(0.024)	(0.023)
G3 average age squared	0.005	0.001***	0.001***	0.001***	0.001***	0.001****
	(0.0003)	(0.0001)	(0.0002)	(0.0003)	(0.0003)	(0.0002)
Constant	0.601	0.616	-0.036	-3.811****	-6.706***	-0.522
	(1.505)	(0.940)	(1.016)	(1.022)	(1.476)	(1.773)